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ib, in part, by J. E. Lee, Esq., and Dr. Bull.

TRANSACTIONS

OF THE

WOOLHOPE

NATURALISTS' FIELD CLUB.

(ESTABLISHED MDCCCLI.)

1868.

"HOPE ON—HOPE EVER."

HEREFORD:
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MDCCCLXIX.

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1868.

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The President and Hon. Secretary of the Caradoc Field Club, Shropshire.

The President and Hon. Secretary of the Worcestershire Naturalist Club.

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1868.

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1868.

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Bowen, J. Mortimer, Esq.
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Turner, Thos., Esq.
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RULES

OF THE

WOOLHOPE NATURALISTS' FIELD CLUB.

I.—That a Society be formed under the name of the "WOOLHOPE NATURALISTS' FIELD CLUB," for the practical study, in all its branches, of the Natural History of Herefordshire and the districts immediately adjacent.

II.—That the Club consist of Ordinary Members, with such Honorary Members as may be admitted from time to time; from whom a President, four Vice-Presidents, a Central Committee, Treasurer, and Honorary Secretary be appointed at the Annual Meeting to be held at Hereford in the early part of each year. The President and Vice-Presidents to change annually.

III.—The Central Committee shall consist of three members, resident in the city or in its immediate vicinity, with the President Vice-Presidents, and Honorary Secretary *ex-officio*. It shall be empowered to appoint an Assistant Secretary; and its duties shall be to make all the necessary arrangements for the meetings of the year, and take the management of the Club during the intervals of the meetings.

IV.—That the members of the Club shall hold not less than three Field Meetings during the year, in the most interesting localities for investigating the natural history of the district. That the days and places of such regular meetings be selected at the Annual Meeting, and that ten clear days' notice of each be communicated to the Members by a circular from the Secretary; but that the Central Committee be empowered, upon urgent occasions, to alter the days of such regular Field Meetiegs, and also to fix special or extra Field Meetings during the year.

V.—That an Entrance Fee of Ten Shillings shall be paid by all Members on election, and that the Annual Subscription be Ten Shillings, payable on the 1st of January in each year, to the Treasurer, or Assistant Secretary. Each Member may have the privilege of introducing a friend on any of the field days of the Club.

VI.—That the Reports of the several meetings, and all the papers read to the Club during the year, be forwarded to the *Hereford Times* newspaper for publication as ordinary news, and that the type be re-set in octavo at the expense of the Club, to form (with such additions as may be deemed advisable) the Transactions of the Club.

VII.—That the cost of any lithographic or other illustrations be defrayed by the author of the paper for which they may be required, unless the subject has been taken up at the request of the Club, and in that case the cost of such illustration to be paid for from the Club funds, must be specially sanctioned at one of the general meetings.

VIII.—That the President of the year arrange for an address to be given in the field at each meeting, and for papers to be read after dinner; and that he be requested to favour the Club with an address at the Annual Mceting, on the proceedings of the year, together with such observations as he may deem conducive to the welfare of the Club and the promotion of its objects.

IX.—That all candidates for Membership shall be proposed and seconded by existing Members, either verbally or in writing, at any meeting of the Club, and shall be eligible to be ballotted for at the next meeting, provided there be Five Members present; one black ball in Three to exclude.

X.—That Members finding rare or interesting specimens, or observing any remarkable phenomenon relating to any branch of Natural History, shall immediately forward a statement thereof to the Hon. Secretary, or to any member of the Central Committee.

XI.—That the Club undertake the formation and publication of correct lists of the various natural productions of the County of Hereford, with such observations as their respective authors may deem necessary.

XII.—That Members whose subscriptions shall remain for *three* years in arrear after demand, be held to have withdrawn, and their names shall accordingly be omitted from the list of Members at the ensuing Annual Meeting.

XIII.—That the Assistant Secretary do send out circulars ten days at least before the Annual Meeting, to all Members who have not paid their subscription, and drawing the particular attention of all those that may be affected by the operation of Rule XII, to that Rule.

XIV.—That these Rules be printed annually with the Transactions, for general distribution to the Members.

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n part, by J. F. Lee, Esq., and Dr. Bull.

ADDRESS OF THE RETIRING PRESIDENT,

(DR. M'CULLOUGH,)

READ AT THE ANNUAL MEETING, MONDAY, MARCH 1st, 1869.

GENTLEMEN,—I am now, at the termination of my period of office, required by the rules to address you on the proceedings of the year. I shall not, however, attempt to enter into the details of our meetings, which have already been reported very fully, but shall pass shortly in review the various subjects which have been brought before us in the different branches of Natural History.

Geology, I think, claims the first place, both from the name of our club and from our traditions. Whilst it must always occupy a large share of our attention, we may congratulate ourselves that it does not predominate as formerly, not, I hope, that we cultivate this corner of our field less, but that the others have been less neglected. To appreciate Nature thoroughly it must be studied as a whole, and however wonderful the records of a dead world may be—and none but those who study them can imagine how wonderful they are—they are even surpassed in interest by the phenomena of the living world, which are passing hourly before our eyes.

Beginning with the oldest formation which we have investigated, the Silurian, we commenced the season at Wicton, in the hope of finding a new exposure of that formation, but although we found undoubted Silurian fossils, they were not *in situ*, and our attention was happily called to a subject of great interest, and one which, perhaps, more than any other requires working out in our district, that of the superficial deposits. In a district such as this, attention is naturally drawn to the older formations, but we must not forget that comparatively recent deposits overlie our old rocks whose history demands investigation, and I trust some of our members may be induced to study them. Our attention was next directed to the Silurian formations by Mr. La Touche, in his able address from the Titterstone Clee, from which he pointed out their relation to the Cambrian rocks in the distance and the coal measures under our feet. To Mr. Salter we are especially indebted. His "Notes on the Onny river section," and his paper on "Some new points in the geology of the Usk district" are valuable contributions to Silurian geology, and those who attended the meeting at Woolhope know how much his lucid description of the fossils contributed to the interest and success of the day. The Rev. P. B. Brodie has given us his very suggestive Palæontological notes, and I trust that what he says of the exposure of Downton sandstone at Purton, where he found abundant remains of Pterygotus and Eurypterus will not be lost sight of. I am convinced that this and the lower portion of the Old Red Sandstone around the Woolhope district will yield a rich harvest to the diligent geologist, and I may remind you that both crustacean and plant remains were found in the latter at Nash Tump during the few minutes halt on our way to Sollar's Hope. Whilst working in the lower Old Red Sandstone at Ewyas Harold, in company with Mr. Salter, I was fortunate enough to add the *Pterygotus Taurinus* to our fossils. This quarry is at no great distance from Rowlstone, where another unique fossil, the *Stylonurus Symondsii*, figured in our transactions for this year, was found. I may observe that in Siluria it is erroneously stated that Rowlestone is in Brecknockshire and near Hay, whereas it is in Herefordshire 13 miles south-east of Hay. In the quarry from which the Stylonurus was obtained I found during the last summer *Cephalaspis* and *Parka decipiens*, and am therefore disposed to place it considerably lower in the Old Red than the zone apparently allotted to it by Murchison. I believe there is still much to do in determining the horizons of the fossils of the Lower Old Red and their relations to the different beds of Cornstones, and I trust something more may be done in this matter during the ensuing season. To those who are working at this subject the publication during the past year by the Palæontographical Society, of the first part of Mr. E. Ray Lankester's monograph on the Cephalaspidæ will afford much assistance, and I hope the remainder will soon follow. As it may confuse some of our members who are not familiar with the strata, I may point out that he erroneously places the Ludlow bone bed above the Downton sandstone. The same mistake is made by Lyell, Elements 6th ed., pp. 106 and 548. The middle portion of the Old Red continues as heretofore very barren in this district, the only thing found in it during the year so far as I know being some traces of plants, and the almost equally barren upper part has only yielded a small portion of fish remains, possibly a part of a scale of *Holoptychius* which I found in the yellowish sandstone beneath the mountain limestone near Gilwern. Without wishing to over estimate the importance of fossil remains, and whilst I would caution you against hunting after fossils merely as fossils, yet I would remind you that they are the chief means by which we are enabled to disentangle the often complex web of geological succession and correlate the deposits in one district or country with their equivalents in time in another.

Passing up to the carboniferous system we twice visited portions of the South Wales coal field. At Pontypool we had a most able address from a former President of this Society, Mr. G. Phillips Bevan, who has done so much in investigating this coal field. We had the pleasure of meeting there the Cardiff Naturalists' Society, under the presidency of Mr. Adams, to whom we are much indebted for showing us his beautiful collection of coal measure fossils. Our second visit was to the northern part of the field at Penwyllt, where we could see as in a diagram the Old Red of the Breconshire mountains, the Mountain Limestone, and the Millstone Grit, dipping under the coal measures. The Rev. W. S. Symonds, to whom we have been so often indebted, kindly gave us the field address, and I need not remind you how comprehensive and suggestive it was, and how well it illustrated the great changes which were recorded in the hills and valleys around us. Our subsequent visit to the beautiful waterfall of the Scwd Hen Rhyd, and the demonstration which it afforded to the merest tyro in geology of the mode in which the valley of the Llech had been and is being eroded, showed us that the present state of the earth's surface is by no means a final one, but that important and inevitable changes are now going on slowly it may be but surely. These changes are again brought before us to-day by Mr. La Touche in his paper on the Alluvial Deposit of Rivers—a subject the investigation of which may enable us to form some reliable estimate of the rapidity of the disintegration which different parts of the earth's surface are now undergoing.

The Animal Kingdom has engaged a large share of our attention, and has enlisted several new workers in our ranks. Mr. Rankin's lucid and able paper on the means of flight of birds brought before us a subject of daily interest, and has probably led many of us to observe with more knowledge and consequently with more pleasure the movements of a class of animals which more than any other adds beauty to a landscape. The Rev. Thomas Phillipps in his paper on Snakes directed our attention to the most prominent characteristics of our few British species of this order of reptiles. It is to be regretted that the dread inspired by these graceful creatures leads to the constant destruction even of the harmless species. The Fishes were brought before us in Mr. Lloyd's very instructive paper on their swim bladders, which I am sure contained matter new to most of us. Many interesting points remain to be cleared up, especially regarding the migratory species of this class of the animal kingdom, and there could be no fitter work for this society. I hope we may have further contributions from the author of this paper on a subject which he has so many opportunities of studying.

Entomology has been much more cultivated than formerly. Mr. Steele's paper on Mason Wasps illustrated a marvellous history of insect life, and Dr.

Chapman in his papers on *Hylesinus* and other wood-feeding beetles not only added to our knowledge but made a valuable contribution to science. If these papers have induced any of you to watch the habits of the insect world I am sure you will feel grateful for having your attention directed to so interesting a field of observation. For myself I know that during the past summer watching these creatures has been the occupation of many a pleasant and instructive hour.

Mr. Houghton in his paper on the reproduction and developement of animals discussed various questions, which are of surpassing interest at the present time, from the light they throw on the changes and gradations which may be traced in different organs, and between different classes of animals. I may advert to a further subject which has long been disputed but which seems to be rapidly gaining adherents, namely, the spontaneous origin of some of the lowest forms of animal life.

The productions of the vegetable world, existing as they do everywhere in boundless profusion and in forms almost infinitely varied, have necessarily engaged our attention on many occasions. We saw them in their grandest and most enduring form in the magnificent oaks and other trees at Hampton Court and Holme Lacy. Not the least valuable of our work is placing on record the measurement of such giants, and directing attention to their most valuable varieties and the conditions most favourable to their growth. Dr. Bull's paper on the Elm tree in Herefordshire will also, I trust, have a lasting influence, by directing attention to a crying want, that of planting avenues of trees in and near our towns.

Two plants have been added to the flora of the county, the *Alyssum Calycinum* and the *Cuscuta Hassiaca*. The latter is of great interest, and has been figured for our transactions. Mr. Lingen, who some years ago brought before the club an interesting variation or reversion in the laburnum, sent us a still more remarkable specimen produced by budding the *Jasminum revolutum* with a variegated form of *Jasminum officinale*. This is so interesting with regard to the variation of species that I would suggest it as a subject for further experiment and investigation. Mr. Blashill's able and exhaustive paper on our native food-producing plants, though showing how many good things are of native growth, must have made us feel how meagre our bill of fare would be if limited to native productions. Mr. B. M. Watkins's botanical stroll shows how much remains to be done in making complete lists of the plants in the different districts of the county, as published in our Transactions for 1866.

The most noteworthy event of the year is the impetus which has been given to the study and, I may add, the eating of Funguses. Dr. Bull's illustrations of Edible Funguses in the transactions of the previous year prepared the way, and his success at the South Kensington Exhibition, which we all felt as a feather in the cap of the society, in addition to the plumes which decorated his own, gave an *eclât* to our Foray amongst the Funguses, which contributed no little to its success. Reflecting, as I often have done, on the difficulty of accomplishing much in the way of field work at one of our meetings, where we sometimes perhaps try to do too many things, the amount of work done at this meeting, when one object only was kept in view, impressed me very much; and it seems worth considering whether we might not occasionally follow the same plan with advantage, and when favourable opportunities occur, limit ourselves for the day to a single pursuit. Not only have we increased our own knowledge of Funguses, but we have had the pleasure of adding two which are new to Britain. I believe much remains to be done in this department, and that many species, new not only to Britain but probably to science, remain to be described. Mr. Lees' paper on Fairy Rings formed a fitting adjunct to our meeting. However we may differ from him as to the sufficiency of his theory to account for all the phenomena, we could not but admire the industry and ability which he brought to bear on it.

The great obstacle to Fungus eating is want of knowledge of the edible species, and though our illustrations do much to supply that knowledge, our meetings do more. The actual inspection of specimens, especially if they are afterwards cooked and eaten, gives a confidence not otherwise to be obtained. It may be doubted whether many of the species will ever be common articles of diet in this country, still it is desirable to keep attention directed to what is not only good but highly nutritious. Liebig, in a recent paper, says: "Fungi contain, wonderful to say, the same nutritive salts, and also in nearly the same proportion as meat." This is perhaps not so strange, when we reflect that Fungi grow in general on matter which has been previously organised, that they are a step further, as it were, from the inanimate world. It is reasonable to expect that the *Fistulina Hepatica*, which feeds on the oak, should attain a more complex constitution than the oak itself, which has to elaborate its juices from unorganised matter. In other respects, too, and probably as a result of this organised food, they resemble animals rather than plants, that is, absorbing oxygen and giving out carbonic acid under the influence of light.

I cannot leave this subject without expressing our deep obligations to Mr. Worthington G. Smith, both for his invaluable assistance at our Foray and the beautiful illustrations you have seen to-day.

With regard to the ærial portion of our domain we have again to thank Mr. Isbell for his elaborate meteorological reports. Those who know with what care his observations are made, will know how to value them as they deserve. We are also indebted to him for the careful and interesting measurement of heights by the barometer.

Though Archæology does not come strictly within our province, it is sometimes convenient to examine such objects as exist in the districts visited. In this department Mr. Flavell Edmunds and Mr. James Davies gave us able papers on Risbury Camp and on a supposed Roman road from Bravinium to Circutio. The antiquities of the Clee hills were discussed by Mr. La Touche, and Mr. Havergal reported the steps which had been taken with regard to the publication of the Mappa Mundi.

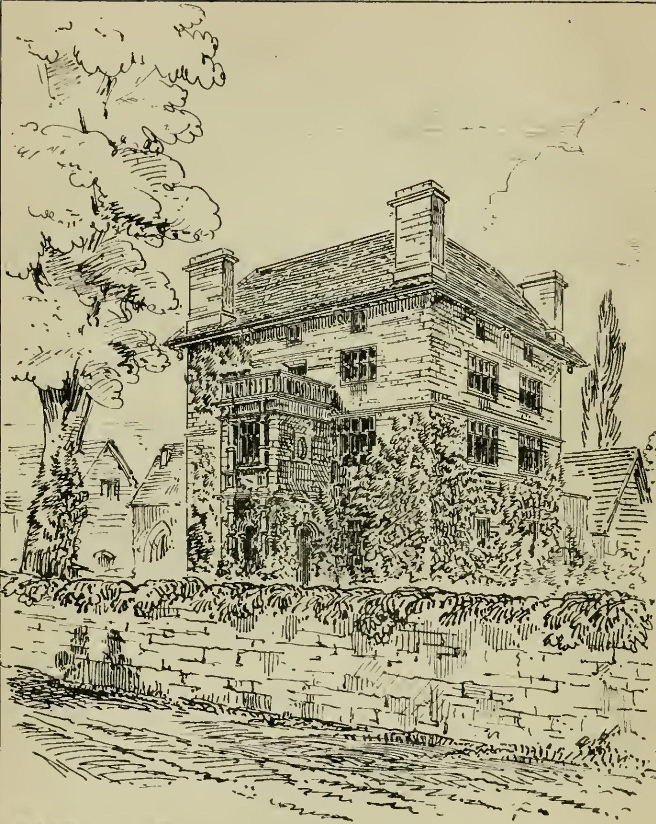
Having glanced at what we have done or attempted to do, I may add a few words as to what are and ought to be the objects of a society such as ours. I would say in the first place, that we do not aspire to enlighten the world at large, or even as the first object to advance science. If in the course of our work we can add a grain here and there to the ever-accumulating mass of human knowledge, it is well; but do not let us regard that as our object, which I take to be, in the first place, the increasing our own knowledge by mutual instruction, and secondly, encouraging like pursuits in those with whom we are brought in contact. It is one at least of the great objects of man's life to cultivate and develope all his powers, and not to narrow and dwarf his mind by too close an adherence to a single pursuit, or the cultivation of one branch of knowledge. What a field the study of natural objects affords for the cultivation and development of these powers. Professor Gairdner who joined us in one of our excursions, in speaking in a recent address of the study of Natural History, says: "It trains at once the mind and the senses, and through the most wholesome and delightful observations of detail it leads up to the most profound generalizations and the most far reaching theories." Another good observer, Dr. Acland says: "I have known some narrow minded naturalists and scientific men, but I never knew a working man in any profession who superadding a branch of natural history to his real work, was either narrow or self sufficient." If the study of natural objects is so valuable to the busy, and to the active mind which seeks relaxation in change of pursuit, what a boon it is or ought to be to the idle who scarcely know how to pass the tedious hours. To those, too, who find their chief pleasure in the active pursuits and amusements of country life, it would add mental enjoyment to the pleasures of physical existence.

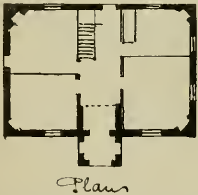
The power or habit of accurate observation is painfully rare, and I know of no better means of cultivating this power than the pursuit of natural history. It would be curious, and I fear humiliating, if it could be ascertained how many people, say in a county or town, believe in the last toad which has been discovered in coal or some equally credible marvel, people who would consider the story of the sleeping beauty in the enchanted castle as fit only for the nursery. Part of this credulity arises no doubt from want of knowledge, say of the age of coal, and of the phenomena of life which cannot be carried on without change, but a great deal of it arises from not giving adequate importance to accurate observation, good faith in the observer being considered sufficient. It has been well observed that a man can see no more than he knows. Not only does knowledge enable us to see more but to see with greater pleasure. He who looks on the sun or moon merely as sources of light and heat cannot appreciate creation so well as he who knows the movements of these bodies, and so far as our knowledge goes their structure and composition, and much as we admired a blue sky before, is our admiration not of a higher kind now that the recent researches of Professor Tyndall enable us to understand why it is blue. The pleasure derived by him who looks on a mountain as a rounded or rugged eminence is very different from that of him who knows why it is rounded or rugged. A swollen turbid river and flooded valleys are striking to any observer, but how much more interesting are they when we can see in them the powers which are grinding down our hills and building up film by film new structures, Again, beauty and design are often visible where the ordinary observer sees only what is repulsive. The changes involved in the decay of animal and vegetable substances, for instance, are at first sight seldom pleasing and very often they are disagreeable, yet we find engaged as active agents in these changes hordes of animals and plants each with a structure and economy marvellously adapted to the end in view. Further, if we reflect on what a dreary world we would soon have if these animals and plants did not aid in removing and converting what has ceased to live, we may see in these operations the sources from which the face of nature is renewed and presented to us ever fresh and young.

Having ventured to say so much as to our objects and the spirit in which we should pursue them, I may pass on to our future work. Not long ago a highly esteemed member suggested that if we went on publishing a volume every year we would soon exhaust the district and leave nothing to be done. A little reflection will show there is no risk of this. Our field embraces both the organic and the inorganic worlds, the life and changes of the present and the records of the life and changes of the past; and when we have investigated these, so far as our unassisted powers enable us, we may call the microscope to our aid, and find new and almost boundless worlds spread before us. Every field, I might say every foot of ground reveals to the careful observer objects of interest, and even the sting of a nettle exhibits phenomena which carry instruction to the wisest. I have said that we should not look on the advance of science as our object, still we should keep it in view, and by doing so we shall probably succeed best in that cultivation and development of our own minds of which I have already spoken. There is work to be done which can only be performed properly by those who reside on the spot. By carefully watching the quarries of the old red sandstone, for instance, fossils might be saved from destruction which would help to elucidate the Devonian system. Our lists of animals and plants should be made more complete, and the almost unworked field of Entomology requires to be cultivated, whilst the continued observation of periodic phenomena, such as those published by Mr. Lingwood in No. 4 of our transactions, would afford valuable and interesting information. The dates of blooming of our flowers, of the ripening of our fruits, or of the arrival and departure of our migratory birds, besides the interest of the facts themselves, may throw light on any supposed cyclical or other changes in the seasons.

The publication of Mr. Darwin's great work on the Variation of Animals and Plants under Domestication, has been the most important event of the year to naturalists. Whatever opinions we may entertain as to the theory of development and the principle of natural selection, there can be no doubt as to the great interest and value of the enormous mass of facts he has accumulated, and we should endeavour to imitate the conscientious care with which he makes and records observations. Whilst changes such as those he points out are occurring among living things, constant changes are also going on in the inorganic world. On the one hand we see our high grounds being disintegrated and carried down lower and lower, and recent explorations have shown that far away in the deep sea new and interesting formations are taking place; while on the other hand, recent earthquakes and volcanic eruptions show that the subterranean forces which may upheave these formations into new continents are still active.

It is to be hoped that the time is passing away when the investigation of the wonders of creation can be regarded otherwise than as a means of increasing our reverence for the Creator. Some who know least of his works seem to have still a vague dread of such pursuits. An old writer says: "The wisdom of God receives small honour from those vulgar heads that rudely stare about, and with a gross rusticity admire his works, those highly magnifying him whose judicious inquiry into his acts and deliberate research into his creatures return the duty of a devout and learned admiration." The more comprehensive the view we take of nature the more we see the analogy and mutual dependence in the different parts of creation, and the more we recognise the evidence of one creative mind which fitted every part to every other part. The operations of a universe are necessary for the existence of the smallest animal or plant, and these, however small, play their parts in the work of the universe.





Wharton, Herefordshire. 1604.
(Porch, upper story & Staircase later)

The Property of J. H. Arkwright Esqre.
Hampton Court. Hereford

Drawn, & kindly given to the Club, by Thos. Blashill Esq. V. P.
May 22nd 1868 —

The Woolhope Naturalists' Field Club

The Woolhope Naturalists' Field Club.

HEREFORD FOR HAMPTON COURT ESTATE.

May 22nd, 1868.

The first meeting for the year of the Woolhope Club took place on Friday, and was very successful. It was pleasant in prospect, an enjoyable day, and has left behind it a bright recollection. There is always a freshness and pleasure peculiar to itself in the Spring meeting, vegetation is full of life, flowers are thickly scattered on every side, the grass tints are lovely, the foliage has all the beauty of youth, and it is impossible to resist the exhilarating influence of everything around you.

> "One moment now may give us more
> Than fifty years of reason ;
> Our minds drink in at every pore
> The spirit of the Season."

As the members of the Club left the train at the Ford Bridge Station and entered the fields, there was a general cheerfulness which showed they did not wish to make any undue resistance to the day's enjoyment. A small advance guard had already inspected the ancient mansion of Wharton, where they had been very kindly received by Mr. J. Meredith, its present occupant. The mansion is interesting as one of the few pure examples of the style of the end of the 16th and the beginning of the 17th century, commonly known as Jacobæan, of which the Coningsby hospitals, in Hereford, are a notable example. It is a stone building, in excellent preservation. Wharton, anciently Waeg-faru-tun—the town by the side of the water way—is further noticeable as one of the few houses which retain, in a modified form, their ancient names, and illustrate the true meaning of the word *tun*, *i.e.*, a single house with a fortification of some kind round it There has never been a village or even a parish of Wharton, yet it remains a genuine town in the true sense of the word. The occurrence of the word Stoke, in the name of the adjoining parish, shows that palisaded fortifications were in use in the district, and would seem to suggest that Wharton was fortified in like manner, *i.e.*, by a ditch and a mound, with a row of stakes on the top of it. Wharton gave a title to the ancient family of the Dukes of Wharton, which lapsed temp. Geo. I.

The route lay directly up the hill towards Wicton, through some pleasant fields. The botanists were directed to look out for the Adder's-tongue fern *(Ophioglossum vulgatum)*, and the Moonwort *(Botrichium lunare)*; the first was quickly found, but the latter was not met with. It grows, nevertheless, in this district. There is half a meadow full of it in the parish of Humber, and it was also said to grow on the side of the same hill in the park. The *Listera ovata* grew everywhere. The *Orchis morio*, *mascula*, and *maculata* were in abundance, and the green frog orchis *(Habenaria viridis)* was also gathered. A small portion of a ring of the St. George's mushroom *(Agaricus gambosus)*, which figured on the programme as destined for a distinguished part of the day's proceedings, was found, but the long dry weather kept back the crop that would otherwise have been present. A large specimen of the Horse mushroom *(Agaricus arvensis)* was also gathered which was somewhat remarkable, so early in the year.

The Club, however, did not give much time to botanising; it had come with the especial object of enquiring into the appearance of certain brachiopod limestone fossils that had put in an appearance here in the most unexpected manner—and on to the Wicton fields they went, over hedge and ditch. The Woolhope Club is necessarily Silurian to the back-bone, and the news of the discovery had aroused its liveliest energies. With business-like activity it pushed on to a lane, where, looking and searching amongst the stones, a few pieces of undoubted limestone with fossils were picked up, and afterwards entered a large field where some diggings had been made. Two large square holes had been dug down some six or seven feet until water was reached, and a pile of stones by each of them of the same character of those in the lane, showed the place from whence the fossils had been taken out.

Whilst the hammers of the gentlemen present were hard at work on the stones dug out of the holes, R. D. Harrison, Esq., read the account of the recent earthquake at the Sandwich Islands, which has just appeared in the newspapers. After which the President called upon Dr. Bull to give them some explanation of

THE DISCOVERY OF SILURIAN FOSSILS AT WICTON.

By Dr. BULL.

Dr. Bull said the President's request reminded him a little of his old hospital days, when the Clinical Professor would pick out one of the pupils, and not always the most attentive, and say, "Now, sir, be good enough to examine this case, and let us know what is the matter." There was no help for the student but to make the best of it he could before the whole class, and he supposed he must be equally obedient now in face of the many excellent geologists around him.

The discovery of these fossils was made in this way. Some little time since Mr. Arkwright observed amongst the broken stones in the lane they had just left, several pieces of fossiliferous limestone, and on enquiring from his bailiff where they had come from, he was told that all the stones broken in the lane had been turned out of the bottom of a four foot drain carried across the field they were now in. It happily occurred to Mr. Arkwright that it would be an object of great interest to the Woolhope Club to examine the locality in which they were found, and if possible to explain their appearance there. The club gladly seized the opportunity and fixed their very first meeting for the purpose of doing so, and Mr. Arkwright has very kindly had these two large holes for exploration, dug specially for this visit.

Now, as you see, these holes tell the same tale as the drain. At four feet from the surface you come to a layer of stones of different characters and sizes, and on breaking up some of these stones from each hole you find the same fossils that Mr. Arkwright found in the lane. It might very possibly have happened that the Silurian rocks which we know to be below this round-backed hill of Old Red Sandstone on which we stand, had been thrust up nearly to the surface, in a similar way to the dome at Hagley Park ; but it is not so, the rocks are not *in situ* here, for all these stones, as you see, are loosely deposited, and are all more or less water worn. Indeed, standing as we do now on this high ground and looking at the very gradual slopes, the rounded contour of all the hills around us, there is nothing to lead one for a moment to suspect the presence of any upcast of Silurian rocks. They all present the graduated inclines of the Old Red Sandstone, made steep here and there, perhaps by a protecting belt of Cornstone. We have nothing to do here on the surface, with the direct effects of volcanic action, or Vulcanicity, and we must look rather for the explanation of any facts that may come under our observation to-day to those gradual changes, produced by the action of causes now in operation, carried on for lengthened periods of time.

If you examine these stones carefully as they appear broken up in the lane, and as you break them yourselves, you will find a very great variety—Sandstones of different kinds and colours, Cornstones of all hues, and fossiliferous limestones of varied character. There are no igneous rocks amongst them—no Basalt or Greenstone ; nor are there any fragments of the higher rocks, the Conglomerate or the Mountain Limestone which formerly overlaid the Old Red Sandstone ; they are all, so to speak, pieces from the rocks of the district, and they are all more or less waterworn.

The slope at the hill on which they are found has, you observe, a northern aspect, precisely similar to the Common examined last year at Llandrindod, and singularly enough higher up in this field, there lies upon the surface, a large block of limestone which involuntarily suggested the idea of a boulder, but the President said, "no !" It was a non-fossiliferous rock so far as we examined it, and there was nothing about it, but its situation, to show that it did not belong to the immediate district. So the question of boulders ice-transported is not to be entertained here as it was there, although the current here, as there, has been from the north.

These stones, in short, are a drift of rocks worn almost to pebbles from the rolling action of water, and it is a drift of a peculiarly interesting character, for it tells its own tale. No one acquainted with the Silurian rocks in this district can look at this fossil, formed as it is by a conglomeration of the shells of *Pentamerus Knightii*, without saying at once that it comes either from the limestone rocks at Aymestry or from those at View Edge beyond Ludlow, where the Aymestry Limestone is also almost entirely composed of this fossil ; for though the Aymestry Limestone was to be found at Woolhope and elsewhere, he did not think it possible to find this shell in such masses anywhere nearer than those two places, and since Aymestry is much the nearest of the two, we may consider that to be their source. The other fossil limestones are Upper Ludlow, and contain *Orthis elegantula*, a *Strophomena*, and some other shells too much injured to name, and several small fragments of an *Orthoceras*, which were beaten out just now. Now Aymestry lies about nine miles, as the crow flies, due North from the hill on which we stand, and if we suppose that these stones have been rolled down the valley now occupied by the Lug they would have to travel about twelve miles perhaps to arrive on this spot.

We come then to the conclusion that this drift of rocks, lying on the North slope of this hill, has been deposited here by a strong current of water, after the Silurian rocks were thrown up, and after the ground here had taken its present form.

The leading geologists for some time past, leaving the fixed rocks, have been calling loudly upon us to examine the drifts and the gravel beds, and very interesting they certainly are, but he could not help hoping that they would soon come a little nearer still to the surface, and give us some information with reference to the formation of the deep clay loam which so often occupies the hills of Herefordshire. Here we are now standing on a tolerably high hill, so high, indeed, that Egdon Hill, which you see in the distance, apparently not much above us, is supposed by the natives in these parts, to be the highest ground in the county. He confessed this sounded to him very doubtful indeed, but it is very difficult to judge accurately of the height of the general surface in an elevated district, and he trusted Mr. Isbell, "our own meteorologist," would be so kind as to ascertain this for us in the course of the summer.

It is however, unquestionably, very high ground, and yet if you look into those holes, you will see four feet of clay loam, above the drift of stones, and there is no saying how much below them, before you reach the rock. It has something of the character of the cold ungenial clay derived from the decomposition of the primitive rocks—from the felspar of the Trap—not so rich for agricultural purposes by any means as its owner might desire. We work upon the surface like moles to turn it to the best purposes—and by the way, when Mr. Talpa himself does speak out about clay, he does so in such a lively, agreeable, cheerful, scientific, instructive way, that it is a pleasure to hear him. But our object now is to ascertain how it comes upon these hills to enable us to work it at all.

One generally considers clay when pure as derived from the complete disintegration of rocks and deposited in tolerably still water. Was all Herefordshire, once upon a time, one vast inland lake? And for how many ages must it have continued so to have deposited so much clay, pure and free from stone, as it often is? If you take your stand on the Malvern Hills and look on either side, at the two counties of Herefordshire and Worcestershire—they seem pretty much on the same level—the Herefordshire side presents a more broken, picturesque surface which makes it look higher even than the Worcestershire side, but yet Geology tells us that it is full two miles lower—that is to say, that you would have to dig down more than two miles on the Worcestershire side to arrive at the same Old Red Sandstone which lies on the surface of Herefordshire. All the Mountain Limestone, the Millstone Grit, all the Coal measures, &c., &c., (not to mention the New Red Sandstone, which may never have been here,) whose thickness taken together amounts, at the very lowest geological computation, to upwards of two miles, has been completely removed from the surface of this county as compared with that of Worcestershire, and yet, after all, it is pretty much on a level with its neighbour.

How has all this happened? Is it possible that when that great,—that awful disturbance of the crust of the earth took place, which affected this district so much; when that great crack was produced, which threw up the Plutonian rocks that form the chain of the Malvern Hills; is it possible that the whole of those rocks were then broken up and swept away? swept off so cleanly that not a single particle, not even a single block of Mountain Limestone remains in the district. Sir R. Murchison, in his last edition of his great work, "Siluria" brings forward the complete and entire denudation of the Woolhope valley of elevation, as an unanswerable proof of the effect of strong currents of water in removing every particle of *débris* and *detritus*, as opposed to its gradual removal by the long continued action of existing causes; and, if this is so there, surely the argument would be all the stronger for the clean sweep by violent force of all this enormous mass of solid matter from the whole surface of the county without leaving a trace behind it.

It is evident, beyond all question, that the violence of the power which threw up the Malvern Hills chiefly affected the district on the western side, and it was the consideration of these circumstances, and the necessary conclusion that the crust of the earth had been here thus much lessened in thickness, that led Mr. Flavell Edmunds to give that theory of the Hereford earthquake of 1863 in the *Hereford Times*,—an explanation that was copied into so many newspapers, though the authority was acknowledged in so very few. Herefordshire was not the only county affected. If this county lost all the rocks above the Old Red Sandstone, Worcestershire lost all above the New Red Sandstone. The great denuding force became less and less severe in its effects as it advanced eastward, until you find the Lias, Oolites, Green-sand, and Chalk in Gloucestershire, Oxfordshire, and the Eastern counties. Might the upheaving force have been at once exerted here to bring the Old Red Sandstone to the level —a "fault" on a magnificent scale? Was the whole country then covered with water, or did water at once wash off and supply the place of the removed rocks, leaving the upheaval of the whole district to be effected by slow degrees over a long period of time? Or have both causes of denudation, that by strong currents of water, and that by the gradual effect of existing powers of disintegration, combined together, with the gradual upheaval of the whole surface to produce the present state of circumstances?

The holes before us tell us nothing of this. They tell, doubtless, of subaqueous formations. We have a layer of clay that indicates a period of comparative rest under water—a layer of drift stones that proves the existence of powerful currents to place them upon it on the side of this high hill; and lastly, another period of rest to cover them with the layer of clay, which is still four feet thick notwithstanding all the agencies at work—the frost and snow to loosen it, and the rains to wash it off into the valleys below. Then, again, the drifts and gravels left at varying levels all through the country, and the ice boulders left on the mountain sides, all concur in proving a former subaqueous period, and in pointing out that the upheaval must have been a work of slow and gradual progress. It would be interesting to examine the surface soils on all the other hills of the county, especially in the neighbourhood of the Malvern hills. In short, I trust the geologists will soon come to the clays; and now, Mr. President, I have done the best I can with the drift, and have certainly drifted myself very far out of my depth. Will any geologist present kindly favour us with his views on the denudation of Herefordshire and the deposit of its clays? (applause).

J. E. Lee, Esq., said it was far easier to ask such questions than to answer them. The President thought there was no time to do so then if he could, since they were due at Risbury camp in eight minutes, and had half-a-mile at least to get there. On went the Club straight for the camp, and crossing the brook with its deep banks, telling of torrents now and again, taking the mill stream at a flying leap and ascending the glacis towards the sally-port on the western side, where the first five members that arrived there stretched themselves on the grass and began the business of the meeting forthwith. The following gentlemen having been proposed at the last meeting were successively elected:—J. M. Herbert, Esq., Rocklands, Ross; E. S. Hutchinson, Esq., Longworth; Arthur Hutchinson, Esq., Hagley Park; Rev. J. Gregory Smith, Tedstone Delamere; Lilburn Rosher, Esq., Trewyn, Abergavenny; F. R. Kempson, Esq., Hereford; John Lambe, Esq., Hereford; Alfred Salwey, Esq., Moor Park, Ludlow; William Aston, Esq., Hereford; John Lambe, Esq., Hereford; Rev. A. G. Jones, Hereford; W. H. Warner, Esq., Ross; Rev. David George, Trelough.

Five other gentlemen were next duly proposed and seconded as members.

The PRESIDENT then said that he had had a deputation from the Cardiff Naturalists' Society, with a request that they might be allowed to join our next meeting at the Crumlin Viaduct. The Cardiff society was only just formed, and Mr. Adams, the President, was a member of the Woolhope Club. This reequest was at once very cordially agreed to, and it was left with the President to obtain a list of the members of the Cardiff Society, that an invitation might be sent to each of them.

By this time all the members had arrived, and the camp was entered. From the northern corner of the entrenchment a brief description was given of this most complete and interesting castrametation. It surpasses all other Herefordshire camps, with the exception of the Beacon, in the perfection of its lines, the extent of eight acres enclosed, and in the amount of labour which had been expended upon the fortifications.—Mr. Flavell Edmunds could not be present to read his paper in the field. It was read in the evening, and it is only necessary therefore to say now, how much it was to be regretted that this camp should have been so concealed, and spoilt, by the trees planted upon and around it. If the whole camp had been left as a grazing pasture it would have formed one of the most interesting places in the county, and would have had visitors to it from all parts, notwithstanding the remoteness of the district in which it is placed.

The approximate height of this spot was ascertained to be 160 feet above the Ford-bridge Station by Mr. Lee's aneroid barometer.

The whole of the party then went through the chief entrance on the eastern side to the space of five acres inclosed by the surrounding ditch as an exercise-ground or *place d'armes*, gathering as they went the *Saxafraga granulata*, and the pretty columbine of the cottage garden, *Aquilegia vulgaris*.

Here was read the paper on

THE CORNSTONES OF HEREFORDSHIRE AND MONMOUTHSHIRE.

By Dr. M'CULLOUGH, President.

Although the Old Red Sandstone or Devonian System, as developed in this and the adjoining counties, does not present those great masses of limestone which characterise many other formations, yet lime is very generally distributed throughout the various deposits forming that great system. Besides a considerable portion being present in many of its sandstones, and in its clays or marls, it is often deposited as limestones, which are usually more or less impure from admixture with other minerals, chiefly sand and clay. These limestones may be divided into two classes. In the first, the lime is deposited in nodules or concretions, the intervals between the nodules being filled up by matter less hard and calcareous than the concretions themselves, so that the mass is easily separated into its component nodules. In the second class, the cementing material is often more calcareous than the particles cemented together, forming a hard coherent band or stratum, after assuming somewhat the character of a conglomerate. The former, or concretionary limestone, is well developed in this neighbourhood, and excellent opportunities exist for examining it at the numerous quarries where it is worked either for burning or for road stone. It is found in beds of varying depth, the thickest which I have been able to examine being from nine to ten feet. Sometimes these beds are immediately overlaid by a stratum of sandstone, and sometimes they pass gradually into a bed of superincumbent marl. Besides these great beds, concretionary limestones are found in thinner bands of one or two feet imbedded in clay in the form of marl, and frequently a single row or course of concretions is found imbedded in the marl, much as a row of flint nodules is seen in chalk. Very often the beds of marl contain numerous small limestone nodules distributed through them without any apparent arrangement.

The second class is very different, and presents many varieties. Most of them contain a greater mixture of other minerals than does the concretionary form; the calcareous matrix cementing together not only calcareous nodules, but also portions of sand and clay, and they vary in texture from a tolerably compact and fine grained stone up to a rather coarse conglomerate. They vary in thickness from an inch or less up to 14 or 15 feet, which is the greatest depth I have observed. Many of them are very hard and durable, and are used as coarse building stone, and some of them are valued as road stone. They are quarried chiefly for the latter purpose, and to this the geologist owes many opportunities of examining them.

I have said that these deposits, regarded as limestones, are more or less impure. The degree of impurity, however, varies constantly, not only in different beds, but in different nodules of the same bed, and even in different parts of the same nodule. Though any analysis, therefore, can only apply strictly to the particular specimen examined, either as regards the amount of lime or the degree or kind of impurity, yet the following analyses give a fair idea of the composition of the less impure varieties. Sir Henry De la Beche (Mem. Geo. Survey) gives the following analysis of a Cornstone nodule:—

Carbonate of lime	69·3
Peroxide of iron	2·2
Silica	19·5
Alumina	7·2
Water	0·9
Traces of chlorides, sulphates, and loss	0·9
	100.0

A specimen of burned lime from the quarry near Ford Bridge station was examined for Mr. Arkwright, by Dr. Voelcker, with the following result:—

Water of combination	9 35
Oxides of iron and alumina	6·06
Lime	52.42
Magnesia	1·73
Alkalies	0·24
Carbonic acid	11.43
Insoluble siliceous matter	18·77
	100·00

Nearly three fourths of the carbonic acid had been expelled by burning. The quantity of lime is equivalent to about 72 per cent. of carbonate of lime. Mr. Arkwright has kindly placed in my hands three other analyses from different quarries on the Hampton Court Estate. In these the quantity of carbonate was found to be—the Sheepstye quarry, 60; Egdon Hill, 67; and Foxalls quarry 69 per cent.

In these thirteen specimens, which I now show you, from different beds and from different parts of the country, and which you will see differ greatly in character, I have found the proportion of carbonate of lime varying from 38 to 88 per cent.

In all the forms I think the lime was deposited from a chemical solution, aided in the conglomerate varieties by mechanical action, and not as in some formations by animal life. In the two classes, however, I believe the mode of deposition was very different. The great beds of concretionary limestone in this neighbourhood do not present any stratification or such irregularities in the different portions of the beds as currents would be likely to produce. The mineral matter mixed with the lime is in the form of an exceedingly fine mud, such as would be held in suspension for some time, and slowly deposited in still water. I think we may infer therefore that they were deposited as a limy mud in a still sea bottom, the nodules being formed subsequently by a process of crystallization, by which the carbonate of lime became aggregated in masses prior to the consolidation of the deposit. The smaller bands, or rows of nodules, found imbedded in marl, may be explained in the same way, sand and clay containing a considerable proportion of lime being deposited, a great portion of the lime subsequently separating itself from the semi-fluid mass.

The conditions under which the other class were deposited must have been widely different. Sometimes the beds may be traced for a considerable distance, but generally they vary much in thickness and structure often even in a few yards, and this variability seems to be in proportion to their approach to a conglomerate form. They are often stratified, and frequently lenticular masses of sandstone are intercalated in them in a way which only seems explicable by currents acting in comparatively shallow water. The coarseness of the materials often included favours the same view. They are not such as could be held in suspension and deposited in deep water at a distance from shore. Many of them evidently contain rolled pebbles derived from pre-existing rocks, and in some of the beds I have found pebbles several inches in diameter, formed of an exceedingly fine-grained limestone, not referrible to any known pre-existing rock. The source of these pebbles is a fertile subject for speculation, and if organic remains could be discovered in them it might throw much light on geological records.

These deposits are called Cornstones, a name originating, I believe, in this locality, and one which has been employed so loosely as to give rise to a good deal of confusion. It is used not only to describe the deposits themselves, but that division of the Old Red Sandstone in which they are believed especially to occur. With regard to the distribution of the deposits themselves they are traceable to within a very few feet of the tilestones or passage beds at the bottom of the system, and so far as I have been able to examine the upper part of the formation in our mountains, I have found in greater or less proportion both forms of deposit which I have described, up to within perhaps 1,000 feet below the carboniferous limestone.

By the Cornstone division, or series of the Old Red Sandstone, is usually meant the lower division, though, as Murchison observes, the middle division contains the greatest quantity of these deposits. It must be borne in mind, however, that these divisions are by no means of a definite kind. If a definite division is possible we must probably wait for it until the various parts of the Devonian system are better understood.

After what I have said as to the distribution of the Cornstones, it will be evident that their palæontology is almost equivalent to that of the entire Old Red system, as the fossil remains are generally found either in the calcareous beds, or in their immediate vicinity. I have never found anything in the nodular deposits. You are probably aware that in some parts of the Old Red Sandstone of Scotland, the calcareous nodules yield a rich harvest of fossils, the organism apparently acting as a nucleus round which the lime was deposited. I am not aware that anything of the kind has been observed in this district, though it would be well to make repeated and careful examination of the nodules. Our scanty fauna is found in the conglomerated Cornstones, and these are not always fossiliferous. It is worthy of consideration whether the deep sea conditions which I have suggested as the origin of the former, and the littoral conditions which seem more probably to have given origin to the latter, help to account for this difference.

I had intended entering into the palæontology of our Cornstones, but think it is better to defer this to another occasion, when it may be possible to discuss the subject more fully. For the present I have treated them merely as deposits of lime, and in connection with this I may refer to the Springs of the Old Red Sandstone being so often hard or calcareous. Water containing carbonic acid has the power of dissolving one thousandth part of carbonate of lime. Rain water contains this gas, and becomes further charged with it by passing through decomposing vegetable matter. Then, as it percolates through the marls and Cornstones, it becomes loaded with lime and issues forth again as a calcareous spring. Some of the springs in this neighbourhood are highly charged with lime. We shall pass in our walk to-day, at least three springs, in which the lime is so abundant that it is copiously deposited on any object placed in them, thus constituting what we commonly know as petrifying springs. From such springs amongst our hills the lime is often deposited as Travertine, as the water trickles over the rocks. On the contrary, the abundant spring which supplies the town of Abergavenny arises in the upper part of the Sugar Loaf above the Cornstone, where there is, perhaps, 500 feet or more of standstones, without either cornstones or marl, and the water is remarkably free from lime ; whilst on the other hand, in the spring of the lower range of the Little Skirrid, which contains both marls and cornstones, the water is abundantly charged with lime, and is therefore very hard.

The Cornstones have played no unimportant part in giving the country its present outlines of hills and valleys. Many of the bands are exceedingly hard and tenacious, and much better fitted to resist denuding agencies than the marls and most of the sandstones. That they helped to withstand the powers which scooped out our valleys in the past there can be little doubt, and that they resist the disintegrating influences of the present we may see in the escarpments of the Black Mountains where, although the adjoining sandstones have crumbled away, bands of Cornstone may be seen standing out sharp and unaltered, and only tumbling down ultimately in large masses when they have become undermined by the disintegration of the underlying strata. Their greater durability is also shewn by the fact that although they form but a small portion of a mountain the large masses of rock lying at its base are often chiefly cornstones, most of the sandstones having disappeared. The same resisting agency may be seen sometimes in the valleys where a river which has cut down through the softer strata is long arrested by a band of cornstone.

Under the guidance of Mr. Arkwright, the club now went down by the mill—mentioned as a source of income in "Domesday Book"—to the interesting old bridge of three arches. Here, when striking into a lovely dingle along a narrow path on its steep side, those who looked back got a most picturesque view of the bridge, the old mill, the murmuring brook, and the stream of gentlemen threading their way up the irregularities of the path. Over a broad weir the road lay, and then for two miles down the side of a charming glen with water on either hand.

A detour was made to visit some very fine old oaks—one of them, "The Rabbit-pool Oak," measuring 23ft. 4in. in circumference at five feet, whilst at the ground level it spread out to 48ft. It is a hollow tree with an opening on one side, which is gradually closing by the formation of new wood, and which is now only from four to six inches wide at the lower part.

Then back again to the glen with the curious name the "Hill Hole" glen—possibly reached in this way: The Holywell brook joins the Humber brook just below the northern corner of Risbury Camp, and is named from the Holywell of Pencombe and by a series of transmutations and corruptions which tradition substantiates, though we won't follow them; the whole glen receives its present singular appellation of "Hill Hole."

Crossing by the large pike pond and the old decoys, down through the deer park, disturbing rabbits beyond number, admiring the grooping of the trees, the gracefulness of the wych elms, and the views opening at every step, the club reached the fine old tree, "The Gipsy Oak."

A large specimen of the common fungus, the *Polyporus Squamosus* was gathered by the way, some 18 inches broad, growing gracefully with an actual stem of its own, from some decayed stump under the turf. This fungus, when dried—cut in strips—and glued on pieces of wood, makes razor strops of the highest virtue.

"The Gipsy Oak" is a noble tree in full luxuriance, with a perfect bole and fine spread of branches—some that nearly touched the ground have been cropped by deer perchance, again and again, until they serve now in their death for places to rub themselves against, or what is of higher import to give an excellent picturesque effect to the tree itself. "The Gipsy Oak," at 5 feet measures 24 feet 1 inch in circumference; but at 2 feet 4 inches from the ground, its smallest girth, the measure is 22 feet 6 inches.

There was no time to linger to measure the other fine trees here, or to watch the pheasants playing amidst the birch boughs lying before the hen coops. The march was resumed, the mansion was in sight, and was soon reached.

The members were most kindly led through the house by Mr. Arkwright to the chapel, where a fine old painted window—noticeable not only for the richness of its colours, but also for the subjection in which all the accessories are kept—through passages filled with cases of well-stuffed birds and animals, through the family museum, where the objects of peculiar interest to the tastes of our Club were far too numerous for any to be mentioned in this hurried sketch—through the suite of rooms—the beautiful conservatory—on to the most striking feature, perhaps, of the whole, the noble lawn—the magnificent stretch of level ground on which the mansion stands—a broad alluvial valley of the Lug whose richness was amply attested by some of the finest trees of their kind in England.

Here is a cedar measuring 17ft. in girth at 6 inches from the ground, above which point the trunk immediately divided, and at 5ft. from the ground after giving off five large branches it still measures 14ft. 8in. in circumference—the boughs of this tree are much broken by the westerly winds; another Cedar in perfection of vigour measures 15ft. 3in. in girth at 3ft. from the ground; two walnut trees measured 15ft. 11in. and 14ft. 10in. respectively; a horse chestnut tree 15ft. 7in.; a tulip-tree of very large size and peculiarly graceful in its growth, and many other trees of great beauty and size which time admitted not of measurement or description.

The charm of this lovely valley, increased as it was on the present occasion to the utmost extent, by the very great kindness with which the members of the Club were received, will ever remain a bright spot in the history of the Clubs wanderings, to those members who had the good fortune to be there.

Crossing the Lug by the bridge from the grounds, Mr. Arkwright led the way to one of those petrifying springs for which the adjacent hills are noted. The water highly charged with lime gives off a portion of the carbonic acid gas which holds the lime in solution, as it escapes from the earth, and thus an immediate deposition of some of its lime takes place over any object it falls upon. Here might be seen forming, both Stalactites and Stalagmites to unite in course of time with such other and form a natural pillar. And here, too, was a basket hanging, already considerably coated with the lime deposited on it. Lime so deposited is called Travertine from being so common in the valley of the Tiber. In the museum in the house, were birds nests and eggs, all stone-coated by this spring.

Craw fish and small crabs make most beautiful objects when nicely covered with lime from springs of this kind, but they must be carefully watched so that the lime is pretty equally deposited, since the beautiful curves of life require to be represented by the stone covering. Craw fish, however, do not live in the Humber brook, or the Lug. It is too liable to inundations of muddy water to be pleasant for them.

There is one pretty creature, however, that does flourish in the locality, and that is that lively cheerful bird the Water Ousel, *Cinclus aquaticus.* It was quite pleasant to hear that, there, in the very centre of the county, no less than three nests were known of this year. One, when examined on May 12, sent forth five young birds in a panic, who would not remain in their nest a minute longer though returned again and again. And curious was it to see the instinct of the young birds at once displayed. They had much less fear of the water than they had of the intruder's hand, and those who saw them not able to fly above three or fcur yards alighting by preference in the stream below, and actually trying to dive, could not hesitate to allow that power to the old birds which has lately been so much called in question.

It was a lovely walk by the river side ; it was very pleasant through the oak groves up the steep hill, with excellent views here and there of the mansion, and the park stretching over the hill beyond.

In the wood some specimens of the birds nest orchis, *Listera nidus avis*, were gathered, a plant so named from its clustering roots. In itself it is only a pale brown flower stem without any leaves at all. Here, too, might have been gathered the bee orchis, *Ophrys apifera*, if there had been time to search for it, as in the Hill Hole glen might have been gathered the sweet milk vetch, the *Astragalus Glycyphyllus*, and the fœtid Hellebore, *Helleborus fœtidus*, but they were not. Here, also, on this very hill, in a little dingle on the Dinmore side of Chancehill Wood,—but too far off for the route to-day—grows wild that exquisite flower—

"Than whom the vernal gale
None fairer wakes, on bank, or spray,
Our England's Lily of the May,
Our Lily of the Vale !"

The *Convallaria majalis* would be in flower too now ! Not a hundred yards from it grows a bed of the Great Water Horse-tail, *Equisetum Telmateja*, which before autumn will be five or six feet high. Tall, graceful, and elegant, it calls to mind a tropical forest in miniature.

The only wonder was that in so hurried a march, and so long a one, that so much was gathered. One plant was collected by C. G. Martin, Esq., new—absolutely new to the county. It was the *Alyssum Calycinum*, the Large-calyxed Madwort, a "Wandering plant;" that is, a foreigner probably introduced here and in many other counties of England with foreign clover, or corn seed. The genus is called *Alyssum* from the Greek negative "α" and "λυσσα," canine madness—one of the many supposed remedies for this disorder. Mr. Martin gathered it in a clover field on the descent of the hill, and it is not known to have grown here before.

The Observatory was reached. An artificial ditch of unknown import was passed on the hill, and soon those who pleased climbed to the top to enjoy the fine view from it. Time got on, time ! time ! inexorable time ! and a rapid descent was made to Dinmore Station, whence the express train quickly carried all the visitors off to Hereford.

The following gentlemen took part in the day's proceedings :—Dr. M'Cullough, the President ; Chandos Wren Hoskyns, Esq. ; James Rankin, Esq. ; and T. Blashill, Esq., Vice-Presidents ; John E. Lee, Esq., of Caerleon ;

John H. Arkwright, Esq. ; Elmes Y. Steele, Esq., Abergavenny ; Dr. Bull ; Rev. J. Raven ; John Lloyd, Esq., Huntington Court ; Rev. H. W. Phillott, and Mr. George H. Phillott ; Rev. W. C. Fowle, and Edward Haggard, Esq. ; John Price Hamer, Esq. ; Flavell Edmunds, Esq. ; Rev. E. Du Buisson ; Lilburn Rosher, Esq. ; Rev. Thos. Phillipps ; J. Griffith Morris, Esq. ; Rev. J. H. Jukes ; Rev. Alfred Phillipps ; James Davies, Esq. ; Rev. J. C. Westropp ; R. D. Harrison, Esq. ; C. G. Martin, Esq. ; Rev. Arthur Young, Tedstone Wafer ; H. C. L. Reader, Esq., Tedstone Delemere ; E. Cowtan, Esq. ; R. H. P. Styles, Esq. ; C. Henman, Esq., and Mr. T. Henman ; H. C. Hurrey, Esq. ; Messrs. Jas. Lloyd, of Kington, J. Pitt, of Freetown, John Andrews, of Bosbury, and A. Thompson.

The dinner took place shortly after four o'clock, and at the dinner table a great feature was the appearance of a dish of the true St. George's mushroom, the *Agaricus gambosus*. It was excellently cooked and served up as it should be, "all hot." There was enough for the majority to taste it—though nothing could induce some of the guests to try it—all who did so, thought it excellent. It was curious to hear the confidential communications that passed from one to the other "I say, that's uncommonly good," as if they had tasted it only as a matter of duty, and fully expected it to be quite the reverse. Requests for more were made on all sides, and the dish was quickly emptied.

Dinner was scarcely over, when the President's rap was heard, and the business of the meeting again commenced. He was sure they all felt much indebted to Mr. Arkwright for his kind reception of the Club. They had had a delightful walk through the Hampton Court estate, through the mansion, and through the grounds. It was only right to say that Mr. Arkwright most kindly invited us all to luncheon as soon as he heard that the Club had decided to go there. But as they knew, it was completely against the Club rules to accept any such invitations, and that one was, therefore, at once positively declined by the Central Committee. It was a very great pleasure and advantage to the Club to be able to pass through an estate and make their own observations as they had done to-day ; and perhaps there never was a day when more time was required, for though they had had such a pleasant walk, the distance was too great to allow of much work in Field science being done, and this it must always be borne in mind is the real business of the Club.

He would now pass round for their examination some life-size lithographs sent by Dr. Howden, of Montrose, of a splendid specimen of *Pterygotus Anglicus*, found in the Lower Old Red Sandstone, at Carmyllie, Forfarshire. The original is in the Montrose Museum, and is believed to be the most complete specimen ever yet discovered.

Dr. Bull, on behalf of the Central Committee, said he had much pleasure in telling them that the volume of transactions for last year, 1867, would be ready for distribution to the members by their next meeting. The reason of some little delay in its appearance was the very satisfactory one of the great length and value of the papers read at the annual meeting in March.

He had now to propose an alteration in the day for their next field meeting, when it was intended to visit the celebrated Crumlin Viaduct and Pontypool. The day fixed was Thursday, June 18th, but the President would be unavoidably prevented from attending on this day, and he had to propose therefore that it be fixed for the next day, Friday, June 19th. The Cardiff Naturalist's Field Club were coming to meet us on that occasion, and it was very desirable that our President should be with us. After some discussion this was agreed to. Dr. Bull then said he had the pleasure to show them a living specimen of the

MOLE CRICKET, OR GRYLLOTALPA VULGARIS.

This creature is by far the most curious of all the British Orthopterous insects. It was captured by Mr. Saunders, when running on the shingle by the river Wye, near the Hole in the Wall, in the parish of How Caple. Mr. Saunders at first sight thought it was a mouse running along, and he had some little difficulty in taking it. He has kindly sent it here with the hope of obtaining some information about it.

This very singular insect is, as you see, of a dark mouse or mole colour, about two inches long. Its great peculiarity is the strength of its chest and the shape of its fore feet, the latter very closely resemble the fore feet of the mole, and not only in shape but also in the oblique way in which they set on. Again, the hard and pointed chest and head, and the small protected eyes, give the creature a mole-like appearance. The Mole Cricket burrows under ground like the mole, and throws up ridges as it proceeds, but not hillocks. It frequents the banks of streams, or ponds or moist meadows, and lives on roots and vegetables. It is a terrible pest in a kitchen garden when a colony takes up its abode there, for it quickly destroys whole beds of peas, cabbages, flowers, or potatoes, since nothing green and juicy seems to come amiss to it.

The Mole Cricket forms her nest of a cell about the size of a small hen's egg, and deposits about 150 eggs in it. It is closed on every side to protect it from a certain voracious black beetle ever on the look out for such delicacies. "Nothing can exceed the care and assiduity of the Mole Cricket," says a writer, "in the preservation of her young. Wherever a nest is situated, fortifications, avenues, and entrenchments surround it. There are also numerous winding bye ways which lead to it, and a ditch encompasses the whole, which few insects are capable of passing." She keeps always on guard herself, and when the marauding beetle enters the circumvallations, down she pounces on it and quickly kills it.

The Mole Cricket is a night wanderer, and is then very active. "At night," says White, "it makes long excursions as I have been convinced by finding stragglers in the morning in improbable places." When dug out during the day it is slow and helpless, never attempting to use its wings. The love song of the Mole Cricket may be heard on fine nights from the middle of April to the middle of May. It is a dull, jarring, continuous chirp, and may be heard at some distance—something between the continuous cry of the house cricket and the fern owl.

Mr. Kirby says, "a Mole Cricket was brought to a friend of his, then (1780) a curate in Cambridgeshire, by a farmer, who informed him that one of his workmen seeing a Jack-o-Lantern, pursued it, and knocked down the insect in question." There seemed some doubt as to whether the Mole Cricket is not sometimes luminous—from some of the authorities he had consulted—but he (Dr. Bull) thought it could scarcely be the case or it would be more generally known, and the singular insect more often found. So few people here have seen it, that in all probability they are rare in this county, but Dr. Bull knew of two localities where it certainly lived—one was in a bank by the road side on the road leading to Burghill Portway, just beyond the little stream which crosses the road. Here, he had several times tried to catch it in vain. He heard them a quarter of a mile off and could get within a yard or two of the insect, but, from the difficulty of making out the exact spot the sound proceeded from, and the dulness of light, he could never get sight of it.

One Mole Cricket had been found in a manure heap in the yard of the gas works in this city some years since, but he had never heard of another. He should like to know whether any gentleman present could tell him whether the insect, under any circumstances, became luminous.

Elmes Y. Steele, Esq., thought not, or it would be better known.

Flavell Edmunds, Esq., explained that the insect had been entrusted to him on the condition of returning it to-morrow, so that there would not be much opportunity of examining it with this view.

Dr. Bull said that Curtis, the naturalist, had suggested "to those who are fond of petting mice and such small gear" that they should get a family of Mole Crickets, and observe their ways and manners. If Mr. Saunders could find the place in the bank of the river from which this one had come, perhaps he might be able to get a few. It certainly would be a difficult prisoner to keep, for it had powerful jaws, as well as claws, and bit through all sorts of roots that came in the way of its burrowings with great ease. The Club were much obliged to him for the opportunity of seeing the specimen he had lent them.

The love of the Mole Cricket for water reminded one gentleman of an invaluable receipt—sure and safe—to remove a domestic nuisance that must be very general, if the sale of poisonous wafers can pay for their advertisements. We give it here entire, and since it is the fashion to specify numerically good suggestions, and lest anyone should attempt to catalogue the bright ideas of the Woolhope Club, we will call this one No. 10,101.

TO BANISH EFFECTUALLY FROM ANY PLACE BLACKBEETLES, COCKROACHES, OR CRICKETS.

Keep it dry.

Yes, that is all. It partakes of the simplicity of a great truth. Stop carefully the leakage from the boiler tap; throw no slops into the purgatory; and clean the place by dry rubbing only, and the thirsty creatures will all disappear. The absence of moisture is fatal to them.

Dr. BULL then read a paper on the St. George's Mushroom, *Agaricus gambosus*, the edible fungus they had so favourably tested at dinner time, and he exhibited a sketch of it in colours. On the proposition of the President it was decided to have the sketch lithographed for the next volume of the transactions, with the hope that the ladies will again be so kind as to colour them. This paper will be published in full at some future time.

THE JAPAN SILKWORM—BOMBYX YAMA-MAI.

The PRESIDENT next showed a number of caterpillars sent by Dr. Chapman,

"That in their green shops weave the smooth-haired silk,"

the *Bombyx Yama-Mäi*, a large silkworm from Japan. It is an oak feeder, and will eat our English species. Dr. Wallace, of Colchester, has reared it on our oak leaves for several seasons, but has not yet succeeded in naturalising it. Like the mulberry silkworm, *Bombyx Mori* it passes the winter in a egg state. *Bombyx Cynthia* the ailanthus silkworm (feeding on *Ailanthus glandulosa)*, an allied species, which Dr. Wallace has introduced from Northern India, passes the winter in the pupa state. The silk of these species, is strong, but difficult to wind on account of the peculiar form of the cocoon. The worms exhibited were from eggs imported from Japan last winter by Dr. Wallace. They were in their first, third, and fourth skins. The largest having cast its skin three times, and being about to cast it a fourth time and assume its last skin, it was hatched on April 17. All the larvæ are a pellucid green colour, very much like that of the leaves on which they feed. The smaller ones have three rows of tubercles on either side studded with black hairs. Those in the third skin have the two first rows of tubercles yellow; the lower row below the spiracles, pale blue; the hairs fewer, long, and black; head and spiracles, brown. The largest one, nearly three inches long, presents hardly any but the anterior tubercles, and they are smaller than before, two of them, however, shine like silver. It has a few scattered black and yellow hairs, head green. The division between the segments are deep, giving a tubulated appearance, especially the anterior segments. A yellow lateral line expands on this last segment, and includes a triangular olive brown patch. The full-grown caterpillar is nearly five inches long, is smooth and less hairy, and its head is green.

Here was read a most entertaining paper on

THE CAMP OF RISBURY.

BY FLAVELL EDMUNDS, ESQ.

Locum vallo fossaque munivit.—*Cæsar.*
Vallo et fossâ circumdedi, castrisque maximis sepsi.—*Cicero.*

Two miles E. of Ford Bridge station, on the Shrewsbury and Hereford Railway, is situated the camp of Risbury. Lying apart from the chief modern lines of communication through Herefordshire, it has been overlooked by most of the topographers, or merely mentioned in the briefest of passing references. It is, however, in itself well worthy of a careful examination by all who would appreciate the history of the district, or who would clearly understand the stormy process through which this once vexed border land gradually settled down into the well ordered Herefordshire of our time. Although for the last twelve or thirteen centuries, as it is now, a sparsely peopled tract of country, there being no more parishes and villages in 1868 than there were in 1086, when Domesday Survey was taken, the hilly plateau in the centre of which Risbury camp stands was important in ancient times as part of the great chain of defences which protected Herefordshire against invaders coming—as most of them did—from the Eastward. A beacon fire on Risbury could be seen and answered from Sutton Walls, and the signal sent successively from it to St. Ethelbert's Camp, Capler, Dinedor, Acornbury, and the Graig; while N.E. the warning flame would be visible at Thornbury Camp, and S. E. at Circutio (now Stretton Grandison)—from whence the "fiery message" could be sped to Wall Hills, near Ledbury, and from thence to the great camp on the Herefordshire Beacon. To the N. another line of camps consisting of Black-caer-dun, Eyton, Gorsey-hill (Pudleston), and Cainham, communicated with the Dinas or fortified British town of Ludlow, which could "speed the message on" by Titterstone and Brown Clee to the great camp on Caer Caradoc.

Although not equal in size to Dinedor or Acornbury, and far smaller than the truly "Great" Camp of Credenhill, Risbury Camp contains eight acres, and may be ranked in the second class of the camps of the district. It seems to have been intended only for use in actual war, having no pools or wells within its *enceinte.* Still the comparatively advanced state of military art which it shows, in the almost elaborate nature of its defences, proves that it was accounted a position of greater importance than either its size or its convenience would imply.

The secret of the care bestowed on this spot is explained by a single fact: it commanded the Roman road, yet used for the greater part of its extent, which left the Magna and Circutio road where Shelwick toll-bar now stands, passed N. by the Withergins bridge, Sutton, Bodenham moor, Risbury, Humber, to the ford of the Hennor brook at the Street-ford (now Stretford), and thence by Gorsey-hill camp to Cainham and Ludlow.

The position of Gorsey-hill camp is very similar to that of Risbury, and it was evidently constructed with a like view to the Roman road, and with like "ulterior objects."

Our business at present, however, is with the S. part of the same hilly plateau, and with its camp of defence at Risbury.

At one point this road descends into a dell, and is crossed by a shallow brook, which, dividing into two, encloses a little *ait* (as the Saxons called a river island), and is spanned by a tiny bridge of three arches, making up with the wooded hills in the background a charming bit for a painter. In ancient times, when the land was densely wooded, no doubt this brook was a river, and the ford was a strategical point, at which an alert enemy might inflict serious loss upon an army passing along the road. Ascend the brook by pursuing the dell to the right, past the mill—itself an antiquity, and the representative of the mill from which (as Domesday book says) the Norman lord received 10d. out of every four shillings' worth of corn ground—and you find the dell deepen and widen, and on your right, rising to a height of 46ft., is the earthen rampart of Risbury camp. Trace the brook, and you find that it forms the first line of defence against an enemy posted upon the road, and this line is continued until you pass the N. extremity of the camp, where the road stretching onward in a straight line passes out of range. You leave the brook, and passingto the E. notice a broad slope, then a terrace, next a ditch some 5ft. deep, then a second slope or glacis, and then some 40 feet of steep hill-side. Resuming your course eastward, along the lowest glacis, you observe the care and regularity with which the work is executed, and the skill with which the natural advantages of the position are made available. More than halfway down the E. side of the fortification, you come upon the main entrance, which is defended by outworks extending for nearly a hundred yards outward from the entrenchments, forming a noble *place d'armes*. Passing onward, you find this elaborate triple line of entrenchment continued for some distance, until as the ground descends it becomes less necessary, and then the entrenchment is merely double. Having passed round the S. end of the camp, between it and the mill, you reach the W. entrance, which is narrow, has no approaches, and is plainly designed merely as a sally-port against an enemy on the opposite ridge, along which runs the Roman road.

Enter the camp, and you see at the first glance that it is a British work from its oval form, analogous to that of the northernmost camp on the same range, on the hill above Pudleston. Risbury, however, was evidently the work of Britons who were far advanced beyond the condition of the men who executed the camp at Backbury, oreven that of Capler. Instead of leaving the summit open, the men who made Risbury camp either raised a bank of earth all round the edge of the precipice or cut down the area within, perhaps did both, thus forming a "breastwork" or parapet of unusual magnitude, being from 5 to 8 feet high, affording a sure protection in days when as yet there were no mortars, and Congreve was not born to kill people under cover two miles off with his death-dealing rockets.

Another peculiarity, which shows how closely the nature of the site was studied by the old engineers, is the position of the entrances. They are exactly opposite to each other, but they are not in the middle of the oval. The great entrance on the east is exactly at that point where the high ground outside makes the approach easiest, while the W. entrance is just at the part where the approach is most difficult, thus plainly showing that the latter was on the side from which the attack was expected.

From all these facts, in the absence of any historical record, I think we may safely assign the formation of Risbury Camp to the same period which produced the great circumvallation of the Herefordshire Beacon. My friend, Mr. Edwin Lees, in his excellent lecture delivered on the spot, at the Club's meeting in May, 1867, showed convincingly that the entrenchments of the Herefordshire Beacon belonged to the end of the ninth or beginning of the tenth century, which was the period of the completion of the Saxon conquest. On a smaller scale, Risbury supplies all the same evidences of a comparatively advanced state of civilisation, in the triple line of defence, the skilfully adapted plan, the elevated rampart, and the position and construction of the chief approach. My theory as to the late period at which Risbury Camp was formed is strengthened by the fact that it has no British or Roman name. It may have been captured soon after its formation, or at least the Britons were so completely extirpated from the spot that its British name, if it had one, was soon forgotten The Saxon names of all the neighbouring parishes show that the district was at length entirely subdued and settled by the conquerors. Marston, Humber, Hennor, Stoke,* Eyton, Ford, Docklow—are all proofs that the Saxon settled in those places, driving out or reducing to thralls the native population. The name of Black-caer-dun is the only trace of the Briton left on the E. side of the Lugg for many miles; and that, it will be seen, in the prefix "Black," shows that the Saxon became dominant there also.

This arrangement of the defences illustrates a fact of history, which is worth a passing reference. The so-called kingdom of Mercia is said to have been founded by Crida in 586, but it would appear that throughout the whole three centuries which elapsed until the time of its absorption by Egbert into the kingdom of Wessex, it really existed only in the valleys and champaign country. Wulforton (now corruptly written Woofferton) seems to have been the abode of Wulfor King of Mercia in 656. It is situated in the low country some eight miles N. of Risbury. Even so late as 924, when the great Athelstan stormed Malvern, and "drove the conquered Britons across the Wye,"† the

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* It should be remembered that the Roman word *vallus*, the etymon of the word "wall," meant originally a stake driven into the ground, e.g.: "Induere se acutissimis vallis aut stimulis."—*Cæsar*. This was precisely the Saxon *stoc* or *stoke*.

† Chronicle of Brut: Sir F. Madden's edition.

Herefordshire hills were held by British princes, who had on the whole held their own against the Mercian kings, although no doubt occasionally reduced to the condition of tributaries. After the destruction of the Romano-British city of Magna, Caer-ffawydd was founded or enlarged, and became the Saxon city of Fernlege, and Sutton Walls became the residence of the Mercian kings. These facts imply the settlement of the vales of Wye and Lugg by Saxon chiefs or thanes; and the predominance of Saxon names in the lowland parishes shows that the invaders completely overpowered the British element. The loftier hills, however, such as Croft Ambury, Malvern, Dinmore, Fownhope, and Dinedor, retain more or less purely their British names. which is merely saying that the British population still held the hill country. Where the Romans had created fortifications, they were no doubt still made available against the Saxons; when the new exigencies demanded new camps, as at Risbury, they were formed. Ever and anon, the dispossessed Britons, descending from their hills, would make a foray upon the herds of a Saxon settler in the vales, and would retire with their booty to their hill retreat. The nursery rhyme of "Taffy" is a mere condensation of the history of these Marches for many centuries:

Taffy was a Welshman,
Taffy was a thief.

Here is Saxon prejudice, abusing by wholesale the people whom Saxon invasion had dispossessed.

Taffy came to my house,
And stole a leg of beef.

Here was the raid upon the Saxon's homestead, and the capture of his cattle. By and bye, the visit would be repaid:

I went to Taffy's house.
Taffy wasn't at home.

He was too prudent to await his visitors when they came in inconveniently large numbers; but whilst they were seeking for him he sometimes made a wide detour, came down like a thunderbolt upon the homesteads which had been left unguarded, and carried off all that remained of the herds which he had previously thinned:

Taffy came to my house,
And stole a marrow bone—

that is, all that was left worth taking. It is unnecessary to pursue the story, as told in the ballad with the characteristic coarseness of mediæval times. The substantial meaning is enough for our purpose. It teaches us how Taffy's retaliation hurried on the catastrophe. Probably, in all such cases, there would be a grand gathering of the Saxon settlers, to which every man who was not a "niddering," or utterly worthless, would be summoned on pain of being harried out of house and home by his compatriots; and then the hills would be surrounded and stormed, and the troublesome hill-men captured for slaves or slaughtered. Against such dire eventualities, the Britons would guard by the formation or careful maintenance of camps like Risbury.

The natural question, why should the enemy be expected to approach from the S. or West, is answered by two facts: the vale of Lugg, which lies to the W., was settled by the Saxons, while Sutton, the seat of Saxon royalty, lay to the S. The enemy might be expected to come along the Roman road, because it was the only road through a wild district. The names indicate that Herefordshire was a land of woods and pools, with here and there a few huts in a "thwaite" or on a dock-covered bank, while devious by-paths concealed rather than led to the chief's "palace" at the head of the dingle (Pen-cwm), or on some quasi-island in the marshes, known to the Britons by the appellation "ynys," to the Saxons as an "eytun" or "marestun."* The whole district which lies E. of Risbury for some miles is still a wild and thinly peopled tract; and the occurrence of such words as Woodfield and Wootton (*i.e.* wood town), in the names of the farms, shows that it was in Saxon times a woodland, with here and there a cleared spot, in which the settler excavated a ditch and threw up a mound round his house. A place so defended was called by the Saxons a *tun*, and the word still survives with an extended meaning in the words *ton* and *town*.

The measurements of the area of the camp are—extreme length, 365 paces; interior breadth from entrance to entrance, 157 paces. From a line connecting the entrances, the N. portion of the area extends 203 paces, the S. portion 162 paces, the former being thus about one-fifth larger than the latter.

Although mentioned in Domesday Book in a similar manner to the adjoining places which are still parishes, and set down on Camden's map with the usual mark indicating a church and a village, Risbury has no church, and is not a parish, but is included in the parish of Stoke Prior.

The allusion in Domesday Book is as follows:—

Wills. de Scobies tent. Riseberie Robt de eo. Eduuin tenuit ibi ii hidæ in ii car. i vill. iii bord. dnio sunt iiii servi. moliri de iiii sol. Vills. redd. x dens. valv. xx sol. modo lx. solid.

Which I thus render:

William de Scobies holds Riseberie. Robert holds from the same. Edwin held here 2 hides. In dominion there are 2 carucates of land, 1 villein, 3 bordars, 4 slaves. William receives 10 pence from 4 shillings' worth of corn to be ground. The value was 20 shillings the quarter; it is now 60 shillings.

The name, like those of all the neighbouring parishes, is purely Saxon. It occurs in Domesday Book as "Riseberie," and in a charter given in Dugdale's "Monasticon" it assumes the mediæval Latin disguise of "Risebiria." The etymology is obvious: *Rise*, a hill, as in Highgate Rise, Clapham Rise, etc.; and *bury*, from *burh*, a fortification. The 4s. worth of corn mentioned was probably a quarter.

The notice of Risbury in Domesday Book is curious, and has a special interest to those of us who assisted at the formation of this club. Our

* Eyton and Marston.

lamented friend and founder was the late Mr. M. J. Scobie; and it is a coincidence that in opening Domesday Book for the purpose of preparing an essay for the meeting of this Club I should find that a Norman lord of the same name held Risbury eight hundred years ago (applause).

Mr. John Lloyd said that when they were on the Herefordshire Beacon, at Malvern Hills, they were told that the approach was on the westward side, and that the eastward side was the strongest, because the attack was expected from that side. Now they were told, in reference to Risbury, that the approach was on the eastward side, because the attack was expected from the westward; but he thought they had not seen anything at the camp to establish that view, and therefore, in arriving at the conclusion advanced by Mr. Edmunds the point should be well weighed. The sally port was certainly on the westward side, and on that side the defences were very strong. He did not see why the attack should be expected from the east in one case, and from the west in the other.

Mr. Edmunds said that at Malvern the only road across the hills came from the N.E. It was manifest, therefore, that an enemy, unless he came out of Wales, must come that way: hence the strong part of the campwas against that road. There was a very steep ascent, and triple fortifications confronted them at the summit. So late as 924, in the time of Athelstan, Malvern was a waste—a royal chase on one side, and an episcopal chase on the other—with only a few huts scattered about. Even 200 years later, when that good man Aldwin, the Monk of Worcester, proposed to go to Palestine as a missionary, and was wisely told by his Bishop—the last Saxon bishop of Worcester—that he would find plenty of heathens at home, he selected Malvern as the scene of his labours, because it was a wild, savage spot, the few inhabitants of which were still in a state of heathenism.

Mr. Lloyd: Mr. Lees argued that Malvern must be a British camp, because it is strongest on the eastward side; you seem to say that Risbury must be a British camp because it is strongest on the westward side.

Mr. Curley, C.E., remarked that the earthworks at Risbury were admirably constructed, and if they had to be executed at the present day, notwithstanding all our facilities, would cost a very considerable sum.

Mr. Edmunds: At Malvern the enemy could come only from the N.E.; at Risbury he must have come from the opposite side, the eastern district being a wild country, and then probably a trackless waste.

Mr. James Davies said he wished that Mr. Edmunds's notes had been read at the *locus in quo*, as he would then have been able to have pointed out to the Club the supposed Roman road, running near Risbury. The subject of this road was not altogether new to him (Mr. Davies), as many years ago Mr. Cherry, of Buckland, had communicated with him upon a supposed Roman road, and if Mr. Edmunds was identical with it it was a very important new theory in connection with the Romano-British history of these parts, as this Roman road was not mentioned in the Iters of Antoninus or Richard of Cirencester. The only Roman roads mentioned in the Iters were those which connected *Magna Castra* (at Kenchester) with *Bravinium*, near Leintwardine, and *Magna Castra* with Wigornia at Worcester, and *Ariconium*, near Ross; but Mr. Cherry thought that he had discovered a road connecting *Bravinium* with *Ariconium*, and the course of it was similar to that sought to be traced out by Mr. Edmunds. It may be followed on the ordnance map.

Mr. Edmunds remarked that he had examined the road all the way from Shelwick bar, over the ancient Withergins (now Wergins) bridge, through Sutton, Bodenham moor, past Risbury and Humber, to some distance beyond Stretford; and on the map he had traced it further north to Stony Cross, Little Hereford, and Ashford, to Ludlow. It was still in use all the way.

Mr. Lloyd: But it is very irregular.

Mr. Edmunds: That would arise from local circumstances.

Mr. Davies: The word Stretford no doubt indicates a Roman road. There is, I admit, as Mr. Edmunds has said, a road running in an almost straight line, a little to the westward of Risbury, which may be traced on the map, and the theory of its being a Roman road is a very interesting one; but I am inclined to think it was a British trackway from the town of Ludlow to Risbury. As to Risbury camp, I agree with Mr. Edmunds in the main, that it was a small British station. The illustrations we have had of Magdala show what a British station was, only instead of having stone walls for their protection, the British generally threw up embankments of earth.

The President: With regard to the theory of this being a Roman road, I am sure you will be of opinion that if Mr. Davies will undertake to investigate it, good results will follow; and if Mr. Davies will do so, and report at a future meeting, we shall be very much obliged to him.

Mr. Davies: I shall be happy to do what I can, but it cannot be in better hands than Mr. Edmunds's.

The President: It is understood that a report will be made upon the subject at the August meeting.

Dr. M'Cullough then read for Dr. Chapman the following interesting and valuable paper:—

ON THE DIFFERENT SPECIES OF HYLESINUS OCCURRING IN THIS DISTRICT.

By Dr. CHAPMAN, Abergavenny.

The genus *Hylesinus* belongs to a family of the *Rhyncophora*, or weevils, named from it the Hylesinidæ, also called by some authors the Xylophaga, and classed as a distinct section.

The Hylesinidæ have the head rounded and sunk in a deep socket in the thorax; the rostrum or snout so characteristic of the weevils is nearly obsolete; the antennæ have a long basal joint, and are more or less clubbed at the extremity, and with never more than ten joints; the mandibles are very strong and prominent, though short; the extremity of the tibiæ hooked, and the third tarsal joint bilobed; the larvæ are footless grubs. All the species are small, black or dull brown in colour, cylindrical in shape, and especially rounded on the upper surface.

It is a very natural group, all the species being very similar in appearance and habits; most of them pass their lives in the inner bark of trees, in which some of them commit great devastations.

The species of Hylesinus are more rounded than those of the other genera of the Xylophaga. They possess antennæ with an oval elongate club, and tibiæ obsoletely spurred.

The perfect insect forms a burrow or gallery in the cambium layer of the bark of recently fallen trees, along the sides of which the eggs are deposited; the larvæ feed in the inner bark during the ensuing months, whilst it still retains a modified vitality, and complete their metamorphosis in time to renew the same cycle the ensuing year. The species of Hylesinus form their burrows transversely to the fibres of the tree; most of the other genera of the family form them parallel with them. The larvæ, starting at right angles to the parent burrow, form theirs in the reverse direction or nearly so, their increase in size makes them diverge from each other and produces rather a fan-shaped marking.

Of the four species of Hylesinus which occur in England, one, *Hylesinus Oleiperda*, which is like a little round dumpy *Hylesinus crenatus*, we will dismiss at once, as I have not succeeded in meeting with it in this district. The two species to which I have directed most attention, *Hylesinus crenatus* and *Hylesinus Fraxini*, are attached to the ash tree *(Fraxinus excelsior)*. The fourth species, *Hylesinus vittatus*, is attached to the elm tree, and is fairly abundant in this district. It is difficult, however, to say of any species of the Xylophaga whether it is abundant or not, as, however difficult it may be to find it, when found it is almost certain to be in some numbers. Thus, though *H. crenatus* is a scarce species, I could have taken it last winter in almost unlimited numbers. *Hylesinus Fraxini* is, nevertheless, an undoubtedly abundant species. At this season (May 22) it may be found on any recently

HYLESINUS AND ITS WOOD SCULPTURINGS.

1.—*Hylesinus Fraxini*, natural size.

a. ,, ,, magnified.

b. ,, ,, ,, lateral view.

c. d. e. Portion of a log of Ash in which *H. Fraxini* has been reared; on one side the remains of the bark are removed, shewing at *c.* the sculpturing of the surface of the wood, the horizontal line being the parent gallery, the vertical lines the grooves cut by the larvæ; at *d.* the upper half only of the parent gallery is removed, showing the row of eggshells along its lower side, these retain the appearance of the fresh eggs except that they contain only larval frass. At *e.* the undisturbed bark shews the exit apertures of the young beetles.

f. A transverse section (magnified) of a parent gallery after the larvæ are hatched; the young larva being developed in the egg with its head towards the surface, leaves the shell from its upper part, and as it proceeds, stuffs the shell behind it with frass. A thin layer of parental frass covers the free surface of the eggshell.

2.—*Hylesinus crenatus.*

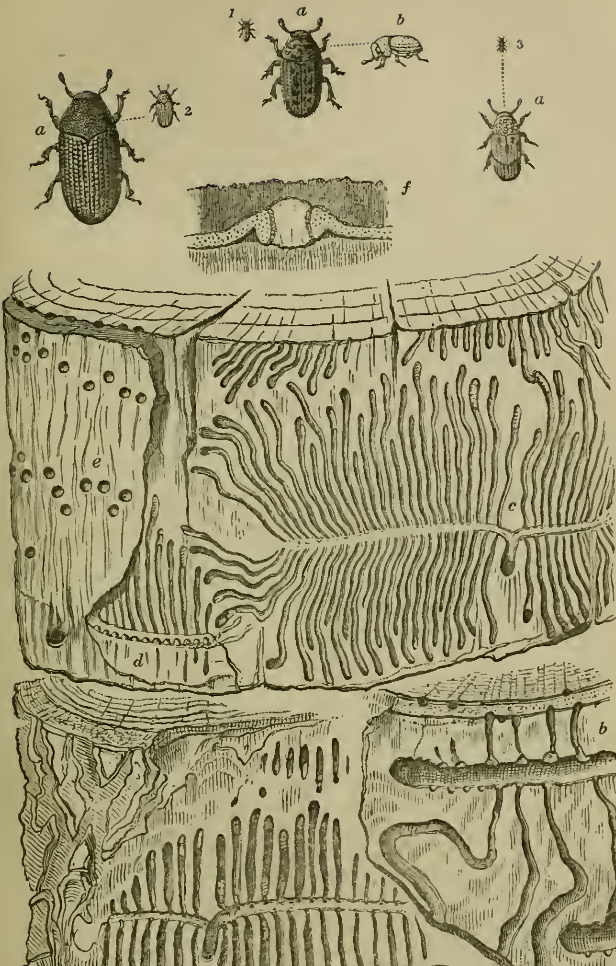
a. ——— ——— magnified.

b. Section of Ash bark, with parent burrow of *H. crenatus*, shewing the deep depressions for the eggs, and the irregular tracks of the larvæ.

3.—*Hylesinus vittatus.*

a. ——— ——— magnified.

b. Bark of Elm, shewing parental and larval burrows of *H. vittatus*, about one-third larger than the natural size. The pupæ are indifferently at either end of the short cylindrical larval burrows.



HYLESINUS AND ITS WOOD SCULPTURINGS.

felled ash timber, busily engaged in oviposition. It is about two lines in length, is clothed above with cinereous and fuscous scales, beneath with an ashy pile, antennæ ferruginous, with a large acuminated fuscous club, legs piceous, tarsi ferruginous ; it is extremely variable in colour, being of different hues of black, piceous, ferruginous, or testaceous, sometimes ochraceous, with the legs and antennæ paler ; usually it is ferruginous, with irregular piceous markings. *H. Fraxini* appears very decidedly to prefer recently fallen timber to the growing tree ; they will even attack wood that has been cut many months. Early in May the perfect beetles are often to be seen swarming about fresh ash logs ; they arrive on the wing, and prefer the warm sunshine of the early morning for their flight ; they must often travel considerable distances. They bore very rapidly, however, into the bark. The female commences the gallery by boring obliquely towards the wood, usually in a slightly upward direction, in large timber choosing the deepest part of a crevice of the bark ; in younger wood a knot or other irregularity determines the preference, so that, unless the frass lies about the aperture, they are difficult to detect. Frass, I may explain, is a term applied to any detritus caused by insects, and especially to the sawdust, &c., made by wood-boring beetles. Usually before the female beetle has quite buried itself in the bark, the male arrives, and is waiting to enter the burrow, if not, the female bores down to the wood, and there awaits his coming ; and I believe I have met with burrows uncompleted because the male insect did not appear. I have satisfied myself that each pair of beetles first meet after the female has commenced the burrow. In a few days the two beetles are to be found rapidly extending the gallery in both directions from the aperture of entry, close to the wood and usually slightly in it, and transversely to its fibres.

I suspect each of the beetles excavates a branch, but I have found no means of observing them at work, as opening the gallery always stops them, and it is possible that the female does the greater part of the excavation, as I have always found her further from the aperture of entry when both were in the same branch of the burrow ; the male is also oftener at its opening, and eggs are laid along each as rapidly as it is formed, not unfrequently the branches of the gallery are of very unequal length, so much so that sometimes there is practically only one—possibly both beetles work together. Undoubtedly the greater part of the excavated material is eaten ; in captivity the beetles will live a long time with fresh ash bark, without it they soon die. Most insects on their escape from the pupal state contain their eggs ready to be laid and requiring only fertilization, but in these, as in many of the more active Coleoptera, the eggs are developed after attaining the perfect state. In the case of *Hylesinus Fraxini* the female is often bulkier when the burrow is half completed than on entering it, and the eggs laid by a single pair must often exceed in aggregate mass the original bulk of the female beetle. The domestic habits and family relations of these beetles deserve further attention. The following suggestive experiment was made : A burrow was partially opened, some few eggs had been laid, each beetle was then blockaded by a bit of bark in a branch of the burrow, and for each sufficient space was left for air and the discharge of frass. A week after each beetle had eaten a narrower burrow just long enough to hold it, merely to sustain life, contrasting with the wider burrow outside, but no more eggs had been laid.

The eggs are laid along both sides of the burrows, usually at very regular intervals, in little hollows dug out to receive them, leaving the gallery of full size for the beetles within it. They are covered with a gummy material, which soon gets a coating of the finer frass. These eggs being laid in rotation, form a good series for observing the development of the larvæ within the egg, the first being often hatched and the young grub boring into the bark before the last is laid. Their longest axis is perpendicular to the surface, and the young larvæ are developed within the eggs with their heads toward it. The eggs laid in one burrow vary from 15 to 40 or 50, or even 60 to 100. The gallery is finished and the eggs laid in from ten to twenty days. During the ejection of the frass, particles adhere by a gummy matter, and form an operculum to the mouth of the burrow, leaving only a minute opening for frass, which on the completion of the burrow is stopped up. Both beetles then usually die in the burrow; the female always does so. The dead beetles may still be found lying in the burrows after several years.

During the summer the larvæ are busily feeding in the bark. They are straight, white, footless, fleshy grubs, with a distinct head and powerful mandibles. In some of my specimens they are already (May 22) hatched. In the autumn they assume the pupa state, and shortly the imago. The perfect beetles, however, usually remain during the winter at the ends of the burrows formed by the larvæ, and emerge in spring to continue their ravages, leaving a very distinct circular aperture; on a sculptured piece of bark all the very obvious holes are apertures of exit, those of entry being very obscure.

It often happens that the parent beetles have made their burrows so close together that the supply of bark is quite inadequate to the wants of the larvæ, so that their very abundance is its own remedy, and most of them perish. In other instances the vitality of the bark ceases before the larvæ are full fed, the tree having fallen too long when attacked, so that but a small proportion usually comes to maturity.

I have remarked the preference of this species *(Hylesinus Fraxini)* for fallen timber, nevertheless they do occur on living trees. On almost any young ash tree marks may be found shewing that a burrow had been formed and a brood of *Hylesinus Fraxini* perfected, and that the tree is now exfoliating the destroyed bark. Sometimes I think the growth and vigour of the trees appear to have been decidedly checked by them; and though I have not met with an example, I doubt not that trees are occasionally killed by this beetle. In other instances trees with these marks appear to be uninjured. Where they are injurious they may be extirpated by cutting down affected trees, stripping off and burning the bark, &c.; but as I suspect that it is the want of dying timber which forces them to attack living trees, I would suggest that placing fresh logs, during the spring months, in the neighbourhood of affected trees, as traps, and destroying the beetles which come to them, would be more effectual.

Hylesinus crenatus, which is also an ash feeder, is larger than *Hylesinus Fraxini*, three to four lines in length, and proportionately a stouter insect, giving it a more rounded and less cylindrical appearance; entirely black; some fine ferruginous hairs on the tibiæ and head; thorax minutely pitted; elytra with eleven rows of small tubercles, which give a rough appearance to the beetle. Though widely distributed and abundant when it does occur, like the *Xylophaga* it seems to be anything but generally common. I have found one tree which owed its fall to its operations. The beetle had obviously been in possession many years; it had commenced the attack near the foot of the tree, on one side the bark was destroyed by it round more than half the circumference of the tree, and to a height of 15 or 20 feet, the limbs above being dead. A zone surrounding this contained the insect in all its stages, the remainder was still unattacked. The portion of bark longest destroyed had fallen away, and the wood beneath was in possession of *Sinodendron Cylindricum* and *Dorcus parallelopipedus*, and was rapidly rotting. The tree was blown over in one of the gales of last winter. I have also found *Hylesinus crenatus* sparingly in several other trees, all pollarded or otherwise sickly. Unlike *H. Fraxini*, *H. Crenatus* takes two years to undergo its transformations, the larvæ assuming the pupal state at the end of the second summer, so that at present full-grown larvæ and perfect beetles are both to be met with. Felled timber would be unable to support this long larval existence, *Hylesinus crenatus* accordingly is never met with except in living trees, and while an affected tree continues alive I believe that none of the beetles desert it for another. They economise it as much as possible, the destroyed bark being more completely riddled and devoured by them than by any other beetle of the family I am acquainted with; the burrows of the larvæ are much more irregular also, so that it is impossible to find one of those perfect maps of their voyages (as in *Hylesinus Fraxini*) which have secured for these beetles as a family the name of "typographers." Last winter the blown down tree I have mentioned contained hundreds of the perfect insect ready to emerge on the approach of spring, and but for the fall of the tree would have made their burrows in it again, but now they have all left it, so that last week I had difficulty in finding a specimen, *H. Fraxini*, of which odd specimens only were to be found during the winter, now on the contrary abounds in it. The parent galleries of *H. crenatus* are proportionally much shorter than those of *H. Fraxini*, and more frequently consist of only one branch, the male and female both enter the burrow as with *H. Fraxini*, but the male usually leaves before the gallery is quite completed. The eggs are fewer than with *Fraxini*, and laid in a deeper cavity, and so thickly covered with a layer of frass as to require looking for.

Hylesinus crenatus appears to be generally distributed in this district, but is hardly likely to prove very destructive; if found to be so, the tree on which it has formed a settlement cannot be rescued without a process of barking—as serious as the beetle. They are not likely to attack the neighbouring trees till driven out of their strongholds, on the fall of an affected tree therefore, they should be destroyed, or they will establish themselves in others. At the same time I would enter a protest against waging war with any species that is to be regarded as scarce or local.

Hylesinus vittatus is about half the length of *Hylesinus Fraxini*, and very similar in general appearance; it is very prettily marked and rather variable; most specimens present a distinct dark spot towards the base of each elytron, surrounded by a paler cinereous area; though feeding on elm it is much more closely allied to *Hylesinus Fraxini* than *Hylesinus crenatus* is; its habits are just the same, it attacks fallen elm as *Hylesinus Fraxini* does the ash; its burrows are shorter, and the two branches are very uniformly of equal length, rarely exceeding ¾ of an inch long; the number of eggs laid are seldom as many as 20, and being usually placed more widely apart than those of *Hylesinus Fraxini*; the burrows of the larvæ are nearly parallel, giving little of that fan form seen in the burrows of that species. It appears much less common than *Hylesinus Fraxini*, though I find their burrows abundantly in a piece of elm fallen about the end of April. The operculum of frass which closes the mouth of the burrow is more complete than in *Hylesinus Fraxini*. They complete their changes in one year. I have been unable to find any evidence of their attacking living trees so that from an economic point of view they must be regarded as very unimportant.

The decay and destruction of fallen timber is much facilitated by these beetles. They partially or wholly destroy the bark; their frass-filled burrows absorb and retain much moisture, which is almost essential to decay, and usually the bark is so much loosened that, after a longer or shorter time, it falls off. This rarely takes place before the wood is much injured by the funguses, for which the damp-destroyed bark has been the nidus and by the various subcortical species of insects for which the beetle-burrows have opened a way. The wood is then easily attacked by the numerous wood-feeders, various *Longicorns*, and *Anobia*, *Sinodendron*, &c., who soon complete its destruction. But the necessity for a natural method of clearing the ground of dead and dying timber has so long ceased in this country, that we have difficulty in regarding these insects as other than noxious pests.

My thanks are due to the President, Dr. M'Cullough, for several of my specimens, and to Mr. Rye, to whom I owe the accuracy of the names of species.

[This excellent paper was admirably illustrated throughout by specimens of all the different beetles themselves, and numerous pieces of bark and wood to show their different modes of boring ; the parent burrows with the eggs arranged along the sides ; and the offspring burrows, made as the larvæ are hatched, at right angles to the parent burrows. In some instances the living beetles were at work and could be easily cut out. It was received with the great interest and applause which the trouble and ability displayed upon it richly merited.]

The Woolhope Naturalists' Field Club.

CRUMLIN BRIDGE AND PONTYPOOL.

June 19th, 1868.

A joint meeting of the Woolhope Naturalists' Field Club and the Cardiff Naturalists' Society took place on Friday, at Crumlin, in the Ebbw Vale, and passed off very successfully.

The Woolhope members having picked up their President at Abergavenny, came in sight of the Blorenge, the great corner-stone of the South Wales coal field. This fine bold hill consists of Old Red Sandstone at the base, and Carboniferous Limestone at the top with a slight covering of Millstone Grit. After skirting Llanover hill to Pontypool Road station, the railway then strikes suddenly into the Coal basin through a gorge of Coal measure Sandstone, and passing the town of Pontypool, and the Crumlin ponds, quickly reaches the celebrated iron bridge over which it passes "by order," at a rate "not exceeding eight miles an hour."

The members of the Woolhope Club were the first to arrive at the trysting place, and at once transacted the ordinary business of the meeting. The following new members were elected :—John Jones Merriman, Esq., Kensington ; John Mortimer Bowen, Esq., Chancefield, Talgarth ; Thos. Edward Williams, Esq., Talgarth ; Mr. Thos. Adams, Marden Court ; and Mr. John Andrews, Bosbury ; and some others were proposed. Still they had time to admire the fine view of this remarkable Viaduct from the bank of the station before the Cardiff train arrived. It soon did so, however, and then, under the guidance of G. Phillips Bevan, Esq., the whole party went on to the bridge, then through a trap-door to a boarded platform between the girders, and so crossed back again to the other side. A train passed over as the passage was made, and the vibration it caused was certainly very considerable. Mr. Bevan here pointed out the chief features of the bridge—the lightness and strength of the open iron work, its diagonal bracings, &c., &c.—and mentioned the great expense that had been incurred two or three years since, on the recommendation of Captain Tyler, the Government Inspector, to give it additional security.

The Crumlin Viaduct is one of those bold works that no description can realise. It requires to be seen to be understood. A photograph will give its likeness no doubt, but it gives no true representation of the effect it produces. It must be felt as well as seen. Look from its highest point on the valley beneath, and a lower world is there, with its works, its cottages, its own railroad, its river, its canal, its ordinary roads, and its little dwarfed men and women moving about here and there—

"The very crows that winged the midway air
Showed scarce so gross as beetles."

And better than all, is the wooded dingle the viaduct crosses, winding prettily away. Pictures, and facts, and figures, with regard to any work of real magnitude, are fallacies. Nevertheless, there are those who cannot be happy without facts aud figures, so here they are, broadly given, and they ought to be correct, too, for they are derived from a Guide Book in royal octavo,—

"All gorgeous in crimson and gold."

"The Crumlin bridge was designed by T. W. Kennard, Esq. It is formed of open iron work, and supported by open cross-braced iron pillars. It consists of ten spans of 150 feet each. Its height above the valley is 200 feet. The length of iron work is 1,500 feet, and, including the masonry, 1,658 feet. The materials consumed were 2,479 tons 19 cwt. of iron, 31,294 cubic feet of wood, and 51,361 cubic feet of masonry. It was three years and a-half building, and was opened for traffic in 1857. It cost £62,000, or about £41 7s. per foot."

How very little all this really conveys! It would perhaps be more simple to say that it is the third of a mile long, and could pass over Hereford Cathedral with 30 feet to spare. And here we leave its statistics and will only say this more of it, that the finest artistic view the visitors got was unquestionably from the stile on the road towards Llanhilleth hill. Here trees conceal the station, the works, the houses, and all that is sordid ; the bridge is in full view, with its graceful curve, at the further end ; its spider-web-like lightness is seen to the greatest advantage ; the base of the pillars is concealed ; and from a slight haze in the broad valley the imagination may picture it as deep as it pleases, and fancy it crosses a broad river, or even a small arm of the sea.

Leaving the valley, luxuriant in the ordinary ferns, the visitors are led up the hill ; higher and drier they find it, the further they go, and the more dusty too.

The glorious summer weather that has brought out the treasures of Flora with such exuberance and precocity in the present season, might be supposed to have offered extraordinary facilities to botanical exploration, and the invocation of the poet Thomson in his "Seasons," for Summer to display itself in "a shower of roses," has not been made in vain this year; though to see them "wither and die" with unusual celerity has been the consequence of the exceptional high temperature which has ruled supreme almost without a single refreshing shower, the sad experience both of the botanist in the field, and the rose cultivator in the garden. But on this occasion the route taken by the united Clubs, chiefly for physical geological examination, was peculiarly unfavourable to botanical hunting. The flowery vales were left behind, and barren uplands in long and wearisome extent were trod, not rising high enough for alpine beauty, and not even in their sterile wretchedness showing an inviting bog, where the Sun-dew or a waving tuft of silken *Eriophorum* might hope to rest and adorn the waste. Nothing appeared upon the arid moor but stunted *Scirpi* and withered grasses, or the stiff and wiry *Juncus squarrosus*. It was truly depressing to botanical zeal to tread these dry rusky wastes, and the only relief to this dreary sameness of vegetation was a slight scattering of the lowly milk-white flowers of *Galium saxatile* here and there; or where a miserable hedge did make an effort to maintain existence, a dwarf solitary *Rosa villosa* gladdened the eye with its deep-red petals.

Collecting in a cluster on a high portion of this broad-topped hill, they all stretched themselves on the tufts of bog-sedge and whortleberry, to listen to the address; and whilst some followed the lecturer closely on the large map brought by Mr. Adams, others opened papers with more perishable contents.

ADDRESS ON THE SOUTH WALES COAL FIELD.

By G. PHILLIPS BEVAN, Esq., F.G.S., &c.

Gentlemen of the Woolhope and Cardiff Natural History Societies,— From the point upon which we stand, viz., the Llanhilleth-hill, we should, if the day was somewhat clearer than it is, have a view of a very considerable portion of the South Wales coal field; and I have selected this point because it embraces not only the coal basin itself, but a distant view of the hills that bound it. Such a view is especially interesting to you as geologists, not merely from its scenic beauty, but from the associations that it calls to the memory of past geological eras. To the North we have the Old Red eminences of the Brecon Beacons, a little to the East of which is the isolated limestone summit of Pen Carreg Calch. Far to the East we see the Red Sandstone of Monmouthshire, beyond which are the collieries of the Forest of Dean; and to the North of which the Silurian district of Usk just comes within the view, the prolongation (though interrupted) of that district of Woolhope from which we take our name. To the South, on the other side of the Bristol Channel, are the limestone ranges of the Mendip Hills, fading away into the Old Red of the Quantock Hills of North Devon. Now what do these distant views suggest? Do they not call to mind the days before denudation had carried away its thousands of feet of intervening strata, and when the South Wales field was united with the Somerset, the Forest of Dean, the Shropshire, the Staffordshire, the Lancashire, and the Irish coal fields? Even if stratigraphical geology did not prove these facts, and even if were not possible to construct horizontal sections to prove the continuity of these basins, we have the lithological and palæontological evidence to help us, as for instance in Lancashire, where the bottom coal beds which are nearest what is there called the Canister rock, are characterised by the same peculiarity of fossil shell that we have in South Wales. If for no other reason, therefore, the view that we now see is a grandly suggestive one, and one can scarcely help re-constructing in one's mind the original condition of those carboniferous shores which we now see so broken up and isolated.

The external shape of the South Wales coal field may be considered as pear-shaped, the broad end of the pear being at the eastern or Pontypool end (close to where we are standing), from whence a gradual diminution of breadth takes place westward as far as Carmarthenshire, which we may consider the stalk of the pear. In its long axis this distance is from 60 to 70 miles, while the greatest breadth of the field is from Hirwain to Cardiff, a distance of some 24 miles. The whole of the circumference, or nearly the whole, is surrounded by a tolerably uniform belt of Mountain Limestone, which on all sides towards the coal field is overlaid by an equally uniform bed of Millstone Grit; but away from it overlooks the Red Sandstone valleys in remarkably fine escarpments. On the north and east sides the Limestone is continuous and persistent, but on the south, beyond Caerphilly, it is considerably intercepted by intervening patches of Permian and Lias deposits. Further west, at Swansea Bay, the Limestone is wanting altogether, the coal beds of the Swansea district being exposed on the shore and running under the bay ; but from Mumbles to Pembrokeshire the Limestone reappears in great force, forming the magnificent coast-line for which Gower and Tenby are so celebrated. Nearly all the north crop, which at the east end near Llangattoc is about 250 feet in thickness, is extensively quarried for the various furnaces and iron works in the neighbourhood ; one reason indeed of their original establishment being the vicinity of this Limestone, which is necessary as a flux in the smelting of iron ore.

Lying conformably on the Carboniferous Limestone, is a thin belt of Millstone Grit, which, like the limestone, is thickest on the North and East crops, and gradually diminishes Westward. On the South crop it is only a few yards in breadth. Here (on the North crop) it is of some scenic importance, as it forms an extensive plateau from which the various rivers of the Coalfield take their rise. The junction of the Millstone Grit with the Limestone is well seen at the Trefil Quarries, where, indeed, great boulders of conglomerate (plum-pudding stone) roll over the edges of the quarries and mix with the *debris* of the Limestone. Commercially speaking, the Millstone Grit, which is of an exceedingly hard quartzose character, is unimportant, it being only used for hearth-stones and for sand employed by the moulders in the furnaces. To the geologist it is interesting simply as an horizon, the fossil remains in it being limited to a few indistinct Calamites and some annelid tracks.

We now arrive at the veritable Coalbeds, which in this case we see repose conformably on the Millstone Grit in regular geologic succession. They do not always do so – as for instance in South Staffordshire, where the Grit, Limestone, and Old Red are absent, and the Coalbeds repose directly on the Silurian Rocks, and in Cumberland, where they lie upon the Limestone, without the interposition of the Grit. On the other hand, the Grit, which in South Wales is regular, though only to a small extent, becomes in the North of England a very important feature, and constitutes large Moorland districts. And now, before we pass to the consideration of the Coalbeds themselves, I would briefly direct your attention to the physical conformation of the Coalfield, which to a geologist is full of the most significant and interesting facts. At the point, or I should rather say the line, where the Lower Coal Measures crop out on the Millstone Grit there is a singular and uniform depression, or nick, which has been taken advantage of on the North crop by the London and North Western Railway to carry their line through Brynmawr and Beaufort to Tredegar, eventually to be extended to Merthyr. Immediately to the South of this line is seen a very singular series of terraced hills, rising suddenly to the height of 1,800 feet, or thereabouts, each hill being very nearly of the same height, and presenting to the North the same kind of face, viz., a series of terraces or ancient sea-beaches. Between each one of these hills runs North and South a deep valley, conveying the drainage of the Millstone Grit plateau to the sea, and serving as an outlet to the shipping ports of the mineral treasures of the Coal-basin. The extraordinary feature of these valleys is their extreme regularity and similarity, and apart from their mineral value, they are full of beauty. The mountains rise on each side with great steepness, leaving at the bottom just room for the river, which is usually fringed in the most charming manner with wild overhanging woods. The native quiet and isolation of these valleys is considerably spoilt by the railways which run up every one of them, but even now there is sufficient beauty to attract the tourist, who, however, very seldom penetrates these unknown districts. From Pontypool to Aberdare, parallel valleys are exceedingly regular, those of the Afon, the Ebbw, the Sirhowy, and the Rhymney converging to the port of Newport; the Taff, with its subsidiary valley of the Cynon, the Dare, the Bargoed Taff, the Rhondda, and the Ely finding their outlet at Cardiff. Westward the Ogmore and the Llynvi run down to Porthcawl, the Neath and the Corrwg to Briton Ferry and Neath, the Tawe to Swansea, the Lloughor to Llanelly, and the Gwendraeth to Kidwelly. How then do we account for these valleys, and the general configuration of the Coal-basin? I believe that the Coalfield was the subject of the following movements, and although I am aware that my views may be objected to on several points, I cannot come to any other conclusion, after many years' study of the district. I consider that the first great epoch was—

1.—The deposition of the Lower Beds (the basin being divided, as we shall see further on, into Lower and Upper beds).

2.—Their subsidence—and so far the South Wales field has the same geological history as any other Coal field.

3.—The occurrence of a great westerly force.

Many eminent geologists, including Sir Henry De la Beche, advocated this theory, which certainly seems to me to account for a great deal of both outward and inward formation of the Coal basin. Suppose we take a plain even surface of clay or mud, enclose it in a box, and then apply an unequal pressure at the side, what would be the result? Why, just such a crumpling up and folding of strata as we see here before us. There will be miniature parallel hills and valleys on the surface of the clay, just as there is in the Coal field. Sir H. de la Beche considered that this force, whatever it was, had its greatest intensity at some point in what is now St. George's Channel, between Wales and Ireland. If we drop a stone into water we see that concentric waves are formed, decreasing in intensity as the distance from the disturbance increases. Now, this is just what we see in the Coalfield. In Pembrokeshire (which would be the nearest point to the disturbance) we have the coal strata contorted and disarranged; we have the *occurrence of Trap Rocks*, the only point any where near the coal field where they occur, and we have the concentrated anthracitic tendency showing itself all over the Lower Measures; this anthracitic character gradually diminishing as we come eastward (away from the centre of disturbance), and dieing out altogether as we approach the East Crop, near Rhymney, where the coals become entirely bituminous. Now, geologists are very much divided as to the cause of anthracite or stone coal. Some say that the cause is chemical, and is still going on ; but to this my answer is,—Why should not the chemical agency be exerted over the whole of the field, instead of gradually decreasing in the way that the anthracitic tendency does? and, moreover, in the very districts of Carmarthenshire and Pembrokeshire, where the anthracitic character is strongest in the Lower Measures, the Upper Measnre Coals within two or three miles distance, are entirely bituminous. If it was a chemical force still going on, how is it that force does not alter the Upper Measures in the very same area as the Lower Measures? We find that this same force had an equal effect in the other direction, viz., in Ireland, the coals in the Kilkenny Basin being equally anthracitic with those of Pembrokeshire. Does not this bear out the theory of a central and radiating disturbance?

Whatever might have been the cause of this disturbance (and I am of opinion that it was one of Plutonic agency), it seems to me that it took place after the deposition of the Lower Measures, and before the deposition of the Upper Measures, the character of which was consequently left untouched.

Another consequence of this force was not only to alter the configuration of the basin interiorly and the character of the coals, but also to cause lesions or fractures in the coals themselves. The results of these fractures were large "faults," which we find running down and parallel with nearly every valley, as though the formation of the valley and the fault were synchronous. These faults contribute much to the main drainage of the valley, afterwards deepened by the action of the surface rivers.

4.—The next great era was the deposit of the Upper Measures, which, wherever they are found, seem to be but little or not at all affected by the main or big faults of the Lower Measures.

5.—Then there ensued a gradual elevation of the whole basin, the effects of which we see in the parallel terraces, or sea beaches on the hills of the North Crop, each terrace marking a period of rest when the waves of the Permian sea washed the bases of the Coal-measure hills.

6.—The last and perhaps most important change was denudation, which has left the Coalfield mainly as it is now. The extent of this denudation may be imagined when I tell you that Professor Ramsay estimated that 9000 feet of Upper Coal Measures have been carried away, and that from the very district on which we stand the whole of the Upper Measures have been swept away, with the exception of a small area of coal which is called the Mynyddwslyn vein, and which supplies the house coal of Newport and Cardiff. This little patch, which is now nearly worked out, represents in the eastern portion of the field this 9000 feet of Upper Measures. But westward beyond the Rhondda-valley, the Upper Measures are found to increase in thickness towards Neath and Swansea, where they are very valuable. Where all this coal has gone to I would rather not speculate, except that we may reasonably suppose that it has helped to form new strata of a subsequent geological era. Such then, according to my notions, is the geological history of the South Wales Coalfield.

Let us now look briefly into the interior, from which so many fortunes have been realized, and in which still more have been lost, for nothing is so precarious as coal-mining, especially now-a-days, when in addition to the uncertainties of the earth's strata the colliery owner has to put up with the certainty of colliers' strikes and the destructive influence of trades' unions. No matter what is the state of affairs in the commercial world, no matter what capital he has invested, no matter whether he is a good master or a bad master, he has to encounter sooner or later the unreasoning and unreasonable hatred of delegates and stump orators, who soon destroy in their listeners every sentiment of good feeling between the employer and the employed, and every particle of gratitude. The South Wales colliers have only just emerged from one of these clouds (by no means the first), and if they ever stop to consider the consequences, they might see them in the banishment of trade to other places, the stoppage of collieries and works, and in the increase of the poor rates.

With regard to the interior of the Coalfield, I have already alluded to the Upper Measures, or rather what remains of them in this district. They consist of two veins of coal—the Mynyddslwyn vein and the Troedyrhiw vein; the latter the lowest in position, and separated from the other by some 250 yards of sandstone. These sandstones are a very important feature in the outward appearance of the Coal-basin, as they form the long ranges separating the parallel valleys, and which I have described as "terraced" at the bend of the North Crop. They are usually called Pennant Sandstones, and are hard micaceous rocks, only good for roofing purposes. In some parts of the district they become a white silicious conglomerate, and are then known as the Cockshoot Rocks, which form a useful horison to the mining engineer. But although the Pennant Rocks in the east of the basin contain only these two seams of coal, they soon thicken as they go westward, and become more valuable as to their mineral contents; the Town-hill, near Swansea, which is of these beds, containing 12 seams of coal. It has been the fashion with some geologists to speak of the Pennant Rocks as the Middle Coal Measures, but it seems to be a useless division, and tends to confusion. Some distance below the Troedyrhiw coal we came upon the Old Man's Coal and the Soap Vein, the uppermost beds of the Lower Measures. Now, although from their association with the Ironstone Measures, the Lower Coal Measures are very much more important and valuable than the Upper Measures, I will not detain you with a seriatim description of each seam, but will merely glance at the general arrangement of the strata and their fossil remains, which, to us, is doubtless the most interesting part of the subject. From the North Crop, where (as the name implies) the coals crop out or come to the surface, the Lower Coal Measures dip to the south with great regularity at an angle of four or five degrees. From the fact of their cropping out here, and their being workable with comparative economy, and also from their association with the iron ores, this district has become famous for its extensive ironworks, such as Blaenafon, Nantyglo, Blaina, Abersychan, Ebbw Vale, Rhymney, Dowlais, Cyfarthfa, Aberdare, and so on, all of which places depended on the close vicinity of Coal, Iron-ore, and Limestone. But as time has passed, circumstances have changed, and the railway system, which then was unknown, has revolutionised the iron trade, as it has other things. The Welsh Clayband or Argillaceous ore, upon which all the works depended, is, in many places, nearly worked out, and the supply is, instead, kept up by foreign ores, such as the Hæmatite from Cumberland, Oolitic ore from Northampton, Magnetic ore from Elba, Spathose ore from Somersetshire, &c. ; the great demand enabling the expensive item of carriage to be brought down to a price that enables foreign ore to compete with native ore.

The Lower Coal Measures then are easily accessible at the North Crop, but they gradually become deeper and more difficult to get at, and, at a distance of six or seven miles, are practically inaccessible to the coal-owner from their great depth. Perhaps when our experience in deep mining is improved, we shall find means to work coal seams at a depth of 3,000 or 4,000 feet, but up to this time the difficulties of obtaining respirable air and ventilation are insuperable. I believe myself that the coal-cutting machine will be one of the principal agents in bringing about this state of things, but at present it seems as if the age was not ripe for it ; for the coal-masters, though confessing its ingenuity and powers, seem shy of introducing it. I have no doubt but that the feeling of the colliers will be generally against it, and in these days we have sufficient storms in the mine atmosphere without rushing into others. Nevertheless, the day will come, most assuredly, when machinery will compel the collier to acknowledge a higher power than himself. Fortunately for the owners of mineral property about the centre of the basin, we find some of the effects of the great westerly force, in the shape of a large saddle, or anticlinal, that runs in the long axis of the Coalfield from Newbridge in Monmouthshire to the Rhondda Valley in Carmarthenshire. Its course underground is very fairly marked above ground by a corresponding depression in the hills, of which the Great Western Company have taken advantage to run their railway from Pontypool to Quaker's Yard. The practical value of this anticlinal is to render accessible the deep measure coals that would otherwise be too far down to be worked, and consequently at the Abercarn Collieries, a little to the South of the Newbridge anticlinal, and at the Maesteg Works in Glamorganshire, the effects of it are seen. Between this anticlinal on the South crop is another "roll" or saddle, of much smaller dimensions. The South crop itself so far differs in its characteristics from the North crop that the strata are at an extraordinarily steep angle, from 30 to 40 degrees, as if they had been set up on edge.

I will close these remarks with a brief outline of the zones of life that these Lower Measures exhibit, and I would observe that they are not merely interesting as a geological study, but have their value as a means of identifying the various seams. Unfortunately, almost every valley has its own nomenclature, so that seams which are obviously the same are called by different names, very much to the confusion of the practical geology of the district. My friend, Mr. Adams, however (whom, by the way, I must congratulate on the strong force of naturalists with which he has this day opened the campaign of the Cardiff Society), with myself and one or two other observers, have succeeded, during several years' careful work, in proving the existence of certain special fossils in their own special zones of coals, an account of which, together with illustrations, you may see in the Geological Survey, No. III., "Iron Ores of South Wales."

Commencing from above downwards we have—

1. Soap vein; iron ore, containing ferns, worm burrow and shells, *Anthracomya.*
2. Black pins; iron. Ferns and shells, *Anthracosia.*
3. Elled coal. Very abundant in ferns, of which some 20 or 30 species have been found. (See Geologist,) Vol. I. Page 124.
4. Big vein coal.
5. Big vein mine; iron. Shells, *Anthracosia.*
6. Three-quarter coal.
7. Three-quarter mine; iron. Shells, *Anthracomya.*
8. Bydylog coal.
9. Pin Will Shone mine; iron. Shells, *Athyris planosulcata*—the highest known occurrence of this shell, which is a Mountain Limestone species.
10. Darren mine; iron. Shells, *Anthracosia*, *Myalina*, &c.
11. Engine coal and mine; iron. Shells, *Spirifer*, *Productus*, &c.
12. Gloin goch Bach coal.
13. Yard coal.
14. Old coal.
15. Black band mine; iron. Shells, *Anthracosia*; fish, *Rhizodus.*
16. Spotted vein mine; iron. Crustacean tracks, *Spirorbis carbonarius.*
17. Red vein mine; iron. Shells, *Anthracosia*, *Modiola*, *Edmondia*, &c.
18. Blue vein mine; iron. Shells, *Myalina*, *Spirorbis.*
19. Bottom vein coal.
20. Bottom vein mine; iron. Fishes, *Megalichthys*, *Palæoniscus*, *Amblypterus*, *Helodus*, &c.
21. Rosser veins; iron and coal.

This latter is a most interesting series, lying in a rock called the "Farewell Rock," close above the Millstone Grit. The obvious impossibility of finding coal at a lower depth has given it this name. In the Rosser veins a very large number of marine shells and fishes have been discovered, and I succeeded in tracing the vein, with its fossil contents, through the whole of the North crop, a distance of 60 or 70 miles.

No less than 33 species of shells, besides fish and encrinital remains, have been identified in these beds.

In this very brief outline I have endeavoured to lay before you the most salient points in the basin which we are now overlooking, and I sincerely trust that the members of the Cardiff club will work out in their domain many hitherto unravelled questions on the Coal Formation.

The address was listened to throughout with very great interest, and on its conclusion the route was continued for Pontypool. A straight road, three miles along the ridge of the hill, leads to the town—but there was an abundance of dust upon it and a hedge on either side—so when a deep dingle appeared it was irresistable, and down its sides they went. It proved to be the "Cwmffrwdor" or the valley of the Coldbrook, and a charming valley it was, clothed with underwood, with ever-changing views, and a brook with as pleasant a noise as one would well wish to hear on a hot day. Its water, however, was not drinkable, it was muddy itself, and coated the stones it ran over with iron oxides.

The dingle was really beautifully leafy, and looked hopeful though watered by a stream whose turbid current was not at all comparable to that of Ilissus or the sparkling fountain described in such brilliant terms by Horace. However, in this glen, and beside a stream once probably pure with mountain freshness, there were seated several plants worthy of note, if not of the rarest kind; and the Ferns especially clustered there, suggestive of a descent from their progenitors of the Carboniferous Limestone; and here *Polypodium Dryopteris* flourished in abundance, and the pretty Beech-fern *(P. phegopteris)* was almost in equal plenty; while *Làstræa dilatata*, and the elegant Lady-fern *(Athyrium filix-fœmina)* grew in great beauty and luxuriance, as well as *Blechnum boreale* in scattered tufts. There was also a variety of *L. dilatata*, with recurved pinnules, that excited some discussion and difference of opinion, and the fern-lovers took the opportunity to fill their vasculums to repletion. A few other plants were also noticed here among the bushes, as the *Vaccinium myrtillus* in young fruit, *Hypericum dubium*, and a considerable quantity of the blue-flowered *Jasione montana*. Brambles were already in flower close upon the footsteps of the Roses, and some of the rarer ones met the view of the critical student of Rubi. These were *Rubus suberectus*, seldom seen but in sub-alpine places, *R. ferox* and *R. carpinifolius*, while the Raspberry *(R. Idæus)* appeared to be quite common. Some other general plants were perhaps rather too much in the ascendant even here, as *Orchis maculata* and *Carduus palustris*. The rarest plant gathered on this excursion was the umbelliferous *Myrrhis odorata*, which Mr. E. Lees found growing in some quantity in a spot near the entrance of Cwmffrwdor, and which is a plant mostly confined to "pastures in hilly districts."

Perhaps the most remarkable feature in the secluded Cwmffrwdor, and which gave a most picturesque character to the dingle, was the numerous old monstrous Beech trees that were scattered on its sides, scarcely indeed growing there, for most of them were dead, or in the throes of decrepitude and decay from whatever cause, while some rudely overthrown looked like huge pachyderms of bye-gone ages left abandoned to rottenness and the gnawing tooth of time. Many had lost their bark, others their branches, all were mutilated in some degree; and a visit to this deep glen by moonlight in the winter season might assist the imaginative pencil of a Fuseli, or inspire descriptions of fright and horror in a poet inclined to imitate some of the descriptions of Dante in his "Inferno." Even Hood might have had some such narrow valley before his view in one of his poems, where he says—

"It was a wild and solitary glen,
Made gloomy by the shade of beeches dark,
Whose up-turned roots like bones of bury'd men
Rose through the rotten soil for fear's remark;
A hundred horrid boles jagged and stark,
Struggled with crooked arms in hideous fray."

and even now, in leafy June, and in the blaze of day, these bleached beeches, some stretching their bare bony arms in mid air, and others partially invested with ivy, had a spectral appearance it was impossible to avoid remarking. A fine specimen of the red-backed shrike, *Lanius collurio*, was seated at the end of a dead bough, and flew off as the members approached. On leaving this secluded glen and entering upon the common ways of life, a feature that is more observable in Monmouthshire than in most other counties was evident in the great quantity of the common elder *(Sambucus nigra)*, which, now in full flower, covered the hedges with its sulphur-tinted umbels.

On either side of Cwmffrwdor was a steep tramway incline, where the full waggons draw up the empty ones, and such natives as were seen had a black and grimy aspect.

In passing over the hill J. Milward, Esq., of Cardiff, picked up a shrew mouse, *Sorex araneus*, lying dead in the road, without apparent injury. It is a curious fact, says Dr. Baird, that every autumn immense numbers of these little creatures (the smallest of British mammals) are found dead on our footpaths and roads. The cause of this great mortality has not been sufficiently explained. The harmless little animal has much interest attached to it. It is very common, but is seldom to be seen in the daytime. It burrows in banks amongst the roots of trees and in brushwood. It feeds on worms and grubs, for the pursuit of which, among the close herbage and on the surface of the soil, its long and thin-pointed snout is admirably adapted. Cats will kill them, as was probably the case with our luckless little wight, but they won't eat them, though weasels, and hawks, and owls will greedily do so.

Then, too, there is the curious old superstition with reference to the shrew mouse, that it seriously injured any cattle it crept over by the mere touch of its body, producing paralysis and divers other ills. The remedy for this was the leaves of a "Shrew-ash," growing in consecrated ground. Gilbert White, in his "Selborne," mentious a Shrew-ash which was regarded with great veneration, growing "at the south corner of the plestor, or area near the church." "The Shrew-ash is made thus," he says:—"Into the body of the tree a hole was bored with an auger, and a poor devoted shrew mouse was thrust in alive, and plugged in, no doubt with several quaint incantations long since forgotten."

The Cwm-ffrwdor joins lower down the "Cwm-nant-ddu," on the valley of the black stream, and the brooks unite to form the Avon-llwyd, or the gray river, which runs through Pontnewynydd and Pontypool.

At Pontnewynydd all the forges were out and the buildings deserted, and but for the bold chimney which bears bravely its misfortune, the whole works would look ruinous. Leaving the enormous mounds of shale thrown out from the works in the Cwm-nant-ddu, and passing many rows of white-washed cottages, Pontypool was soon reached. Here again the tin-plate works were deserted, and that enormous steam-hammer, which formerly beat night and day incessantly, was silent. How the night's rest of the good people at Pontypool must have been disturbed when it ceased to lull them to sleep! The town seemed unusually quiet, which might have been due to the closed works, but more probably to the time of day. The strong body of naturalists, however, created some little sensation, and the wonder ran, what was it all about? A welcome was ready at the "Three Cranes," and good preparation had been made in the spacious room there. Whilst some few take a stroll in the beautiful park of Pontypool, and others try to get rid of the dust, we will take the opportunity of telling who they were.

The members of the Woolhope Club present were—Dr. M'Cullough, the president; the Rev. H. C. Key and Jas. Rankin, Esq., M.A., vice-presidents; Phillips Bevan, Esq., F.G.S., &c., and Edwin Lees, Esq., F.L.S., &c., honorary members; John Edward Lee, Esq., F.G.S., &c., The Priory, Caerleon; R. Lightbody, Esq., Ludlow; the Rev. Berkeley L. Stanhope; Elmes Y. Steele, Esq., Abergavenny; Dr. Bull; Arthur Armitage, Esq.; the Rev. E. Du Buisson; T. Cam, Esq.; the Rev. F. Merewether; the Rev. E. Malleson; the Rev. R. H. Williams; Wm. Aston, Esq.; the Rev. J. H. Jukes; J. Jancey, Esq.; the Rev. T. West; C. H. Gardiner, Esq.; George Cocking, Esq., Ludlow; D. R. Harrison, Esq.; the Rev. J. E. Jones; John Lambe, Esq.; E. Cowtan, Esq.; C. G. Martin, Esq.; Alfred Purchas, Esq.; Dr. Davies, Abersychan; T. G. Matthews, Esq., Ludlow; Edward Jones, Esq., Varteg; Mr. John Andrews; and Mr. Arthur Thompson.

The Cardiff Naturalists' Society was represented by the President, Wm. Adams, Esq.; Professor Gagliardi; J. Millward, Esq.; the Rev. J. H. Protheroe; Dr. Taylor, Cardiff; Peter Price, Esq.; George Thomas, Esq.; the Rev. E. Cook; G. W. Penn, Esq.; George White, Esq.; the Rev. G. K. Meaby; John Morgan, Esq.; R. W. Boyle, Esq.; Charles Truscott, Esq.; Richard Hill, Esq.; and Edward Brown, Esq., Mountain Ash.

The dinner took place punctually at three o'clock. It was scarcely over when the president called upon

Elmes Y. Steele, Esq., who rose to propose success and prosperity to the Cardiff Naturalists' Society, which had joined the Woolhope Club that day for its inaugural meeting (applause). Mr. Adams, the president, was an old member of the Woolhope Club, and he hoped, therefore, that he was not presumptuous in supposing that the Cardiff Society was in some measure the offspring of the Woolhope Club (hear, hear). However that might be, the Woolhope Club felt a great pleasure, indeed felt it an honour to meet the Cardiff Society under these circumstances, and he hoped it was but the first of many similar meetings (great applause). He felt sure he only expressed the unanimous feeling of the members of the Woolhope Club in giving a hearty welcome to their brethren from Cardiff (applause). With his friend Mr. Adams for their president, he did not fear that it had before it a long and useful and prosperous career (applause).

Dr. Bull seconded the proposition very cordially. The Woolhope Club was getting on in years, and it was very pleasant to see young societies formed around it to stimulate each other in the pursuit of science. He did not rise however with this object, for it was not necessary. He had been requested by the president, and with the permission of several members present, he had a proposition to make with reference to Mr. G. Phillips Bevan, who had given them such an excellent address on the hill to-day. Mr. Bevan had changed his residence, and had therefore resigned his membership, but the Woolhope Club did not like to part with old friends, especially when they were so able (laughter). Gratitude for past favours is always greatly increased when there are hopes in the future (laughter), and he thought it better, therefore, boldly to admit that by thus keeping him as a member they hoped he would occasionally be induced to run down to our meetings as he had done that day (laughter). He begged to propose Mr. Bevan as an honorary member of the Woolhope Club (applause).

The President felt sure that, from the applause, he might at once regard that proposition as carried by acclamation (applause) ; and as time was short, he would now ask Mr. Adams to exhibit the beautiful collection of fossils he had so kindly brought with him.

Wm. Adams, Esq., said that he must, in the first instance, thank them very sincerely in his own name and that of the Cardiff Naturalist's Society, for the compliments paid to them. He thought that, as a young society, they could not do better than make their first excursion with the Woolhope Club, which had had so much experience and was managed so successfully. They were very much indebted to them for receiving the Cardiff Club so kindly, and he could only repeat Mr. Steele's wish that they might meet on many other occasions (applause).

Mr. Adams then proceeded to exhibit his collection of fossils, and a beautiful and interesting collection of the fossils of the Coal-field they are. It was from this collection, with those of Mr. Bevan and some few others, that Mr. Salter wrote the article on "The Fossils of the South Wales Coal Field," which is published in the Memoirs of the Geological Survey of Great Britain.

The following specimens amongst others were shown :—

Anthracosia acuta	Rosser veins, Dowlais ; Blue vein and Old coal, Ebbw Vale : ditto, Rhymney.
Anthracomya subcentralis	Wyndham pits, Ogmore valley ; Black vein, Machen ; ¾ coal, Victoria.
——— pumila	Ditto, ditto ; ¾ coal, Victoria.
——— Adamsii, n. sp.	Soap vein, Ebbw Vale.
——— modiolaris	Rosser veins, Ebbw Vale.
Asterophyllites grandis	Ell coal, Beaufort.
Bellerophon Urii	Rosser vein, Ebbw Vale.
Diplodus	Blaena black band.
Athyris ambigua	Fydylog coal, Beaufort.
Alethopteris (pecopteris) heterophylla	Ell coal, Beaufort.
Calamites cannæformis	Black pins, Ebbw Vale; Pennant rocks, Victoria.
Discites sulcatus	Rosser veins, Rhymney.
Fish remains	Sirhowy No. 1 pit.
Fragments of fish bones and scales	Bottom vein, Ebbw Vale.
Headbones of fish	Bottom vein, Gantre.
Ferns	Coalbrook colliery, Llwchwr.
"Jack"	Black pins, Ebbw Vale.
Goniatites Listerii	Rosser veins, Rhymney.
Lepidodendron dichotomus	Bottom vein, Ebbw Vale.
——— Sternbergii	Ell coal, Ebbw Vale.
——— obovatum	Bottom vein, Ebbw Vale.
Lepidostrobus ornatus	Black pins, Ebbw Vale.
Modiola	Black band.
Myalina carinata	Blue vein, Ebbw Vale.
——— modiolaris	Bottom vein, Ebbw Vale.
Megalichthys Hibberti	Bottom vein coal, Ebbw Vale; Rosser vein, ditto.
Ditto scales and teeth	Tounley colliery, Durham ; Gantre.
Old Red fish (?)	
Orthis resupinata	
——— Michelini	Rosser veins, Rhymney.
Productus semireticulatus	Rosser veins, Rhymney and Ebbw Vale.
——— scabriculus	Pontypool; Blaendiare; Meadow vein, Pontypool.
——— cora	Rosser veins, Ebbw Vale.
——— Höninghausi	Ell coal, Beaufort.
Palæoniscus sp.	Bottom vein, Gantre pits, Ebbw Vale.
Pecopteris abbreviata	Ell vein coal, Beaufort.
Psammodus porosus	Capel Newydd.
Rhizodus Hibberti	Black band; Bottom vein, Ebbw Vale.
Sphenopteris linearis	No. 6 coal, Prince of Wales pit, Abercarn.

Sphenopteris elegans	
——— arbe	Northumberland.
Spirifer Urii	Rosser veins, Rhymney.
——— striata	Capel Newydd.
———	Capel Newydd.
Sigillaria	Ell vein coal, Beaufort.
Ulodendron minus	Ditto, ditto.
Xenacanthus	Bottom vein, Ebbw Vale.

Whilst these fossils were being examined, G. PHILLIPS BEVAN, Esq., said that, in spite of the rules of the Woolhope Club, he must crave permission to thank the members for their great kindness in electing him an honorary member. He did so very sincerely, for he thought it an honour, and was very pleased to belong still in this way to the club. After all he had not gone so very far off. He hoped to remain at Cheltenham, and he could only say that it would give him great pleasure at any time when he was able, to render any service to the club (applause).

NEW MICROSCOPIC LAMP.

EDMUND BROWN, Esq., of Mountain Ash, then exhibited Collins Microscopic Lamp. It was just brought out, he said, and as he could testify was a most useful lamp, far surpassing any he had seen before. It was made with Fiddian's metallic lamp shade and chimney, and, indeed, its great novelty consisted in its skilful adaptation to this invention. He had found its great advantages to be—

1st. That it throws its light solely on the object to be examined.

2nd. That being made of copper it acts as a perfect shade, and protects the eye from all extraneous light.

3rd. Being coated internally with a wash of plaster of Paris, it emits an intense white light imitating closely the white cloud illumination so prized by microscopists; and 4th, being metallic and not liable to break there is a great saving in the expense of glass chimneys.

He had no hesitation in saying from his experience with it that with these qualities the lamp and shade is as good as can be made for perfect vision with the microscope and a very great boon to all microscopists. To medical men using the opthalmoscope and laryngoscope he could strongly recommend it as a most useful illuminator, since only the ray of light coming from the lamp could enter the eye or throat. He ought to add, the whole cost of a perfect lamp with proper adjustments and reflector was 30s.; the shade alone, which could be fitted to any lamp, was 8s. 6d.

In answer to a question, Mr. Brown said he burnt paraffin oil in it, and certainly the light it emitted was very pure and white.

The PRESIDENT thanked Mr. Brown for calling their attention so ably to such a useful lamp. Any one accustomed to work with the microscope must at once be convinced of its great usefulness.

He then called upon Mr. Rankin to read his paper:—

ON THE FLIGHT OF BIRDS.

By JAMES RANKIN, Esq., M.A., Vice-President.

The following paper on the means of flight of birds, I propose to divide into three sections :—

1st. The general structure of birds and the relation which it bears to the purpose of flight.

2nd. The special structure of the wings of birds.

3rd. The mode of action in flight, and some of the specialities in form of wings and feathers and manner of flight.

Section i.—General Structure of Birds.

Birds, as a class, are distinguished from other animals by the following peculiarities :—"They are vertebrate animals, breathing atmospheric air by means of lungs ; with warm, red blood, and heart biventriculate and biauriculate, all oviparous, covered with feathers, with bill rather prominent, naked, destitute of teeth. Extremities, four : the anterior changed into wings, and almost always adapted for flying."

The above, I believe, is a sufficiently comprehensive definition of the class Aves, for it points out how they differ from all other animals, except Fishes, Reptiles, and Mammals, in the possession of backbones ; how they differ from Fishes, in the possession of lungs ; how they differ from Reptiles in having warm blood, and from Mammals in being oviparous.

The possession of wings and feathers, though, by far, the most striking peculiarity of Birds, is not of so much classificatory value as might be supposed, for, both among Mammals, Reptiles, and Fishes, are found animals which have wings of some description, as, for instance, the Bats, the *Pterodactyl*, and the *Exocctus* or flying-fish, and also some birds have a very rudimentary condition of wings.

As it is not intended, in this paper, to discuss the question of the systematic position of Birds, I will only mention, in passing, that the morphological affinities of birds connect them more closely with the class of reptiles proper (i.e., excluding the amphibia) than with any other vertebrates, for birds and reptiles differ from amphibia and fishes, in the absence of bronchiæ at all periods of their existence, in having a well developed amnion and allantois, and no parasphenoid bone in the skull, and they differ from mammals in having a complex lower jaw, a quadrate bone, nucleated blood-corpuscles, and a single occipital condyle.

Passing on to the consideration of the structure of birds, we find, with regard to the skeleton, that it is extremely light, but that the texture of the bones is firm and close, thereby combining lightness and strength, two important points with respect to flight. The bones of the skull differ from those found in the skulls of Mammals in the complexity of the lower jaw, and in its being attached to the skull by the interposition of another bone called the quadrate-bone, instead of being attached by a condyle.

The backbone of birds is remarkable from the anchylosis or union which takes place in the lumbar and dorsal regions of the back, so that in birds the neck and tail vertebræ are the only moveable ones. This immobility of the dorsal and lumbar vertebræ is for the purpose of giving firmer and steadier points of attachments to ribs, and to avoid the danger of dislocation during the movement of the wings. The hip bones are long and thin, and the pubic bones do not join to form an arch as in mammals.

The thigh bones are short but very strong and cylindrical, especially in those birds which run. The tibia or leg-bone is long, and the fibula is present as a small fine bone which usually coalesces with the tibia.

The tarsus and metatarsus are represented by a single bone, which is very various in length and shape in the different families of birds, and is one of the most important members in classifying.

The toes vary from five to two, but there are usually four : three anterior and one posterior. The number of bones in the toes (unlike mammals) vary according to the position of the toe, the outermost toe having five bones, and the innermost one bone, and the three intermediate toes having four, three, and two bones respectively.

Passing on to notice the breast-bone or sternum, we find it assume very much the shape of a boat, being convex outwards and of large size, and along its median line is situated a projecting ridge called the keel, which ridge is immensely developed in birds of powerful flight, but nearly absent in cursorial birds, such as the ostrich. The breast bone extends beyond the thoracic cavity and embraces part of the abdominal also.

The ribs of birds present great peculiarities, for there are, as it were, two sets of ribs, one a vertebral and the other a sternal set; these sets of ribs both start in a posterior direction and join at an acute angle, and from the vertebral ribs, which are the longest and strongest, a bony appendage proceeds upwards and backwards and overlaps the next rib behind, the whole apparatus of vertebræ, ribs, and sternum forming an elastic, though firmly knit, case for the internal viscera.

It should be mentioned that some of the ribs, both anterior and posterior, are not attached to the sternum.

The anterior members of birds, that is, the wings, are composed of bones which are homologous to the bones in the arm of man ; they are the humerus or the arm, the radius and ulna or fore-arm, the wrist or carpus, formed of two small bones; the metacarpus, of two tubular bones which have coalesced, and two fingers and a thumb, one of which is very much larger than the other, and consists of two or three joints.

I will not delay longer upon this part of the anatomy of birds, as in the next section I shall have to describe the wing more particularly, and I will pass on to notice that portion of the internal organisation of birds which is most specially adapted to the requirements of flight.

Internal Anatomy.

With regard to the digestive organs I will only notice that birds possess similar parts to mammals, but that the intestinal tube, from the gullet to the pylorus, presents considerable diversities, there being present, generally speaking, two enlargements of the œsophagus, one called the crop, and the other, which is just above the gizzard, the proventriculus. In both of these receptacles the food is mixed with juices which accelerate digestion.

The stomach or gizzard, as it is called, is a very peculiar organ, and is, in fact, a sort of grinding mill, where the food which enters it is ground down. The cavity of the stomach is very small, and the muscles which surround it are very large.

The intestines are variable in length, and do not present any marked division into large and small intestines. They receive, as in mammals, the secretions from the liver and the pancreas.

With the above brief notice I will pass on to the organs of respiration, which as clearly as anything in nature, show the marks of a designing hand.

The lungs of birds are of a lengthened oval shape, and are firmly attached to the dorsal surface of the thorax; they are not divided into lobes, and from each lung proceeds a bronchial tube, which tubes unite together to form the trachea, or wind pipe, and it is at the junction of the bronchial tubes that the lower larynx, where the vocal sounds of birds are produced, is placed.

The main trunks of the bronchii after passing through the lungs open into the cavity of the thorax, and admit the air freely all through the body, for in birds there is no proper diaphragm, but the whole of the thoracico abdominal cavity is divided into cells which communicate with each other, all of which are freely permeated by the air, which therefore surrounds all the vital organs, and penetrates in many cases into the interior of the bones and muscle.

The bones which are most commonly found hollow and pneumatic in birds, are the humerus, or arm bone, the breast bone, and the cranial bones. Sometimes, however, the other bones are found so also.

The pneumatic bones receive their air from the air-sacs which are connected with the lungs; but the cranial and facial bones receive their air partly from the Eustachian tubes, partly from the tympanic cavity, and partly from the nasal cavities which conducts it to spaces under the eyes, whence it penetrates further into the bones of the skull.

With regard to the uses of this pneumaticity of the bones the most probable are the following :—

1st. The air, by penetrating all parts of the body, secures the perfect oxygenization of the blood, a highly important matter for animals like birds, which undergo violent muscular exertion.

2nd. The air becoming rarified by the high temperature of the bird's body, the specific gravity of the bird is diminished, and less exertion required to maintain its flght.

To this use I must again refer in No. 3 section.

3rd. From the inflation of the body the muscles are enabled to act with firmer purchase and better leverage.

4th. It is from this arrangement of air-sacs that the singing birds are enabled to prolong their notes.

SECTION II.—STRUCTURE OF WING.

There is nothing, I think, in the whole range of Zoology which more forcibly illustrates the great truths of unity of design and adaptibility to special purpose which pervade creation, than the wing of a bird.

For first let us briefly inquire what it is that a wing is required to do, and then let us examine how the vertebrate anterior member is modified to meet those requirements.

First then, a wing is the instrument by which a bird strikes the air and raises itself from the ground and maintains itself in the air, and also is enabled to progress.

A wing then must be an instrument capable of producing by its strokes an amount of resistance in the air, superior to the entire weight of the bird's body.

It must also be capable of producing progressive motion as well as upward motion, and it must be most completely under the control of the bird to allow of all those beautiful adjustments which no one can fail to notice and admire in the flight of birds.

Looking now carefully at the wing we find that, as I mentioned before, the internal structure of the bones and muscles are homologous to the fore-legs or arms of Mammalia, that is the wing is composed of a humerus articulated with the shoulder blades and clavicles or collar bones.

In birds, however, there is a further provision for the stability of the wing in the shape of the coracoid process of the scapula, which assumes the mportance of a separate bone, and is firmly attached to the breast bone.

The clavicles also are modified and joined together, forming what is usually called the "merry thought," but which anatomists designate as the Furculum. This bone forms a sort of spring which prevents the wings pressing too tightly upon the chest, and it also affords surface of attachment to the great pectoral muscle.

Next to the humerus come the two bones of the fore-arm, the Radius and the Ulna, of which the Ulna is usually the strongest. These two bones are homologous to our fore-arm bones, from the elbow to the wrist. At the elbow of birds there is often found a little bone which is a sort of elbow cap or arm pan.

Beyond these again we have the wrist or carpus, formed of two short bones; the metacarpus of two tubular bones which have coalesced at both extremities, and generally two fingers and a thumb; the thumb is usually nothing but a thin stiliform process, and one finger is always very much larger and longer than the other.

It will be noticed here by those who have paid any attention to Comparative Anatomy, that the modifications which I have mentioned above, are such as frequently present themselves in the vertebrate series, and it will also be noticed that those modifications consist of the coalescence of parts and never by their transposition.

I will pass on to notice very briefly the muscular system by which these bones are set in motion.

This is extremely similar to that observed in other vertebrate animals.

The great peculiarity of the muscular system of birds is the enormously developed pectoral muscles; these muscles are well known to everybody in the shape of a chicken's breast. They often weigh more than all the other muscles of the body put together. Although resembling one muscle, the mass of flesh upon the breast is really divided into three different muscles.

The great pectoral is attached to the sternum or breast-bone at one end, and at the other to the humerus or arm-bone, and its function is to depress or pull down the wing.

It will be easily understood how important a muscle the pectoral is to birds of prolonged or constant flight, for it is by the action of this muscle chiefly that a bird is enabled to give those powerful and rapid strokes upon the air which are sufficient to sustain it.

I would also call attention to the fact that the pectoral muscles being so placed that the centre of the bird's gravity is considerably below the line of the outstretched wing, so that in flying a bird has no difficulty in keeping its position, and has no inclination to topple backwards. This feat is sometimes performed by the tumbler pigeon, but it is a work of some difficulty, and the bird almost always requires the assistance of the wind.

The muscles which raise the wing are the deltoid and the second smaller pectorals.

The deltoid muscle is attached to the shoulder-blade and to the top of the humerus, and by its contraction raises the wing.

The lesser pectorals are situated beneath the great pectoral, and arise from the base of the crest of the sternum; they pass upwards, and the tendon by passing through the interspace between the clavicle, coracoid scapula, has the direction of its force altered, and being inserted on the upper part of the humerus, serves as an elevator of the wing.

This is a peculiarly beautiful contrivance, as it enables the mass of the muscle to be kept low, and thereby the centre of gravity also—a point of great importance in flight—and it also provides for the raising of the wing.

It is evident that the muscles used for raising the wing need not be so strong as those employed in depressing it; for in the up stroke the wing is always drawn in and the feathers overlap one another, so that a comparatively small surface is presented to the resistance of the air. They must, however be capable of intensely rapid action, as the up stroke must be repeated as often as the down stroke, and in some birds this is very many times in a second. The other muscles of the wing are the extensors and flexors of the fore arm and the fingers, by means of which they are enabled to stretch out or draw in the wing.

With this brief review of the muscles of the wings, I will pass on to notice the feathers. Birds are the only animals furnished with feathers, and no covering could possibly be imagined which combined the needful qualities of warmth, firmness, flexibility, lightness, and I may add beauty, more admirably than feathers. A feather is composed of a quill which is prolonged into a shaft which runs the whole length of the feather, and from each side of the shaft proceed branches; these branches are set on obliquely and point toward the end of the feather; from each of the branches fine rays set very close together proceed, and on the side next to the shaft, small hairs turned so as to form hooks overlap the rays of the next branch and hold it firmly together. It is these minute hooklets which give the appearance of the vane of a feather sticking together when it is attempted to separate it. The whole feather is composed of a horny substance and is not vascular after the growth has taken place. It must be carefully noticed that the wing feathers have the shaft placed not in the middle of the vane, but considerably to the front, so that the stiff portion of the feather is presented to the wind and the more flexible part is behind: the object of this I will notice in the next section.

The feathers of the wing are divided into primaries and secondaries: the primary feathers are much the longest and stiffest, and are the chief instruments in flight; they are situated on the fingers and hand or carpus; the secondaries are situated on the fore arm; they are much more numerous and also much more irregular in number than the primaries; they are also more flexible. The primary feathers are important aids in classification.

Section III.

Having now taken a brief view of those points in the structure of birds which are peculiarly modified for the purpose of flight, and also having noticed the structure of the wing, I will pass on now to consider the kind of action and the mechanical laws which are called into play during flight.

The first requisite for flight is weight, that is, the action of gravity, which pulls a bird to the ground.

It may seem a little strange, at first sight, that the law of gravity, which birds in flying are using great exertion to overcome, should be actually indispensable to flight, but if birds had not more weight than the air they could not fly, for they would simply float in the air like a feather, and be at the mercy of every current.

Thus we see that weight is necessary for flight in order to give the power of directing the course of a bird, and to enable it to fly against the wind.

It is a mistake, however, to suppose that great weight is essential to flight, for so long as the weight of the bird is greater than that of the air, the lighter the better for sustained and continued flight, for it requires less force of wing to raise and support a light bird than a heavy one, and it is to this end, as we have already seen, that the bird's body is made light by several beautiful contrivances. I mention this as the Duke of Argyll, in his very interesting book the "Reign of Law," in the Chapter on "Contrivance or Necessity," seems to scout the idea that the air-cells of birds have any function whatever in decreasing specific gravity. Now although this is probably not the only function of the air-cells, as I have already mentioned, yet it is most undoubtedly one of them, and I think can hardly fail to strike everybody as a most beautiful contrivance for lessening the weight of a bird, and at the same time not interfering with its muscular power.

Having now seen that some degree of weight is necessary for flight, I will pass on to consider the method by which that weight is raised, sustained, and caused to progress in flight.

The instrument by which flight is accomplished is, as is well known, the wing. I have already described the animal mechanism of the wing and will now attempt to point out how it acts when employed in flight.

The wing, when in the act of flying, may be regarded as a lever of the first kind ; that is to say, when the power and the weight are on different sides of the fulcrum, but act in the same direction ; for in the case of a bird flying, the air below the wing is the fulcrum, the body of the bird is the weight, and the power is applied at the end of and along the wing.

It must be observed, however, that although in mechanics forces are always regarded as being applied at definite points, yet in the case of a wing the power is applied throughout the whole length of the wing decreasing from the point of the wing inwards ; likewise the fulcrum acts as the resisting force all along the wing and not at any one particular point ; nevertheless for the sake of clearly comprehending the principle the action of flight, it is quite allowable to suppose all the force applied by the wing to be concentrated at the end, and also that all the resisting force of the air, that is the fulcrum, should be applied at a point, which would be somewhere not very far from the end of the wing, for the resistance of the air is necessarily much more intense near the tip of the wing than near the body.

Thus we may say for sake of clearness that the action of a wing in flight is the same as the action of a rigid rod placed across a bar, which is the fulcrum, and which rod has a weight at one end and a power or force at the other end, both of which pull or act in the same direction. Now it is a fact in mechanics that the length of the lever from the fulcrum to the power multiplied into the power, must equal the length of the lever from the fulcrum to the weight multiplied into the weight, to produce a balance or equipoise, and therefore it is apparent that the shorter the arm of the lever next to the power the greater must be the power in order to balance the weight. Now that is just the case with a wing, for the fulcrum there is nearer to the end of the wing, or where the power is applied, than to the body of the bird or the weight, and therefore, as we have seen above, it will be necessary, to produce balance, that the power should excced the weight. In flight, however, more than balance is required, for it is necessary that the body or weight should be lifted, therefore it is evident that a much more intense force is needed.

From the foregoing arguments it may be concluded that the power or force applied in the stroke of the wing is considerably greater than the weight of the bird's body.

We may sum up, therefore, the mechanical principle of the action of the wing in flight, as that of a lever of the first kind, where power and weight are acting in the same direction but on opposite sides of the fulcrum, the power being applied to the shorter arm of the fulcrum, and therefore requiring to be considerably greater than the weight.

Before proceeding to notice the niceties of adjustment found in the wing, and the methods in which progression, soaring, hovering, and other motions are attained, I will just pause for a moment to point out that the wing, with reference to the body, may be regarded as a lever of another kind. That is a lever where the power and the weight are on the same side of the fulcrum but act in opposite directions, and where the power is next to the fulcrum. This, which is called the third kind of lever, is the class to which all bones and muscles belong, for in the case of the wing the fulcrum is the shoulder joint; the power is the muscle or tendon applied just over the joint, and the weight is either the limb itself or some actual weight attached at the other extremity.

In this kind of lever the power must always be in excess of the weight, and therefore this kind is never used in mechanical operations for raising weights, but inthe animal organisation it is the kind always found, because the fulcrum and the power are thus placed close together, and a great economy of space and compactness is gained.

I have made this special notice of this kind of lever, which is not in any way *peculiar* to the wing or connected with the mechanical principles of flight, because in the book which I have referred to already, in pages 158 and 159, the Duke of Argyll speaks of the wing as an implement through which the vital force (muscular I suppose) is exerted with immense mechanical advantage for the purpose in view, viz., flight. Now we have seen that the wing in flight does really act as a lever, but that it is a lever which places the power at a disadvantage, or in other words the power or vital force must be in excess of the weight to be moved ; and again, if the Duke is referring the wing to the third kind of lever, which I hardly think he can be doing, he has missed altogether the principle of flight, for he has not got any fulcrum on which the lever may act ; and indeed, throughout his argument, it seems to me that he misses the great point of the air being the fulcrum.

I mention this because I think his use of the word mechanical is apt to mislead, for according to the usual acceptation of the term, there is certainly no mechanical advantage in the kind of lever to which the wing belongs ; and with regard to the third kind of lever to which bones and muscle belong, the advantage is not mechanical, but merely convenience.

It is very necessary to bear in mind, when speaking of the principles of flight, that the fulcrum is not altogether a fixed one, but is a compressible fluid which endeavours to escape in every direction, and therefore it is apparent that much of the force of the stroke of the wing is lost owing to the fulcrum giving way, so to speak ; for it is easy to see that the body of the bird is moved upward a very short space in comparison with the space through which the wing moves.

The same thing is observable in rowing a boat, for the water which is, in that case, the fulcrum, is to some extent displaced, and the boat does not move through so great a portion of water as it would do if the oar acted against a fixed and immoveable fulcrum.

This motion of the fulcrum, allowing a corresponding motion to the wing or lever, seems to give the idea that the body or weight is attached to the short arm of the lever, whereas, as far as the mechanical principle is concerned, it is attached to the long end.

I make these remarks because, although in flight the compressibility of the air is a most important condition, yet no mechanical principle is involved in it ; for in mechanics a moveable fulcrum would be a contradiction.

While speaking of the compressibilty of the air, I would call attention to the concavity of the wing below and its convexity above ; this form confines the air as much as possible, and allows the wing to act firmly upon it in the down stroke before the air escapes ; and in the up stroke the convex form of wing allows the air to roll off with but comparatively little resistance.

This brings me to speak of the up-stroke ; here the mechanical principle of the stroke is quite altered.

The air is no longer the fulcrum but the weight, the shoulder joint is the fulcrum, and the deltoid and lesser pectorals are the power: this is a lever of the third kind, where the power and the weight act in opposite directions but on the same side of fulcrum, the power being inside, or next to the fulcrum.

It is to be noticed, also, that in the up stroke the feathers of the wing fold over one another, and the arm bones are drawn in, so that a comparatively small surface is presented to the air: this is very essential, for if it were not so the bird would lose during the up stroke what it had gained in the down stroke.

Having now looked into the laws of the strokes of the wing, I will briefly direct attention to the manner in which progression is effected.

Birds, when flying straight forward horizontally, keep the body nearly horizontal, and flap their wings nearly perpendicularly to the horizontal line.

When in that position the motion of the wings has the tendency to send them forward as well as sustain them; and the cause of this is a very beautiful contrivance in the structure of the wing.

It will be remembered that I called attention to the fact that the shaft of the wing feathers was not set in the centre of the vane, but considerably forward. Now the whole wing is constructed on the same principle, namely, that the ridge which meets the air is stiff and inflexible, and all the feathers which cover the wing have their stiffer side presented to the wind, and their more flexible portion turned backward. The effect of that is that the air, when compressed by the down stroke of the wing, and trying to escape in every direction, finds the ends of the feathers offer but little resistance to it, and it therefore bends them up, and that resistance or force sends the bird on in a horizontal position. The up stroke, also, must have some effect in this way too.

In proof of the above statements I would call attention to the position of a bird when soaring or hovering, which is always more or less inclined to the horizon: the reason for the bird adopting this position is to alter the direction of the force of the air upon the flexible ends of the feathers, so that it shall act as a raising and not a propelling force.

When there is a considerable breeze less inclination is necessary for the resultant direction of the forces of the wind and the down stroke is upward.

Some birds rarely hover or soar except when there is a wind.

There is no motion which requires more complete command over the wings, and greater muscular power, than soaring and hovering; but, indeed, it is quite impossible to watch any of the motions of a bird without being struck with admiration at their ease and elegance, and with the perfect command which birds have over their wings, being able to adjust them to the very nicest balance.

Time does not allow me to go into the subject of the varieties of wing found among the feathered tribes, and therefore I will only make a few concluding remarks upon the subject of flight.

In all birds of long sustained flight the wings are long and pointed, and the primaries are set close together so that no air can escape between them.

The advantage of a long wing is simply that it is capable of a longer and therefore more powerful stroke than a short wing, and it offers more surface for the support of the air. Types of the long wing are to be found in the Albatros, the Swallow, and among the Hawk tribe.

Those birds which fly fast but seldom fly far have usually rounded wings and much shorter wings; the rounded form is given by the first two or three of the primary feathers being shorter than those which follow them; this is the case amongst the gallinaceous birds, such as the Pheasant, Grouse, Partridge, &c.

This kind of wing requires very intense action and rapidity of stroke to enable it to sustain the bird, as it cannot be worked to so much mechanical advantage as the long wing, and the quills not being placed so closely together the air escapes upwards.

I will only add a few words upon the mode of turning of a bird.

This is usually effected by the bird depressing the inside wing, so to speak, and elevating the outside, and by so doing throwing the centre of gravity inside or towards the direction in which the bird desires to turn, and by this means overcoming the law of motion which urges it on in a straight line, and at the same time presenting the wings to the air or wind like a sail and thus being blown round; this motion may frequently be noticed in the flight of the swallow.

If a bird merely requires to alter its course a little, the change in direction is effected by simply altering the muscular force on one side of the body or the other just as a man turns in walking; it is also not at all improbable that the wings assist them in turning, although it is difficult to detect any difference in the stroke of the two wings.

And now to conclude, I will just notice the tail-end of our subject. This feature in birds has given rise to a good deal of discussion and difference of opinion; it used to be and still is very frequently given, as its function that by it the bird steers or turns itself; that this cannot be its chief use a moment's reflection will prove, for it is set on horizontally and not vertically as a rudder should be.

This then cannot be its chief function, and its use probably is to balance the bird, and it also is a great assistance in stopping a bird.

All hovering birds have fan-like tails, and all long-continued flyers have well developed tails. It is very likely that the tail is a great assistance in turning by enabling a bird suddenly to stop, but undoubtedly the great function of the tail is to add to the general stability and balance.

Having now briefly reviewed some of the principles of flight and also some of the main features and adaptations of the feathered races, which enable them to take advantage of those principles, I would venture to point out to those who may not have had their attention already directed to it, that the whole range of creation, and as I think, especially Comparative Anatomy affords endless examples of creative wisdom and design, and that the more these subjects are studied the more will the student be led to exclaim, "O Lord, how manifold are Thy works: in wisdom hast Thou made them all."

The PRESIDENT gave the thanks of the Club to Mr. Rankin for his excellent paper, amidst general applause; and called upon Mr. Steele to read the following paper—

ON SOME SPECIES OF MASON WASPS AND THEIR PARASITIC BEES.

By ELMES Y. STEELE, Esq.

Gentlemen,—Obedient to the call of our President I rise to present a few observations on the habits of some species of hymenopterous insects, belonging to the families of the solitary earth-working wasps, and of the bee-like insects, their parasites. I ought perhaps to apologise for bringing this subject before you, because my limited acquaintance with Natural History gives me no pretension to the title of an entomologist; but as a field naturalist I have been for the last few weeks past deeply interested in studying the operations of these insects under the promptings of their marvellous instinct, and I have thought that the page I have thus been reading might possess sufficient attraction to gratify those members of our club who may not be already familiar with it. Let me, then, introduce to your notice a sunny spot within a quarter of a mile of Abergavenny, where lies an ash tree of about fifty years' growth, prostrated by one of last winter's gales. This tree had been for about two years under the keen observation of my friend, Dr. Chapman, who discovered that it was being ravaged by a wood-boring beetle, *Hylesinus crenatus*, and that ere long it would decay and fall to the ground. When this predicted event had come to pass it became the prey of *Hylesinus fraxini*, and of many other insect wood-destroyers. Dr. Chapman, whose interesting paper, read at our last meeting, was published in the *Hereford Times* on the 13th inst., computes that up to the present time at least forty species of insects have found a lodgment and food within, or building materials upon, this fallen trunk. It was whilst pursuing his hunting explorations after beetles that my friend became aware of the fact that *Odynerus Spinipes*, one of the solitary wasps had taken possession, not indeed of the tree itself, but of the sandy clay which had been brought up with the roots when it fell. This curious insect (*Odynerus Murarias* of Latreille, *Vespa Muraria* of Linnæus) is called solitary because each female excavates a burrow in the soil, wherein she forms cells for the lodgment of her eggs, and does so unaided by other individuals of the species; unlike, in this respect, to the tribe of wasps, with which we are more familiar, who, as is well known, construct a complex habitation, built up of woody fibres agglutinated together into a sort of paper, in which operation they are associated, often in great numbers, and thence are called *social* wasps. *Odynerus Spinipes*, if it be not social, is not, however, unsociable, for. as in the instance I am relating, many individuals may congregate on the same spot if the material and the situation be favourable. I need not enter into a systematic description of her anatomy, for I have come provided with the insect herself, which I will now pass round the table for your inspection. You will find her set up in company with the other insects, to whose history I propose to draw your attention. Well, then, this wasp, which is a burrowing

ODYNERUS SPINIPES.

A Colony of Odynerus spinipes, with the tubes of open filagree work, where the wasps are still working, and the closed mouths of completed burrows. A section of some of the burrows shews their arrangement and contents.

a. A section of an uncompleted cell partially filled up with the larvæ of *Hylotoma.*

b. A closed cell, the larvæ of *Hylotoma*, half-eaten by the grub of *O. spinipes.*

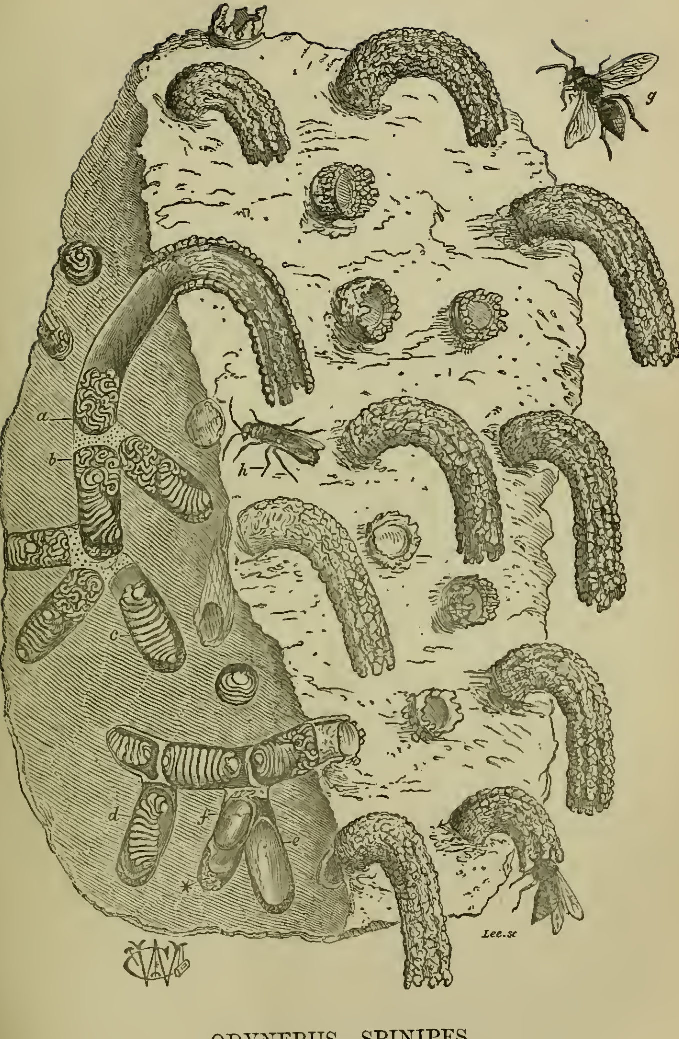
c. A cell containing a full-grown grub of *O. spinipes*—debris of *Hylotoma* only remains.

d. A cocoon of *O. spinipes* opened, shewing the contained grub awaiting its change to pupa.

e. An empty cocoon of *O. spinipes*, the grub being removed.

f. A cocoon of *Chrysis ignita*, or *bidentata*—it does not fill the cocoon of *O. spinipes* in which it is made.

g. Odynerus spinipes. *h. Chrysis ignita.*



ODYNERUS SPINIPES.

and a building insect, having chosen her ground, begins operations by scooping up with her jaws a portion of the soil, and, with the aid of moisture, procured from some neighbouring water supply, moulding it into a pellet, which she fixes on the circumference of the depression she is making, thus forming in due time a parapet, and, as the excavation is progressed with, a great number of such pellets are in turn brought out and fixed, so as to form a tube of filigree work, more or less curved, with the orifice invariably placed downwards. As the tube, like the burrow, is made too narrow to permit of the wasp turning her long body within it, she comes out tail foremost, and settling her hind legs, as mainstays, on the outside of the tube, she, with mandibles and forelegs combined, fixes each pellet in its place, while the forepart of the body and the head are still within the orifice, After settling the pellet in its appointed tier, she proceeds to the excavation for another. When the outer tube has attained the length of from one to two inches or thereabouts, she ceases to build, and drops the superfluous pellets which, falling to the ground, often accumulate in small heaps beneath. I have gathered up some of these, and send them round in a small box.* You will see that our little friend, besides being a burrower, is a builder. These covered ways are outworks to their more secret passages. and may serve in some degree as a protection to them, but, as you will presently hear,not a sufficient fence to keep out the allotted enemies of these builders. There are the tubes, whatever may be the purpose they may serve, and very curious structures they are. I have endeavoured to procure a sketch of a remarkable collection of them, which I will now hand round, and I only regret that my skill as an artist is scarcely on a par even with my knowledge, imperfect though that be, of entomology. I have derived encouragement and great assistance from our President, as well as from Dr. Chapman, and most of my observations have been made in their company. In the sketch I have introduced what purports to be a section of a part of the wasp's territory, exposing to view three or four of the burrows, with the cells and their contents. Let me then go back to the wasp where I left her busily constructing, which she does apparently in sunshine only; at other times, when the sky is overcast or when the wind blows cold, she ceases to work and keeps close in her burrow. Having scooped out a smooth circular passage about three or four inches deep in the earth, she rounds off the bottom of the cavity and there deposits a pale yellow egg of a cylindrical shape, rounded at each end, and about two lines in length, slightly fixed to the bottom of the cell by a thread of silky web.† On the top of the egg the mother packs in, one after another, from 20 to 35 larvæ, maggots

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* I have observed that sometimes she brings out the pellet, and, taking a short flight, drops it on the wing; at others she clings on to the end of the tube and parts with it by a swing of the head.

† As already remarked the wasp cannot turn in her tube, hence after working in it she comes out backwards, and if the sunshine happens to fall on the filigree work as she is passing down it is curious to see how rapidly the backward exit is performed. On the other hand, when about to lay her egg, she ascends the tube abdomen forwards, and it is interesting to observe how, to accomplish this movement, she smoothes down and settles her wings with her hindlegs, to prevent them catching over the edge of the tube.

of a species of *Hylotoma*, one of the *Tenthredinidæ* or sawflies, which, being of a bright green colour, are conspicuous to view on opening the cavity. The wasp's sting is not sufficiently pungent to penetrate the human skin, but is yet strong enough to puncture the integument of the larva, which is wounded, though not unto death.

Poisoned by the sting it becomes torpid, however, and lies quietly inhumed in the tomb-like cell ready to become food for the larva of the wasp as soon as this latter shall be hatched, which, from our observation, must occur in a few days in such warm and genial weather as the present month has afforded. I understand that in unfavourable seasons the hatching may be much retarded or even not take place at all, in which case the stored up larvæ and their destined devourers decay in the earth together. The wasp maggot is of a pale straw colour, deepening to yellow as it grows; it rapidly attains its full size, feeding on so amply stored a larder. It consumes the sawfly larvæ one by one, leaving nothing of them but their horny heads. The instinct of the wasp teaches her to store the cell with none but vegetable feeders, from whose assaults her own offspring are thus secure. Having completed her office of purveyor, which she does by carrying in the green maggots between her mandibles, she closes the cell with a thin layer of prepared mortar and immediately repeats the process, till in succession, as many cells have been furnished as the length of the burrow permits of her making. Where the quantity and the nature of the soil are favourable she sometimes branches off in different directions, but she contrives so to mine her approaches as to avoid encroaching on the limits of her neighbour workers. Sometimes we have found a number of cells filled with their usual contents in close proximity one to the other, although evidently traceable to distinct burrows. Having filled all the cells of her burrow she closes the orifice. And here comes in one at least of the uses to which she applies the outworks, for she detaches as many pellets from the mouth of the tube as will suffice to plaster up the cavity to within one or two lines of the surface, making fresh burrows elsewhere if required to exhaust her stock of eggs. Her labour is now done—she has accomplished the ultimate task of her life by providing as best she may for her progeny, and soon after she dies.

Meanwhile and during the performance of the busy operations I have just been describing, we shall see in part the most marvellous passage in this insect history. Not only shall we, if we take our post in front of the burrows, see the wasps building their cells and carrying within their still living prey, but flitting about in the sunshine smaller insects will appear, now settling for a moment or running with restless speed here and there, but, ever and anon one of them will enter one of the burrows; sometimes to be immediately expelled, if the wasp happen to meet her in the passage, not seldom remaining in for a minute or two. These are the *parasites*, who, like the cuckoos amongst birds, come to take unfair advantage of the labours of the wasps. Their bee-like shape will strike the observer, but they are not true bees, although belonging to a section *(Pupivora)* of the same great *Hymenopterovs* class. They are members of the family of *Chrysididæ*. Of these we have caught and observed three distinct species :—*Chrysis Ignita*, *C. Bidentata*, and *C Neglecta*. The first-named being by far the most abundant. These active and beautiful little creatures are conspicuous for their gorgeous colours and metallic lustre. *C. Ignita* has the head and thorax finely punctured and coloured of vivid blue or green variously intermixed. The abdomen, also finely punctured and terminated by four distinct spines, is of a ruby red, with coppery glance, and in the sunshine gives to the insect the aspect of being on fire; hence the specific name. *C. Bidentata* is of a rich golden or crimson red, sometimes with coppery lustre. The head, emargination of the prothorax, metathorax, body beneath, and terminal segment of the abdomen, blue or green. *C. Neglecta* has the head, thorax, legs, and basal joints of the antennæ dark blue, varied with bright tints of green, sometimes splashed with gold; abdomen very finely and closely punctured of a rich carmine, with a central longitudinal elevation in the middle of second segment. Apex without teeth. Each of these species and many others of the same family deposit their eggs in the cells of other *Hymenoptera*. The egg of *Chrysis* is placed in the cell at the moment of its completion and before or immediately after the mother wasp has closed it with mortar, the ovipositor of the parasite enabling her to penetrate through the obstruction for her deposition of the egg, which does not hatch until after the wasp larva has attained its full growth and assumed the condition of pupa by the consumption of the food in its larder. Then the maggot of the *Chrysis* sets to work and feeds on the body of its guest, so that, after passing through the pupal stage in security it comes out of its habitation, a young *Chrysis* where a young *Odynerus* should have burst the cell.

I am afraid that the sketch I have given of one species of wasp and of her satellites, mere outline though it be, has left me no time to devote to the other species of whom we have watched several. One of the most interesting is *Odynerus parietum*, a very elegant insect, which has been sent round with the various other specimens to which I have had occasion to allude. This wasp does not make a burrow but selects a suitable cavity in the stone of a wall and after making mortar from a mixture of sand and clay with water, she brings it by repeated journeys and shapes out her cells. As soon as one of these is completed she deposits an egg and supplies the cavity with seven or eight caterpillars. Sometimes the larvæ of *Alucita Hexadactyla*, or that of the feather moth, *Simaethis Fabriciana* or of some other, but invariably the prey selected belongs not to the HYMENOPTERA, as in the case of *Odynerus Spinipes*, but to some species of the class of LEPIDOPTERA. *Chrysis* then finds her out, and drops her egg in the nest to be matured, generally by the following spring, and at the expense of the pupal wasp. *Odynerus parietum* generally builds in succession as many cells as the cavity of the stone will admit, and then, if her stock of eggs be not exhausted, she seeks some other favourable spot for the completion of her appointed task. One of these creatures gave a remarkable example of aberrant instinct, or misplaced confidence, by building within the tube of a rain-guage in the garden of our President. This happened two or three weeks ago, and, of course, the first storm would have swamped the insect babitation, at the same time probably interfering with the meteorological record of our friend, Dr. M'Cullough. He, however, spied out the busy intruder, and, lest a worse fate should befall it, captured the insect which has now the honour of appearing before you, and very scientifically demolished the structure, exhuming sixty-nine larvæ of the *Simaethis Fabriciana*. Of the other species of the solitary wasps, one, *Crabro patellatus*, scoops her cells in the earth and stores them with spiders; another, *Crabro cephalotes*, stores *diptera*; *Crabro leucostoma*, small *diptera*; *Pemphredo lugubris* collects *Aphides*. These latter are not earth-workers, but excavate holes in rotten wood and fill them with their prey. Thus does each, according to the instincts implanted in her by the great creative power, provide for the care of those of her race who may come after her, helping, at the same time, in her small way to exhibit an interesting example of that varying beauty of contrivance which ever pervades the works of Nature.

The paper created much interest and was much applauded on its conclusion; but time was now up, and a general move was made for the railway station. The Woolhope Club saw off their visitors for the day, and thus concluded a very interesting and satisfactory meeting.

The Woolhope Naturalists' Field Club.

MEETING AT PENWYLLT AND SCWD (YSGWD) HEN RHYD.

TUESDAY, JULY 14, 1868.

The Extra Field Meeting for the year of the Woolhope Club was held on Tuesday last. It was the Ladies' Day, the only day on which the explorations of the Club are graced by the presence of ladies. Unusual efforts are always taken, and special anxieties felt, that this day should prove an interesting and successful one. On the present occasion it has certainly gone off most pleasantly, and passes into history with bright and sunny—uncommonly sunny—recollections. The members of the Club met early at the station to transact the usual business of the meeting, and were thus ready to receive their visitors before the train started.

The following gentlemen and ladies left Hereford:—J. M. Herbert, Esq., Rocklands; the Rev. Robert Temple, Montgomeryshire; Dr. Bull, and two Master Bulls, Miss Baines, Miss Taylor, and Miss Cunningham; the Rev. H. J. W. Stillingfleet and Miss Evans; Mrs., Mr. Reginald, and Miss Edith Symonds; the Rev. Wm. Stanhope, Holm Lacey; the Rev. Thos. Phillipps, Mrs. and Miss Augusta Phillipps, Dewsall; F. Jones, Esq., Manorbeer; T. Cam, Esq., and Miss Cam; Wm. Aston, Esq.; F. R. Kempson, Esq.; C. G. Martin, Esq.; T. Curley, Esq., F.G.S.; Mr. and Mrs. Downing; Mr. John Pitt, Miss Pitt, and Miss Bayliss, Ledbury; J. T. Owen Fowler, Esq.; O. Shellard, Esq.; and Mr. Arthur Thompson. At Credenhill Station—The Rev. H. Cooper Key, vice-president; the Rev. W. C. Fowle; Marcellus Newton, Esq., Sugwas; Mr. and Mrs. Herbert and Miss Eckley, from Credenhill Court; and J. P. Hamer, Esq., joined the train. At Moorhampton the Rev. R. H. Williams came. At

Eardisley a stronger party was found on the platform, consisting of R. Banks, Esq., of Kington; R. W. Banks and Mrs. Banks, Ridgebourne; the Rev. James Davies, Miss Davies, Miss Mary H. Davies, Moorcourt; Miss Dimmock, Stoke-upon-Trent; and Mr. Lloyd, Kington. At Talgarth—Wm. Banks, Esq., F.S.A., and Mrs. Banks, of Pont-y-wal Hall; Miss Morgan and Miss Annie Morgan, Bronllys Castle; the Rev. J. Bowen, Mr. Wm. Bowen, and Mr. John Bowen, Llangorse; J. Mortimer, Bowen, Esq., Miss Bowen, Chancefield; and Mrs. Ellis Jones, Donnington, Wroxeter.

But it was at Brecon that the strongest reinforcement was met with. Here Dr. M'Cullough, the president, joined the club, with Miss M'Cullough, Miss Isabella Steele, and Miss Bertha Steele, from Abergavenny; Lilburn Rosher, Esq., Trewyn, and Dr. Yellowlees, Bridgend. Here, too, came the Rev. W. S. Symonds, F.G.S., the lecturer for the day, with Miss Symonds, Pendock; Miss Mary Symonds, Broomyhill; Edward Stone, Esq., Miss Stone, and Miss Lennard, Chambers Court, Upton-on-Severn; Dr. Lucas and Mrs. Lucas, the Bulwark, Brecon; D. J. W. Thomas, Esq., Mrs., and Miss Thomas, The Watton; John North, Esq.; George Overton, Esq., Watton Mount; Dr. Talfourd Jones; Jas. Williams, Esq., Rev. Charles Griffith, Glyncelyn; Joseph Josephs, Esq., Brecon; H. St. George Caulfield, Esq., Ely-place; Alfred Henshaw, Esq.; Mrs. Broughton, Miss and the Misses Alice, Annie, Mary, Jessie, and Kate Broughton, Llandefaelog; Miss Filcock and Miss Kirkland; E. C. Phillips, Esq., Fennifach; James Buckley, Esq., Llanelly; James Morgan, Esq., Neath; and Thomas Morley, Esq., Neath.

By the kind arrangements of the railway authorities the same carriages were carried on by the special train, and after that series of shunting and re-shunting, and backward and forward movements, which seem so perplexingly unnecessary to those whose anxiety is only to get on, the train at last set off. At the private station of Abercamlais, John Lloyd, Esq., of the Central Committee, was taken up, with the following ladies and gentlemen:—Rev. Fenton Hort and Mrs. Fenton Hort, Glanwysk; Mrs. G. Williams, Misses Williams, and Master Williams, Abercamlais; Miss Williams and Miss K. Williams, Llandaff; and lastly, at Penwyllt, W. Price, Esq., of Glan Twrch, with Miss Price and Miss Dora Price; and the Rev. Thos. Walters, the rector of the parish of Ystradgynlais, to which our day's visit was appropriated.

Never, probably, was the platform of Penwyllt station so brilliantly crowded; and though there was some little delay there, the station wall itself afforded some natural objects of great interest. It was coped with tall stones whose long rounded forms and open cavities made them seem like the bones of some gigantic animals, but they were really masses of mountain limestone, snow-worn and water-worn, which had been brought from the neighbouring hills, and on examining them closely there were numerous shells and corals which had also been worn even with the stone in which they were imbedded. It was said that there are immense masses of the same limestone projecting from the neighbouring hills. There also Mr. Banks exhibited a collection of the Fossils of the Lower Coal Shales, which had been brought for the purpose from Onllwyn. The tickets were speedily taken, and the ladies having given up the pretty rose-coloured invitation cards of the club, the day's route was commenced.

Not a hundred yards from the station, after a sharp chase, a snake was captured as it ran quickly along the grass. It was a young specimen of the common, or ringed snake, *Natrix torquata*, about a foot long. It had not long cast its skin, for its spots and colours were very clear and well marked ; but as it was held up for admiration, it gave out such a disagreeable odour, that nobody but a true lover of science could have continued to bear it. Snakes have this power when alarmed or irritated, and this young creature exerted it. It is a harmless snake, though, as it constantly kept projecting its long black tongue, bifid one-third of the way down, it looked to the ladies monstrously suspicious. The heat of this summer must be most favourablo to snakes—and no less than three were found during the day's walk, and a second one, full two feet long, was also boxed alive.

The route taken was up a ridge of Mountain Limestone which was extremely picturesque and pretty, and after a short ascent the summit, capped by the conglomerate of the Millstone Grit, was reached. This was the lecture-point for the day, and the aneroid of the President proclaimed its approximate height to be 1,250 feet above sea level. Whilst the ladies and gentlemen wind up the hill in so picturesque a stream a brief sketch of the immediate district may be given. The stand-point was a small hill from the mountain side projecting into the valley of the Tawe, surrounded by the fans of Breconshire. Close before you, looking south, was another projecting hill of Mountain Limestone, the Craig-y-rhiwarth, and further on the Tan-y-rogof and Twyn Walter mountains of Old Red Sandstone, whose strata could be beautifully seen dipping down so as to come beneath the Mountain Limestone. Then across the valley, in an easterly direction, was a remarkably fine bold mountain, the Gwdun-wra, a Limestone Hill, whose quarries could be clearly seen. To the south-west, were the tops of the Y. Fan-gihirach, 2,382 feet high, and the Y. Fan-ffraith, and immediately above the station we had left, could be seen some bold, craggy, shivered ridges of the Millstone Grit over-lapping in its turn the Mountain Limestone. The highest and most prominent ridge was called the Carreg-llwyd. To the north stretched the valley of the Tawe, with the river winding prettily amidst its scattered houses and whitewashed cottages, with again hills upon hills beyond, the whole scene being well varied by the sunshine and cloud of the hour. When the whole party were assembled, and had stretched themselves on the ground, the President called on the Rev. W. S. Symonds to give the

ADDRESS ON THE GEOLOGY OF THE DISTRICT.

BY THE REV. W. S. SYMONDS, M.A., F.G.S.,

PRESIDENT OF THE MALVERN NATURALISTS' FIELD CLUB.

Ladies and Gentlemen,—When I received a request from your president and my friend Dr. Bull that I would undertake to deliver an address upon the Geology of the District we have visited to-day, I felt somewhat embarrassed as to the manner in which I should treat the subject, and whether I should give you a palæontological history of the rocks and the various organisms they contain, or whether I should deal more particularly with the physical geology, and describe, though necessarily very briefly, the way in which I conceive the hills and vales by which we are now surrounded to have been moulded into their present shapes, and assumed their present outlines of rock and hill, deep valleys and high table lands.

When the young geologist comes for the first time to the physical study of mountain scenery, and examines the crags and vales, the ravines and precipices, with fragments of rock lying strewn over the sides and in the hollows, he is very apt to attribute the broken features he beholds to convulsions caused by the volcano, and the earthquake, which hurled up the mountains and threw down the glens and rent asunder the valleys, down which now flow the rivers and the brooks. I am old enough to remember the time when almost every hill in Wales was attributed to a catastrophic elevation, and every valley was believed to have originated in an earthquake rent. As years passed by sounder views respecting the origin of such scenery have been arrived at, and we have learned to attribute the principal existing features of the land we inhabit, whether we live among the mountains, by the sea-side, or in the river vales, to the operation of pre-existing and natural causes, which in the glacier and snow drift were at work for unnumbered ages, and natural causes which are still at work through the action of frost and snows, rain, rivers, brooks, tides, in short all the many agents of *subaerial denudation* which may now be observed in full action upon the surface of this planet, mouldering the hills, and wearing and carrying away the rocks. I must not, however, be misunderstood, and supposed to say that the hill and mountain configuration of many districts visited by the Woolhope Club in their distant explorations does not owe much to the eruption of volcanic materials, and large accumulations of ancient lavas and volcanic ashes, which were poured during earthquake convulsions into the beds of seas which no longer exist, and which lava currents often stand out as bold hill rocks, and serve as protectors of the softer sea-beds among which they are frequently interstratified. During the period of the deposition of the Lower Silurian rocks there must have been active volcanos in several parts of Wales and Siluria, and probably volcanic islands were formed around the volcanic vents. In the neighbourhood of *Builth*, some 20 miles distant, as the crow flies, many animals which lived in the Lower Silurian seas have left their remains in volcanic ashes, which are interstratified with Llandeilo shales and muds which were accumulated in those seas, and which are themselves overlaid by sheets of lava, which must have poured into the sea. The same history attaches to the *Corndon country*, which you have visited from Church Stretton. The Corndon mountain is a mass of igneous rock which was erupted through the overlying Llandeilo rocks, and on the westeın flanks of the Stiper stones are bands of volcanic ashes which are interstratified with marine strata; and these ashes were probably ejected from a volcanic vent which reared its crest above the Llandeilo seas. It is not, however, to *direct* earthquake and volcanic action that we owe the peculiar scenery of Builth, and the Corndon and Stiperstone districts. It is to *denudation* that we owe the general moulding of the features of this country; to *denudation* before the submergence of Wales beneath the glacial sea; to *denudation* during that submergence beneath an ice-traversed sea; and to sub-aërial denudation by glacial action, by frosts, snows, rains, and rivers, which has been going on for ages since the land has been elevated as it is now.

As there may be some present who may not understand the broad sense in which the term *denudation* is used by geologists, I may be excused if I explain that it implies the removal of portions of solid rocks *in situ*, and the transport of their materials by various agents into estuaries, the bed of the sea, or lakes, by brooks, rivers, floating icebergs, or any other method by which those materials were moved from the parent rocks and carried as boulders, pebbles, silt, and mud, to accumulate as new strata perhaps hundreds of miles from the original rock mass from which they were abraded. It applies also to the action of the waves upon a coast line. *Subaërial denudation* is applied chiefly to those subaërial agents such as glaciers, frosts, snows, rain, rivers, brooks, and springs, forces which are always at work moulding the surface of the earth and subaërially denuding its crust.

All the great sedimentary rock masses which constitute the crust of the earth, whether Cambrian, Silurian, Carboniferous, or Tertiary deposits, are the result of the denudation of some pre-existing rock surface, the materials of which were spread beneath the sea. We have abundant evidence throughout Wales of the action of ancient igneous and volcanic forces; but this is as nothing compared with the evidence we obtain respecting the forces of *denudation* acting throughout incalculable epochs.

The geologist who explores in Wales and Siluria will do well to note the effect of powerful volcanic forces during the Lower Silurian periods, and the evidences of the fracture, dislocation, and upheaval of the Lower Silurian rocks; but he should note also the *denudation* of those strata before the deposition of the Upper Llandovery rocks, a denudation probably of Lower Llandovery date.

The hardness of the lava beds, and the softness of the Llandeilo slates, and the interbedded ash beds, are the cause of the irregularities of the Builth and Corndon districts. *Denudation* and its agents have excavated the rocks into their present form.

I have no doubt that the hard volcanic rocks of both the Carneddau at Builth, and the Corndon Mountain, were once hidden and covered up by masses of Upper Silurian strata, and other later beds of deposition, which have all been denuded and swept away, and thus the harder masses beneath have been left exposed like the kernel of a peach, or a nectarine, when the softer parts of the fruit have been removed. In some parts of Wales, as along the *Longmynd range*, we find evidence that the Caradoc rocks and the Upper Llandeilo deposits had undergone denudation before the deposition of the Upper Silurians, for the Upper Llandovery beds are seen resting on the old Cambrian rocks, as well as on the Caradoc and Lower Llandeilo beds. In fact the Lower Silurians, with their interbedded igneous rocks, had undergone a series of volcanic and earthquake contortions, and a great thickness of Lower Silurian strata had been removed by *denudation* before the vast thickness of Upper Silurian strata was accumulated.

There are few members of the Woolhope club who are not acquainted with the distinct groups of the Upper Silurian rocks, with their bands of limestone and their beautifully preserved fossils. In the region which the club have visited on this occasion the Silurian rocks are covered up by a great thickness of Old Red Sandstone, and by a series of carboniferous strata which once spread north of this country over the great Silurian region of Northern Wales.

All the Upper Silurian rocks are of marine origin, as is evidenced by their fossils. They are of great thickness, entering in North Wales into the formation of considerable hills, and, although in certain places they are much faulted by earthquake movements, display but little evidence of intruded volcanic masses, or the infiltration of igneous dykes through their beds. The only example I know of is the protrusion of the igneous rock of Stanner, near Kington, where the old lava of Stanner is seen to traverse and metamorphose the Lower Wenlock or Woolhope limestone.

Above the Upper Silurian rocks are deposited a great mass of red and grey sandstones, shales, and cornstones, surmounted by a series of brown and reddish saudstones, known as the "*Old Red Sandstone*," and which has a thickness of several thousand feet. Above these again, in the Silurian area, there rests a thick pebble bed known as the "*Old Red Conglomerate*" and over this there follows a series of yellow and greenish sandstones which I believe to be the real base of the over lying Carboniferous series. The *Old Red* at its base contains a few Upper Silurian shells intermingled with certain forms of peculiar fish ; while the yellow beds at the summit contain *Pterichthys*, and *Holoptychius*, fish which at Farlow, near the Clee Hills, are found associated with a carboniferous marine shell, an *Orbicula*.

With regard to the evidence of volcanic or igneous agency as associated with the Old Red we have very little positive proof. The well-known lava dyke or Greenstone of Bartestree, near Hereford, and one at Brockhill, on the Teme, are the only igneous rocks I know of which are seen in contact with the Old Red rocks of Wales or Siluria. Yet we cannot but observe that great earth movements everywhere affected these strata, for we have numerous examples, as at Woolhope, Shucknell, Usk, and other localities, where the under lying Upper Silurians have been upheaved through the overlying Lower Old Red Sandstone. If the Woolhope Club wish to study the effect of earth movements and upheavals, also of denudation, I should recommend their paying a visit to the northern district of Siluria, to the Forest of Hayes on the Long Mountain, or to Clun Forest on the borders of Shropshire, bearing in mind the position of the Lower Old Reds in the Ledbury, Ludlow, and Kington districts. The Clun Forest country is a fine study for the young geologist, who can there mark the physical teaching of *outliers*, with their history of denudation, and behold the evidence of earth movements and upheavals in the elevation of the Upper Silurians, with the Lower Old Reds resting upon them, and upheaved with them.

There are four *outliers* of Lower Old Red, separated by Silurian hill masses, around the picturesque town of Knighton. There is the Clun outlier, and the Bettws-y-Cryn outlier, with two smaller patches west of the Teme, and an outlier north of Knighton.

Near Presteign we find a large mass of Lower Old Red running northwards; west of Brampton Bryan, these strata, like those of Clun Forest, are elevated with the Silurian hills ; and south of Presteign there is a patch of Old Red of the greatest interest, as indicating the former continuity of the Lower Old Red over the Silurians in this part of the country. It is called Lower Radnor Wood, and lies just west of the upcast of the Woolhope limestone by the Stanner trap, which looks as if the Stanner rocks were not injected and erupted through the Woolhope beds until after the deposition of the Old Red. I might mention many other examples within the cognizance of the members of this society, but I select themost striking, as it is impossible to examine all these isolated patches of a great formation without feeling positive that the strata were once continuous with those of the Hereford and Ledbury country on the south.

I do not know a more interesting exploration for the geologist than to take the section from the Upper Silurian rocks of Llanstephan, and Craig-pwll-du, to the summit of the Black Mountains, which are capped by the Upper Old Red Sandstone, the encampments of which stand out so boldly above the plains. The rocks on the summit dip to the south under the Old Red conglomerate and Carboniferous Limestone of the South Wales coal field. I could say much respecting the denudation of these upper Brownstones of the Old Red, which once extended far beyond the edges of their present boundaries over the vales of Herefordshire and Breconshire ; but the position in this country of certain rock masses consisting of *Carboniferous Limestone*, and *Millstone Grit*, tell the history of denudation perhaps even more vividly than do the Old Red summits of the Brecon and Caermarthen vans, or those of the Black Mountains of Llanthony, and the Hay, which once stretched far over the now denuded Wales. All those who love the lore of the rocks will not fail to have remarked during their expedition this day how the Old Red Sandstone of Hereford is overlaid by the hill masses of the middle and upper Old Reds, and these again are surmounted by the Mountain Limestone and the Millstone Grit.

The Mountain Limestone is beloved by the palæontologist for its picturesque scenery, its caves full of the remains of wild animals that once roamed over the hill sides of ancient England, and the number of fossil shells, and fishes, that once frequented its seas. The botanist, too, rejoices in the rare and beautiful plants nourished in its fissures and on its slopes ; while the archæologist marks many a cromlech, camp, and dyke ; and the historian lingers amid the memories of many a hard-fought battle, and many a struggle for independance fought out to the death among its ravines and dingles. But for the physical geologist there is a tale of waste and denudation, and former extension, told by the crags and outliers of the Mountain Limestone and Millstone Grit, which no true eye and head can miss.

It is impossible to enter much into detail in an address of this kind ; and the utmost I can do is to give to the members of this society a few examples of the points I wish to draw attention to on this occasion, namely, the upheavals and subsidences among the rocks we visit to-day ; and the denudation they have undergone.

I do not know whether any here are infected with the denudation mania, and imagine that rain and rivers have been the *only agents* which have effected the construction of the country as we now see it. If so, I recommend those that are thus afflicted to visit the noble Fans of Caermarthen, and examine the position of the Old Red conglomerate on the heights of the Fan-sir-gaer and see it dipping on its strike to the westward under the carboniferous limestone, within a short walk. Then let the student take the hill side walk, and visit the down-throw of the mountain limestone at Castel-cerrig Cennen. The Old Red conglomerate, which on the Fan-sir-gaer occupies the crest of the hill, at Cerrig Cennen is thrown down to the bottom of the valley, and above it rises the wonderful dislocated mass of limestone, on which stands the ancient fortress of a Norman chief. Neither rain or river washed this limestone peak to its position, although the little Cennen has had its share in after denudation.

It is only of late that geologists have begun to unravel the history of pre-glacial, glacial, and post-glacial periods, and it is necessary to collect all the evidence we can respecting geological changes that occurred during all these periods, if we would understand the origin of the scenery around us. The earth has undergone dislocations and upheavals, downthrows and subsidences, and there were hills and valleys in pre-glacial times, as there are now ; and rain and rivers did their work with other atmospheric agencies, and for ages moulded the old pre-glacial continents. The influences of intense frosts, glaciers, and ice sheets, must also be borne in mind as having moulded this old land for unnumbered ages. The glacial submergence ensued, and with it came other forms of denudation. The post-glacial emergence succeeds, and for thousands of years great cold was the condition of the British Isles, cold more intense than we ever experience now. In post glacial times our country was roamed over by the mammoth, the long-haired rhinoceros, the bison, the cave lion, and the cave bear. The musk ox, and the marmot, were also inhabitants of the country, and the presence of arctic plants in the post-glacial clays of Devonshire tell us of the bitter cold that still lingered in the vales of southern England, where now grows the myrtle and the vine. And he who wanders among the hills of Wales and would decipher the history of its boulder drifts, its disintegrated rocks, its vales, and rounded hills, or bluff escarpments, must bear in mind that he has *post-glacial action* to register, the action of snows, glaciers, and frosts which were prolonged into comparatively late times, as well as the action of present subaerial agents and the action of existing rivers, springs, and brooks. It is *geological nonsense* to talk of the valley of the Usk having been eroded by the existing Usk or an Usk like the present. The Usk was a very different stream to the present when swollen by melting snows, or large ice masses and boulder rocks rushed down its stream, and this happened in *post-glacial times*, as any observer may see for himself if he will trace the old river drifts from Abergavenny to its source. No one is more convinced of the endless, steady results of modern denudation, if I may so express it, more than myself, but there are scored upon the hills and vales of Wales the witnesses of other denuding powers than are now present there, the no longer existent powers of ice and melting snow, of torrential rivers and of bursting lakes. Rains, springs, and frosts are engaged widening and deepening our valleys now, but there was the action of *land ice* and *glaciers*, and at sea icebergs at work modifying the land we now live in, in *Post-glacial times*, and that kind of denudation has now ceased in Wales. I do not therefore think it philosophical to attribute the contour of scenery we now behold to causes *now in existence* in this country, when some of the principal agents have passed away. Rain and rivers have done much, no doubt, in moulding the scenery of this beautiful district—and of every other district—but they have *not done all*; and he who would attribute everything to rain and river agency only rides his hobby to death, and brings ridicule upon philosophy.

The Carboniferous limestone of the South Welsh coal field forms a girdle to that great coal field, and everywhere dips underneath the carboniferous grit and coal measures. But I should like to be able to show you two outliers which are cut off from the rim of the coal field between Merthyr and Brecon, and which are surrounded by Old Red Sandstone which has been denuded of the Limestone, the Millstone grit, and all the Coal measures. They lie to the east of the road between Merthyr and Brecon, and among the beautiful glen scenery of Abercriban and Cwm Cellan. The most remarkable of all the mountain limestone outliers in the neighbourhood of the South Wales coal field is Pen Cerrig Calch (the Top of the limestone crag), which was selected, through its name, by Sir Roderick Murchison, when engaged upon that noble work, the "Silurian System." He ascended the Black Mountains in order that he might ascertain why such a name had been used in a district appearing to consist exclusively of Old Red Sandstone. This insulated outlier of Mountain limestone, capped by Millstone grit, is distant about five miles from the edge of the northern rim of the Welsh coalfield, and is separated from the mass of that great coal field by the denudation of the intervening valley of the Usk, the valley itself running along a line of fault, which has upheaved the Old Redhills of the Black Mountains (with Pen Cerrig Calch on their summit), on the north bank of the Usk, and depressed the strata on the south. Pen Cerrig Calch is 2,200 feet above the sea, and is uplifted several hundred feet above the limestone with which it was once continuous, and which ranges on the other side the vale of Usk. It is impossible to visit this outlier without being impressed with the fact of the dislocation of the earth's crust along the Usk valley, while denudation has also been carried on upon a grand scale; and some of the relics of which are still piled in boulder clays, and old river beds, along the flanks of the hills.

It is not only with the nearer outliers that the geologist learns to connect the Mountain limestone and the overlying Millstone grit. We feel sure that these rocks were formerly spread in a continuous series over the county of Hereford to the distant Clee-hills of Shropshire. Nothing appears to me more ridiculous than to suppose that the Clee-hill Mountain limestone, or the outliers of North Wales, such as the Ormes-head, were little isolated coral reefs accumulated in particular spots in the mountain limestone sea. The Millstone grit which overlies them should be sufficient to demolish such ideas, for allowing that isolated coral reefs did grow upin the mountain limestone sea, we cannot understand how the millstone grit could have been deposited in such an accommodating manner above every outlier by particular and peculiar currents, which spread their strata over the coral islands, and adapted their flow to such widely-distant and separated areas as are those of the Little Orme district, near Llandudno, the Titterstone Clee, and Pen Cerrig Calch, near Crickhowell.

There are few geologists, however, who doubt the former great extension of all the Carboniferous deposits, and of the Old Red sandstone, over areas from which they have in later times been denuded. The question I draw attention to more particularly on this occasion is, *when* they were denuded, and *how* the present surface configuration of this country has arisen? Notwithstanding the evidences of volcanic action, as displayed in the eruption of masses of igneous rock among the Carboniferous deposits at the Titterstone Clee, and during Old Red and Silurian times; notwithstanding the evidence we possess of considerable earth movements, movements of elevation and depression, we still arrive at the conclusions that Hutton enounced when he said that "the mountains have been chiefly formed by the hollowing out of the valleys, and the valleys have been hollowed out by the attrition of hard materials coming from the mountains." Of course one of the principal agents of denudation is the great abrading power of the sea. We see everywhere loss of land along coast lines, and when we see this we behold the effect of marine forces which have been in work throughout all ages. Without doubt ancient continents have been eroded by waves acting on their coasts, but the action of breakers and waves upon coast lines have had little to do in the formation of such scenery as we have visited to-day, or when we traverse the hills and valleys of the interior of Wales and Siluria. All marine denudation tends to form great plains. The elevation of a few hundred feet would elevate our British straits into a nearly horizontal plain, and further elevation would elevate them into table highlands. I do not doubt that many of you must have been struck by the features of the scenery among the Welsh hills when standing upon some mountain top which stretches away into a hill table land. Such are the old table lands of the Silurian hills above the Wells of Llanwrytyd, or the table lands that would be so uniform in this country were it not for the valleys cut into the land.

I firmly believe that the Upper Old Red Sandstone hills of Brecon and Caermarthen are but fragments of an ancient sea bed, which once extended to the Black Mountains, and thence over Radnorshire and Breconshire, a table-land which was once the bed of the sea. These surfaces owe their origin to the levelling power of the sea, and to after levelling by land ice, while the valleys which intersect the hills have been cut out of the hills by floods produced by melting snows, by ice, frost, and by rain and rivers, and other agents of subaerial denudation. No doubt fractures and faults produced by earthquake movements on the earth's crust have often determined the direction of many of the vales, as does the fault which runs along the vale of Usk; but there are many glens where is no evidence of any fissure or fault, and where the once continuous strata have been cut into by the erosive power of streams, rivers, and brooks acting for long ages upon the emerged land. The old table-lands which you see on ascending the hill country of Wales and Siluria have been cut into a regular network of interlacing vales. These vales generally owe their origin to the effects of rain and springs, ice and snows, and have had nothing whatever to do with the sea or the agencies of marine denudation.

Much of the denudation of ancient surfaces has been attributed to erosion during the Glacial epoch, but I believe that the principal valleys in Wales and Siluria were excavated and channelled out in Pre-glacial times. There was a long geological period which intervened between Pliocene times and the submergence of Great Britain and much of Europe during the Glacial epoch, and which we call the Pre-glacial period. It is called Pre-glacial in the sense that it preceded those excessively cold periods during which the lands we now inhabit were submerged beneath the glacial ocean, and preceded the intense cold that set in during the maximum of the Glacial epoch.

It was during the Preglacial period that England enjoyed a climate similar to present times, but somewhat colder, and when elephants, rhinoceri, and other large animals lived in the old "Forests" of Norfolk (Forest of Cromer period), and their remains were deposited with river shells and land plants, the species of which are still in existence. This was a great Continental period. The land was probably higher than now, and this country was joined to France and Belgium. The cold went on increasing until it is not unlikely that

Wales and Siluria were covered with ice and snow much as Greenland is at the present time, so that during the close of the preglacial continental period the land was almost entirely enveloped in an ice shroud. Large glaciers filled the vales of the higher mountains, ploughed out the glens, and wore down the surfaces, and the land which once sustained the great animals of the Preglacial forest period passed into a phase sterile as that of Greenland. The denudation by land ice and other agencies must have been very great, and probably it went on for age after age until the submergence of the whole of Wales, to an extent of not less than 2,000 feet placed the whole country, with the exception of some of the highest hills, beneath the waters of the glacial sea. During this depression of Wales, denudation must also have gone on, for the erosion effected by ice grinding along the bed of the sea must have been considerable. Boulders carried by icebergs drifted southwards, and when the old ice covered land of the Preglacial period was submerged the boulders were dropped upon surfaces which are now elevated into high Silurian table lands. And with respect to the valleys and river systems I have every reason to believe that their principal features were marked out in Preglacial times, and before the great submergence took place, and Wales had settled below the Glacial ocean.

I believe that the deposit we term "Till" or Boulder clay was forming and collecting before the old continent was submerged, and that the boulder clay accumulated for ages both during and after the glacial submergence. There is good evidence that the great vale of Usk was filled with boulder clay to the depth of several hundred feet, and that this was eroded by post glacial Usk. I may say the same with the vale of Towy and the valleys of the Wye. The boulder clay probably accumulated both before and during the submergence of the land, and the greater part has been swept out since by the action of post-glacial ice, melting snows, streams, and rivers. Nor is it to be supposed that during what geologists term the *Post-glacial* period the climate was not very severe. When the land was elevated, after the great submergence, there is good proof that the iron grasp of ice lasted among its hill tops for ages. The ice after the submergence was probably not so extensive as it was during the latter part of the continental ice period when every vale was filled with ice, but there are traces left of glacial action in Wales since the present configuration of the British isles, that we must refer to Post-glacial times.

Those who travel through Wales as I have done, and endeavour to trace out the last geological changes, will be struck with the masses of rock that have been transported from the position the parent rock occupies *in situ*, and lie now stranded upon rocks with which they have no connexion. Much of the debris we see scattered about the hills is due to the action of rain and frosts upon the weathered rock surfaces; but much is not so, for we occasionally find masses of Millstone Grit resting on Old Red Sandstone, and the only way in which we can account for their transport is that they were moved by the aid of melting snows and ice. The remains of an ancient glacier may be traced among the heights of the Caermarthen Vans, and there is a very perfect moraine made up of masses of Old Red Conglomerate which bars up the old glacier lake of Llyn-y-van. Masses of this Conglomerate also lie to the westward on the Carboniferous Limestone, and they could have been hardly carried there by rain! I particularly direct the attention of the members of the Woolhope Club to the traces of later ice and snow action among the hills of Wales. They are abundant. What, for instance, could have moved the massive blocks of erratics that lie at the entrance of the little gorge between Builth and Wellfield? They are all local masses, but no rain or river ever stranded them.

Upheavals and subsidies have left their records on our noble hills, and our winding rivers have done much in excavating the vales where now our harvest waves; but the sun arose upon a very different scene in Post-glacial times, for the glacier swept down from the mountains, and torrential, ice traversed, rivers flowed where now meander the Wye and Usk; and man hunted the mammoth and the bear where now pasture the sheep and the ox; and the cathedral and village church now stand upon the ice-carried *debris*, and old river drifts, that furnish us with their fossil remains to enable us to tell you of this bygone history.

The address was remarkably well delivered and rivetted the attention of the auditors to its close. It was received with much applause and a vote given by acclamation to the eloquent lecturer. The route was at once continued, and though its difficulties were said to be such as would vanish on the attempt to overcome them, the ladies had high walls and rough rocks to surmount, and it is not likely that they will forget the peculiar characteristics of the six successive outcrops of Millstone Grit they passed over, along that mountain side.

The rarest plant of the day, was the rare and local fern, the *Asplenium viride*, which was gathered by Mr. Lloyd from a fissure in the limestone rock, immediately below the place where the address was given, and it was afterwards found pleutifully on the rocks below the waterfall. A barren district for plants is the surface of Millstone Grit, and but little is to be found there but the plants that thrive in the bogs so generally prevalent. The cotton grass, or moss-crops, *Eriophorum angustifolium*, with its waving cottony capsules existed everywhere in abundance, and the single-headed hare's-tail cotton grass, *Eriophorum vaginatum*, was observed in several places.

There was one most marked peculiarity in the walk to the waterfall, which no botanist could fail to be struck with. The route led apparently over green meadows, but the ground was cool and elastic, and was indeed nothing more than the surface of a bog dried up by the long-continued drought of the summer. It is not often that the leaves of the Bog bean, *Menyanthes trifoliata*, form a dry and safe carpet for the traveller's foot; it is not often that you can gather the bright gold spikes of the Bog Asphodel, *Narthecium ossifragum*, where you might naturally expect buttercups; nor indeed that the buttercups you do find should be the Lesser Spearwort, *Ranunculus flammula*, a true plant of mountain bogs. Unexpectedly your foot would fall on little crowded tufts of the Bog Pimpernel, *Anagallis tenella*, whose delicate pale purple blossoms, with veins of slightly deeper colour, contrast so well with the pretty light green of its little smooth and wreathed leaves. It is, indeed, a wildling

> "Of fairer form and brighter hue
> Than many a flower that drinks the dew
> Amid the garden's brilliant shew."

The pretty Marsh Cinquefoil, *Comarum palustre*, which generally wants some manœuvring to be gathered without wet feet, was easily got to-day, and so, too, were numerous rushes; and upon one of them several larvæ of the *Hadena Pisi*, a very handsome grub, with his deep chocolate-brown coat, yellow striped sides, and pinkish feet.

The walk, indeed, was most remarkable as a proof of the extreme dryness of the season. In an ordinary year it would have been simply impossible, and to do so without damp sufficient to wet your shoes was most astonishing. It was happy it was so for the ladies, for it enabled them to take a direct route to the Fall. The sun had come out powerfully, and as the party reached the last small hill, it was a great relief to find the Pont Hen Rhyd, the bridge of the Old Ford, close at hand, standing, as it seemed uselessly, high and dry above the rocky bed of the river Llech, or the river of the flat stone, as the name indicates with singular exactitude. It flows over strata lying horizontally, whose holes and irregularities are due to the power of the stream, when in full force angry, impatient, and violent.

Here attendants and hampers came pleasantly in sight, and the first instinct of every one seemed to be to rush into the bed of the stream. It was delightful to do so, and after the hot walk, to seat oneself on the large cool stones under the shade of the alders that fringed its banks, and rest with the gentle murmur of the stream at your feet. It was a most picturesque place, with enormous masses of rock all tossed and waterworn, and between them holes of varying depth of the clearest water, which, without a ripple on its surface, looked far too innocently pure and gentle to be suspected for a moment as the cause of all the results of wonderful force around it. The rocks—the unvarying insensible rocks—looked much more guilty, though their sides were hollowed out into large holes, and though they had been driven here and there with remorseless energy.

A few of the visitors, more bold than the rest, climbed round the edges of the great pool to the very brink of the precipice.

> "Crept stealthily to catch a trembling glance
> Into the dread abyss;"

and a very good view they got of the valley a hundred feet below, pretty, quiet, and peaceful! Standing where human feet may rarely stand, and yet with an utter absence of awe or dread, or any other of the thrilling nervous sensations that the activity, power, and terrific roar of such a fall at other times could not fail to produce. It was all unreal, the spirit of the fall was absent, and the observation of a practical gentleman afterwards, "that the whole river would run through a three-inch pipe with a proper inclination," did not seem out of place, and was certainly correct.

Within six or seven yards of the extreme edge is "The Maidens' Pool," a large pool into which the river falls some six feet, with a force that has hollowed out a large round space in the rock at the side. With a full quantity of water, this must be an awful cauldron, and in its present smooth and quiet state it was at least eight or ten feet deep, and large enough to suggest a swim. Here in ages past, the legend runs, two young and lovely girls, locked in each other's arms, threw themselves in despair—

"Mad from life's history,
Glad to death's mystery,
Swift to be hurl'd
Anywhere, anywhere,
Out of the world."

Never again were they seen, but ever will they be associated with the horrors of the Pwll-y-forwyn.

"What became of the gentlemen?" was asked. "Oh, fair Madam, it was not their privilege to throw an air of romance over so lovely a place—they get not the sympathy of succeeding generations! Doubtless they carried their griefs bravely, covered their broken hearts with a calm outward appearance, and spent, we will hope, ever after, their lives in quiet deeds of kindness and charity; or perchance—though history names them not—they may have died in the Holy Land fighting the Saracens, from a reckless disuse of the coat of mail of the period."

The bed of the river was filled now with parties in pretty irregular groups pic-nicing most temptingly, and in addition to the difficulties of the passage through the rocks, the gauntlet of the most hospitable offers had to be run. The President's party had taken an open position in the field by the side of the fall, in full view of the lovely wooded glen that took its winding way through the hills. Of the next twenty minutes we will only say, that if the fair hostess does not ever hereafter live in the grateful recollection of her guests as a benificent creature, distributing to all comers, at a minute's notice, on a sultry day, unceasing supplies of iced claret cup, our faith in the gratitude of mankind in general will be greatly shaken. A Welsh woman from a neighbouring cottage was greatly surprised, as well at the number of the visitors as at the whole proceedings. Seeing the quantity of ice the President had so thoughtfully brought with him, she exclaimed, "Indeed, yes, it is ice, that is odd indeed."

Immediately after luncheon, a paper was read on

THE ELM TREE IN HEREFORDSHIRE.

By Dr. BULL.

"Not always city-pent or pent at home
I dwell; but when Spring calls me forth to roam,
Expatiate in our proud *suburban* shades
Of branching Elm, that never sun pervades."
Milton.

In the valleys of the Thames, the Avon, and the Severn, and for the most part in the open country of the southern and midland parts of England, the Elm is the most common timber tree. This is not the case in Herefordshire. The deep tenacious clay loam that prevails so generally here is not the soil that any kind of Elm delights in. There are nevertheless so many remarkable trees of the common Elm in the country that they require and deserve some special notice from our Club; and, moreover, the commercial value of the tree has suffered so much, in late years, that the fashion for planting Elms seems dying out, and it may be useful once more to bring forward its great advantages as an ornamental tree.

The common English Elm for height and size, for grandeur of form, and for majestic growth, combined with great lightness and beauty, has few competitors. It gives to our parks and pleasure grounds, grand avenues and noble groups of trees; it enriches our home landscapes; adorns our houses; and gives everywhere a shade in summer that adds greatly to our personal enjoyment and makes it perhaps in its homely and domestic associations the most general favourite of all our large trees.

[*Note.*—"There fast rooted in his bank,
Stand, never overlooked, our favourite Elms
That screen the herdman's solitary hut."
Cowper's Task.

"Almost every place," says Mr. Edwin Lees, in his charming book, *The Botanical Looker-out*, "has its favourite old Elm, of large dimensions, sanctified by some local name, often on a common, or beside a rustic inn or foldyard—once the resort of buoyant childhood—now abandoned for ever—and yet a hallowed landmark in the tearful vista of memory."]

To the ordinary observer the Elm is the best known tree and the most readily recognised, and yet to the botanist it offers one of the most difficult studies. Nature never seems more prolific in endless variety than in the seed bed of the Elm. A glance at the plants will instantly show their great variations.

THE REMARKABLE TREES

OF

HEREFORDSHIRE.

THE KINGS ACRE ELM, TWO MILES WEST OF HEREFORD.

APRIL, 1869.

This noble tree is situated at Kings Acre, on the high road to Hay. It is long past its prime, and has lost some branches, though it is still very luxuriant. At five feet from the ground, where the card of the Club is placed (in size 1ft. by 6in.), it measures 18ft. 8in. in circumference. At about 12ft. from the ground, it divides into three stems of great size, of which the one on the south side rises to a height of about 95 feet

Ladmore and Son, Photographers to the Woolhope Naturalists' Field Club.

The leaves will be small or large, rough or smooth, narrow or broad, curled or variegated; and the bark too will be red or yellow, rough or smooth; some will be early and some will be late; some will be short and some will be tall; and they will present in their after mode of growth the same wide differences: in short as a French writer (Baudrillart) has remarked "while botanists describe and cultivators sow, they will find that Nature sports with their labours and seems to delight in setting at fault alike the science of the one, and the hopes of the other." And thus in an Elm-growing district the student is constantly puzzled with the trees he meets with. Well he may be! for if you refer to that monument of labour and perseverence, Loudon's "Arboretum," you will find that he has given the names and distinguishing characteristics of no less than eleven species and sixty-eight different varieties of Elms, and even then, he alludes to several other kinds that have also been brought into notice. Herefordshire, however, as has been said, is not a true Elm-growing county—except perhaps on the southern side, in the Ross district. It is not necessary therefore to weary you, or perplex myself about these variations, and setting aside moreover the strictly botanical classifications, which vary too, it will be more simple and sufficient for all practical purposes to consider that there are really but two distinct species of Elm, the *Mountain*, *Wych*, *or*, *Scotch Elm*, and the *Common*, *Small leaved*, *or English Elm*, from which, or between which, all the others have been derived.

"Harp of the North! that mouldering long hast hung
On the Wych-elm that shades St. Fillan's spring."
Scott.

The *Ulmus Montana*, the Mountain, Wych, Broad leaved, or Scotch Elm is undoubtedly a true native of Britain, as it is of most of the Northern temperate parts of Europe. It is very general in Scotland, and is also the native Elm of Ireland, and it is only, says Loudon, "within the present century that it has been much planted in England." It does not send up suckers from the roots but produces an abundance of perfect seeds, and is thus propagated.

The Wych Elm flowers in March long before the leaves appear, and the capsules, which are winged all round like hops, rapidly develope themselves, and produce a very striking effect. It is quite characteristic of the tree, which seeds so plentifully as completely to cover the spray; and thus in spring, the Wych Elms in a wood are seen at a glance.

The Wych Elm grows very rapidly, and when well grown makes a large spreading tree. It loses its central column at no great height from the ground in branches that spread loosely around and which generally assume graceful forms. The colour and markings of the bark, and the tuberous growths to which the tree is liable, greatly increase its picturesque effect. Gilpin rather undervalues this tree, but Sir Thomas Dick Lauder, his Editor, thinks it "one of the most beautiful trees in the British Sylva. The trunk is bold and picturesque in form, covered as it usually is, with large excrescences ; the limbs and branches are so free and graceful in their growth ; and the foliage is so rich without being leafy, or clumpy as a whole, ; and the head is generally so finely massed, and yet so well broken, as to render it one of the noblest of park trees ; and when it grows wildly amid the rocky scenery of its native Scotland, there is no tree that assumes so great or so pleasing a variety of character." (Lauder's edition of Gilpin's "Forest Scenery").

The Wych Elm in rural districts is very frequently pollarded, and when often treated in this way, the head in course of time becomes very large, and assumes a singularly gnarled grotesque appearance. It sends forth branches abundantly wherever cut, like the Hydra of old :

"Though wounds and hatchet cuts conspire,
It scorns them all and mounts the higher."

Some of its seedlings have become so generally known as to require a brief notice here.

The Huntingdon, Chichester, or American Elm (*Ulmus montana vegeta*) for they are all one, is a seedling from the Wych Elm, and perhaps the most widely cultivated of all of them. It grows rapidly, is very ornamental and produces good timber ; qualities which have rendered it a great favourite with nurserymen.

The very ornamental Weeping Elm (*Ulmus m. pendula*) is another very beautiful variety, and has, moreover, a local interest for us. It was raised in 1810 in Smith's Nursery at Worcester, from seeds obtained from a Nottinghamshire tree. Mr. Andrew Knight, of Downton Castle, grew some of the seedlings, and one of them proved to be so beautiful a tree with its pendulous or weeping branches, that it became celebrated as the "Downton Elm," and it is said that all the Weeping Elms of the present day owe their origin to this very tree.

There is another well-known variety, the Smooth leaved elm *(Ulmus m. glabra)*, which when with larger leaves *(Ulmus m. g. major)* is called the Canterbury elm. The Scampston elm (Yorkshire) and others too numerous to mention.

The Wormsley Grange or Byford Elm was probably a variety raised from the Scotch elm seed, by Mr. Knight of Downton. I am unaware of the nature of its peculiarities, or whether any specimens of this tree exist at the present time. Dr. Lindley thought this, and also the Black elm of Ireland, worthy of being considered not as varieties but as separate species.

The Wych elm, and probably the same rule applies more or less to most of its varieties, likes best the light, rich loam of an alluvial soil, which must be well watered and well drained. It *will* grow and adapt itself to many soils and situations, but it really requires a good, light and rich soil, and will not thrive luxuriantly in any other.

Grotesque Wych Elms at Cradley, Herefordshire.
Sketched by Edwin Lees, F.L.S.

The Wych elm and its varieties are not, therefore, suited generally to Herefordshire. Though in some situations, as at Aymestry, in the Cusop dingles, Titley, and other places they grow luxuriantly, scatter their seed freely, and have become naturalised. They are to be found in all directions through the county, but not generally in a thriving condition. They live and grow in a stunted, unkind manner that does not belong to their nature when placed in a congenial soil, and they rarely attain any considerable size. Loudon does not give a single reference to Herefordshire for any remarkable tree of this kind. There are, however, fine specimens at Hampton Court, at Moorcourt, Brinsop, The Mynde Park, Pengethly, Lystone, Titley, The Whitehouse, Croft Castle, Brampton Bryan, and isolately in many other parts of the country; but still there are scarcely any to be found of a size that could be called remarkable.

Weird-like superstitions attach to the Wych elm, or Wych hazel, as it is generally called in connection with them. A spray of Wych hazel, with its fine broad leaves, is at once a potent safeguard against witchcraft and a wand of awful import in the hand of a witch. It was formerly used as a riding-switch, to ensure good luck on the journey. Had Tam O'Shanter but possessed this, he could not possibly have lost his horse's tail! Forked branches of the Wych elm, as of hazel, were used as divining-rods, and formed the *virgula divinitoria* of the experts. Until quite recently, if not to this very day, not a rural churn was made in the midland districts without a small hole being left in it for the insertion of a bit of Wych elm wood, in order to insure the quick coming of the butter.

[*Note.*—In the Mynde wood, at this time, a Wych Elm grows over a haunted well, and has attained a high degree of respect. The belief is that whenever it is cut down the owner of the estate will die. It was first cut down by Mr. Symons' grandfather; he died shortly afterwards. The boughs that grew up from the stool were cut down with the rest of the wood by Mr. Symons' father; he died within a fortnight. And only six or seven years ago, when the underwood near it was cut down, it is a positive fact that the timber dealer who bought the fallage died in a few weeks! Even so, in these enlightened days, the giant Superstition is but scotch'd, not slain!]

The Wych elm was used in ancient times, says Gerard, for making the long bow, and is thus mentioned in several old English statutes. Boys in Northamptonshire choose it now for this purpose, without being aware of such ancient authority.

[*Note.*—The Act 3 Hen: VIII. c. 3 required every Bower "for every Ewe bowe" to make "at the lest 11 bowes of Elme Wiche or other wood of mean price "under penalty of imprisonment. Ascham in his Toxophilus, (p. 113) says "As for Brasell, Elme, Wych, and Ashe, experience doth prove them to be but meane for bowes."]

"The tall abounding elm that grows
In hedgerows up and down,
In field, and forest, copse, and park,
And in the peopled town,
With colonies of noisy rooks
That nestle on its crown."
Hood.

The *Ulmus campestris*, the Common, Small-leaved, or English Elm, which we all know so well—the tree which gives so much of its character to the English landscape—the tree which has so thoroughly established itself here and been so widely planted by Englishmen in other countries as to have gained for itself the name of "English," is the chief object of the present paper, for to this kind belong almost all the remarkable Elms in this county.

There is no record of its introduction into England. It has been known from time immemorial in our plains and valleys, but in mountainous or inaccessable districts—as throughout Wales—it is not a common tree. Old Aubrey, in his "History of Wiltshire," says of it: "I never did see an elme that grew spontaneously in a wood as oakes, ashes, beeches, &c., which consideration made me reflect that they are exotique; but by whom were they brought into this island? Not by the Saxons; for upon inquiry I am informed that there are none in Saxony, nor in Denmarke, nor yet in France, spontaneous; but in Italy they are naturall, *e.g.*, in Lombardie, &c. Wherefore I am induced to believe that they were brought hither out of Italy by the Romans, who were cultivators of their colonies. The Saxons understood not nor cared for such improvements, nor yet had hardly leisure if they would." The Roman officers had luxuriant villas in England, and had time and opportunity to introduce trees, &c., as the Vine, the Box, the Elm, and other plants.

Throughout England, and chiefly in the ancient Mercian counties, there are no less than twenty-four places that have Saxon names taken from the elm. Worcestershire offers some examples, as Elmley Lovett and Elmley Castle, but it is remarkable that there is not a single instance in Herefordshire.

[*Note.*—It is a curious fact that the common English Elm is still called by old people in Herefordshire "The Worcester Elm;" another straw which seems to show that the stream of civilization came from this direction.]

Bromfield, in his "Flora of the Isle of Wight," and some other botanists have pointed out, as a remarkable fact in the natural history of the Elm, the occasional irregularity of its blossoming; some years scarcely a single tree is to be seen in blossom, at others every particle of spray is covered with flowers. The elm flowered early and most exuberantly this year (1868), and from the great heat and drought of the present summer, will probably do so again next year.

Elliot says with reference to it as a sign of spring—

"When the elm blossoms o'er the brooding bird,
And wide and wild the plover's wail is heard."

The budding of the elm tree was noted warily in days gone by, when garden calendars were less plentiful. The old rhymes tell us—

"When the elmen leaf is as big as a farding,
'Tis time to sow kidney-beans in the garding.
When the elmen leaf is as big as a penny,
You must sow kidney-beans if you aim to have any."

And so too the farmer took it as a sign of the season :—

"When the elmen leaf is as big as a mouse's ear,
Then to sow barley, never fear.
When the elmen leaf is as big as an ox's eye,
Then say I, high boys, high!"

The Small-leaved, or English elm, is only able to ripen its seeds in England in unusually favourable seasons. It is propagated therefore by layers, or by grafts, or by suckers, which it throws up very readily from the roots, and hence it is that its individual character has everywhere been so completely maintained. Pliny says that it rarely produced seeds in Italy, and we know from Virgil that it was chiefly propagated there by suckers.

[Pullulat ab radice aliis densissima sylva,
Ut cerasis ulmisque.—Geo. 2.]

Some from the root a rising wood disclose:
Thus elms, and thus the savage cherry grows.

It is a hardy tree, that bears transplanting well at any age or size, and may be pruned at all seasons to any extent. It grows quickly, though not nearly so quickly as the Wych elm. According to Evelyn "it will yield a load of timber in little more than 40 years. It does not, however, cease growing until it is 100 or 150 years old, if planted in a favourable situation, neither too moist nor too dry, and it will live for centuries."

The Elm is one of the first trees to show the influence of spring, and is amongst the last to shed its leaves in winter. Early in March, and often in February, whilst other trees are still in the depth of their winter's sleep, the elm gladdens the eye with the reddish purple tint from the numerous little tufts of blossom buds that adorn every spray. In April and May the leaves begin to appear, and their light and cheerful green colour soon makes an agreeable contrast with the olive tint of the oak foliage. As the summer advances, the leaves gradually deepen in colour until they become of a dark and glossy green, harmonising well with the sombre hue of the Scotch fir, or even the Yew-tree, which are often planted near it, and in autumn they fade away to a fine clear yellow in successive patches, often making the individual trees very beautiful objects in the oblique light of a sun low in the horizon, and always mixing kindly with the orange and red of the beech tree, the duller yellow of the oak, and the many other hues of the fading woods.

The autumn tints of forest trees have been well noticed by Buchanan—

"The woods how beautiful! The oaks yet green,
Blent with the pale ash and willow hoar,
The purpling beech and yellow sycamore,
The blood red rowan and brown birch between,
And mottled elm: no royal robe, I ween,
Not flowery Spring nor rosy Summer wore."

Tragic Dramas and other Poems.

The Elm is never heavy in its foliage like the Horse-chesnut, the Sycamore, or even the Lime tree. "As a picturesque tree," says Gilpin, "the Elm, when without its leaves, has not so distinct a character as either the oak or the ash, . . . but in full foliage its character is more marked. No tree is better adapted to receive grand masses of light. In this respect it is superior to the oak and the ash. Nor is its foliage, shadowing as it is, of the heavy kind. Its leaves are smaller, and this gives it a natural lightness; it commonly hangs loosely, and is in general very picturesque."

Very many varieties have been raised from the seeds of the English Elm· Amongst the best known are the Red English Elm *(Ulmus c. Stricta)*, one of the most valuable timber trees; the Kidbrook Elm *(Ulmus c. virens)*, which is almost evergreen in a mild winter, and as such is a most ornamental tree; it has red bark and a spreading habit; the Cornish Elm *(Ulmus c. Cornubiensis)*, a tall and distinct upright variety; the Cork-barked Elm *(Ulmus c. Suberosa);* the Dutch Cork-barked Elm *(Ulmus c. S. major);* the delicate twigged Birch-like Elm *(Ulmus c. Viminalis);* the Birch-leaved Elm, the White-leaved Elm, the Sharp-leaved Elm, the Elm with variegated leaves, and a very great variety of other Elms, for an account of which, let those who please, look into the subject in Loudon, or any other of the gardening authorities.

Many of these varieties are doubtless growing in Herefordshire, but none have reached the position of trees remarkable for their size, and do not therefore find a place in the list I have now to put before you.

"A goodly Elm of noble girth
That thrice the human span,
While on their variegated course
The constant seasons ran
Through gale, and hail, and fiery bolt,
Had stood erect as man."
Hood.

Loudon, in his catalogue of "Recorded Elms," mentions only three trees in the whole county, "One at Eastnor Castle, 18 years old, is 55 feet in height." "One at Croft Castle is 95 feet high with a diameter of six feet, and of the head 60 feet." With reference to these trees I have no information. Lastly he mentions and gives a figure of—

The *Rotherwas Elm*, which shows it to separate into three large branches at about 12 feet from the ground, and makes it 112 feet in height. The trunk of this fine old tree was completely blown down in 1865, and it now lies a shell upon the ground. In its shrunken and dried form it measures as it lies, 29 feet six inches at five feet from the base, and in its living state must therefore have been considerably larger.

The *Kingsacre Elm* is situated about two miles from Hereford on the turnpike road leading to Hay. It has a girth of 18 feet eight inches at five feet from the ground. At 12 feet from the ground it divides into three stems of

THE REMARKABLE TREES

OF

HEREFORDSHIRE.

THE HOLME LACY ELM.

(Ulmus campestris.)

APRIL, 1869.

This fine old tree is situated in the Park at Holme Lacy (Sir E. F. Scudamore Stanhope, Bart.) It is hollow throughout, and all its large lower limbs, and many others up the tree, are broken off. It keeps its full height nevertheless, and has still many luxuriant boughs. It measures 27ft. in circumference at 5ft. from the ground, where the card of the Club is placed (this in size, is 1ft. by 6in.), and its exact height is 104 feet by Mr. Wells's clinometer.

Ladmore and Son, Photographers to the Woolhope Naturalists' Field Club.

great size, the one on the south side rising to the greatest height. This tree s past its prime and has met with many misfortunes although still very luxuriant. So far back as March 1827 a violent storm of wind one Sunday morning broke off a large limb hanging over the road, which so completely blocked it up that horsemen had to leap into the neighbouring garden or field to get by it.

> [*Note.*—This same storm was felt so severely in Hereford that the service at All Saints' Church was stopped for fear the spire should be blown down, and the rector (Dr. Symons) and all the congregation speedily left it.]

The *Stretton Rectory Elm* is a very fine old tree standing close to the west end of the church in the rectory grounds. It has lost many limbs and is much decayed, but the trunk is entire, and measures at five feet from the 20 feet eight inches in circumference, and its full height, which it still keeps well, is about 102 feet.

The *Wormbridge Elm* (of which an account will be given in another place) measures 17 feet 8 inches in circumference, and is still a very luxuriant tree.

The *Holm Lacey Elm* is situated in the Park at Holm Lacy—on the flat ground, on the eastern side of the house. It is a very fine old tree, which still keeps its original height and luxuriant upper boughs. It is hollow throughout, and all its larger lower limbs and many others up the tree are broken off. It measures 27 feet in circumference at five feet from the ground, and its exact height, as ascertained by Mr. Wells's clinometer, and by its shadow measure, is 104 feet. There are two other fine elms at Holm Lacy. The *Terrace Elm*, with its ivy-covered stem,

> "The female ivy
> Enrings the barky fingers of the Elm."
>
> *Midsummer Night's Dream, Act II., Scene* 1.

near the western gate into the park, has a circumference of 15 feet; and another Elm in the park near this one, with a hollow stem and battered branches, measures 16 feet 6 inches in circumference, and is 97 feet high.

The *Much Marcle Elm* grows near Hom House, in the field above the kitchen garden. The girth at 5 feet from the ground is 18 feet 10 inches. It is a vigorous tree, showing no sign of decay, with a clean bole and one main stem. The height, roughly calculated by shadow measure, is 90 feet. It stands well, and forms a landmark for the neighbourhood. (Dr. J. H. Wood).

The *Prophet* at Credenhill Court is worthy of note from its name. Whenever a death is about to take place in the family, it is said to be foretold by the breaking off of a large bough, and the most convincing (?) instances are given of its correctness. It is a fine tree, and grows in the garden on the western side of the house. It presents a fine, tall, straight bole, which measures 14 feet 11 inches, and which rises some 40 feet before giving off any branch of importance, and is said to contain 365 cubic feet of timber.

The *Ridgemoor Elm*, near Leominster, is a very fine tree, and in full luxuriance. It measures 19 feet 5 inches in girth at 5 feet from the ground, and is very much larger at the base. At about 20 feet from the ground it divides into two branches, one of which quickly separates, and the other shoots up to a considerable height before doing so. It has met with several casualties from the storms it has encountered, in the loss of some of its tertiary branches, but it is still a healthy tree, and rises to the height of about 100 feet. A court leet was formerly held under this tree.

[*Note.*—There is a curious covered walk of elms in Leominster churchyard. They are cut so as to form an arched roof over the broad walks which lead to the south doorway, and along the west side of the churchyard. The trees were planted about 70 years ago by Mr. Francis Woodhouse.]

The *Westhide Elm* is a very picturesque tree, of remarkable size. It is a hollow tree, but still about 80 feet high, and owing to the excrescences on the trunk, measures no less than 34ft. 3in. in girth, at 5 feet from the ground.

The *Castle Green Elms* at Hereford are said to have been "transplanted from the Parsonage garden at Weobley, and presented to the committee who superintended the original construction and arrangement of the present walks, in the reign of George II., by the Rev. Morgan Evans, vicar of the parish."

The authority upon which this is stated is not given, but to judge from the trees themselves, it must have been in the earliest years of his reign—perchance on his accession in 1727. Allowing five years for the age of the young trees when planted, they would be now 146 years old. There are still twenty-one trees left, and beginning at the corner near the Infirmary, they measure at 5 feet from the ground, 12.6 ; 12.7 ; 13.2 ; 12.6 ; 11.11 ; 12.7 ; 13.10 ; 10.9 ; 12.6 ; 13.5 ; 12.4 ; 11.8 ; 10.2 ; 10.9 ; 12.7 ; 11.8 ; 10.4 ; 10.6 ; 12.3 ; the corner tree, and on to the two near the keeper's house, which measure 12.2 and 12.11 respectively, making an average of 12 feet circumference. The trees are beginning to show signs of rapid decay, and scarcely a violent storm occurs but that a branch from one or other of them is broken off.

The Cathedral Close Elms, Hereford, are smaller trees, but from their general condition and appearance would seem to have been planted about the same time. There are ten old trees, and beginning at the corner near St. John's-street they measure 8.3 ; 9.8 ; 9.7 ; 10.4 ; 8.8. ; 9.11 ; 9.8 ; 9.5 ; 9.11 ; and 9.9 respectively.

The Ross Churchyard Elms were formerly much more numerous than they are now. They are believed to have been planted by Kyrle—some say on the restoration of the monarchy of Charles II.—but it is generally believed that they were not planted until about the year 1700, that is 24 years before Kyrle's death. An archway erected in the prospect bears that date. There are now only twelve trees left, and beginning opposite the rectory and going regularly round they measure, in feet and inches, at 5 feet from the ground as follows :— 14.1 : 12.1; 11.8½ ; 12.3; 13.8 ; 12 ; 14.10 ; 14.10 ; 14.8 ; 12.11 ; 12 ; 12.7 and 9.7 respectively, giving an average of 12 feet 8 inches. These trees are now decaying fast and have lost many branches. A large branch fell the other day from the weight of leaves being too much for the rotten limbs to carry.—(Mr. Henry Southall).

[*Note.*—Two young elm trees have sprung up within the church and have been allowed to remain there. They are suckers from the roots of the trees on that side of the churchyard, cut down many years since. They are said, by the man who shows the church, to grow in the pew in which the "Man of Ross" was accustomed to sit, and thus do reverence to his memory.

Kyrle also originated the causeway from the south side of the bridge to the town of Ross, and "with his own hands planted shady rows of elms on each side." These elms no longer exist, having probably had to give way to the improvements effected there.]

The Hill Court Elms, about two miles from Ross, form a very noble avenue of trees, the finest in the county. Captain Manly Power has very kindly taken the following measurements of them at this time for me "at five feet from the ground :—15.6 ; 14.2 ; 15.2 ; 14.8; 12.2; 13.7 ; 13 ; 15.7 ; 15 ; 14.8 ; and 14.10 respectively. The remainder of the trees would average about 12 feet in girth. The trees are in full vigour but getting past their prime and many have lost some large lower limbs. The largest trees grow on the higher ground in a light sandy loam, and they decrease in size as they get towards the bottom of the avenue where the soil is rather stronger and not so near the lime-stone, and there the oak and the thorn grow better. It is believed that they were planted about the year 1700."

These measurements will serve to give a good general idea of the size to which the common English Elm will grow in Herefordshire. Many other elms of great size and beauty exist in the county, and the regret that their measurements have not been obtained would be the greater if there was not so good a chance of their being carefully recorded in the reports of the Commissioners of the Club.

Noble trees are to be found at Kentchurch, Sufton, Longworth, Ledbury, Stoke Edith, Moorcourt, Croft Castle, Brampton Bryan, and throughout the valleys of the Wye, the Lug, the Arrow, and the Teme.

[*Note.*—On the accession of Charles II. the joy of the people took the fancy for Elm tree planting to commemorate the restoration of the monarchy. The Elms in the broad walk at Christchurch are said to have been then planted ; and some of the Elms in the long walk at Windsor—trees very similar in condition and size—are said to have been planted by King Charles himself.]

"Beneath those rugged Elms."
Gray's Elegy.

The English Elm is not so fastidious and delicate as the Wych Elm. It will thrive and grow well on very varied and inferior soils, light or heavy, and frequently attains its largest size on strong clay loam, much too stiff and adhesive for the *Ulmus montana.* The size of the trees now recorded proves that it will grow to its full size in Herefordshire, but at the same time it must be stated that on our strong land it quickly decays at the heart, and it is rare that a tree of any size is felled without its being found more or less hollow. Here, therefore, it gives way to the oak, and is only grown as a timber tree on lighter soils. The English Elm in ordinary Herefordshire soil will grow more rapidly than that most vigorous growing of all the varieties of the Wych Elm—the Chichester Elm,—a tree that in suitable soil will often make shoots of from six to ten feet long in a single year. The actual experiment has been made. Planted side by side, the English Elm grows most quickly, and general observation here seems to confirm it. I wish to lay stress upon this point, because it seems to explain the complaint that has met me from several quarters, that the English Elms you buy now are "such poor elms that they wont grow well, and no dependance is to be placed upon them." The fact is, the English Elms are now sent out grafted on the Mountain or Wych Elm; they make wood much more rapidly, and have not the disadvantage of sending up suckers from the roots. "I think I may say, sir, that 'grafted English' is universal in the trade," was the result of my inquiries of a nurseryman. So long as the tree is planted in the rich loamy soil, so prevalent in nurseries, the advantage is undeniable—a larger tree is grown in a shorter time and equally good—but remove it to the ordinary stiff clay loam of the county, and the roots of the Wych Elm rebel, the tree may grow but will not thrive. The conclusion is evident. If you wish to plant English Elms in common soil, you must get them on their own hardy root stocks; and to do this you must make a home nursery and grow them from suckers yourself.

The value of Elm timber has become much depreciated of late years. The cheap introduction of foreign timber; the manufacture of improved pipes; the extensive use of cast iron and galvanised iron, for all the under-ground and under-water purposes for which Elm was especially adapted, have rendered it much less in request than formerly. It is not, therefore, likely to be planted as an article of commerce where a better kind of timber will grow.

Elm leaves were formerly dried in the sun and kept for feeding animals. "In some parts of Herefordshire," says Evelyn, in his "Sylva," "they gather them in sacks for their swine and other cattel. . . . . When bay and fodder is scarce. They will eat them before oates, and thrive exceeding well with them; remember only to lay your boughs up in some dry and sweet corner of your barn." In dry seasons on the Continent this practice is not unfrequently adopted. The leaves are said to contain a mucilage which is very abundant and nutritious, and the animals feed quickly upon them.

THE REMARKABLE TREES

OF

HEREFORDSHIRE.

THE TREVIL ELM. TRELOUGH.

APRIL, 1869.

This fine picturesque old tree, sometimes called The Wormbridge Elm, is situated by the high road on the green at Trelough. At five feet from the ground, where the card of the Club is placed (in size 1ft. by 6in.) it measures 17ft. 8in. in girth. It is 86 feet high, and has an east and west diametric spread of foliage of 31 yards.

Ladmore and Son, Photographers to the Woolhope Naturalists' Field Club.

["Fœcundæ frondibus Ulmi."—*Virgil.*]
Fertile in leaves, the Elm.

"But thou, O Pteleas (the Elm), to the swain allows
Shades to his cattle, timber for his ploughs."
Cowleigh.

The notices of the Elm in the classical writers are very numerous. It is celebrated in the Iliad for having formed the bridge by which Achilles escaped the Xanthus when that river, by overflowing its banks, endangered his life.

Virgil says the husbandmen bent the young elm whilst growing into the proper shape for the "buris" or plough tail:—

["Continuo in Silvis magna vi flexa domatur
In burim et curvi formam accipit ulmus aratri."
Geo. I. 169.]

Young Elms with early force in copses bow,
Fit for the figure of the crooked plough.—*Dryden.*

The Romans used the elm as a support for the vine.

["Ulmisque adjungere vites."]
The lofty elm with creeping vines o'erspread.

Its straightness of growth, the abundance of its small branches, and above all the perfect freedom with which it may be pruned at all times, rendered it at once a natural support, as beautiful and elegant as it was economical and effective. In the south of Italy it is still so employed, as is also the Lombardy poplar. Columella informs us that elm-tree vineyards were called *arbusta*, the vines themselves being called *arbustivæ vites* to distinguish them from others grown in more confined situations. Virgil takes it for granted that the Vines will be trained over Elms :

"Inde ubi jam validis amplexæ stirpibus ulmos
Exierint, tum stringe comas," &c.
Geo. 2, 367.

"But when the rooted vines with steady hold
Can clasp their Elms, then, husbandman be bold !"—*Dryden.*

And in other passages also. Once in two years the elms were carefully pruned, to prevent their leaves from overshadowing the grapes, and this operation was deemed of great importance. Corydon is reproached by Virgil for the double neglect of suffering both his elms and vines to remain unpruned.

["Semiputata tibi frondosa vites in ulmo est."]
"Your vine half pruned upon the leafy elm."

This union formed a fruitful subject of allusion to their authors and poets. Ovid delights in it, and uses it with much elegance in the speech of Vertumnus to Pomona, when recommending matrimony to her :

["At si staret, ait, cœlebs sine palmite truncus,
Nil præter frondes, quare peteretur, haberet.
Hæc quoque, quæ juncta vitis requiescit in ulmo,
Si non nupta foret, terræ acclinata jaceret.
Ovid, Metam., Lib. XIV.]

"If that fair elm, he cried, alone should stand,
No grapes with gold would glow and tempt the hand:
Or if that vine without her elm should glow,
'Twould creep a poor neglected shrub below."
Dryden.

[*Note.*—The same custom is alluded to by Milton in narrating the occupation of Adam and Eve in Paradise:

"They led the vine
To wed the elm; she, spoused, about him twines
Her marriageable arms; and with her brings
Her dower, the adopted clusters, to adorn
His barren leaves."

And Shakspere, in the "Comedy of Errors," where Adriana is repulsed by Antipholus her husband, as she believes, makes her say with sweet entreaty to him:

"Come I will fasten on this sleeve of thine:
Thou art an elm, my husband, I a vine,
Whose weakness married to my stronger state
Makes me with thy strength to communicate.
If aught possess thee from me, it is dross;
Usurping ivy, briar, or idle moss,
Who all for want of pruning with intrusion
Infect thy sap and live on thy confusion."—*Act* 2, *Sc.* 2.

It was a case of mistaken identity—the lawyers par excellence !—her husband's twin brother.]

Spencer, in his "Faerie Queen," speaks of

"The Vine-propp Elme."

Wordsworth, in his "Pillar of Trajan," again revives its use:

"So, pleased with purple clusters to entwine
Some lofty elm tree, mounts the daring vine."

And so too does Rogers in his poem on Italy (on Naples):

"Here the vines
Wed each her Elm, and o'er the golden grain
Hang their luxuriant clusters, chequering
The sunshine."

And numerous other poetical allusions, ancient and modern, to the same custom might be given. The real practical application is shewn by Pliny, who says—"That elm is a poor spouse that does not support three vines."

The Greeks and Romans considered all trees that did not produce food fit for human use as funereal trees. Homer alludes to this in making Achilles raise a monument to the father of Andromache in the midst of a grove of elms.

. . . "*περὶ δὲ πτελέας ἐφύτευσαν
νύμφαι ὀρεστιάδες, κοῦραι Διὸς αἰγιόχοιο.*"
Iliad—Lib. vi., 419 420.

"Jove's sylvan daughters bade their elms bestow
A barren shade, and in his honour grow."
Pope.

And whether from this classic origin of the idea, from the shade they produce, from the open space afforded, or from the homely domestic feeling with regard to the tree, the Elm has ever been frequently planted in churchyards.

Mrs. Hemans, on a Sunday morning in Spring, says:

"How many blessed groups this hour are bending
Through England's primrose meadow-paths their way,
Tow'rd spire and tower midst shadowy Elms ascending,
Whence the sweet chimes proclaim the hallow'd day."

Was it this association, or was it rather some morbid fancy of the hour, that made Hood write his melancholy poem on the Elm?—

"'Twas in a shady avenue,
Where lofty elms abound,
And from a tree there came to me
A sad and solemn sound,
That sometimes murmur'd overhead
And sometimes underground.

Amongst the leaves it seemed to sigh,
Amid the boughs to moan,
It muttered in the stem, and then
The roots took up the tone;
As if beneath the dewy grass
The dead began to moan."

And so it goes on with the repetition of the melancholy refrain again and again, to keep up the feeling of mysterious gloom. It is false, however, to the tree, and simply reflects the sadness of the author's mind.

Wordsworth is much more true to nature in his "Churchyard amongst the Mountains," where he calls it—

"The JOYFUL ELM
Around whose trunk the maidens dance in May."

The Elm a melancholy tree! the very rooks that love to build their cities in its topmost boughs forbid it by the active bustle of their lives. There is indeed nothing gloomy about the Elm. It is associated with all our life-long summer pleasures; we play under it in our earliest years; we swing upon it, we climb it as boys; in love and in friendship we revel in its shade; and as age advances on us we rest and meditate at leisure, enjoying the cool protection it affords from the hottest summer's sun. The Elms of home hang on the memory when away, and in the outline of their tall forms we first recognise from afar the reality of our return; the village Elm is the pleasant lounge of the inhabitants; on its trunk public notices are fixed; beneath its shade all the news of the neighbourhood is talked over; and there, too, stood in the days that most of us can yet remember, the parish stocks, to give the depth of tragical interest to the brighter tints of its usual characteristic features.

[*Note.*—The space so commonly to be found

"Amid the gloom,
Spread by a brotherhood of lofty Elms,"

near the churches and in other public places on the Continent, is so thoroughly recognised as the general gossip shop, as to give rise to the old ironical proverb for a private assignation

"Attendez-moi sous l'Orme."

The spirit of which will be best shewn perhaps in English, by the vulgar saying, "Don't you wish you may get it."]

"Ται δε παρ αυτάν
Αιγειροι πτελεαι τε εὔσκιον αλσος εφαινον."

And there beside
Poplars and Elms their grateful shade threw wide.

Theocritus—Idyll 7, 8.

For our parks and for our pleasure grounds the value of the Elm as an ornamental tree wants no recommendation, but its advantages to give beauty to our towns and cities seems not to be so fully appreciated in England as it should be. The Elm is peculiarly adapted for this purpose, and as a tree for close contiguity with houses it has no rival. It bears well the smoke of towns, and whilst it throws a constant shade below, its boughs hang loosely, and it leaves broad open spaces from side to side to let in light and air ; and, moreover, where these are not found sufficient for the houses near, whole branches may be removed without injury to the tree, and if carefully done, without marring its beauty. On the Continent its virtues are fully appreciated, and whenever they get space sufficient, they plant Elm trees in preference even to their great favourite, the Lime tree ; and in such places, happily, they leave them liberty of growth.

In Herefordshire, the great progress of recent years has set ornament aside. An utilitarian spirit has prevailed, and everything has given way to commerce ; our towns are becoming simply lines of houses in brickwork, in Bath stone, or in stucco ; without the quaint gables, and windows of mediæval times, to give them interest, or without the fresh foliage of trees to relieve the monotony and glare of the streets.

Few cities have improved more rapidly than Hereford during the last ten years : its streets have been enlarged, its pavements widened, old obstructions have been removed, new houses have been built, new shops opened, and plate-glass has become general, not to mention those great unseen improvements, more important still—complete drainage and water supply. If its commerce has increased, if its inhabitants have grown more numerous, the foresight and wisdom of its rulers have more than kept pace with the advance. The public spirit they have shown, the great expenditure they have incurred, will redound more and more to their credit as years roll on. And yet, what is the general effect on the appearance of the city itself? What might an art critic say of it? "Yes, gentlemen, you have no doubt very much improved your city for all commercial purposes ; but you have swept away its picturesque features ; you have carried off its old market-house, knocked down its projecting porticos, cropped off its pretty gables, plaistered over its old timber houses, until nothing is left of interest except such objects as you may see in the shop windows." And there is a germ of truth in this, since the want of green foliage to relieve the monotony has not yet been supplied. The trees our ancestors planted are all that we have, and they are so rapidly decaying that nearly every storm brings down a bough. An Elm at the end of the Old House in the High-town, in front of the Kerry Arms, or in St. Peter's-square, would be an abiding pleasure; and on the Continent certainly trees would be planted down Commercial-road. If, however, it should be thought that space fails in the city itself, trees could certainly be planted on the new ground of the Castle-green, here and there in the Cathedral-close, and readily in the approaches to the city of Aylstone-hill, the Above-Eign, and Widemarsh.

Hereford does not stand alone; our other towns are the same. Why should the Grange at Leominster be the ugly place it is, when the simple planting of Elm trees around would, in a few years, make it the glory of the town? Had the Man of Ross been alive when the new ground was added to the churchyard there, would he not have planted young Elms, to be the pride and ornament in after ages that his own trees are now?

> "Our fathers knew the value of a screen
> From sultry suns, and, in their shady walks
> And long-protracted bowers, enjoyed at noon
> The gloom and coolness of declining day."—*Cowper.*

John Lloyd, Esq., in thanking Dr. Bull for his eloquent paper, begged to propose a resolution :

"That the Central Committee of the Club be empowered to take such active steps as may be deemed advisable, to encourage the planting of young trees of the common English Elm, in our towns, and public pleasure grounds."

This was at once seconded by the Rev. James Davies, of Moorcourt, and was carried unanimously.

The President had brought with him some fine specimens of a beautiful caterpillar, the *Lophocampa Caryæ*, so named from the plants it feeds upon belonging to the genus *Carya*, or the Hickory tree. These pretty creatures, covered with grey tufts of hair, were feeding on leaves of the common walnut, *Juglans regia*, the only representative in this hemisphere of the natural family of the Hickories. The *Lophocampa caryæ* is a native of the Northern States of America. The larvæ shewn were hatched on June 5th from eggs laid by a moth brought from America in the pupa state, under the care of Dr. Chapman, of Abergavenny. They had just entered their last skins. The larger and more handsomely tufted larvæ will probably produce female moths, for amongst insects the female sex is usually the larger and stronger.

The Rev. Arthur Gray, of Orcop, sent a fine specimen of the Greater Broom rape, *Orobanche major*, 21 inches long, in seed. This singular plant, which grows as a parasite on the roots of the broom, clover, and some other plants, has been unusually common this year. The Rev. George H. Cornewall has said how very plentifully he has found it growing in large patches on the roots of clover.

C. G. Martin, Esq., also brought two specimens of the *Hieracium aurantiacum*, the Orange Hawkweed, which, with *H. pilosella*, are the only Hawkweeds that send out scions from theroot. These plants, though gathered growing and wildly self-sown, were from so suspicious a situation, as to be clearly "garden wanderers."

The whistle now sounded, and a general move was made for the dingle, where already many of the party were busy digging up roots of the oak and beech fern which grew there in great abundance and luxuriance. A sharp descent by a path but little prepared for such visitors as threaded its wanderings to-day, led into the fine amphitheatre in front of the fall. The River Llech here falls a clear hundred feet, and must be a magnificent sight when the river is full from the autumn rains; now the small stream that fell over into the pool below was dashed into spray, and although the prismatic colours—the rainbow of the fall—were exceedingly pretty, it could not make up for the absence of life and spirit, of activity and force, of rush and roar, which are the true characteristics of such grandeur in material. There is ample space behind the water for visitors to pass and many ladies did so, and there, had a capital opportunity of observing in perfection the beautiful fringe moss, *Mnium punctatum*, the Green spleenwort, *Asplenium vivide*, and also other mosses with the usual abundance of liver-green, *Marchantia Polymorpha*, and other moisture-loving specimens of vegetation.

A more promising place for a charming picturesque ramble in search of plants than this lovely dingle can scarcely be imagined. The river itself affords a series of cateracts and whirlpools; that is to say, it would do so in action, but on the present occasion it was a succession of clear transparent pools with overhanging rocks, and a little invisible current of water running beneath the stones to connect them. Its bed could be better seen and examined now perhaps than at any time. Geologists could knock out the large Calamites and other fossils from its shales with an ease and comfort not often to be found. It must seldom happen too, that the Water ouzels can be so readily disturbed in their most secret haunts, as they were on this occasion. Time, however, admitted not of any accurate research, the whistle sounding loudly three times at the foot of the fall, when

The Rev. W. S. Symonds made some very interesting remarks on this beautiful "Valley of erosion," which he explained as the result of natural causes —the effect of those powerful torrents produced by the sudden thaw of snow and ice under a hot summer's sun, and he pointed out the varying character of the debris, the large fragments of Mountain Limestone, of Millstone Grit, and of Old Red Sandstone, all lying mixed up together on the lower Shales of the bed of the river below the Fall—as an example of mixed rocks brought within the waters influence, in great part by the great weight-bearing powers of ice, and concluded with some general observations on the powers of denudation now in operation around us.

The time had now expired, the whistle began to blow continuously and frantically, and all made their way quickly to the upper regions. Here the kind people who sacrificed themselves so unselfishly for the general benefit, had got all the valuables re-transmitted to their hampers, and leaving the ground strewed with the bottles whose spirits of sparkling Moselle, of sparkling Burgundy, or of Seltzer had departed, hands were readily given to the baskets, and all marched off for the train. It stopped specially near the Fall to take the company up again. The engine whistle shrieked loudly for some minutes and with wonderful effect, for there was little delay, and yet, so far as is known, none were left behind—though a hat or two and a coat could not be found.

The railway carriages thoroughly heated by the sun made the short run to Brecon, the most trying part of the day, but it soon passed, and the visitors were left in pleasurable contentment at the successive stations where they had been taken up.

Edward Stone, Esq., of Chambers Court, Worcestershire, an active member of the Malvern Naturalists' Club, was very desirous of expressing his great sense of the admirable arrangements for the day. They were certainly due for the kind co-operation of the several railway authorities over whose lines the club passed; and particularly must they here be expressed to Wm. Banks, Esq., of Pont-y-wal Hall, the Chairman of the Brecon and Neath Company, and the active manager, Mr. Morley, for the train they had put on specially for the convenience of the club, and also for the kind personal superintendance they both of them gave to ensure the comfort of the members and their visitors.

The Woolhope Naturalists' Field Club.

MEETING AT LUDLOW FOR THE TITTERSTONE CLEE HILL AND OAKLEY PARK.

JULY 28TH, 1868.

A friendly meeting of the Caradoc and Woolhope Naturalist Field Clubs took place at Ludlow on Tuesday last. The weather was very favourable, and it is scarcely necessary to say more than this, to show that it was well attended, and that a most enjoyable day was spent. Ludlow offers such a combination of attractions, and receives its visitors so well and so spiritedly, that his mind would be poor indeed that did not have it greatly enriched, and carry off, moreover, the happiest recollections. Geology was the main object of the present gathering, and to the student of geology Ludlow is especially interesting. It is the best starting point for a district to be carefully studied by the physical geologist. Here the highest beds of the Silurian system are best developed; here is that remarkable bone bed so instructive and valuable with relation to the beginning of vertebrate life; it is within easy reach of the celebrated Churchhill Quarry, where the earliest fish was found; and it has a Museum excellently arranged, and of the highest interest. This Museum contains the best collection in England of the Lower Ludlow star-fishes, some of them unique specimens. A valuable collection of birds has been recently added to it, and it is indeed highly creditable to the town, great as its opportunities certainly are. On the present occasion the Museum was thrown open for its visitors, and R. Lightbody, Esq., to whom belongs many of the most valuable specimens, very kindly attended himself to point them out, and give every explanation that might be required.

The Woolhope Club was the first to arrive, and spent an hour at the Museum with much profit and pleasure; that is to say the science of the Club was there, for, sooth to say, there were many to whom its beautiful Church, and the extensive ruins of its interestling old Castle, proved higher attractions still. We will trust that the town was new to them, and a better excuse could not possibly be found, for the satisfaction with which they set off to visit them. At the Church, which was admirably restored about eight years ago, their attention was particularly directed to the old wood carving on the stalls in the chancel, the old glass still preserved in some of the windows, and the fine carving of the screen dividing the chapel of St. John from the church. On reaching the Castle a delay was occasioned by—may we call him the seneschal?—not being at his post. Loud were the appeals to the long and awkward knocker of the gate, frequent were the calls, and many the glances at the watches, when, to the delight of the visitors, at last the porter with his large keys appeared. But only a hasty visit to the interior could be allowed. The round chapel, with its Norman arches in such perfect preservation, was visited, the courts were hastily passed through, the apparatus where on occasions of great public rejoicing, the ox is roasted whole, with the horns of the victims suspended above it was noticed, and then the principal tower was ascended—but alas! as ever, time was inexorable, and not even the lovely view on this most lovely day might detain the delighted beholders. The Clee Hill was before them—that was the object of the day's excursion, and ruin and river, pasture and pleasaunce, must detain them no longer. They had to retrace their steps to the "Feathers," where all the assemblage was to meet the carriages at half-past eleven o'clock. A goodly number of gentlemen, and many ladies were soon collected, and they rapidly increased by the arrival of the members of the Caradoc Club and their visitors. "But where was the leader for the day? where was Mr. La Touche?" was asked. "He will be here presently; he is guarding a model that two men are carrying up from the station," was the answer. Of this we shall have more to say presently. The distribution of carriage tickets is now going on rapidly, and as break and omnibus, dog-cart and carriage arrive at the door they are loaded and sent off to Clee Hill. They were heavily laden, and whilst this necessary delay takes place, it will be best to give a list of those present.

The Woolhope Club was represented by its President, Dr. M'Cullough; George Bentham, Esq., President of the Linnean Society; and J. W. Salter, Esq., F.G.S., honorary members; T. Curley, Esq., F.G.S., John Lloyd, Esq., and Dr. Bull, of the Central Committee; Miss Read, ; Richard Hereford, Esq., Sufton Court; Capt. Hereford, Capt. R. G. Hereford, the Rev. R. Hereford, and Mr. George Hereford; R. Lightbody, Esq., F.G.S., C. Lightbody, Esq., and Mr. Lightbody, Ludlow; the Rev. J. F. Crouch, Pembridge; the Rev. R. Dixon, M.A., F.G.S., Nottingham; Humphry Salwey, Esq., Mrs. Salwey, Mr., Miss, and Miss Annie Salwey, Ludlow; the Rev. Wm. Stanhope, Holm Lacey; George

Cocking, Esq., Ludlow; the Rev. W. C. Fowle, Brinsop; Wm. Haggard, Esq., and Mr. Andrew Haggard; the Rev. F. J. Eld, M.A., and Erling Clark, Esq., Worcester; the Rev. E. Du Buisson, Breinton; Miss Hodgson and Miss Lewis, Ludlow; the Rev. R. H. Williams, Byford; T. Weyman, Esq., and Mrs. Weyman; H. Weyman, Esq., and Miss Weyman, Ludlow; the Rev. P. Hammond, the Rev. C. J. Robinson, Norton Cannon; C. G. Martin, Esq., Hereford; Capt. Williams, Talgarth; Jno. Lambe, Esq.; J. T. Owen Fowler, Esq., and Mrs. Fowler, Hereford; J. H. Wood, Esq., Tarrington; E. Cowtan, Esq., Hereford; Mr. John Pitt, Freetown; Mr. John Lloyd, Kington; Mr. Andrews, Bosbury; and Mr. B. M. Watkins, Hentland.

The members of the Caradoc Club and their friends present were: The Rev. J. Brooke, Shiffnal, vice-President, and Mrs. Brooke; the Rev. J. D. La Touche, Stokesay Rectory, and three sons; the Rev. William Houghton, M.A., F.L.S.; the Rev. W. A. Leighton; the Rev. T. L. Gleadowe, and the Misses Gleadowe (two); S. Downward, Esq., Mrs. Downward, and Miss Turner and friend, Meole Brace, Shrewsbury; the Rev. Lionel Corbett; E. Calvert, Esq., and the Misses Calvert (three); Mr. and Miss Blunt; the Rev. G. T. Hall; W. S. Buddicom, Esq., Mrs. Buddicom, Miss Hornby, and Miss Purton, Ticklerton Hall, Church Stretton; the Rev. J. Chapman; J. C. Scott, Esq., Manor House, Rattlershope; Folliott Sandford, Esq., and Mrs. Folliott Sandford, Shrewsbury; the Rev. Holland Sandford, Eaton Rectory; B. Matthews, Esq., Ludlow; the Rev. R. Hopton, and Mr. Burns, Stokesay.

The roads were happily excellent—too good to escape special notice;—hard, smooth, and level, they were roads in perfection, and the absence of dust gave pleasant proof of their power to bear traffic with the smallest amount of destruction. They are formed of the igneous rock of the Titterstone Clee Hill about to be visited. The Basalt, a trap rock, commonly called "Jew, or Dew Stone," possibly (as its colour implies) from the word "dhu," black, "the black stone." Mineralogically speaking, it is composed of augite, felspar, and iron oxide. Its special peculiarity is the hardness and fineness of its grain and the great proportion of iron oxide that it contains in comparison with other igneous rocks. This rock is said to contain 20 per cent. of iron oxide. It is seldom found associated with palœosoic rocks of a late period. It makes here admirable road metal, and is now being distributed far and wide for this purpose, notwithstanding its great weight. The city of Hereford has lately become familiar with its appearance, and its use on our county roads is becoming more and more general, as its indestructable qualities become more recognised.

The ride of 5 miles, with beautiful views, ever changing in character, and varied delightfully by cloud shadows, was very enjoyable. The Titterstone Clee Hill was ever a-head, its summit rising to the height of 1730 feet above the sea-level, and a massive round-backed hill to the left, the Brown Clee hill, which seemed lower from its greater distance off, is nevertheless higher still, and reaches 1806 feet. The rain the week before had freshened all vegetation, and fields beautifully green once more gladdened the sight. Passing the young Turkish oaks with their pretty foliage—rejoicing in this splendid summer as they seemed to do—the fine upright English oaks, so valuable for timber—the tall Elms of Henley Hall were reached. Here crossing the Lutwyche—noted for its fishing—the ascent began, and soon called for the extra assistance of a couple of horses to draw up the carriages as they successively arrived. The mining district was soon reached with its basalt-built cottages becoming more and more numerous as the brow of the hill was gained. Here the visitors left the carriages and seemed by instinct to make for that noted land-mark, "the fork-ed stick." It was not the right way however. Mr. Cocking and the leaders bore to the left over a rough common, dry and arid as the fashion of the year is, and took the direct road to the summit across those mysterious lines of stone which puzzle antiquaries to explain. The ascent would have been remarkably easy if the turf had not been so dry and slippery, nor was it long, for in about a mile and a half the lecture point, above the Giant's Chair, was reached. The wind by this time had freshened to a point that rendered elastic fastenings for hats highly valuable. Taking the sheltered side of the summit, lying and seated in a close group, whose picturesque effect was heightened, here by a young lady on a white pony, and there by a docile chestnut standing amongst the rocks on the steep hill side, as quietly as if he too was deeply interested in the excellent "Address on the Geology of the District," which was here given by the Rev. J. D. La Touche, with a clear, distinct enunciation which enabled every one to hear it plainly.

GEOLOGICAL ADDRESS ON THE TOP OF THE TITTERSTONE CLEE HILL.

BY THE REV. J. D. LA TOUCHE.

Ladies and Gentlemen,—If, starting from the base of the hill on which we stand, we were to traverse a straight line in a N.W. direction, and, as we advanced along this line, were to observe the inclination of the rocks wherever exposed to view, we should find that, as a general rule, they all fall away or dip to the S.E., until we arrive at the Longmynd, that dark range of hills which nearly bounds our view from this point; but on arriving there, any observant person would be much struck by the fact that the dip of the rocks would be exactly reversed—that they are inclined to the N.W., and at a very much higher angle than before. The conclusion to be drawn from this fact is inevitable, viz., that that high ground which stretches for a distance of some 20 miles in a N.E. and S.W. direction is the centre of a vast upheaval of the strata which had previously been deposited horizontally.

It is evident that for the most part these rocks which are now so much tossed about in so many directions and at so many angles, were once lying level at the bottom of the sea, and that their present position is due to the disturbing forces which have acted upon them from beneath. Here, then, before us is a grand instance of this disturbing force. The Longmynds are the axis of this elevation, which has thrown off on both sides the more recent rocks which have been inclined at angle corresponding to the application of the force which has disturbed them. Just peering over the tops of the Longmynds, and apparently resting on them, we see a few projections. These projections really are part of a ridge lying behind that range, and separated from it by some miles. They are called the Stiperstones, and are gigantic masses of quartzose grit, which stand out on the summit of the hill, the rest of the stratum having been washed away or denuded. This Stiperstone range is by Sir R. Murchison supposed to be the same as the Lingula flags of Wales, but Mr. Salter tells me that the evidence that it is so is slight, and that in his opinion they have more appearance of belonging to the Arenig rocks of Wales, which, as here, lie at the base of the Llandeilo. This latter series occupies the fine undulating country about Shelve and Corndon, and is in some parts highly fossiliferous. The thickness of these several strata is very great. Starting from Church Stretton, where, as I have said, the break occurs on this side, and travelling westward, we pass across the edges of what might be likened to the leaves of an enormous volume, of some 8 or 10 miles in thickness. The Longmynds alone measure, according to Ramsay, 26,000 feet, which estimate, however, Mr. Salter thinks may be reduced by the doubling over of some strata, whereby they would be counted twice over. However, even if we take the smallest estimate of 10,000 feet, no one can examine the structure of these rocks, which shows that they were for the most part deposited on a succession of level sea beaches, exhibiting thin cracks, ripple marks, and the traces of worms which crawled over their surface when they were laid bare by the receeding tide, without being impressed by the immensity of time required to form them. Such evidences meeting the geologist wherever he turns—evidences as certain at least as any upon which he can rely upon all ordinary subjects of knowledge—convince him that cycles of time may be assigned to the production of these strata as liberally as space is assigned to contain the countless worlds which we witness on a starry night.

This part of the country is not devoid of evidences of the violent action which even in the present day produces sudden changes in the crust of the earth. In the Corndon and in several masses of igneous rock in the neighbourhood are to be found traces of the forces which have elevated tho Longmynds and the surrounding country; besides the course grit and felspathic ash which are often found there interstratified with clay shale, are memorials of great submarine volcanoes which time after time cast up cones of lava and ashes from the bed of the sea, these were then dispersed in every direction till the cone was levelled and disappeared beneath the waves, and the whole was then overlayed with a stratum of clay. Upon the nearer side of the Longmynd the strata is sufficiently regular, but it is not so easy to determine their exact relation to the rocks on the other side. This is caused by a vast fault of some 2,000 feet along the Stretton Valley which has cut off the upper strata from the lower as seen on the western side of the ridge. There seems reason to believe that the Caradoc is only the upper member of a long and regular series of which the lowest is the Arenig—but however that may be the Caradoc strata on this side of the range are deposited on the edges of the Cambrian rocks, while on the other, the Stiperstone flags and Llandeilo are conformable to them.

Before leaving the neighbourhood of these hills we must notice a fact which throws light on their early condition and history. We find along most of their eastern flank, and also along their southern extremity and a portion of their western flank, a stratum of the Mayhill grit and conglomerate succeeded by the lower beds of purple Wenlock shale; a little consideration of this fact will suggest an important inference; we find these strata dipping at a tolerably equal angle on every side away from the strata on which they lie—such an arrangement seems only explicable on the supposition of their having formed a portion of an ancient beach along the Longmynds as a shore—observe that a similar deposit is made all along the coast of any existing land: all along the western shores of our island, far out into the depths of the Atlantic Ocean, there would be found to be a stratified deposit dipping away just as this does from the flanks of the Longmynd, and consisting as this does of the larger pebbles close to the beach, and further out of finer mud, the one in course of time becoming what is called a conglomerate, the other the ordinary sandstone and shale which is so much more common.

According to this the Longmynd would be an island standing out from the surface of the primeval sea before the time when all the succeeding strata which now intervene between us and it, were formed—that is, all above the Llandovery. Such strata are well developed within sight of the spot where we stand—on the one side we have the parallel ridges of Wenlock edge and Aymestrey limestone extending from Wenlock to Ludlow, and thence thinning out in their course southwards.

Due south is the district of Woolhope, most interesting as including within itself an epitome of most of the Silurian rocks and proving the persistency of their relative position over so large an area; and lastly, Malvern, which also presents the same order of strata, the Wenlock overlying the Llandovery, and this succeeded by the lower and upper Ludlow rocks with the intervening stratum of Aymestrey Limestone.

In all these places the Silurian rocks are found to protrude from under the old Red Sandstone, which was therefore deposited subsequently to them and which occupies nearly all this immediate neighbourhood. This extensive deposit is remarkable by its being the first in which vertebrate fishes have left any extensive traces. It would, indeed, be rash to assert that such did not exist previously. When we hear of such a fossil as that of the Archœopterix being found in rocks which, though well searched, had, till a short time ago, failed to yield a single specimen of it—when Mr. Darwin tells us of a plate of a kind of barnacle being found in the secondary rocks—a single specimen in that wide, and as was supposed, well-known stratum, proving, as certainly as thousands of such specimens could, that the ancestors of these little animals which now clothe the rocks of our sea shore with their innumerable and curious dwellings had this remote antiquity—in the face of these facts, I say, it would be rash to assert that the vertebrate animals of the old red had no representatives at an earlier age. "It is as rash" (to use Mr. Darwin's own words) "in us to dogmatize on the succession of organic beings throughout the world, as it would be for a naturalist to land for five minutes on some barren point in Australia, and there to discuss the number and range of its productions." The same conclusion is forced upon us by finding at the summit of the Silurian rocks, but below the base of the old red, a remarkable bone bed, which in some places is some eight inches thick. This deposit consists almost entirely of spines and bits of the skin of innumerable fishes of which, however, not a single specimen to which they can be assigned has come to light. In the Lower Ludlow rock, indeed, a few specimens of Pteraspis have been found, but it is by no means sure that these fish defences belonged to these creatures. Such a fact shows us how little, after all, we know of the life of those early times, and how unwarrantable it would be to assert that any particular stratum is the first in which a particular fauna came into being—since though a good geologist is able from the predominance in certain particular rocks to identify them with very great precision, and so his study may be said to assume the dignity of a science; yet to proceed to this further generalization would seem more than he is justified in doing.

And now we arrive at this more immediate neighbourhood where we find the Mountain limestone, the Millstone grit, and the Coal measures succeeding each other in their ordinary succession. The Millstone grit constitutes that ridge which stretches out from the Titterstone to the N.E., where it presents the appearance of a coarse conglomerate; it is to be found also to the S. and S.W. round this hill. At the spot on which we stand, I would call your attention to the basaltic rock, or, as it is locally called, Dhu stone, which is here so extensively seen. There can be no doubt but that the great blocks of stone upon which you are now reclining were at one time in a state of fusion. It has been the custom up to late years to call a very great variety of rocks igneous, such as the Granites, Gneiss, and Syenite. In obedience, however, to that excellent law by which every scientific theory is open to question and examination, and by which the mere dictum of the learned is not sufficient to decide its truth, there have been found some who are sceptical as to the wide range of truly igneous rocks; and it is now more than suspected that numbers of those which up to a recent date have been classified as such, are really of sedimentary origin, altered or metamorphosed by certain chemical and physical changes going on within them during the enormous periods of time which have elapsed since their formation. Such is not, however, the case with the rock upon which we now stand. There can be no doubt that it was at one time liquified under the action of heat, that it was protruded through the overlying strata, and overflowed all along that Hoar edge along which we have toiled up to this spot, spreading itself out like a gigantic mushroom upon the surface of the coal measures. The evidences that such is the fact, may be seen—1st, in the columnar structure which is to some extent observed in the rocks just below us, called the Giant's Chair, and which, though not very visible to those who approach the Clee-hills from the Ludlow side, is very striking to any one who views it from the east; 2ndly, the constituents of the stone itself, which I am told proves its relation to known volcanic rocks; 3rdly, that it has actually been melted up by the application of heat, by which it becomes so plastic and tractable as to render it capable of being cast into various forms, so much so, that a manufactory to cast ornaments for architectural purposes out of the Rowley rag was, I understand, some years ago started at Birmingham, but it was found that their surface always became so yellow when exposed to the air, from the oxydizing of the iron it contains, that it has not been extensively used for this purpose; and lastly, it has been proved by actual experiment that a shaft of basalt pierces the underlying strata. This is detailed fully in Sir R. Murchison's larger work. He there describes how the coal seams were found to assume a sooty appearance as they approached the wall of Dhu-stone, and that they were at last all cut off by it, and yet that the contents of these measures gave, under the blow-pipe, bituminous products, thus in every way proving that the core of basalt had been intruded after the formation of the coal strata, and not only so, but had by its great heat changed the form—burnt into cinders and soot—of their contents.

In this very hard and permanent rock may be seen the cause to which we chiefly owe the existence of this and the neighbouring Clee Hill, of the Wrekin, and a few other hills within this horizon. These hard rocks have been a standing barrier to the ceaseless forces which have worn away and carried down to the sea the enormous masses of strata through which they were protruded. When you look to the Brown Clee Hill, about four miles to the north of this, and see that the coal strata on the summit of it, like the coal strata on the summit of this, are nearly horizontal — if you travel northwards to Coalbrookdale and the black country, as it is called, and observe a similar fact, and that under these lie in regular succession the strata of the Millstone Grit, and under that, the Mountain Limestone, and under that, the Old Red Sandstone—when you see that these strata have been cut off abruptly, and that if they were continued from one chain of hills to the other they would just coincide—(indeed in the minor divisions of the coal seams, these successive layers are said to be traceable over very great areas). When you consider these facts, it is impossible to resist the inference that these Coal deposits were at one time all connected, and formed one great plain, one flat swamp. It has usually been supposed that these great swamps were the estuaries of vast rivers, and as vast rivers imply still vaster continents upon which the rain would be precipitated, imagination might construct, *ad libitum*, pile on pile of upland and mountain somewhere. But where ? That question is not easily answered. My friend Mr. Salter, however, has shown that not only a much simpler mode of formation of these coal fields is possible, but that there are positive evidences that it was the true one, and that is, that these tracts of forest were marine marshes. Such are occasionally found in the tropics in the present day, and not only the flora themselves, but the existence on them of fossil sea worms, proves their marine origin.

I have next to call your attention to a period in the history of our globe when all these rocks had long been formed at the bottom of the sea, hardened into rock, upheaved, sculptured out into hills and valleys, other rocks formed on their edges, and then in turn denuded, each one of these operations involving countless time. We at last arrive at a period when the land was gradually assuming the shape we now behold it, and in that distant, low lying country to the west we behold the clearest traces of this last process, that is, the great valley which extends from the river Dee, which now flows into the sea to the N.W., near Chester, all along the low lying country to the E. of the Malverns, and on, southwards along the course of the Severn, till at last it joins the sea in the Bristol Channel.

All along these Malvern Straits, as geologists call them, and in all the valleys which extend from them, are beds of gravel and sand stratified in exactly the same way as we may see them in any river bed, and revealing as certainly, their origin, and the conditions under which they were found. No one who examines these beds can for a moment doubt that the only possible way in which they can have been deposited was by the action of the sea washing backwards and forwards, wearing down the subjacent rocks and throwing them down at various depths in proportion to the size and weight of their materials, the lighter floating out further from the land, and the heavier being deposited close to the shore. On examining the contents of these gravel deposits we find that while a great part of them consists of materials brought from a great distance, and ground up into pebbles of various sizes, far the largest proportion is derived from the subjacent rocks, which is just what we might expect. Professor Buckman has also observed that the general character of the flora of that valley is more marine than that of the surrounding country; plants which affect the sea-shore having lingered longer in its neighbourhood than in higher ground, where traces of them are now obliterated. All these facts point to one conclusion, and prove that the country around us, and the whole of Wales was at the period that these sands and gravels were deposited, cut off by a great strait from the rest of England.

The country in the immediate neighbourhood of Shrewsbury is about 110 feet above the level of the sea. I am not sure of the level of the country intervening between that place and the course of the Dee, but it cannot be very much more, as according to the map the Severn and the Dee approach each other near the same spot. We see, then, that a depression of only say 150 feet would suffice to transform all this side of England into an island. When we reflect upon how slight an elevation 150 feet represents compared with the enormous altitudes at which there are evident indications of sea beaches (one is mentioned in North Wales at the height of 200 feet above the sea)—when we consider that probably since the introduction of the human race to this earth no very great change has taken place in the configuration of the land (for it is believed that the drifts of the Malvern Straits are older than those of Abbeville, in which flint weapons occur), we may form some idea, though it must be admitted a very dim and indistinct one, of the last scenes of the formation of the world as we now behold it.

Nor has the glacial period passed without leaving its traces hereabouts. We have not, indeed, the rounded and scored rocks of the Llanberris Pass to indicate the existence of vast glaciers, writing with pens of adament on their surface the indellible characters which tell their history, but we have, scattered over the country, masses of granite, and in the higher grounds, whole acres covered with these boulders, showing that here the iceberg melted, and as it did so, deposited its load of stones around; we see the tops of the Longmynd hills planed off to a certain level, looking almost like a series of truncated cones, and the most probable explanation is, that to the action of great masses of ice passing over them as they lay beneath the surface of the sea, is due this very striking appearance.

But it is time to bring this sketch of the Geology of this District to a close. We have now reached a period in its history of which perhaps the most remarkable feature is that we are deliberately using up the products of former geological epochs as they never were before. The same course of denudation that has hitherto operated in wearing away and depositing the rocks in newer forms is still at work, and at the bottom of the Atlantic and other oceans, fresh rocks and the materials of other continents are being laid down; but we see no indication of fresh supplies of fuel being found for that improved race which is to succeed ours. Perhaps as the inhabitants of the northern and colder countries have generally superseded the more effeminate inhabitants of more tropical climates in intellect, so our descendants reduced to depend less on the sensual enjoyments of the fire-side, may surpass us who, unfortunately, are so dependent on these creature comforts. It is useless to speculate, but evident it is that the contents of the Coal seams cannot last for ever, and that some considerable modification of the present state of things will be necessary when the last pit is exhausted and the last collier's grimy occupation gone.

With respect to objects of antiquarian interest on these Clee hills, I have, after diligent inquiry, been able to obtain only the most meagre information. That they were in very early times the scene of human operations of some kind there are some works to show—on this, the Titterstone—there is to be found towards the east a line of stones which have the appearance of having once formed a considerable wall, but except this I am not aware of any evidences of early structures on this hill; but the summit of the Brown Clee is enclosed by a very high and broad circle of stones, and within it are a number of smaller ones scattered about in a somewhat irregular manner, and, of course, these afford some grounds for speculation. Mr. Hartshorn, in his "Salopia Antiqua," has at great length discussed the possible objects of these structures, and has come to the conclusion that they were "devotional and sepulchral," but an unfortunate note in this author's book has brought a good deal of discredit on his opinion. Among other reasons which he brings to show that this part of the country was particularly sacred, he observes that old Leland says, "The Clee hills be holy in Shropshire," in which passage the word "wholly" which we spell with a "w" is without one, and the meaning "entirely" would be transformed to "sacred."

I have been favoured by my friend Mr. Wayne with a note of his observations on these structures, and as this seems to contain all that is at present known about them, and quite coincides with my own impression of their object, I shall here insert extracts from it. With respect to the lofty circle which crowns the hill Mr. Wayne says, "Some years ago I met with a collier on the Barf,* with whom I had some conversation about it. He said the stone mound was once a wall; that buried beneath the stones, the wall, 'as well-built a wall as you would need to see,' was still to be met with in places; that he himself had come upon it three times over when making a road through the Vallum, and twice in different parts when getting stones for colliery purposes. I have since spoken with other colliers at work in the Barf, and all agree that it has been a wall, and that the foundations are occasionally laid bare." "The ruin," he continues, "of Abdon Barf is so total, not a trace of a wall being visible, that in the absence of some evidence of a wall no one would perhaps be justified in maintaining that it had been anything else but a mound of loose stones. But being satisfied that it has been a wall, I was pleased to discover, as I think, the cause of its total overthrow, a cause now at work and which in my memory has produced very visible effects; it is no other than the never ending pursuit of the innumerable rabbits which seek safety among the stones, and which I suppose people have been getting out ever since the rampart ceased to be kept up as a place of refuge and defence.

If the present vallum represent what was once a wall of defence it must have had habitations within it, and a work which I have only recently met with, "A Perambulation of the Ancient and Royal Forest of Dartmoor," by the Rev. Samuel Rowe, confirms the idea that the circles of stones within the vallum are remains of cabins. At page 182, Mr. Rowe describes the remains of an aboriginal "settlement," "town," or "village" on Dartmoor in these words: "Its site is on the slope of the common inclining to the southwest, and the ground over which the circular foundations of houses (circles of stones) are scattered is of considerable extent;" and at page 44, Mr. Rowe gives a view of Grimspound, a work which bears a striking likeness to Abdon Barf.

Utterly shapeless as is the mound of stones at Abdon Barf in its present state we might perhaps infer the probability of its having been originally a wall, from a comparison with an enclosure on Wortlebury-hill, near Weston-super-Mare. Of this latter enclosure I have a more lively recollection from having viewed it with Abdon Barf in my mind, to which it bears a striking resemblance. The wall forming a considerable enclosure near Weston is almost wholly in a state of ruin, as utterly shapeless as the mound of stone at Abdon Barf, but in two or three places there still stands a wall rising, without mortar, from 8 to 12 feet or more above the remains accumulated at its base"—and Mr. Wayne concludes by suggesting the following questions: "Do you see reason to think the great enclosure contemplated from the summit of the Titterstone Clee-hill may

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* This is the local name given to the summits of these hills.

never have been fully carried out? and if not, does the abandonment of it mark the transition in British Fortifications from stone walls to earthworks? and again does this suggest the probable period of the work?"

I have dwelt on this subject although it relates rather to the Brown than to this Clee hill, because that it is improbable that the Club could manage a journey to that more remote region, and yet individual members may, in consequence of these remarks, have their attention drawn to the subject, for I must admit that unless our attention was especially drawn to the existence of these circles they would not force themselves upon it. There can be no doubt of their existence, and they can even be measured accurately across, but they are merely indicated by occasional stones of no very great size peeping through the turf, and my own impression is that they are of no very great antiquity. Although Mr. Hartshorn traces them up to the Druids, and invests them with very awful and mysterious attributes, he tells us in a note that an old man whom he met told him that these circles were nothing like so perfect now as he recollected them to have been. One would think that if they had fallen so much to ruin in the life of an individual man, it is not probable they can have existed from such profound antiquity as Druidical times.

The summit of these hills has evidently for ages been the scene of coal mining operations, and it appears to me most probable that in these very irregular circles we have nothing more or less than the foundations of the hovels of the miners.

Camden has the following notice of this district:—

"When Temd now is leaving Shropshire behind it, not farre from the bankes thereof there raise themselves up northward certaine hills of easie ascent. Cleehill they call them, much commended for yielding the best Barly in great plenty, neither are they without Iron mines; at the descent whereof is a village called Cleybury Hugh Mortimer built a castle, which King Henry Second forthwith so rased (because it was a noursery of sedition,) that scarce there remaine any tokens thereof at this day; also hard by standeth Kinlet, where the Blunts flourish. Their name in this tract is very great, so sirnamed at first of their yellow haire; the family noble and ancient, and the branches thereof farre spread."

Leland, in his "Itinerary," fol. 89 b., has the following:—

"No great plenty of wood in Cle Hills, yet there is sufficient brushe wood. Plenty of Coal Yerth Stone, nether exceeding good for Lyme, whereof there they make much and serve the contre about. Cle Hills come within 3 good myles of Ludlow. The village of Cleybyri standythe in the Rootes by Est of Cle Hills, 7 myles from Ludlow, in the way to Beaudelay. There was a Castle in Cleberie nighe the Church by North. The Plot is yet cauled the Castell Dike. There be no Market Townes in Cle Hills. The highest part of Cle Hills is cawlyd Tyderstone. In it is a fayre playne greene, and a fountain in it. There is another Hill a three miles distant from it caulyd the Brown Cle. There is a chace for Deare. There is another cawlyd Caderton Cle, and there be many Hethe Cokks and a broket caulyd Mille Brokeet springethe in it and afar goithe into a Broket called Rhe, and Rhe into Tende by neth Tende Bridge, There be some Blo Shopps to make Yren upon the Ripes or Bankes of Mylbroke comynge out of Caderton Cle or Casset Wood."

The "Blo Shopps" were evidently blast furnaces for smelting iron, traces of which are to be found of an early date, though not, according to Mr. Wm. Purton, in the place mentioned by Leland. Lastly, as to the name Clee, though, perhaps, with this I ought to have commenced, Mr. Purton appears to incline to the belief that its origin is simply the Latin word "Clivus," since, in old documents, this district is sometimes spoken of as "Les Clives," and sometimes the Clives. The other derivation from the Saxon word "clay," unless on the *lucus a non lucendo* principle cannot be defended, as the immediate hill is more deficient in that material than any of the surrounding tract.

Dr. M'Cullough, as President for the day, gave the thanks of the meeting to Mr. La Touche, amidst general applause; and Mr. Salwey expressed his strong sense of its value, by requesting its publication in full.

At the request of the President, Mr. Cocking then read the following

SONNET,

Written on the Titterstone Clee Hill, by the author of "Geology for Beginners," and never before published.

Scene of creative grandeur, power, and might,
That first in deep unfathomed mines of earth,
In time primeval, hadst thy mystic birth,
And thence impelled hast reached this mountain site.

What wonders taught by thee the soul excite,
What throes of nature, by convulsion riven,
What chaos wild, and strife, when earth met heaven,
Ere thou couldst soar to this volcanic height.

Nor is the joy the less, meanwhile, to trace
The varied charms that deck the vale beneath,
Where every gentlest grace hath twined a wreath—
A zone of beauty circling round thy base;
Whence thy majestic piles sublimely soar,
Leaving the mind to muse, to wonder and adore.

G. F. Richardson.

A general move was now made for the return. Mr. Alfred Marston was not able to be present, and the hunt for fossils amongst the Coal shales—where by the way they may be found pretty plentifully—was abandoned. A direct course was taken down the side of the hill for the great quarry at the head of the steep railway incline. Here the hill was much more abrupt, and thanks to the dry turf, the way was slippery indeed. Happy he who had spikes in his shoes, and thus secure in his own perpendicularity, could give steadiness and safety also to some fair votary of science. Many of the fragments of rock which covered the hill side presented the columnar structure which Basalt so often presents, and similar in their hexagonal shape to those well-known and striking examples, the Giant's Causeway and Staffa. One or two streams were passed in the descent, and the hearts of the botanists revived. Mr. Lloyd, of Kington, ever fortunate, was the first to find the Parsley fern, *Allosorus crispus*, about which the wording of the programme seemed to throw some doubt. The

Rev. R. H. Williams got a root of the *Wahlenbergia hederacea*, the little fairy-like ivy-leaved bell flower, and some specimens of the *Achillœa Ptarmica* the Sneeze-wort Yarrow. The pretty *Viola lutea* grows plentifully here, but was not in flower, and had the walk extended further the *Scutellaria minor*, *Sedum Telephium*, *Polygonum convolvulus*, *Inula Helenium*, *Saxifraga hypnoides*, *Narthecium Ossifragum*, and other interesting plants might also have been gathered. On the lower slopes of the hill, too, Mr. Williams has gathered the more rare fern, the Moonwort, *Botrichium lunare*, and in its bogs the ever interesting Royal fern *Osmunda regalis.*

The great Basaltic quarry was soon reached and here the great steam rock-crushing machine was visited. It was not at work, but the machinery was visited, and some members on going up through the great supply trough got into the works above, when the columns of the rock were being quarried for cutting up into blocks for paving, building, road-making, &c.

The carriages were soon reached, and quickly conveyed the visitors back to the Angel at Ludlow where dinner had been provided.

The tables were crowded with guests, and if there was a little want of elbow room—if one or two more adventurous than the rest had occasionally to go in search of what they or their neighbours needed—it mattered little, for with unfailing good nature and plenty of liveliness, if not of learning, they discussed the creature comforts provided.

Before the tables were cleared, the President called upon the Rev. Wm. Houghton to read a paper

ON THE REPRODUCTION AND DEVELOPMENT OF ANIMALS.

BY THE REV. W. HOUGHTON, M.A., F.L.S.

By the term development is to be understood the whole series of changes that takes place in the life-history of any animal, from the germ to the time when it attains its adult form. Relatively to a sexual mode of reproduction, animals may be divided into three divisions, namely:—

I.—Those which produce ova whose embryos contract a vascular connection with the uterus, and arrive at a perfect form within the body of the parent.

II.—Those which produce ova whose embryos do not contract a vascular connection with the uterus, and which undergo their development, partial or complete, within the body of the parent.

III.—Those which produce ova, which undergo their development after deposition by the parent.

The three-fold phenomena represented above are generally expressed by the terms, Viviparous or Placental, Ovo-viviparous, and Viviparous, respectively.

In the first division are included all the Mammalia with the exception of the Marsupials, whose embryo never contracts a vascular connection with the uterus, from which it is expelled at an early period, and is then received into the abdominal pouch. In the second division, the Ovo-viviparous, are included the Marsupials, a few fishes as the viviparous blenny *(Zoarces viviparus)*, whose young at birth are fully formed; a few species amongst the Plagiostomous tribe of fishes, as some of the sharks and dog fish, several reptiles, as our common viper, the slow worm, and viviparous lizard; it is probable, however, that in some of these cases laceration of the thin egg-membrane takes place, and is occasioned by parturition, for an American boa constrictor has been known to produce both young and eggs at the same time. Amongst Molluscs several bivalves are ovo-viviparous, as *Cyclas*, *Kellia*, *Pisidium*, *Unio*, *Anodonta*, which retain their fry within the mantle or the gills, where they undergo either complete or partial development. Amongst ovo-viviparous Univalves I may mention *Paludina vivipara*, *Helix rupestris*, and *Pupa umblicata*. The scorpion produces its young alive, and in this curiously enough, the embryo is developed in the ovum while still in the ovary. The scorpion family is an exception to nearly all the other *Arachnida*, which are oviparous.

The various species of *Aphis* amongst insects are an exception to the general rule, being for the most part ovo-viviparous; but to this subject I must return by and bye. In the last division, of Oviparous animals, when development of the germ takes place out of the body of the parent, either with or without incubation, are to be enumerated all birds, without a single exception, nearly all fish, most batrachia and reptiles, insects, crustacea, annelida, &c.

Embryology will form the only true basis of a natural classification. I dare say many here are cognisant of the form of that strange frog-like fish, the angler, *Lophius piscatorius*. This fish was placed by Cuvier amongst a small group of fishes which he designated *Pectorales pediculés*, "having pectoral fins like feet." But this may be, indeed is most likely to be, a thoroughly artificial mode of classification. It never does to select one particular characteristic, though pertaining to a number of animals, as a basis of classification. Fish, "with pectoral fins like feet," comprise species having no clear affinities with each other. How does embryology aid us in assigning the frog-fish or angler to its proper place? Is the *Lophius*, or angler, a higher development of the Blennies, Gobies, Cottoids, and *Sculpius*? Has it anything whatever to do with them? Agassiz shall answer this question. He says, "Another well-known family of fishes is that of the *Lophioides*. To this group belongs the *Lophius*, or goose-fish, with which the Cottoids, or *Sculpius*, and the Blennioids, with *Zoarces* and *Anarrhichas*, the so-called sea-cat, ought to be associated. It was my good fortune to have an opportunity of studying the development of the *Lophius*, and to my surprise I found that its embryonic phases included the whole series here alluded to, thus presenting another of those natural scales on which I hope all our scientific classification will be remodelled when we obtain a better knowledge of embryology. The *Lophius*, in its youngest state, recalls the Tænioids, being long and compressed; next, it resembles the Blennioids, and, growing stouter, passes through a stage like *Cottus* before it assumes the depressed form of *Lophius*."

What is the relative standing of skates and sharks? Which shall we place highest?

"On geological evidence I had placed the skates highest because the sharks precede them in time; but this fact had not been established on embryological evidence. Professor Wyman has followed the embryology of the skate through all its phases, and has found that in its earlier condition it is slender in outline, with the appearance of a diminutive shark, and that only later it assumes the broad shield-like form and long tapering tail of the skate."

It is well known that all the various animals on the earth, from lordly man to the humblest polype, start from the same point. As Huxley has said: "If you trace back to its first germ, a man, or a horse, or a lobster, or an oyster, or any other animal you choose to name, you shall find each and all of these commencing their existence in forms essentially similar to each other;

and, furthermore, that the first processes of growth, and many of the subsequent modifications, are essentially the same in principle in almost all." Now, what is this original starting point? It is a single vesicle of minute size, with a still smaller nucleus in its centre; and for a short period the development proceeds in parallel lines. There is a wonderful difference between a sparrow and a cat that would eat it, but there is a period in the embryonic development of the sparrow when I would defy you to be able to say whether the embryo sparrow would turn into a bird or a mammal, supposing, of course, you had no knowledge of the source where the embryo was derived. I will instance this by an example that came under my own notice a short time ago. A swallow's egg was brought to me, and on breaking it and placing its contents in a saucer of water, I discovered an embryo about four lines long and 1 or 1½ lines broad. After detaching it from the yelk by dividing the umbilical vessels, I placed it in a small flattened glass tube filled with clear water. I showed it the same evening to five or six gentlemen who were dining with me, and asked one after the other if he could tell to what animal the embryo belonged? Well, various guesses were given: one thought it was the embryo of a dog, another of a mole, another thought it was that of a lobster. At last I asked whether they were quite sure it did not belong to some bird? A chorus of negatives followed my query; whatever the embryo was, it certainly was *not* that of any bird. And certainly the embryo would remind anyone rather of a mammal than of a bird; the head had assumed as yet nothing ornithic about it; the wings were represented by two anterior cylindrical processes, the legs by two similar posterior processes, scarcely distinguishable from the former; at the end was a single process representing the tail. Nor, indeed, can experienced Naturalists distinguish embryos at certain periods of their development. Von Baer, to whom science is so much indebted, says: "In my collection there are two little embryos which I have omitted to label, so that now I am quite incompetent to say to what class they belong. They may be lizards, they may be small birds, or very young mammals; so complete is the similarity in the mode of formation of the head and trunk. The extremities have not yet made their appearance. But even if they existed in the earliest stage, we should learn nothing from them, for the feet of lizards, mammals, and the wings of birds will arise from the same common form." Agassiz examined more than a hundred species of bird-embryos, and found that at a certain period they have all bills, wings, legs, feet, &c., exactly alike. The young robin and the young crow are web-footed as well as the duck." I can testify to the fact of the young embryo of the blackbird being web-footed, and probably this is the case with most birds. Now the embryology of birds can be pretty readily observed, and I hope that another year some members of the Woolhope Naturalists' Field Club—a club that evidently means work, and assembles at its different meetings for practical scientific purposes, and not for picnics—will turn their attention to ornithic embryology, and make collections of embryos of different birds at various periods of their development.

Animal development often presents us with phenomena of a very curious, exceptional and inexplicable nature. I just now mentioned that, as far as is yet known, all British osseous fishes are oviparous with the exception of the viviparous blenny. The medium in which the young of all other species of blennies are developed is the salt water; that in which this ovo-viviparous species reaches its adult form is at first a peculiar tenacious fluid with which each ovum is supplied; this fluid, as development proceeds, disappears just before the young are born, probably by absorption into the body. The ova of other osseous fishes are impregnated after exclusion—it is obvious that impregnation in this exceptional case must take place internally; yet the structure of the generative organs in the viviparous blenny, both male and female, differs in no respect from that of ordinary oviparous genera. It is evident therefore that the fertilising fluid of the male must find its way to the ovaries of the female. How are we to account for this curious exception to the general rule.

The development of the young of the Syngnathidæ or pipe-fishes is very curious, and presents phenomena which call to mind the Mammiferous Marsupials, with, however, this marked difference, that in the Mammiferous Marsupial it is the female that has the pouch, in the fish the male. This pouch consists of two large valves beneath the tail, posterior to the cloacal orifice; internally the surface is indented with a number of cells; in these cells the eggs are hatched and the young pipe-fishes developed; and Mr. Couch tells us that even after they are fully formed a kind of attachment still continues between the parent and the young, for in case of alarm, they fly again to the shelter of the pouch and are readily received into it. I should mention that the female pipe-fish herself deposits her eggs into the marsupium of the male who opens it to receive them. A still more curious mode of piscine embryological development has recently been investigated by Agassiz as occurring in certain species of fish he found in the basin of the Amazons. The locality, in which the ova are developed, is certainly one which you never could have guessed; it is absolutely in the mouth! In a letter to Milne Edwards dated September 22nd, 1865, Professor Louis Agassiz thus writes of a species of *Geophagus:* "This fish has a most extraordinary mode of reproduction. The eggs pass, I know not how, into the mouth, the bottom of which is lined by them, between the inner appendages of the branchial arches, and especially into a pouch formed by the upper pharyngeals which they completely fill. There they are hatched, and the little ones, freed from the egg-case, are developed until they are in a condition to provide for their own existence. I do not yet know how long this continues, but I have already met with specimens whose young had no longer any vitelline sac, but were still harboured by the progenitor."

At page 238 of "A Journey in Brazil," further information is given of these fish. "The story of the *Acaras*, the fish which carries its young in its mouth grows daily more wonderful. This morning Mr. Agassiz was off before dawn on a fishing excursion with Major Estolano, and returned with numerous specimens of a new species of that family. These specimens furnished a complete embryological series, some of them having their eggs at the back of the gills, between the upper pharyngeals and the branchial arches ; others their young in their mouth in different stages of development, up to those a quarter of an inch long and able to swim about, full of life and activity, when removed from the gills and placed in water. The most advanced were always found outside of the gills, within the cavity formed by the gill-covers and the wide branchiostegal membrane. In examining these fishes Mr. Agassiz has found that a special lobe of the brain, similar to those of the *Triglas*, sends large nerves to that part of the gills which protects the young, thus connecting the care of the offspring with the organ of intelligence."

If we restrict the use of the word *metamorphosis* to designate those changes which take place in the ovum after deposition by the parent, whereby we are presented with larval and nymphal forms, &c., we find amongst vertebrata few instances of it. Of course the metamorphosis of the frog, toad, newt, and *Batrachia* generally, has for ages been known. No fish, however, was supposed to go through a larval state until Auguste Müller, in 1856, showed that what had hitherto been supposed to be a particular species of fish was merely the larval form of another well-known kind. I allude to the *Ammocœtes branchialis*, the Sandprey or mud-lamprey. This fish, evidently one of the *Cyclostomes*, and very similar in form to the common river Lamprey, differs from it in the semi-circular form of the upper lip and the absence of teeth. Müller has shown that this supposed new genus of *Cyclostomus* fishes was really the young or larval form of the Lamprey. When four years old the edentulous and semi-circular mouth are exchanged for a circular multidental mouth. It has been thought that the *Leptocephali*, as the Anglesea *Morris*, and the *Branchiostoma lanceolatum* (Lancelet) of our own coasts were only incomplete larval forms of some known fish ; but from the recent researches of Dr. Kowalesky and M. Bert, it would seem that the latter named fish is a fully developed form. The eggs are said to be expelled by the opening of the mouth !

Ordinary sexual reproduction may be divided into *Diœcious* and *Hermaphrodite* ; of the former there are, as we have seen, three kinds, the oviparous, ovo-viviparous, and the viviparous or placental. Of hermaphrodite reproduction we meet with a great number of instances in the animal kingdom, as in most of the molluscous and radiate classes, worms, some of the *entozoa*, &c. No insects, no crustacea exhibit normal hermaphroditism. Amongst the *Vertebrata* naturalists long considered that *normal* Hermaphroditism never occurred. I say normal, because abnormal instances of animals, as fish having roe on one side and milt on the other, in the same individual, have long been known. A few years ago, however, M. Dufosse, published an elaborate memoir to show that a genus of percoid fish, the *Serranus*, was normally bisexual, and was able to fecundate its own ova. M. Dufosse's memoir is accompanied by a plate shewing the anatomical arrangement of the generative organs, and his conclusions are the result of several experiments. I confess, however, that I was somewhat sceptical with regard to this unique exceptional phenomenon in the vertebrata. Professor Owen, to whom I wrote to ask whether the bisexual structure of the genus *Serranus* was accepted by naturalists, replied that he for one was certain that the conclusion was based on erroneous observation. I wrote to Mr. Couch, of Polperro, for specimens of the smooth Serranus, which is sometimes caught in the crab pots off the Cornish coast. He did not succeed, I am sorry to say, in obtaining for me more than a single specimen; this, on a very careful examination, I found to present nothing approaching a bisexual character. On this subject, therefore, I suspend my opinion.

But the study of the development of animals makes us acquainted with other modes of reproduction besides that which results from the union of the sexes. If we take numbers of individuals alone into consideration we shall find many thousand times more creatures to be born by non-sexual reproduction than by sexual reproduction. True, for the most part we find that this non-sexual mode obtains amongst animals of very low organisation, but there are some very striking exceptions to the rule. I dare say many in this room are acquainted with that small jelly-like thing common in weedy pools, known by the name of *hydra*. This animal throughout the whole of the spring and summer months produces thousands of offspring, but not one from an egg. The body of the parent at first shows a little swelling in the form of a papilla, budding out from one or two portions of it; in time this bud grows tentacles like the parent to which in all respects it becomes similar. Towards the end of autumn, however, when the November days become cold, this budding process ceases, and the *hydra* produces on two different parts of the body one or two round bodies containing ova and the same number of oval ones containing *spermatozoa*. The ova, when mature, are pushed through the body-wall, and, after having been impregnated, are attached to some water-weed awaiting the warm weather of spring, when they will develope into young *hydra*. Here, then, we have two modes of reproduction—the one sexual, the other gemmipparous or asexual. It is not, therefore, true to say with Harvey "omne vivum ex ovo" as the *hydra* produces many young ones, *not* from an egg, but directly from the substance of the parent's body by a process analogous to that of the budding of plants. This leads one, naturally enough, to say a few words on what has been termed *Parthenogenesis*, a word which implies that there exists amongst certain animals a power to produce young without intercourse with the male sex. It was in 1745 that Bonnet proved the astonishing fact that insects of the genus *Aphis* produced young ones when no male insect was present, and further that these young ones are all females, and that they gave birth to a fertile progeny in their turn and so on to eleven generations. At the end of autumn, however, male insects appear, and eggs are laid by the females, which attach themselves to the bark of trees or other substances. These eggs lie dormant through the winter, but in the spring of the following year give birth to the productive virgins I have been speaking of. Thus it would seem we have a combination of viviparous generation at one season and of oviparous generation at another, in the same insect. I feel, however, pretty certain myself from several observations that the so-called eggs laid in the autumn are not eggs, but immature larvæ, differing in no respect from the viviparous larvæ except that they are enveloped in a covering. We must consider this non-sexual reproduction, then, as analogous to the gemmation of other animals as polypes generally, and the sexual reproduction to result in the impregnation of internal ova which develope themselves into larvæ with a tegumentary covering within the body of the parent. These are deposited by the parent on leaves and trees and have been regarded as ova; I maintain they are developed larvæ with a horny case to serve as a protection during the winter months. Professor Huxley believes that there is no distinction between the ova which produce viviparous aphides and those which are deposited by the perfect winged female. Is it possible that under the favourable conditions of nutriment and warmth this non-sexual reproduction might be continued indefinitely without any recurrence to the sexual process? And it would appear that Parthenogencsis, far from being an exceptional phenomenon, is a normal process in many animals. It is strikingly manifest in bees and some moths. To Von Siebold, I believe, we owe this important discovery. He isolated a few female moths, and placed them in boxes with glass lids. They laid eggs which actually gave birth to young caterpillars. The moths here alluded to belonged to the genus *Solenobiæ*, one of the *Teneidæ*, the larvæ of which family reside in a portable case. After the perfect insect appears, she clings to the outside of the case or sac from which she has just emerged. Von Siebold was particularly struck with the behaviour of the female *Solenobiæ*, which, he says, commence the business of oviposition very soon after exclusion; they possessed such a violent impulse to lay their eggs, that when he removed them from their sacs, they pushed their laying tube about in search of the orifice of the sac, and at last let their eggs fall openly. "If I had wondered," he continues, "at the zeal for oviposition in these husbandless *Solenobiæ*, how was I astonished when all these eggs of these females, of whose virgin state I was most positively convinced, gave birth to young caterpillars, which looked about with the greatest assiduity in search of materials for the manufacture of little sacs." The phenomenon of Parthenogenesis has been described in other moths, as in the silk-worm moth *Bombyx mori*, and *Psyche Helix*. It has been proved, beyond a shadow of doubt, that the males of the hive bees are produced from sexual propagation; the impregnated eggs turn to queens and imperfect females (neuters, as they are popularly called), and these larvæ, as is well known, under certain conditions, might themselves become queens. Sometimes the neuters lay eggs, which produce drones alone. Other animals, *as some molluscs, crustacea, and other groups of insects, besides those of which I have spoken, exhibit the phenomenon of Parthenogensis.

* The phenomenon described by the expression "alternation of generations," is now generally regarded by Naturalists as essentially one of internal budding, or of fissiparous generation, which is identical with it.

One would perhaps naturally anticipate that the same order of animals in which the different genera and species bear, in their *adult* forms, considerable resemblance to one another, should present a corresponding similarity in their *larval* state. This, however, is not always the case. We have a striking illustration of this in the family of *Ephemeridæ* amongst insects. The genus *Ephemera* differs from the genus *Baëtis* in the perfect form of the insect very slightly. The one has three caudal setæ, the other two. This is the only obvious difference to an ordinary observer. Now look at the larvæ of these two insects. What similarity exists between them? Amongst the Crustacea, the *Macroura*, or long-tailed family—familiar to all in the shape of lobsters and crayfish—bear in their adult form great resemblance to each other; but how wonderfully different are their larval forms. "The young lobster has divided legs like a *Mysis;* the *Palæmon* appears under the form of a *Zoea,* and *Peneus* under the *Nauplius* form." The cray-fish undergoes no metamorphosis. Nay, even the larvæ of closely-allied genera differ considerably.

Again, amongst the fresh water *Planari*, the young ones issue from the eggs as perfect *planari*, but in a marine *Nemertes*, a turbellarian worm of great length, the larva appears in the form of a helmet, with a long bristle-like appendage at the top like a plume; from its shape it was called *Pilidium*, and was supposed to be a new animal. What are we to gather from these facts, and how are they to be accounted for? Mr. Darwin considers that they demonstrate the absolute independence of old and new structures. He says:— "According to the belief now generally adopted by our best naturalists, all the members of the same order, or class, the Macrourous Crustaceans, for instance, are descended from a common progenitor. During their descent they have diverged much in structure, but have retained much in common, and this divergence and retention of character has been effected, though they have passed and still pass through a marvellously different metamorphosis. This fact well illustrates how independent each structure must be from that which precedes and follows it in the course of development."

I shall conclude this paper with an extract from an article by Dr. Allen Thomson, who has in a few graphic words described the extreme importance of the study of animal development:—

"It will be enough at this place to advert to the extensive range of topics which must be embraced in an attempt to trace the history of the first origin and subsequent evolution of all the parts of so complex and various a structure as the body of animals; and to remind my readers that this department of science professes to describe not merely the successive changes of external form and relation by which the several organs, springing from imperceptible beginnings, arrive at their perfect condition, but also the more minute phenomena of histological development or changes of the several textures, which accompany the more obvious formative processes; that, as in many instances, the complete knowledge of the structure and function of an organ is only to be obtained by the observation of its fœtal conditions—the study of development is accessory or supplementary to many departments of anatomy and physiology; that in recent times no branch of inquiry relating to organic nature has made more rapid progress, has presented a greater amount of new discoveries, or has influenced in a greater degree the views of scientific men on allied subjects than the science of embryology; that it is co-extensive with, and illustrative of, the whole range of comparative anatomy; that no system, therefore, of zoological classification can be regarded as philosophical or complete which neglects the facts and principles of fœtal development; finally, that some departments of pathological anatomy receive considerable illustration from our science, and that more especially the scientific study and comprehension of teratology or congenital malformations is founded entirely on an accurate knowledge of the phenomena and laws of development. Our subject, therefore, is not only interesting by itself, but deeply important as an essential branch of philosophical anatomy and physiology."

The Rev. J. F. Crouch, of Pembridge, brought to the meeting a box full of specimens of a very elegant and sweet-scented Cuscuta, which he very kindly distributed amongst the botanists present. It proved to be the

CUSCUTA HASSIACA.—*Pfeiff.*

THE LUCERN DODDER.

Cuscuta corymbosa *(Ruiz et Pav.)* C. suaveolens *(Ser.)* C. racemosa *(Ingelman,)* Grammica aphylla *(Lour);* and Ingelmannia or Cuscutina suaveolens *(Pfeiff.)*

Stems branched thread-like, of a pale orange colour.

Flowers fasciculate, on short stalks in racemes, white, or a pale lilac tint.

Calyx funnel-shaped; segments semi-transparent, erect, ovate, acute and close pressed to the tube of the corolla.

Corolla more than twice the length of the calyx; tube campanulate with a five-cleft spreading limb, the lobes ovate, acute

Scales large and broad with fimbriated edges, incurved over the ovary, as long as the tube of the corolla and nearly closing it; transparent, and with cells reflecting the light, as if frosted. These glistening cells were also scattered over the upper portion the tube of the corolla.

Stamens exserted, filaments broad, half the length of the segments of the limb: anthers bilobed, yellow, becoming brown.

Styles two, erect, unequal, as long as the ovary; stigmas round.

Capsule subglobose, two-celled, seeds oblong.

A very elegant species, with a scent rather resembling that of the Heliotrope. It is parasitical on Lucern, yellow Bedstraw, wild Chamomile, Sow-thistles, &c.

The Cuscuta Hassiaca is among the species excluded from the London Catalogue of plants, nor is any representation given of it in the new edition of Sowerby's great work now in course of publication. It was found by Mr. Varenne, near Witham, Essex, 1851; and also previously, near Riven Hall, in the same county. It is not known to have occurred since that time, until the attention of the Rev. J. F. Crouch was drawn to it by W. Langston, Esq., M.R.C.S., in whose field at Marston, in the parish of Pembridge, it was growing plentifully on Lucern. The Lucern was raised from seed purchased in London, and was of probably foreign growth.

The Illustration opposite is very kindly presented to the Club by Mr. Crouch.

The next paper read was

CUSCUTA HASSIACA.—*Pfieff.*

The Lucern Dodder.

ON OUR NATIVE FOOD-PRODUCING PLANTS.

BY THOS. BLASHILL, ESQ., VICE-PRESIDENT.

Let a man be called antiquary, epicure, or philanthropist, busying himself with the past, the present, or the future; or let him as a naturalist belong to all time—the study of our Native Plants brings food for that particular organ, noble or common-place, which makes him what he is. It shows the sources from whence our remote ancestors drew the vegetable portion of their daily fare, perhaps their whole sustenance in times of scarcity, and it accounts for habits and prejudices which survive through centuries of civilization. It shows moreover what plants are undoubtedly fitted for our soil and climate, and may be most easily improved by cultivation, and it enables us to distinguish those which are wholesome, toothsome, or nutritious, from such as are poisonous, distasteful, or simply indifferent. Practically it ought to teach us how to add to the food of our people, and also how to introduce variety into household cookery, a point less regarded in England than in any other country of Europe.

From the accounts of mediœval manners we can form but a mean opinion of the vegetables supplied to the best tables down to the time of the later Tudors. Whether gathered from the garden or the field they were not, as a rule, far advanced beyond the wild state except in such plants as Coleworts, Cabbages, or Greens, which are easily improved by cultivation in rich soil. Many kinds were often mixed in the same dish with the view of diluting the pungent flavour of some by the addition of such as were mild or tasteless, and a "grené sauce" composed chiefly of Sorrel leaves pounded in vinegar and verjuice was eaten with fish, flesh, and fowl. Whatever may have been the available supply of vegetable food it seems to have been possible to keep body and soul together upon it alone, for the most strict of the monks of old were teetotal abstainers from fish as well as flesh—they only touched them on a doctor's certificate. On the other hand John Russell, usher and marshall in hall to good Duke Humphrey, who cannot have been so bad a host as some have thought, says in his "Boke of Nurture," "beware of saladis, grene metis, and frutes rawe; for they make many a man have a feble mawe." And this advice which he offered to the young gentlemen of the 15th century seems to have become part of the wisdom of future generations, for as the Potato came into general use several of the native vegetables, with some excellent ones of foreign origin, dropped out of the bill of fare and are now only to be found at the tables of those who are curious in matters of horticulture. So late as the end of the 17th century, the ordinary dinner of good gentry and townsfolk consisted of two kinds of meat, one of which might have been salted and boiled, surrounded with five or six mounds of Cabbages, Carrots, Turnips, and other herbs or roots, with melted butter poured over them, bread being hardly tasted with the meat. Then came jocund "pudding time," to an Englishman the happiest time in the world, but ending rather ingloriously with a bit of cheese, for fruit formed no part of dessert. Such is the account given to the world by a foreigner who well knew the England of that day.

Amongst the chief classes of our native plants from which food is obtainable the *Cruciferæ*, consisting chiefly of the various kinds of Cresses, have pungent juices, but become mild by cultivation and form useful salad and pot-herbs. They are rich in nitrogen and their tendency to form masses of succulent foliage as in the Cabbage, enlarged inflorescence as in the Cauliflorwer and fleshy roots as in the Turnip and Radish, renders them valuable as food. The *Rosaceæ* produce the most wholesome and delicious fruits. The *Umbelliferæ* are generally poisonous when wild, but some behave like the Cruciferæ under cultivation producing the garden Carrot and Parsnip. The *Compositæ* have usually milky juices which are bitter, aromatic, and medicinal, but many, like the Dandelion, are good salad or pot-herbs. The *Campanulaceæ*, with bitter milky juices also, are scarcely used. Many seasonings, such as Mint, Thyme, and Marjoram, come from the Labiate plants, but the native grasses produce us nothing like Wheat, Oats, and Barley, the great sources, next to animal food, of solid sustenance for man in temperate climates.

It is clear, then, that in treating of the food-producing plants of Britain, we must look upon them only as accessory to a more substantial diet. Let it be understood, therefore, that when a plant is herein said to be wholesome or agreeable, it will generally be found more wholesome or more agreeable in company with a piece of bacon boiled or fried, and that the improvement will be reciprocal. Though all, except Cherries and a few others, are to be taken *cum grano salis*, what is here said about them may be taken in that or any other way until fairly tested; and if any poor sinner is inclined to curse the daily iteration of potatoe and cabbage, he may find here a few hints which will at once improve his dinner and his morals.

It seems convenient to divide our edible plants into the three classes following:—

1. Fruits.
2. Salad-herbs.
3. Pot-herbs.

OF FRUITS.

The Wood Strawberry *(Fragaria vesca)* excels most others in respect of wholesomeness and flavour. Comparing it with the large species and varieties we observe that it obeys the general law with plants. The proportion of special or characteristic flavour diminishes as the size increases. The Raspberry *(Rubus Idæus)* grows wild in the highest perfection in some of our northern vallies, and the Bramble or Blackberry is generally so abundant in Herefordshire, and so good, as to excite one's regret that it is not more generally gathered for the use of the poor in towns. The Dewberry and Cloudberry are excellent but less common. I shall not disturb the ancient companionship of

"—— the blackberry, haw, and hip,"

the love of which, generally attributed to the religious orders, seems to have had at least one exception. From the hip of *Rosa canina* comes the best conserve of roses, once used in tarts before other fruits of less flavour became plentiful. If the Haw (on which the Ancient Britons are believed to have fed freely) had more pulp and less stone, more might be said of it; yet the inhabitants of Kamtchatka still use it as food. The Crab Apple *(Pyrus Malus)* though displaced by its own offspring as a table fruit, and no longer found "hissing the bowl," is still much used for making verjuice, a better article than most modern vinegars. The wild Pear *(Pyrus communis)* may be classed with the various species of wild Cherry and Plum, all of which have a pleasant acid mixed with their otherwise bitter principle, and are to be valued chiefly on account of the merits of their cultivated varieties. The whole of the above plants belong to the natural order *Rosaceæ*, rich in Peach, Nectarine, Apricot, Almond, and such as are the most valued fruits of our modern gardens.

The Barberry produces a useful acid fruit. Who keeps up the old practice of preserving them in bunches? The Gooseberry and the black and red Currant are not found wild in great plenty, but are amongst the best garden fruit. On our mountains and moorlands the Bilberry, the two Whortleberries, and the Cranberry produce fruits of a peculiar and agreeable flavour, but are seldom eaten away from those localities; the wise natives take care of them! The Cranberry may however be grown in a garden pond.

I may here remark, as illustrating the natural taste of the Anglo Saxon on both sides of the Atlantic, that while fruit, and combinations of fruit with pastry, excite a tender interest sometimes even an enthusiasm pleasant to witness, ordinary vegetables and their combinations with meats are almost matters of indifference, except at the very moment of dinner. There is at all other times an absence of heart and soul in talking about them which is perfectly shocking.

Of dry fruits, the wild Hazel *(Corylus Avellana)*, from which we have the garden Filbert and Cob-nut, is good and nutricious, and was once useful as food. The Spanish Chestnut, which we cannot fairly reckon as a native tree, produces fruit which is very wholesome when cooked, and is the chief food of the people in some districts of France and Italy. The fruit of the Oak is always reckoned amongst those used anciently in Britain, and the acorns of some species are now eaten by the Moors both raw and cooked, as well as by the inhabitants of Spain, Portugal, Greece, and Asia Minor. The Sea-pea *(Pisum maritimum)*, a bitter seed, has been used in time of famine. I could not recommend it at any other time.

Two species of roots may from their mode of usage be added to the above list. The Earth-nut or Pig-nut *(Bunium flexuosum)* is common on dry pastures, and very palatable, and the Heath-pea *(Orobus tuberosus)* common on dry banks. This pleasantly astringent root has a liquorice flavour, and is chewed commonly in the northern islands of Scotland as a means of keeping off hunger and thirst. In times of scarcity the roots have been found very nutritious when boiled, and in Holland they are roasted after the manner of chestnuts. So say the authorities, but I believe they are boiled until they are tender. They may be also cultivated in the garden, and Mr. Johnson, in his work on "The Useful Plants of Great Britian," suggests a trial of their powers of improvement.

SALAD HERBS.

It may fairly be doubted whether the salad will ever become so thoroughly naturalized with us as to render its vegetable ingredients of any great importance. The labourer in towns finds the half of a Lettuce with a few middling sized Onions very much to his taste, but the majority of people look with indifference upon a carefully concocted salad. Our salads are dressed with a pungent mixture that reduces all nice fractions of flavour to a common denominator, making indeed a very good raw pickle rather than a salad. The French have always used a little vinegar, oil, salt, and pepper. The German races long used the herbs and the vinegar but barred the oil. Mons. Gerard pathetically laments the cost of progress in such matters; according to him it required the victories of Turenne, which wrested Alsace from Germany to introduce oil into the salads of that province, and even yet the people use it but little. Let us see what wild salad herbs we may gather if we will.

Sorrel *(Rumex acetosa)* formed the chief ingredient in the green sauce of the middle ages—it is commonly called "green sauce" to this day. Wild and cultivated it is much used in France and should be found in all salads. The Wood Sorrel *(Oxalis acetosella)* is also used in France and in Ireland, but its acid, though very pleasant, is too powerful for use in large quantities.

The Water Cress *(Nasturtium officinale)*, in respect of utility, stands at the head of the wholesome cruciferous salad plants, all powerful antiscorbutics. It is now so much used in towns as to be credited with a large share in the improvement of the health of town population. The Scurvy Grass *(Cochlearia officinale)* may be equally useful, but is not so inviting. Two species of Lady's Smock *(Cardamine pratensis, and C. amara)* are sometimes eaten, and the Winter Cress *(Barbarea vulgaris)*, which stands the cold well, was often sown in the autumn as an early spring salad. The Garlic Hedge-mustard *(Erysimum Alliaria)* is much used in Germany with salt provisions, its tender leaves have an agreeable flavour of Garlic, mingled with the hot savour of the Cresses. To leave the Cresses for a moment, we have in the Chive *(Allium Schœnoprasum)*, an old-fashioned species of true Garlic, which is good in salad, but, like all its congeners, needs to be used with something of the artist's hand. Leeks, Onions, and Garlic figure largely in old English cookery, often in company with Saffron, and the Spaniards now eat garlic and saffron with almost every dish. The Shepherd's Purse *(Capsella bursa-pastoris)* when grown in its wild state, in rich soil, and particularly if cultivated, produces enlarged leaves, which have been much employed. The first leaves of *Sinapis alba*, or white Mustard, is much esteemed in company with the garden cress. *Barbarea præcox* is also a good early spring salad, if sown for the purpose.

The Rosaceæ offer the Salad Burnet *(Poterium Sanguisorba)*, which has an agreeable flavour of Cucumber. The Avens also *(Geum urbanum)* is constantly found in old receipts, its leaves and roots are astringent, and in the north of Europe they are put into beer to give it the flavour of the Hop.

The Umbelliferous plants generally possess semi-poisonous properties, and are therefore to be eaten with caution. Celery or Smallage *(Apium graveolens)* is sufficiently popular as a salad when blanched and enlarged by cultivation ; it deserves, however, to be more generally used in cookery. The Alisander, which grows wild in many places, was once much used, and though not quite so good as Celery has a peculiar flavour, and ought not to be lost to the garden. Chervil *(Anthriscus cerefolium)*, hardly to be rckoned amongst native plants, is excellent in salad, and but little employed.

The young shoots of the Wild Briony *(Tamus Communis)* are said to be eaten by the Moors.

The Composite plants, amongst which we reckon the Lettuce, furnish also some other useful salad herbs. They have generally a milky juice and a bitter flavour, and possess useful properties. The Dandelion is commonly found in French salads both in winter and summer, being cultivated and blanched for the purpose. The young leaves of the wild plant when quickly grown are also used, and are of an agreeably bitter taste, which should be better known. From France also we learn to utilise the roots of the Wild Chicory *(Chicorium Intybus)*, which plant having been sown in the gardens in the previous spring is cut down in November, the roots being planted in boxes in a dark place. The blanched shoots are cut when five or six inches high, and make the excellent salad known as "Barbe des Capucins." The tender leaves of the Goat's-beard *(Tragopogon pratense)* are likewise eaten. The Rampion *(Campanula Rapunculus)* produces a root of an agreeable flavour when eaten raw—the leaves and slices of the root are put into winter salads, but its use is almost obsolete in England.

The French consider the leaves of *Sedum Telephium* equal to Purslane : in Holland *S. Reflexum* and *S. Rupestre* are also eaten. The Buck's-horn Plantain *(Plantago Coronopus)* is sown in France as a salad, The Corn Salad *(Fedia Olitoria)*, although small in a wild state, is one of the best salad herbs, and much cultivated in France as *Salade de Chanoine.* The Samphire, the young shoots of the Fennel, and the scraped root of the Horse-radish may be added. The flavour of the young and tender tops of the Borage is seldom detected in the modern salad—more frequently in those curious compound drinks which have claret for a base, and to which it imparts a pleasing illusion of coolness. Even here, however, it is replaced by such substitutes as the thin rind of lemon, a slice of Cucumber, or this last combined with one leaf of Mint, all good in their way; but if Borage is worth imitating it is worth cultivating. We must not, however, enter upon the consideration of that large class of plants which, like Mint, Thyme, Parsley, &c., are used for flavours rather than food.

From an ancient cookery book, entitled "A Forme of Cury," compiled about the end of the 14th century, by the master cooks of Richard 2nd, I extract this receipt for a salad, modernising the language :—"Take Parsley, Sage, Garlic, young and old Onions, Leek, Borage, Mint, Porrectes, Fennel, and Cresses, Rue, Rosemary, and Purslane ; lave and wash them clean ; pick them, pluck them small with thine hand, and mix them well with raw oil ; lay on vinegar and salt, and serve it forth." As usual, with old receipts, and very proper, the proportions are left to the internal consciousness of the compounder, so that a pretender to cookery might manage to make a rather nasty dish of it. Observe, however, this great truth : The salad must be plucked or broken, not cut in pieces with a knife. The dressing is French in principle, and doubtless tells the origin of the receipt.

Salads used in moderation are allowed to be wholesome to most persons ; they have also this great advantage : they are easily prepared ; while those with whom a good salad does not agree cannot do better than pass round the dish.

POT HERBS.

We now come to the larger class of plants that are adapted for food by being subjected to heat, chiefly by boiling. By this means the hot and bitter principle of most plants becomes softened, and some that are poisonous in a raw state are rendered safe : roots also and the harder tissues of some plants become edible. Quoting again from the same authority we have the following receipt for a mess of herbs :—"Take Borage, Colewort, Bugloss, Beet, Orach, Avens, Violet, Savory, and Fennel, and when they are sodden press them well small, cast them in a good broth and serve them forth." Colewort, one of the species of *Brassica*, partially improved by cultivation was much used, and was no doubt pungent when compared with our enlarged forms of this class of plants. All the forms of this natural order (the Cruciferæ) are very valuable antiscorbutics, and most of them may be used in cookery. Even *Sinapis arvensis*, the wild Charlock of the fields is thus employed in Holland and Sweden. *Brassica Oleracea*, the source of all Cabbages, Cauliflowers, Brocoli, and kindred Greens, grows wild by the sea in great plenty and is eaten by the country folks. The large solid-headed Cabbage is used for the home manufacture of Choucroute or

Sauer Kraut in North Germany and the North-west of France, every family having its stock of this partially fermented vegetable for use during the winter months. The wild Navew *(B. Campestris)*, of which the Turnips are varieties, produces useful foliage, but is chiefly valuable for its fleshy root when cultivated. The Shepherd's Purse, already mentioned as a salad, is also cultivated as a pot-herb, and the Garlic Hedge-mustard, above referred to, is in Germany boiled in company with mutton, while in Wales, it is fried with bacon and herrings. Sea Kale *(Crambe maritima)*, the tender shoots of which spring up amongst the stones and sand of the sea shore, has been locally used for centuries, but it is only in recent times that it has been regularly cultivated for the table. It is one of those delicate and wholesome plants which, requiring a little care in cultivation and in cooking, are comparatively little used. The blanched shoots which spring in winter from the crown of the stored turnip make a good substitute for it. *Cardamine Pratensis*, enlarged by cultivation, is sold as a pot-herb in the neighbourhood of Philadelphia.

Those who love the delicate flavour of Spinach will find something to say against most of its substitutes, but the Mercury-leaved Goose-foot or Good King Henry is a fair imitation of it and is sometimes preferred. The tender tops of the Nettle *(Urtica dioica)*, gathered in early Spring, have an agreeable flavour of their own, and although generally boiled as spinach are useful also in soup. You may cut them in mid-winter if the roots have been planted under a frame in rich soil, as seems to have been well known to Sir Walter Scott, one of whose characters plumes himself upon having been bred "where they raise lang kale under glass and force early nettles." A friend from farthest Shetland has grave fears that their use is decreasing. It was an old practice in Alsace to boil them with the leaves of the violet. The young leaves of the Dandelion make a good dish when boiled, and those of the sea-beet *(Beta maritima)* are gathered for the pot by the cottagers on the coast. They are good, especially with salt meat, and the worst I can say of them is that they are rather "earthy" as compared with spinach.

The common Chickweed *(Stellaria media)* is remarkably nice when boiled. The young shoots of the Bladder Campion *(Silene inflata)* have a strong flavour of green peas, and, though rather bitter, that objection may be removed by blanching. They are much used in the Levant.

The Asparagus *(Asparagus officinalis)* a seaside plant very partially distributed is well known in cultivation for the delicious flavour of its young shoots. Of plants which are cooked in imitation of it, the Hop produces young shoots which are much used in France and in some parts of England under the name of "Hop tops." In Belgium there seems to be a practice of blanching them by means of sand. Linnæus recommends the young shoots of the Sea Holly the roots of which may also be candied and used as a sweetmeat. The young flower spikes of the tall Star of Bethlehem *(Ornithogalum pyrenaicum)* a rare plant allied to the lilies are also boiled in the neighbourhood of Bath. The shoots of Good King Henry, peeled and boiled, taste like asparagus. In Scotland the soft cores of Cabbage stems, called castocks, are thus cooked, as also are the shoots of *Epilobium angustifolium* and *Tamus communis*, the tender stalks of the Burdock cut and stripped just before flowering are delicious, and so are several others—more or less. Indeed it seems somewhat superfluous to plant asparagus, such is the magic of toast and butter.

The Alisander was used as a potherb as well as in salad, just as celery may be used now. *Picris hieracioides*, *Hypochœris maculata* and several other of the milky compositæ are described as good. The Sow-thistle *(Sonchus oleraceus)* was used by the Romans as well as by old English cooks, and is still boiled as spinach in some countries and much praised. Mons. Soyer says it has been given up to the rabbits who are likely to retain undisputed possession of it. If one could be quite sure that he had tried it we might be better inclined to take his word as to its value. The milk thistle *(Carduus Marianus)* used to be cooked for the table, and I have seen a receipt dated about 1760 for cooking the blanched root leaves of the largest of our thistles after the manner of Cardoons. The peeled stems and the thick mid-ribs of the leaves in the whole tribe are decidedly nutricious—let those who know and love the Cardoon look kindly on these poor relations for its sake. In Belgium they boil the roots of the Wild Chicory parsnep-wise. Salsify *(Tragopogon porrifolius)* is an excellent table vegetable, now again somewhat more in fashion. The common yellow goatsbeard *(T. pratensis)* may be similarly used, and was cultivated in old gardens. The French continue to use it under the name of *Salsifi des prés.*

Amongst the Umbelliferous plants — two roots — the Carrot and the Parsnep require cultivation to reduce their strong flavour and poisonous properties. Professor Buckman experimented for several years upon the Wild Parsnep at the Agricultural College, Cirencester, and produced a middling sized and very regularly shaped root, with a better colour and more flavour than the rather mild vegetable with which our ancestors qualified their diet of salt fish. This, which is named the "Student" Parsnep,is succeeding well in the hands of Messrs. Sutton of Reading, who say that it is the best now grown.

The tuberous root of *Stachys palustris* is rich in starch, and makes a palatable dish, especially if grown in rich soil. That of the Goosegrass *(Potentilla anserina)* is roasted or boiled in Scotland, and has the flavour of parsnep. Of roots which are used in making bread, those of the Meadow sweet are ground up for that purpose in Sweden. Those of the Buckbean and Bistort have also been employed.

The large roots of the black and white Briony and that of the Meadow Saffron, *(Colchicum autumnale)*, although of an acrid nature, become mild by cooking, bruising, and washing in water. The milky root of *Arum maculatum* being thus treated, loses its pungency, and is commonly eaten in the neighbourhood of the Isle of Portland as well as being manufactured for sale in London under the name of Portland sago. All these plants should, however, be very cautiously dealt with by amateurs. From the roots of two species of Orchis, *mascula* and *morio*, is made Salep, which of all substances produces the greatest amount of jelly in proportion to its bulk. In the East it is used as food. It is said that one ounce of it per day will support a man for several days together. I have made it on a small scale, by following the ordinary directions : to scald the roots, rub off the skin, dry in the sun if possible, and then to reduce them to the state of flour, which is to be boiled in milk or water. The roots of the water Arrow-head may be treated like those of the orchis : they shonld not be used without care.

For all information relating to the British Edible Funguses, I gladly refer to Dr. Bull's illustrated paper in the last volume of our Transactions. Those to whom he has given a taste of their quality, owe him a double debt. I may, however, mention two cryptogamic plants. *Fucus vesiculosus*, a sea-weed, said to be mingled with flour in bread, and *F. palmatus*, which in the north of Scotland is freed from salt and eaten in milk or broth. Certainly the northern islanders eat small quantities of Hindware and two kinds of Tangle, and the preparation from sea-weed known as "Laver" is relished as a luxury by many persons.

If I have not in each case subjected the plant (and myself) to actual experiment, I have done so wherever I was able, and I live to tell the tale. In inquiring into the truth of the ordinary statements handed down from author to author as to the use of herbs in particular localities, I came to this conclusion. Wherever a wild plant is said to be used on the Continent it is actually used at the present day, and often forms an important part of the food of the people, but when it is said to be used in England, it will probably be found to be either forgotten or only eaten occasionally as fancy dictates. The general enclosure of lands in this country, and the constant appendage of a garden to each cottage, disposes our poor to depend upon such plants as they can grow rather than such as they may or may not be able togather. If a wild plant is really good, it is often more economical to grow it in the garden than to seek it in the field. But the great reasons for the neglect of wild vegetables seem to be :—1st, a very general ability in all ranks to obtain really good bread, potatoes, and even meat, in fair proportion ; and 2nd, a lamentable want of aptitude for the practice of cookery as a fine art. We are not simply content with plain roast and boiled, they are part of our national glory. I well remember the contempt with which some English villagers spoke of a small colony of French artizans who had settled in their neighbourhood and might be seen "picking up all manner of rubbish out of the hedges to eat."

But it is not everyone who has a garden. And if by a little ingenuity—such as every French peasant knows how to apply—a good dish of vegetables may be obtained free of cost, the requisite knowledge is worth acquiring. Nor is the subject without bearing upon the health of those classes even in which the question of expense is unimportant. The effect of the particular flavours by which we distinguish plants seems to go beyond the palate, and it is in accordance with the best opinions to suppose that the moderate use of a variety of such vegetables as please the taste is more wholesome than an adherence to one or two, however valuable they may be. There is hardly a succulent plant, not poisonous, which cannot by the skilful addition of some simple seasoning be made into an agreeable dish.

In pointing out the raw materials for a lenten meal I will only add that the wise man who knew all plants from the cedar to the hyssop tells us with what sauce a "dinner of herbs" may be made to excel a more substantial feast.

THE AIR OR SWIM-BLADDER OF FISHES.

BY JOHN LLOYD, Esq.

Whether we examine, as is the wont of the members of our Woolhope Club, the position and nature of the primeval rocks, the parts and functions of animals, the structure and uses of plants, or other special branches of natural history,in all alike we find signs of the wise providence of our Creator. In earth, air, and water, and in their denizens, animate and inanimate, we see the wonders of the creation displayed, and a marvellous adaptation throughout, of the means to the end.

The birds when formed to fly in the air had wings given them, and their locomotive powers specially adapted to act npon that medium ; and fish likewise were furnished with fins framed to act with the greatest power on their element, water— and in both auxiliary air cavities are provided.

In birds the central cavity of the bones, usually occupied by marrow, is filled with air ; and it has been found that in proportion as their bones are connected with the respiratory process, and their interior filled with air instead of marrow, so are their special powers of flight increased. In fish the air cavity is the subject of this paper—the Air or swim-bladder. Here it has been said that those capable of the most vehement and prolonged efforts possess the largest air bladders, and those with the quickest action. In the cases both of the bird and the fish the chief and primary object is by the introduction of a considerable quantity of air to lessen the specific gravity, and thus aid locomotion ; and in proportion to the amount of air thus held, their speed and power of progression is in both animals much enhanced.

The Air bladder of a fish is a most beautiful and admirable device. Paley calls it a philosophical contrivance, and brings it forward in his "Natural Theology" as an instance of the wise design of the Creator. He further says : "The principle of the design is clear, and the application of the principle is clear also." The principle is clear enough, it is true, but its application in all cases is far from being so. The subject of the Air-bladder of fish has engaged the attention of the most eminent naturalists, including Munro, Lacèpède, St. Hilaire, Cuvier, Müller, Owen, and Milne Edwards, and though all agree as to the principle, yet they differ widely as to the application. In preparing this paper, and following them through the mazy labyrinths of their disquisitions, the endeavour is made to get hold of some clue, which, if not entirely explaining this *vexato quæstio*, may help us on our path.

The Air vessel consists of three coats or coverings lying closely one over the other. The interior one is a thin serous lining membrane, by which the air is secreted. Next to this is a vascular membrane full of conspicuous blood-vessels, which supplies the blood from which the air is secreted by the inner membrane. The third and outer covering is a strong fibrous coat, which serves to protect the apparatus from injury by accident or sudden movements : it is also often muscular, giving the fish power to contract the vessel at will.

It is the opinion of some physiologists that the Air bladder in its most simple form is developed as a process or *diverticulum* from the upper part of the alimentary canal, so that when it forms a closed sac the original communication must have been obliterated. However this may have been, we find in the large majority of fish possessing air bladders that the sacs are closed on everyside, and have no communication with any other organ. This is the case in the order of Acanthopteri (Müller), which includes among other kinds the Perch, and one kind of Mackerel, and also in the Gadidæ branch of the Anacanthini, consisting of the Cod, Haddock, Turbot, Ling, &c. The air bladder of the Cod is of large size, commonly called the sound, and is covered with thick coats. It is entirely destitute of any communication with the stomach or gullet, as we shall find to exist in those of nearly all fresh water fishes. This is also the peculiarity of the orders of Pharyngognathi and Plectognathi, consisting almost entirely of sea fish. On the other hand, we find that all the fish of the order of Malacopteri, such as the Herring, Salmon, Trout, and the Salmonidæ generally, Pike, and the Eel, possess a communication between the air vessel and some part of the alimentary canal near to the stomach by a short duct called *ductus pneumaticus ;* and in the Cyprinidæ or Carp tribe this duct leads to the Œsophagus or gullet. A similar duct is found in the Ganoidei order, and in the British family of the Acipenseridæ or Sturgeon tribe, which have very large air bladders, and communicating with the gullet by a short and wide duct.

These air vessels are, in some instance, as in the Salmon, Trout, Pike, Perch and Eel, closely attached to the side and the spine of the fish, while in others, as in the Carp tribe, they float loosely in the stomach. There are also intermediate varieties. Their shape varies much. The ordinary simple form is that of a single lobe of an elongated-oval shape, or two arcs of a circle joined together. In all the Salmon, Herring, Pike, and Eel families, it is one elongated cylindrical tube lying close to the under surface of the backbone and adhering to it, and in some cases, as in the Pike, connected with the ribs by strong ligaments. Another and quite distinct form is that where there are two chambers or lobes with oblong cavities, the anterior one generally slightly truncated at the end placed one behind the other, and connected by a short tubular neck. In all classes of fish where the air vessels are of this form, and not being closed sacs, there is a duct leading from the anterior part of the hinder lobe to the œsophagus, and in this duct there is a valve closing outwards, which while it allows the air to be expelled prevents its admission. This is the character of the Cyprinidæ, and some of this family have also a connection between the anterior lobe and the acoustic organs by a chain of vesicles. Some of the Cyprinoids have also air vessels in three divisions, placed one behind the other, and in some of the Gurnards, a fish of the order of Acanthopteri, the air vessel has three lobes placed side by side, while in others it is only bilobate. In this species there are many various forms of air vessels.

The nature of the air or gas contained in these bladders has been the subject of repeated inquiry. Monsieur Fourcroy found some azote in the vessel of a Carp, while Dr. Priestly states that he found in those of several fish oxygen mixed with a considerable quantity of another gas, of which he had not found out the nature. Dr. Brodbett examined some Sword fish, and found pure nitrogen. Lacépède examined some Tench, and found hydrogen gas. Yarrell states that various chemists have found the air in different fishes to consist of nitrogen, oxygen, and carbonic acid, the nitrogen in greater proportion, and the oxygen smaller, than in atmospheric air. In marine fishes the oxygen is in excess, varying from 40 to 87 per cent., depending on the depth at which the species usually remain. Fish, like the Gurnards, having closed air bladders are the best subjects for this examination, because the vessels can be removed from the interior of the fish without any of their contents being lost. In the air bladders of all sea fish a greater proportion of oxygen is found. Biot detected as much as 87 per cent. of oxygen in the air bladder of deep-sea Mediterranean fish. Professor Owen states generally that oxygen predominates in the air bladders of all sea fish living at great depths; and that in most fresh-water fishes the air bladder is filled with nitrogen, mixed with a very small quantity of oxygen, and a trace of carbonic acid. According to Humbolt there is 4 per cent. of oxygen, and 96 per cent of nitrogen in the air bladder of the Gymnotus, and Dr. Davy found in the air bladder of a Salmon in fresh water a little carbonic acid, 10 per cent. of oxygen, the remainder being nitrogen. Carpenter says that "the gas which the air bladder contains is composed of the same elements as atmospheric air, namely, oxygen, nitrogen, and carbonic acid, but these are mixed in proportions that are very liable to variation."

From this conclusion, it has been argued that the excess of oxygen in the bladders of sea fish is given for a special purpose, and intended to serve as a substitute for the deficiency of oxygen in the sea water itself. There is some weight to be attached to this argument, and independently of the different physiological properties of the gases, it is strengthened by the consideration of their different specific gravity. The specific gravity of fresh water being much less than that of sea water, being as 1,000 to nearly 1,030, and nitrogen being a much lighter gas than oxygen, fresh-water fishes are supplied with the more buoyant gas ; and thus in each the degree of buoyancy is adjusted to the specific gravity of the water in which the fish lives.

One evident purpose of the air-vessel is to lessen the specific gravity of the body of the fish, which is in itself heavier than the quantity of water whose place it occupies. This is effected by increasing the size of the fish without any appreciable addition to its weight, and thus creating a displacement of water equal in weight to that of the fish. The body without the air-bladder weighs say 10 oz., and the water displaced weighs only 9 oz.; hence the fish must sink, unless it used incessant muscular exertion; but the presence of the air-bladder removes this difference, and thus the great end is obtained of enabling the fish to poise or balance itself at varying depths of water, or according to its temperature, and thus to remain at rest with the slightest amount of muscular exertion.

This use is of a passive kind; another of a more active kind is attributed to it. This is :—

To enable the fish to raise or depress itself in the water at pleasure. Opinions of learned naturalists differ somewhat on this point. Lacèpéde asserts, as a fact beyond question, that fish raise or depress themselves in the water by the contraction or expansion at will of this vessel. He says "that the gas, when transmitted through the pneumatic canal to the swimming bladder, which is called the aërial bladder, swells and extends that vessel, renders it much lighter than water, and gives to the fish the facility of raising itself in this liquid. When, on the contrary, the animal wishes to go down, it compresses its swimming bladder by means of the muscles which surround this organ; the gas escapes by the pneumatic tube, and the weight of the solid parts of the fish drags down the animal more or less rapidly to the bottom of the water. This effect of the swimming bladder on the rising and descent of fish cannot be questioned, since, independently of other reasons, and, as Artedi has announced, any one can prove the fact by piercing with skill, by means of a suitable needle, the air-vessel of a living fish, when it will be found that the fish can no longer rise in the water." Lacèpéde further states "that this fact is well known in countries where the art of fishing has been much cultivated, and that there the fishermen, in order to prevent the fish leaping over the sides of the troughs in which they are placed, pierce the air-bladders, and then the fish lie quietly at the bottom." Wood, in his Zoography, mentions this as being commonly done by the Cod fishermen at the Newfoundland fisheries.

Yarrell says "that one use of these air-bladders to the fishes possessing them is to enable them to alter their specific gravity with reference to that of the fluid they inhabit seems almost certain. We see the gold-fishes in our ornamental vases ascend and descend in the water without making any visible external muscular effort. In this respect their action is to be understood and explained by the well-known hydrostatic toy of the philosophical instrument makers, in which a small glass balloon, or other figure, confined in a column of water, has its weight, by the introduction of a small quantity of air, so nicely balanced in reference to the specific gravity of the water, that it is made to ascend or descend according to the degree of pressure made by the finger on the elastic cover of the top." Paley, in his "Natural Theology," says: "The use of the organ to sustain, and at will also to elevate the body of the fish in the water, has been proved by observing, what has been tried, that when the bladder is burst the fish grovel at the bottom; and also that Flounders, Soles, and Skates, which have no air-vessels, seldom rise in the water, and then with effort." And he says, "This power is derived by the contraction of the bladder when the fish descends, and the expansion when it rises." This has doubtless been the general belief, but Mr. Carpenter states that this is an error, as, by experiments made, the fish still retains the power of raising or lowering itself in the water after the organ has been removed.

In order to reconcile these statements, we must remember the great distinction before noticed between fish that have closed sacs, and those that have sacs provided with an outward communication. Now when the sac is closed, and full of air, it seems impossible to eject the air and so loose the buoyancy, though certainly the compression of the bladder and therefore of the air may have the same effect in a degree, but in these cases it would seem that the air vessels are given simply to fulfil passive purposes, and that the fish being thus made buoyant, as before said, has no weight to lift, and is able to raise and depress itself by the smallest amount of muscular exertion. When there is a pneumatic duct attached, it is evident that the fish, by muscular action, can discharge the air through the duct, and is thus enabled to lessen its specific gravity, and pass more rapidly downwards through the water. Many of our fresh-water fish of prey, the Pike for instance, have very strong ligaments connecting the air-bladder throughout its length with their ribs, and thus by sudden movements of the body have instantaneous control over that organ. The Pike, as is well known, remains for a length of time stationary, or slowly moving in mid-water, until, sighting its prey, it makes a rapid dart in pursuit, and thus must find such an immediate control over its own specific gravity of the greatest use. As a general rule in all cases where there is a pneumatic duct there is also a power given by muscles or ligaments to act directly on the air bladder and lessen its contents.

The changes of temperature to which shallow water is so manifestly liable must often increase very much the size of the air-vessel, and would seem in itself sufficient to prove a source of great discomfort to the fish. It is probably due to this cause that in hot weather, especially when it has come on suddenly, the fish in ponds are observed moving about in shoals upon the surface in a thoroughly listless way, refusing to bite, or take any interest in things in general. The provision of an air-duct in fresh water fishes, to which of course these remarks chiefly apply, would more or less quickly give them the required relief.

The Air vessel has also been considered to be a rudimentary organ of respiration. Fish constitute the lowest order of the vertebral branch of the animal kingdom, and many anatomists have sought to give to the air vessel the character of a homologue of a lung. Professor Owen considers it to be this, and Dr. Roget says "it is regarded by many of the German naturalists as having some relation with the respiratory functions, and as being the rudiment of the pulmonary cavity of land animals, the passage of communication with the œsophagus being conceived to represent the trachea." Harvey observed that the air in birds passed into cells beyond the substance of the lungs, thus showing a resemblance to the cellular lungs of reptiles, and the air bladder in fishes. M. Agassiz, in dissecting a species of *Lepidosteus*, or "bony Pike," a fresh water fish of North America, found the air bladder to be composed of several cells, with a tube proceeding upwards into the pharynx, and entering by an elongated slit, having everted edges, resembling a glottis or tracheal aperture. Yarrell states that various Siluroids and Protopteri possess air bladders with similar pulmoniform complications, and that though it is generally admitted that the chief function of the air bladder is to regulate the specific gravity of the fish, yet comparative anatomists consider it to be the homologue of the lungs of the air-breathing vertebrata, or the rudimentary state, in which that organ first appears in the ascending scale of the animal creation.

Carpenter says that "the cavity of the air bladder is in some instances so divided by membranous partitions, as to give to the organ the character of the lung of a reptile. The true relations of this organ are most remarkably shown in the *Lepidosteus*, which presents many reptilian affinities. Another fish may also be mentioned as presenting an apparatus adapted for atmospheric respiration, which is rather a peculiar development of the bronchial apparatus than the rudiment of a lung of air-breathing vertebrata. This is the *Cuchia*, an eel-like fish of the Ganges, in which saccular prolongations are found in one of the gill-chambers used for atmospheric respiration. The power which this animal has of distending the respiratory sacs with air when on land, and the necessity it is under of rising to the surface of the water for the same purpose prove beyond a doubt that they perform the function of lungs, and lead us to the conclusion that the *Cuchia* is amphibious in the strict sense of the word—forming a connecting link between the Ophidian reptiles and the Synbranchus among fishes. In some other fish, especially such as naturally inhabit small collections of fresh water, whose temperature is liable to be considerably raised during the heat of summer, the mucous lining of the alimentary canal appears to act as an additional organ of respiration; for such fish are seen frequently to rise to the surface, and *swallow* air, which is subsequently discharged by the anus with a large quantity of carbonic acid substituted for its oxygen. This is the case with the *Cobitis* (Loach); and it would seem as if under these circumstances some such supplemental means is required for carrying on the respiratory process with unusual activity." Carpenter sums up thus: That where there is a short and wide opening to the œsophagus the air-bladder may serve as an accessory organ of respiration, atmospheric air being taken in, and carbonic acid ejected through the alimentary canal; but in those whose air-bladder is a closed sac, it seems that it cannot in any way conduce to the aeration of the blood. This appears to be one of the many instances which may be pointed out in the animal and vegetable kingdoms, where the rudimentary form of an organ that attains its full development in other classes, is adapted to discharge some office quite different from that to which it is destined in its perfect state." But how diffidently do all naturalists speak on this subject!

The Air bladder does not exist in all fishes, and is absent in those sea-fish accustomed to remain at the bottom, and whose movements are slow. Such is the case in the order of Dermopteri, consisting of the Lancelet, Myxine, Lampern, and Lamprey, and in the Pleuronectidæ, a sub-order of the Anacanthini, consisting of Plaice, Sole, Flounder, Brill, Turbot, Helibut, and Dab, commonly called "flat fish." It is easy to understand why, in the order of Pleuronectidæ, this organ is absent, because the habits and form of this class of fish are not such as to require it. Flat fish frequent sandy and muddy shores, swimming closely to the bottom, with their white and under sides frequently resting on the mud. Their form also, width without depth, give them additional buoyancy in the water. The air-bladder is also absent in the large order of the Plagiostomi, divided into the sub-orders, Squali and Raiæ, the former consisting of Dog-fish, the Shark family, and the Angel-fish, and the latter of the Torpedo, Skate, Thornback, and a variety of Rays. The Shark family are provided with very strong muscles and numerous fins, which compensate in some measure for the absence of an air-bladder, and though capable of vehement efforts, cannot prolong them. It may be added that since the air-vessel at all times requires considerable space in the abdominal cavity, there would scarcely be room in the internal structure for viviparous reproduction.

The sub-order of Raiæ swim sideways, like the flat-fish, and in addition to the advantage of having their weight distributed over a considerable surface, some of the species have their body fringed with a web somewhat resembling a continuous fin, or the wing of a bird, which being muscular, assists much in the support of the body. Almost the only fresh water fish in which the air-bladder is not found, is the well-known little Bull-head, or Miller's Thumb, the latter name being derived from its flat head, resembling in shape the miller's well-worn and flat thumb. The habit of this fish is to hide under the stones in the river's bed, beneath which it is able to thrust easily its appropriately-formed head, and though it swims away rapidly when disturbed, seldom rises from the bottom.

There are exceptions, however, to this rule of nature, for which it is impossible to account. We have two Red Mullets without swim-bladders, and yet they seem to possess all the powers in the water of the Indian and American species, which have them. The two British species of Mackerel both swim near the surface of the water with the same ease and swiftness—one has a swim-bladder, the other has not. Of our two species of *Orthragoriscus*, which appear to possess the same powers—one has the swim-bladder, the other has not. Such exceptions add much to the interest with which this subject is replete, and when we seem to have hit the truth, we find ourselves wide of the mark.

It will be interesting here to give a description of the swimming bladders in our common fishes.

The *Salmon* has an air-vessel consisting of one elongated cylindrical tube, lying close to the back-bone, which opens almost directly into the pharynx, or without the intervention of a distinct duct. The air-vessel is much more delicately formed than that of the Pike, and is connected with the ribs and spine by much finer ligaments. Trout and nearly all the Salmonidæ have similarly shaped air-bladders. The *Grayling*, however, has an air-bladder communicating with the œsophagus by a very small tube.

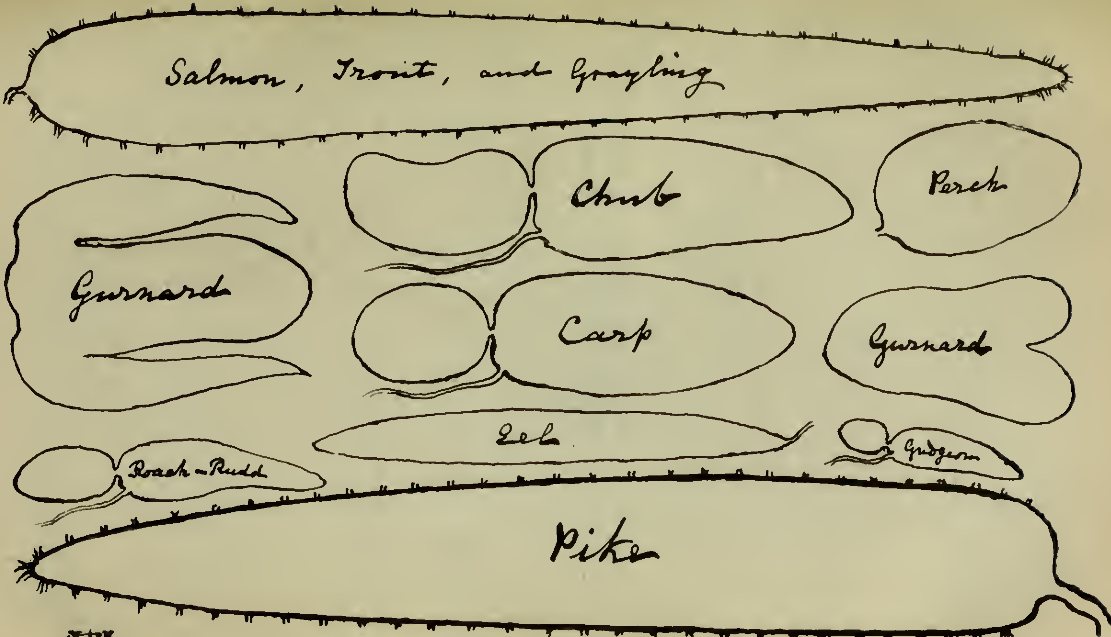
The *Carp* family, consisting of the Carp, Roach, Chub, Rudd (or Red-eye), Barbel, Bream, and Dace have large air-vessels divided by narrow and short necks into two or more chambers. The Chub, Roach, and Rudd, have two large chambers, the anterior one slightly truncated at the upper end, and connected with the posterior one by a short tubular neck. From the upper end of the posterior one a duct runs forward into the œsophagus. The air-vessel of the Dace is similar, except that the posterior chamber is comparatively longer, more narrow, and cylindrical. The air vessel of the Gudgeon resembles that of the Dace, though the posterior chamber is hardly so narrow, and in both the anterior one has a slightly truncated end.

In all the family of Cyprinoids the air-bladder, though closely packed in and enveloped by the intestines, is loosely fixed in the abdomen, and is not connected with the ribs or spine by any strong ligaments as in the Pike. The covering is, however, muscular, and the fish has thus the power of contracting the vessel and expelling the air through the pneumatic duct.

The air-vessel of the *Pike* forms one long and large sac extending the whole length of the abdominal cavity, and only separated from the spine by the blood vessels. Externally it has a very tough fibrous membrane of great strength, and is connected on both sides to the ribs, and also to the spine by short strong ligaments. At the upper end there is a small round tube of about half an inch in length communicating with the gullet. If you attempt to pass a probe from the gullet into the air-vessel it is stopped, but if you pass the probe from the bladder into the gullet there is no resistance. It is clear therefore that the communication between the air-vessel and the gullet is guarded by a valve, which allows the air to escape outwards, but not to enter. In a pike of 12½lbs. weight the air-vessel was 12 inches long.

The *Eel* has an air-bladder of very delicate construction. It is fusiform, with two short processes at the anterior end, enveloped in the common integument; the inferior one, or vertical process, is closely bound to the œsophagus, and is cellular, as is also the posterior end of the vessel. There are, moreover, several membranous diaphragms in the air-vessel of the Eel, with a vascular ganglion; and a duct leads from it to the alimentary canal near the stomach. It is closely connected with the intestines, and is with difficulty separated from them in making an examination.

The *Perch* has a simple large air-vessel or chamber fixed close to the spine,



Forms of Swimming Bladders.

more closely even than in the Salmonidæ. It is also of more delicate construction, consisting of very fine transparent membrane, extending between the vertebral column and the abdomen. This membrane forms also the covering or lining of the ribs and spine, and so closely adheres to them that it is impossible to take out the air-vessel entire. The delicate inner lining is plainly visible. The air-vessel forms a closed sac, and there is no communication from it either to the gullet or œsophagus.

From the preceeding remarks the following general conclusions may be drawn:—

1. All fresh-water fish, with a single exception, and the generality of sea fish, have air-vessels.

2. In the large majority of fresh-water fish there is some communication between the air-vessel and the intestinal canal.

3. In the large majority of sea fish the air-vessels are closed sacs.

4. The position of the air-vessel is always the same, near the centre of the body.

5. The air-vessel varies considerably in shape in different fish.

6. The gas contained in the air-vessel is secreted by the lining membrane of the sac.

7. Its constituents are the same as atmospheric air, but vary in their proportions. In the air-vessels of fresh-water fish nitrogen is in excess; and in those of sea fish oxygen is most abundant.

8. The chief use of the air-vessel is to lessen the specific gravity of the fish, and thus to enable it to poise or balance itself with the smallest amount of muscular exertion.

9. Fish possess the means—more or less evidently shown—of regulating the amount of air in the vessel, so as to adapt their specific gravity to the position they occupy in the water, to the temperature of the water itself, or to the purposes they wish to effect.

10. Where the sac is closed, the change is probably produced by the slow process of reabsorption of the air.

11. Where the duct of communication—the *ductus pneumaticus*—is small and long, as is most frequently the case, the change is more readily affected.

12. When the *ductus pneumaticus* is short and large, a great change may be instantaneously affected.

13. The air-vessel is a rudimentary lung, adapted to fulfil the secondary object of lessening the specific gravity of the fish.

14. In some rare cases it may still form a portion of the respiratory apparatus, and possibly does so in many more when an emergency calls for it.

15. Fish without air-vessels are usually such as frequent the bottom of the water; but there are exceptions to this rule—in some an increased muscular development seems to render it unnecessary, and in others there is no clear explanation of its absence (applause).

(The paper was illustrated by dried specimens of air-bladders and outline sketches.)

The Rev. W. Houghton said he could make many remarks on Mr. Lloyd's interesting paper, but he should confine what he had to say to a few points, as there was very little time for discussion. As to the gaseous contents of the air-bladders of fish, he confessed he shared with the late Dr. Davy considerable doubt. That the same organ should secrete two such different gases as nitrogen and oxygen seemed certainly very anomalous. It was generally believed that salt-water fishes secreted oxygen, and fresh-water fishes nitrogen, in their air-bladders. Humboldt, experimenting on the *Gymnotus Electricus*, of South America, found the gas to consist of 96 per cent. of nitrogen and 4 per cent. of oxygen. M. Biot, on the other hand, experimenting on some deep-sea fishes of the Mediterranean, found 87 per cent. of oxygen, and the rest nitrogen, with a trace of carbonic acid. The secretion of oxygen by any animal was remarkable, and one might as well expect this gas to be exhaled from the lungs in respiration, as separated from the blood by secretion from the inner tunic of the swim-bladder. Mr. Houghton did not mean to deny the results obtained by Humboldt and Biot, but he thought the matter required further verification.

As to the function of the swim bladder he regarded it as simply a mechanical one as affecting the specific gravity of the fish; but he did not agree with Mr. Lloyd in regarding its presence as an important organ. This was evident from the fact that in closely allied species of fish, with precisely similar habits, one species had a swim bladder and another had not. For instance, the common Mackerel has no swim bladder,—one or two other species of Mackerel have one. Of the two British species of sun-fish (*Orthragoriscus*), one has a swim bladder, and the other has not. Some of the Siluroids were possessed of a very complex swim bladder, others again had none at all. Other instances might be given.

With respect to the question of the swim bladder of fishes being homologous with the lungs of air-breathing vertebrata, this was the most interesting and important point of all. Although, functionally, scarcely a single fish, perhaps, uses the swim bladder as a respiratory organ, yet it was quite clear from the case of the mud-fish, or *Lepidosiren*, that those anatomists who regarded the swim bladder as the homologue of the lungs, and the pneumatic duct, where it existed, as the homologue of the trachea of air-breathing vertebrata were correct. The *Lepidosiren*, whether of the African or South American rivers, appears to be at one time a Fish, at another a Batrachian, so far at least as its respiration is concerned. Whilst it inhabits the water it breathes by means of its gills as a fish, but when it burrows itself in the mud of these tracts, which after the overflow of the river are left dry, then the swim bladder and *ductus pneumaticus* come into play, and respiration is carried on mainly through them. The swim bladder of the *Lepidosiren* is double, with many cellular divisions, lung-like. The pneumatic duct is wide and short, and opens out into the Œsophagus. It is kept open by a special provision; there is, moreover, a pulmonary artery which conveys blood to the lung-like swim bladder. So amphibian-like is the *Lepidosiren* in some respects that naturalists differ whether they are to regard it as a Fish or a Batrachian. Owen is satisfied that "the totality of the organisation of the *Lepidosiren* exemplifies its fundamental ichthycic nature." In the structure of the swim bladders of the *Polypterus* and the *Lepidosteus* we meet with transitional states connecting the simplest closed swim bladder with the double lung-like organ of the *Lepidosiren*; and this seems to be a verification of Mr. Darwin's remark on the swim bladder of fishes when he says, "There seems to me to be no great difficulty in believing that natural selection has actually converted a swim bladder into a lung or organ used exclusively for respiration." Mr. Houghton thought in *Lepidosiren* we have a living witness of a Fish in a transition state towards becoming a Batrachian. The embryology of the *Lepidosiren* would doubtless throw much light on this question (applause).

Had time permitted there would have been a long discussion on this interesting subject.

PALÆONTOLOGICAL NOTES ON THE SILURIAN STRATA IN THE WOOLHOPE VALLEY.

By the Rev. P. B. BRODIE, M.A., F.G.S., Vice-President of the Warwickshire Naturalists' Field Club.

The fossils of the Ludlow formation and Wenlock Limestone, including in the latter the Woolhope Limestone, which is only a local development of the Wenlock series, are so well known that it may seem a work of mere repetition to make any remarks upon them ; but a recent sojourn of a fortnight in this interesting and most instructive district, during which I visited nearly every quarry, escarpment, and available section, has led me to form some conclusions respecting the range and number of the organic remains which may be worth recording.

In this part of the Silurian area, the sea evidently abounded in corals, as it did elsewhere ; many of them—especially *Stromatapora striatella*, *Halysites catenulatus*, *Favosites Gothlandica*, and some of the larger and frequent species of *Heliolites*, *Arachnophyllum typus*, *Strephodes vermiculoides*, and *Cyathophyllum articulatum*—being of massive form, are often well preserved, and widely distributed ; but I failed to detect many, if any, of the rarer genera which occur at Dudley, Wenlock, and other places. I was particularly struck with the comparative paucity of shells, both gasteropods and molluscs, *Leptæna euglypha*, *Atrypa reticularis* (a very ubiquitous shell, being the only one which passes into the Devonian and Carboniferous), *Spirifer*, *Euomphalus*, and a few others were common enough, and in this respect differ widely from the richer districts of Malvern, Dudley, &c. In the catalogue of the Geological Survey a larger list of Conchifera is given, including many genera I did not meet with, but still the number is not great, and absolutely small when compared with other upper Palæosoic regions, and so far bears out the view advocated in this paper. The Wenlock Shale, and lower Ludlow beds contain, as might be expected, a larger assemblage, but nothing like the remarkable abundance and variety which occurs in the Wenlock Shale at Ledbury, Walsall, and Dudley. The same may be said of the Crustacea, which appear to be positively rare. The common genera, *Calymene Blumenbachii* and *Phacops caudatus*, being apparently very sparingly distributed, less so though in the Shales than in the Limestones. I turned over hundreds of slabs of the latter, which at Dudley swarm with organic remains, and only remarked a few small corals, *Bryozoa* and shells, and those chiefly *Atrypa, Spirifer, Leptæna*. Broken stems of Encrinites are abundant, but only once did I discover any portion, even of a head. As I carefully searched over a very wide extent of the calcareous portion of the series, the result is certainly remarkable, for had my investigations been limited to only a few quarries, the comparative rarity of many genera and species more or less common elsewhere would not be unusual, since certain localities with favourable conditions are often prolific in forms which are usually rare, as in the case of the abundant star fish in the Ludlow formation at Leintwardine. A rather unusual fossil from the Palæozoic rocks of this district is a set of horny hooks of some Cephalopod, which I found in a nodule in the Wenlock Limestone at Dormington, which although not uncommon in the Lias, have not, I believe, been before detected in the Silurian formation. From the abundance of Orthoceratites it may be inferred that these horny hooks belonged probably to the animal which inhabited these shells, and their preservation is due to their horny nature, the softer parts of the mollusc having perished, the former being at present, as far as I am aware, the first and only trace of the animal in the more ancient rocks. The lower Wenlock, or Woolhope limestone, contains portions of Trilobites, especially *Bumastus Barriensis* and *Homalonotus cylindricus* (N.S.), the latter never entire, the former very rarely so, and a few molluscs, but by no means abundant. Mr. Dixon, in speaking of the Llandovery limestone, remarks that it would be a great find to discover any fossils in the Woolhope area. Though much less abundant than at May Hill and elsewhere, I found a few of the characteristic species, viz., *Petraia bina, Pentamerus oblongus*, and the rarer *Stricklandina rens*, in blocks of sandstone on the slope of Haugh Wood, just above Scutterdine, and also in a field near Woolhope. In a narrow lane near Littlehope a very fair section is exposed in the fossiliferous bands, the best section I have seen in the district, though it also crops out on the road side near the Common at Woolhope. Sections being very few, it is desirable to note these.

The conclusion at which I arrive, then, in the Woolhope Silurian area, is that on the whole the *Cœlentreata* form here, as in certain portions of the Old Red (Marine Devonian) in Devonshire, the chief and most abundant representatives of the life of the period, though at the same time it is rather difficult to understand why there should not have been as great a variety of Molluscs, Crustacea, and Radiata as elsewhere, other conditions being apparently equal. One interesting exception is to be noted in the Downton sandstone (passage beds so called) in a small section exposed at Purton, near Stoke Edith, where remains of *Pterygotus* and *Euripterus* abound, intermingled with frequent fragments of vegetable matter, including some small preserved seed vessels, a few small semivalves, and a coral. In a thin band of sandy shale, I was fortunate enough to find a considerable number of the remains of these crustacea, and possibly of some other allied forms which may be new, consisting of heads, body-rings, entire tails, portions of the body of some size, claws, and swimming-feet, more numerous and on the whole better preserved than any previously detected in England, and for the most part larger than those obtained in the equivalent stratum near Ludlow. Some of the bodies have as many as eight or body-rings attached, but without the head or tail, owing, I believe, in a great meeasure to the difficulty of working the bed, and the consequently small fragments which could be got out, even with the greatest care and labour. I am in hopes that the entire collection will be placed in the hands of a competent authority, when the most remarkable will be duly figured and described. In the same beds at Ludlow remains of these singular Crustacea are numerous, but I am not aware whether they have been observed in almost equal abundance at Purton. If the quarry was worked I have no doubt some entire specimens might be procured, but unfortunately there is no hope of this, for, although there is a capital band of adjacent sandstone, it is not allowed to be quarried.

At Lesmahago, in Scotland, where the Silurian rocks are much altered and more of a fine slaty character, very perfect specimens of *Eurypteri* and *Pterygoti* occur, many of the latter indicating great size. I have two body-rings of this genus of gigantic proportions from the Old Red Sandstone in Scotland much larger than any in the Lesmahago Silurian rocks; and Mr. Salter has lately obtained some remains of pterygotus in Wales, and especially near Pontrilas, from the Old Red Sandstone, which must have been of enormous size. The only way in which we can account for the better preservation of these Scotch-Silurian Crustacea arises, no doubt, from their rapid and immediate preservation in the Silurian mud after death, which, as in the Oolite at Solenhofen, in Germany, and in the Lias at Lyme Regis, in Dorset, accounts for their fine condition. These crustaceans, as well as the trilobites, were easily separable after death, and unless instantly embedded would soon decompose and break up and be scattered into fragments by waves and currents; hence they are so often found in a mutilated state, the heads, tails, and single body-rings being most usually preserved.

In this short notice my object has been purely Palœontological, therefore I will not make any remarks on the physical geology of this district, which is, however, most interesting and instructive, being probably the finest example of a valley of elevation in England, and it has been already ably described by Sir R. Murchison, and one of your own members, Mr. Dixon. With the exception of occasional visits of the Woolhope Club, and a few wandering geologists this district is little or not at all known, and it offers to tourists some of the finest views and most striking scenery in this beautiful county. The hills are richly wooded and much broken and diversified by extensive fractures and subsequent denudations.* Some of them rise to a considerable height, commanding on all sides grand and extensive views over the adjacent counties and the more distant mountains of Wales. The intervening vallies are also very picturesque and well wooded. The Railway Stations of Stoke Edith and Holm Lacey now render it comparatively easy of access, and it only wants to be better know to be more frequently visited.

* It is an important question to decide what has become of the drifted matter, the quantity of which must have been enormous; and, as my friend Mr. Symonds observes, the only drift in the neighbourhood, full of remnants of Silurian rocks, is to be seen at Mordiford, and nowhere else.

NOTES ON THE ONNY RIVER SECTION.

By J. W. SALTER, Esq., F.G.S., &c.

The gorge of the river Onny is classic ground. It is one of the best sections in Siluria, and it has, besides, a little difficulty in it which misled the earlier observers, and which may yet furnish work for the Naturalists' Field Clubs.

Indeed, though much has been done in it, there is yet enough left to do. The western end, where the river cuts through the faulted Cambrian ground, will furnish many a day's work for the man who cares less for fossils than for geological structure. The various sub-divisions of the Caradoc—which it was the good fortune of Mr. Aveline and myself to disentangle—should each be carefully marked out on the parish maps, and then transferred to the small ordnance scale :—

1. The Hoar Edge grits of Corston, &c., with the Horderley limestone.
2. Soudley and Long Lane sandstones.
3. Cheney Longville flags (Chatwall, Broome, &c.).
4. Calcareous beds of Batch gutter, Ticklerton, Plash, &c.
5. *Trinucleus* shales of the Onny section.

All deserve separate mapping, and will repay the toil.

And if the observer will be only careful to spot them down on the map where he sees them, without attempting to join up the broken lines, he will do more for the geology of Shropshire than has yet been done, for a simple reason worth recording. The whole ground is highly, nay, intensely, faulted. These faults are not marked on any map ; and in attempting to carry on unbroken lines of strata from end to end of the Caradoc valley, the arrangement of these faults is so utterly obscured that nothing but a fresh survey will make them intelligible. This survey should be the work of the Caradoc, Severn Valley, and Ludlow Clubs.

As a contribution to this good work, I have taken advantage of the hospitality of my friend the Rev. J. de la Touche, to re-examine the cliff section of the *Trinucleus* shales, with the overlying May Hill group, which is so clearly displayed at Cheney Longville footbridge.

The length of the accessible section is considerable, but it is cut off at either end by several faults. So it is best to confine ourselves to the low bank and river section which extends from the first beds visible west of the foot-bridge, to the cliff of green and gray shales, now rather well known and well hammered by the Ludlow geologists. Only the north bank shows the section. The beds, though they doubtless cross the river in some places, are mostly lost on the south side by the considerable fault which runs along the course of the river in a direction about W. by N.W., and not quite in the same direction as the river. Such dislocations in many places cross the Caradoc range on its S. end.

Measured roughly along the bank by paces, the *Trinucleus* shales, with the calcareous gray layers at their base, occupy 130 yards, dipping at a low angle. For 40 yards they form only shelves in the river bed, and are slightly nodular and calcareous at the western end.* Then, for 45 yards, the low cliff exhibits green and gray concretionary shales of a very uniform fine grain, without bands of limestone or sandstone of any kind, and full of various forms of Trilobites, chiefly *Trinucleus concentricus*, easily known by the laced border. *Ampyx*, *Remopleurides*, *Lichas*, and *Calymene*, are more rarely found. But a tolerably full list may be found in the paper above referred to in the Quarterly Geological Journal for 1854—(*Aveline* and *Salter*).

The angle of dip in these shales is seldom more than 25°, except where they are overlaid by the May Hill Sandstone bands, where the dip accidentally deepens to about 30° or even 35° in parts, with which dip the beds plunge into the trout pool. The exact spot is now easily marked; a couple of large trees have fallen—one on each side of the deeper water (it is but a few feet in summer time), and a holly tree hanging from the bank, exactly covers the line of unconformable junction. Roughly measured, the thickness of the gray (or, when weathered, greenish) Caradoc shale is 35 feet, and in all this, no beds of limestone or calcareous sandstone occur.

This is immediately followed by bands of impure Limestone. 3 or 4 inches or less in thickness, with greenish or grey friable shales between the limestone bands. The shales so exactly resemble the underlying Caradoc shale, that any one might mistake the one for the other. But when hammered, they yield not a single *Trinucleus*, or any of the characteristic fossils of the Caradoc shale. On the contrary, they contain *Pentamerus linguifer* in abundance, a fossil which abounds all along the line of junction—in these May Hill rocks up to Buildwas and the Wrekin base. In the beds of limestone are *Pentamerus*, *Atrypa reticularis* in plenty, *Leptæna transversalis*, *L. scissa*, and *Chonetes lævigata*, some corals *(Petraia* and *Favosites)*; and these abound, and are wholly unmixed with any of the small *Nucula*, *Bellerophon*, *Holopea*, &c., which are found in the lower (Caradoc) beds.

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* Similar beds, with rather thicker bands, occur along the course of the river for some way up. The ground must be much faulted judging from the area covered by these beds. The same grey shale extends to Church Preen.

So sudden is the change of the fauna, that even were the slight unconformity more difficult to detect than it really is, there could be no doubt of its existence. It was in vain Mr. la Touche or myself, in a baking sun, set ourselves steadily to pull down and examine the shale. *Pentamerus* and *Atrypa* everywhere—but not a Caradoc fossil, such as must have mingled with them had there been a true passage from one rock to the other.

Next, I measured the thickness of the May Hill band up to the point where the green-grey shale is mingled with purple shale, and at the utmost this can only be 30 to 35 feet; beyond which 20 to 25 feet may be reckoned for the claret-coloured purple shale.

Returning to the junction at the holly tree, 12 feet of alternating limestone bands and green-grey shale take us to a bed, 6 inches thick, of calcareous sandstone, very micaceous, and permeated throughout with worm burrows and tracks on the flat lines of bedding. I do not stop to describe these here—they are simple and branched—the branched ones being what are commonly and falsely called *Fucoids*. This bed, in which are no *Pentameri*, shows the jointed structure to which I beg to direct the attention of the club. It is cut up into inumerable dice-like blocks, the sides of which lie respectively in the direction of the valley, i.e., 35° north of west, and the direction of the Great Wenlock Valley 30° east of north. The latter direction is not exact, but the main joints are in the direction of the Onny, along which, sometimes crossing the stream, sometimes keeping to the north or south of it, runs a "fault," which is not laid down on the map, but probably extends quite into Wenlock Edge. The direction of these joints should be carefully noted on the map. The result would be very obvious in a few years, for the relation of the jointed structure to the faults of the district is more than probable—it is in many cases proveable. We must proceed with our section.

Six feet of very green shale, like the Caradoc, above this band, takes us to a similar band four inches thick. The green shale still contains *Pentamerus linguifer*, *Strophomena applanata*, with the *Leptæna transversalis.* And now comes eighteen feet more of rubbly shale, greenish and gray, and in its upper part striped by numerous purple layers. It is interstratified with thinner and thicker layers of calcareous sandstone, full of mica, and marked in some layers by worm tracks: in others more calcareous, sandy, and full of the fry of *Leptæna*, *Atrypa*, and *Chonetes*. Twenty feet of purple shales, rich in fossils, conclude the section, for beyond this point, I think, no beds show on the water's edge. Either the fault crosses here, or the soft layers, no longer protected by the intervening bands of limestone, have been wholly denuded, a clayey drift filling up the low ground.

*   *   *   *   *   *   *

I prefer the term, May Hill Sandstone, to the new appellation, Upper Llandovery, for two reasons. One is, that except in the presence of *Pentameri* and *Atrypæ*, the May Hill rock has nothing to do with the Llandovery, to which in Wales it is an unconformable cover. The Llandovery has Caradoc species mixed with *Pentameri.* The May Hill rock, of which the purple shale forms the natural cover, has Upper Silurian species mingled with *Pentameri*, and passes truly into the Woolhope beds. The second reason is that, in science, the discoverer and true describer of a rock has the right of priority to name it ; and the recognition of the true characters, position, and contents of the May Hill Sandstone, as distinct from the Caradoc, is due to Sedgwick, who, with a rare generosity, applied the name first used in the Silurian system. The purple shale is a very continuous formation. It is nearly colourless in North and South Wales, where it is known by the name of Tarannon Shale, and has but few fossils.

The Rev. J. D. La Touche, exhibited a very beautiful model, in relief, of the Onny River Valley and surrounding hills, made to scale and coloured. It was very generally admired, and the wish was loudly expressed that some member of the Woolhope Club would construct a similar model of the Woolhope Valley of Elevation. And Mr. Salter took the opportunity of pointing out very ably the great use of such models, and called upon the geologists of Ludlow to mark down on a map all the minor faults and dislocations, which were so numerous in the rocks of the district. Not to complete their lines by hypothesis, but simply to mark down their exact occurrence in the exact spot, and when this had been carefully done, the key to their explanation might very possibly be found in the study of all the separate observations.

The carriages for Oakley Park were now announced, and several of the visitors that the early trains had not cruelly carried away, set off to visit the celebrated old oaks there. Crossing the river Teme towards the White Cliff, the beautiful view of the castle, which is so well known, would gladly have been sketched by more than one of the company, had time permitted. The grounds of Oakley park were entered by the private road, and a beautiful drive of nearly two miles led to the mansion. Here the visitors alighted, at once paid a visit to the very interesting old oak trees, knotted and knarled, with trunks covered by excrescences, and all more or less decayed. Some still bore a goodly canopy of green leaves, but others had nothing to show but hollow boles and rotten boughs, or limbs broken and bare, presenting great variety in picturesque form and outline, and to each one of them might be addressed Cowper's beautiful lines—

> "Time made thee what thou wast, king of the woods;
> And time hath made thee what thou art—a cave
> For owls to roost in. . . . . .

. . . . . Through all stages thou hast push'd
Of treeship—first a seedling, hid in grass;
Then twig; then sapling; and as cent'ry roll'd
Slow after century, a giant bulk
Of girth enormous, with moss-cushioned root
Upheaved above the soil, and sides embossed
With prominent wens globose—till at the last
The rottenness which time is charg'd to inflict
On other mighty ones found also thee."

Are they Druidical? Well, they seem to inclose in double semicircle, the northern side of a green open space some 60 or 70 yards in diameter. No trace of trees of a similar character on the southern side exist, and perchance it may be that too much sunshine has destroyed them early, as too much prosperity is apt to carry off creatures who should better know how to guard against it. There are but some half-dozen of the old, old trees remaining, and all of the true pedunculate variety. The tape gave their meazurements at 5 feet from the ground 19ft. 4in., 18ft. 6in., 25ft. (hollow and open), 23ft. (covered with excresences), 23ft 8in. (the same), and one was too divided to measure at all, and the largest bough of another, alas! lay rotting on the ground.

A walk over a covered bridge led to the fernery and flower garden. Here the quaint box edgings of our forefathers are still carefully cultivated. Here, on the lawn, too, was a beautiful specimen of the Deciduous Cypress, *Taxodium distichum*, whose feathery foliage is so very ornamental. Its trunk, at 5ft. from the ground, measured 4ft. 9in. in circumference.

The pleasure grounds, stretching for nearly half-a-mile on the steep bank of the Teme, were next visited, and many of its beautiful trees measured and greatly admired. The most striking feature of the grounds, perhaps, was the tall straight boles cf so many of these trees, which give that delighful aërial shade so charming in our hot summer days. A Spanish Chestnut, though only some 11 or 12ft. in circumference, had a stem some 40 or 50ft. high, without a bough or an imperfection. Two Silver Spruce Firs were said to be 120ft. high, and looked it; they measured 11ft. 1in. and 12ft. 1in. respectively. There were two very perfect specimens of *Pinus cembra* growing well, measuring 6ft. 4in. and 5ft. 10in. respectively. Two beautiful trees of the *Pinus Douglasii* as ornamental as fancy can picture, measured 7ft. 10in., and 6ft. 6in., respectively at 2 feet from the ground. Then the tape went round a Scotch fir of 10ft. 2in., a lime tree of 13ft. 3in.; an ash of 13ft., and some other trees that space fails us to enumerate. In the grounds is a Maze with privet hedges having in the centre a fine 18ft. specimen of the *Wellingtonia gigantea*, which they who would admire in close contact must walk many paces to reach, and be fortunate if when half way they don't find that they have taken the wrong road. The shades of evening were rapidly approaching—the slight shower which fell here had passed off—the carriages were quickly gained—and so in due time was Ludlow reached, and the late train carried off the last of the Woolhope members to their several homes.

The Woolhope Naturalists' Field Club.

MEETING AT HEREFORD FOR WOOLHOPE,

AUGUST 25TH, 1868.

On Tuesday the Club made its annual visit to the district from which it takes its name. About ten o'clock two well-laden coaches left the Green Dragon Hotel, and passing by Hampton Bishop, Mordiford, and Fownhope, finally set down their passengers near the Lindels Quarry, a little beyond Sollers Hope. Here the Aymestrey Limestone is interrupted for the distance of nearly a mile, and the two ridges of Wenlock Limestone meet at an acute angle, showing dips in different directions.

The ride of nine miles was very enjoyable. The welcome rain of the last few weeks had completely renovated nature. The yellow leaves of premature autumn had disappeared, and the trees accorded once more with the fresh and bright verdure of the pasture. The anomaly of the early ripened fruit, the bright hips and haws, and the size of the acorns, which are peculiarly abundant this year, alone remained. Autumn had seized nearly all vegetation, but summer again for a time resumed her sway, and made the journey very pleasant.

The nature of the ground visited gives prominence to Geology in the day's work; and though neither plants nor insects, nor anything capable of being baptized with a Latin name comes amiss, somehow or other the earth, and the things under the earth, receive the largest share of attention in these gatherings, perhaps because they are the largest.

As far as Mordiford the route presents little or no feature of interest. Alluvial flats bordering the Wye, and Old Red Sandstone Hills on the left and right, had nothing but perfect beauty of outline and rich agricultural value to recommend them. The wooded hills of the Woolhope "anticlinal," were the points of attraction for the day. Skirting their western side the road to Sollers Hope does little more than mark the boundary of the two formations,—Old Red Sandstone, and Upper Silurian Rocks. There was therefore plenty of opportunity for those disposed to find "faults" in the outline to do so. The Woolhope hills are full of faults, and it so happens that they are very plentiful and conspicuous on the western side along which the coaches were running. Mordiford presents one great "fault," but it is only a specimen of many that cross from S.W. to N.E., and slice up the pear-shaped mass into manageable portions.

At Fownhope, and Sollers Hope, faults cross the oval. Between these two places they run along the outline, and the effect of both sets, as was pointed out on the spot by Mr. Salter, has been so to shatter and bewilder the strata on the western side, that they dip more sharply, and occupy much less breadth than on the opposite side.

The Lindels limestone quarry was first visited. It is solid limestone for six feet at the base, with bands of nodular limestone and shale above ; from the top perhaps measuring twenty-six feet. Corals and shells abound. Thirty or forty pairs of hands, and some of them with hammers in them, soon gathered a heap. The corals were *Favosites*, *Cœnites*, and *Heliolites*, two or three species of each, the latter especially being in beautiful preservation, and almost like living specimens. By the bye, it was observed that the *Blue Coral* of Australia was hardly to be distinguished from this. Shells were plentiful, almost all *Brachiopoda*, the tribe most abundant in Silurian times. The *Strophomena depressa* comes out entire in this prolific spot. *S. euglypha* is common, *Spirifer*, two or three kinds, *Rhynchonella*, and chief of all, the ubiquitous *Atrypa reticularis*. This shell, named by Linneus, occurs all over the world in Silurian Limestone ; at least it has been found from China to the Rocky Mountains, and from Australia to the North Pole —very perfect specimens were procured here of all of these. A few Trilobites, chiefly *Calymene Blumenbachii* and *Phacops caudatus*—a worm tube or two— and a great sponge (*Stromatopora*), were also met with. One peculiarity was noticed, the Limestone is largely *pisolitic*, like the beds of inferior Oolite. Professor Phillips noticed this in the Wenlock Limestone of Malvern.

The Aymestrey Limestone is quite a different thing. Flat beds of hard Limestone, with very little shale between, form a very solid rock. No wonder therefore that the Ridgeway stands up so high.

Whilst the geologists were hammering away at the rocks, the botanists had time to look around them. The Dwarf Thistle, *Carduus acaulis*, was found growing abundantly ; a vigorous plant of the Bear's Foot, or Fetid Hellebore, *Helleborus fœtidus*, was observed ; the *Chlora perfoliata*, *Eupatorium cannabinum*, *Chrysanthemum segetum*, *Inula conyza*, *Lithospermum arvense*, and some other plants were also observed.

On leaving the Lindel's Quarry the route was taken for the Camp on Oldbury Hill, under the guidance of the Rev. F. Merewether. Here the view was magnificent and almost panoramic. It excited so much interest and pleasure that but little attention was paid to the camp itself. It seemed a large inclosure of an oval form, and protected chiefly towards the south and western side. It presents no great signs of strength, but it is of considerable size, and is taken full possession of by agriculture for the growth of wheat and barley. The same elements of interest and beauty in near and distant scenery were presented by the whole length of the ridge of Aymestrey Limestone which was followed. On the one side was the May Hill, the whole range of the Malvern Hills, and those still more distant in Gloucestershire and Worcestershire—the cathedral and city of Gloucester were plainly visible—and on the other side, spread out before the observer, lay the whole valley of Woolhope and its successive ridges of limestone with its dome of May Hill Sandstone in the centre. The merest tyro in science could have made out the geology. Standing on the outer and highest ridge, the Aymestrey Limestone, the lower ridge of the Wenlock Limestone, forming, as it were, an inner line of defence, was immediately in front. Between the two. with a varying depth, runs the fosse, excavated in the soft Lower Ludlow Shale. Outside, the Upper Ludlow Rock slopes gradually away to pass as regularly and conformably under the Old Red Cornstone and Marl, as on the other side it is plunged irregularly against it. The difference is all due to the faults which were pointed out by Mr. Salter on the ground. They cut up the north and west side of the valley, as it is called, being a space encircled by hills, and leave the eastern side almost free. But this irregularity, great as it is, does not prevent the pear-shaped mass from being at once the most regular, as it is the most beautiful, of our Silurian districts. It was the general exclamation that nowhere in Herefordshire could so beautiful a walk be found, for a similar extent. Partridges seemed to appreciate it also, for no less than four goodly covies were disturbed in the walk.

At Sleeve's oak a quarry of Aymestrey limestone was examined. Here the jointed structure of the rock is very remarkable. Joints in three directions were observed on the Woolhope side. The fossils gathered here were chiefly Brachiopod shells, *Rhynchonella nucula*, and *R. didyma*, the former in profusion; *Lingula Lewisii* and *Chonetes lævigata*.

The route was continued to Hooper's oak, when the descent began and the Wenlock ridge was again crossed. In the valley some specimens of *Boletus Satanus* were gathered, as poisonous as its name and its lurid red colour might lead one to expect. A hopyard in beautiful luxuriance. How very fine and abundant the hops of Herefordshire are this year! they seem to have enjoyed thoroughly this lovely summer, and to have cared but little moreover for the drought. On the ridge of the Wenlock Limestone was an old kiln, quite remarkable for the beauty given to it by a luxuriant growth of the Traveller's Joy, *Clematis vitalba*, which covered it.

The broad valley of Wenlock Shale was then passed to gain the hospitable shelter of Woolhope rectory. At Fowmer's farm there is a good section of this shale, and fortunately recently made, for it so soon decomposes to mud that no section can be permanent. Here Mr. Merewether guided some of the visitors to a rock he considered to be May Hill Sandstone. It was a very unexpected place to find it, but such nevertheless it turned out to be. It was not another outbreak of this rock, but a series of large broken fragments resting on the shale, transported as drift by some more modern agency, and so arranged as really to look like a bed of the rock *in situ*.

At Woolhope, the celebrated limestone that bears the name of this village emerges from beneath the shale, and near the rectory shows itself as a tesselated pavement of rock. Time did not admit of any close examination of the strata here, or of the dome of May Hill Sandstone in the central Haugh Wood. The whistle of the leader was imperative, and it was well it was so, for days instead of hours could well be occupied in this interesting locality.

A rapid descent by the Littlehope or Scutterdine quarries, which could only be glanced at, showed again that this, like all other "Hopes" in the district, was *at fault.* The word "Hope" means "a sloping ascent between hills," and they are evidently here caused by "faults." The rapid change of the dip and the curving of the strata indicate them ; but, of course, better evidence is afforded by the abrupt juxta-position of strata which should lie part. Such, for instance, on leaving the ground, as was seen in the Pentelow brook, where the Woolhope limestone lies cheek by jowl with Aymestrey rock, and May Hill sandstone abuts against the Wenlock shale.

We should have noticed, that on the road to Sollers Hope the party alighted for awhile, and the President and Mr. Salter, who had been working together previously in the Old Red Sandstone, found both plants and crustacea *(Pterygotus)* in the Old Red Sandstone of Nash Tump.

The coaches pulled up at Mordiford Toll-gate, and a rush was made for the entrance to the grounds of Sufton Court. Here a very fine and complete "fairy ring" of the large or horse mushroom *(Agaricus arvensis)* was visited, and many of them carried off. Some specimens of the yellow Boletus *(Boletus luteus)* were also gathered, and it is as well perhaps to say at once, that both were cooked and eaten with much relish at the dinner in the evening.

The coaches were quickly regained and as they make their way back we will take the opportunity of naming those who were present at the meeting—the President, Dr. M'Cullough ; the Vice-Presidents, Chandos Wren Hoskyns, Esq., and James Rankin, Esq. ; J. W. Salter, Esq., F.G.S. ; the Rev. Wm. Houghton, M.A., F.G.S. ; Professor Gairdner, Glasgow ; R. M. Lingwood, Esq. ; Elmes Y. Steele, Esq., and Mr. Elmes Steele ; the Rev. J. F. Crouch, Pembridge ; Dr. Bull and Master Bull ; John Lloyd, Esq. ; the Rev. F. Merewether, Woolhope : the Rev. Arthur Gray, Orcop ; the Rev. Thomas Phillipps, Dewsall ;

the Rev. E. Du Buisson; the Rev. W. C. Fowle; James Haggard, Esq., and Mr. Chas. Haggard; Marcellus Newton, Esq., Sugwas; the Rev. E. Cunningham; Wm. Aston, Esq.; the Rev. J. C. Robinson, Norton Canon; J. Griffiths Morris, Esq., and Master Morris; the Rev. J. H. Jukes; Thomas Turner, Esq.; the Rev. C. J. Westrop, Wormbridge; Dr. J. H. Wood, Tarrington; J. Mortimer Bowen, Esq., Talgarth; J. T. Owen Fowler, Esq.; Mr. John Lloyd, Kington; Mr. Adams, Marden; Mr. Pembridge; and Mr. Arthur Thompson.

Punctually at 4 o'clock the travellers returned to be refreshed, according to the programme, at the Mitre Hotel, and well indeed was the programme carried out in this respect.

Immediately after dinner a paper was read

ON THE DISTINCTIVE CHARACTERS OF BRITISH SNAKES.

By the Rev. THOMAS PHILLIPPS, M.A.

In our walk across the usually boggy mountain side from Penwylt to the Scwd Hen Rhyd waterfall, on our Ladies' day in July, two or three of these reptiles were picked up by some of the more adventurous members of our party, and exhibited to the rest of the Club. I was then so much surprised at the mistaken remarks which I heard made on several sides as to what was their nature and even their name, Vipers being called Snakes, and Snakes Blindworms, that I determined to brush up my old experiences respecting them, and to make the attempt to point out what the distinctive marks and peculiarities of these reptiles are.

There are only three British (so called) Snakes, and they are—

1st. The Viper or Adder *(Pelias Berus)*.

2nd. The common Grass Snake or Ring Snake *(Tropidonotus Natrix)*.

And 3rd. The Blind-worm or Slow-worm *(Anguis Fragilis)*.

First with regard to the Viper, often locally called Adder. It is the only one of the three which possesses a poison-fang, and fortunately, too, it is the least common of the three. It is now, in fact, rarely found in England, except in unfrequented, and generally boggy localities, such as the Cambridgeshire and Lincolnshire fens, where, in my younger days, I killed and examined a great many. A good deal of the country around Penwylt is not very dissimilar from what these fens, in my Cambridge days were, although many of them now are thriving corn-fields. The bite of the Viper is seldom fatal where assistance can be had and proper remedies applied; but I remember two or three cases where men had been working alone in the fens far away from house or home, that did terminate fatally, and as is usual, in such cases, under very painful circumstances.

The Viper belongs to the great order, *Ophidiæ*, to the sub-order Viperidæ, and the genus *Pelias Berus.* As it relates to unscientific observers one great mark of distinction between it and the Snake is, what is considered to be, the figure of a V upon the top of its head: formed, I believe, by a raised nose between the two inflated glands, one on each side of the head.

Another mark by which a Viper may generally be known is, a fine and somewhat elegantly-shaped neck, which contrasts strongly with its flat and ugly head.

But the third and most observable outward distinction of all, between the Viper and the Snake is, a sort of diamond-shaped line of black-looking scales which run down the whole length of the viper's back : though this sort of harlequined back is much brighter in some specimens than it is in others; probably owing to the more congenial circumstances of locality in which they may be found. And, I think I may say also, that the Viper in general, is, a smoother-looking, smaller, and more delicately formed animal than the Snake,

To those who have a chance to examine the Viper's head and open its mouth, the poison bag and fangs are easily discovered. The fang in all serpents is attached to the bag or pouch which contains the poison, and it is hollow, with a small hole at the extremity, through which, after the bite, the poison is injected into the wound. The fang in our British Viper is very small and fine, and the animal has the power, I am informed, of drawing it up and almost concealing it within the poison pouch, so that too superficial a look may deceive even here.

It is well known that the poison fluid of all serpents, although so deadly when introduced into the blood and veins, is perfectly harmless when swallowed and taken into the stomach. Lucan, in his "Pharsalia" (and poisonous reptiles still abound in the plain of Pharsalia, that is, near the present town of Larissa in Thessaly) tells us of a physician named Tozzi (learned above his day), who horrified the Prince of Thessaly and all his court by drinking off in their presence a considerable quantity of venomous serpents' poison, in order to exhibit his skill, and the power which he wished them to understand he had over such poisons.

Lucan's words are—

> "Noxia serpentum est admisto sanguine pestis :
> Morsu virus habent, et fatum dente minantur:
> Poculo morte carent."—*Phars.*, *Lib.* ix., 614.

and when translated, run thus :—

> Mixed with the blood the venom slays alone ;
> His bite is poison, death is in his fang,
> But the draught is innocuous.

This remarkable peculiarity in the poison-fluid of serpents is one of the numerous mysteries and yet wise ordinances of Divine Providence over his creatures, for a large portion of the serpent tribe obtain their food by means of this fatal bite, and if the food was at the same time made poisonous thereby the result of course would be very unprovidential as well as disastrous. But we all know that there are no such mistakes as this in the works of God, and there is something very assuring in this fact that throughout all creation we cannot point out one object that can be called a mistake ; and surely nothing accidental could have effected this, nor any law or "reign of laws" which had not been divinely ordained.

The second Snake is our common Grass-snake (*Tropidonotus natrix*), by some authors called *Coluber natrix*, and by others *Natrix torquata*. The marks of distinction by which this Snake may be known from the Viper I have already pointed out. On our very pleasant excursion to the mountain district of Penwyllt (or Head of the Wind) a very large and fine specimen of this Snake was also picked up.

The general outward appearance of our common English Grass-snake is I think I may say, coarser, of a less elegant shape, and of a duller colour than the Viper, and, I think I may say, too, as a general rule, that its average size is larger than that of the Viper, although I am quite aware that large Vipers are occasionally met with.

The Grass-snake, we all know, is usually met with upon our mossy banks and hedge-rows, and therefore is an evidently land animal, and yet all those who are acquainted with the habits of the Snake are perfectly well aware that it is a lover of water and a good swimmer also, and that even sea-water does not seem to be disagreeable to it; for it is commonly asserted by those who live on the shores of the Menai Straits, in North Wales, that Snakes are not unfrequently seen swimming across between Carnarvonshire and Anglesea. It is well known, too,—and I remember an instance of it myself,—that in the roughs of old quarries frequented by Snakes, where there are water-pits, a Snake when disturbed will frequently make direct for the water, and, if afraid to cross it from persons standing round, that it will not only dive to the bottom, but remain there for a very considerable time, and apparently without any sort of inconvenience to itself.

I wish some of our more scientific members would explain to us the formation of the respiratory organs of these animals, which enables them to live in either air or water and appear to be at home in either. They don't belong to the order Amphibiæ, and yet there is an amphibious nature about them like frogs, they will live for hours in the water—long after they have lost their fish-like organs.

The common Grass or Ringed Snake lays from 14 to 16 eggs connected together in a string, though, as far as my own observation goes, I should say it lays separate eggs, for I have found, on two occasions, a single egg laid upon small dry sticks at the bottom of an old hedge. The eggs are covered by a sort of whitish-brown membrane, and through which, in those I found, the twisted up young snake was distinctly visible. They had been left to be hatched by the heat of the sun in the same manner that a great many of the eggs of other reptiles are.

The principal food of Snakes and Vipers is frogs, and it would be interesting to know (if any member can tell us) whether either of these reptiles capture frogs in water as well as on land.

The last of the British serpents (so called) is the Blindworm or Slowworm *(Anguis Fragilis)*. Although the term *Anguis* is still retained, the Blindworm is now considered to belong to the great order LACERTINIDÆ, that is the Saurian or Lizard tribe; and the term *Fragilis* has been given to it from the known facility with which it is divided or broken into two, and this dividing takes place, as with other lizards, exactly at the point or joint where the tail joins on to the body of the animal; and it will be found on examination that the tail-half of blindworms is of somewhat smaller circumference than the body of the animal. I have heard it asserted that the Blindworm when irritated will divide itself at this juncture. I have never observed this, although they abounded on the slope between the house and the river at Eaton Bishop, where I was born and bred, and where I have very often irritated them and given them reason to divide if they would do so. I have frequently witnessed the facility with which a very slight blow will divide them, and then watched the two ends wriggling off in opposite directions—the body always to get under the grass and conceal itself, whilst the separated tail retains its vitality and will wriggle about vigorously for some time. The tail of course dies, but a new tail will grow from the body in course of time, as is the case with lizards.

Another reason which has induced naturalists to class Blindworms with the Saurian or Lizard tribe is the somewhat remarkable fact of an undeveloped formation of legs, found upon dissection in the front part of the body. The connecting link between the Blindworm and true Lizards is found in the little animal common in some parts of France and Italy called the Seps *(Seps tridactylus)* which has legs so small and feeble as to be of not much more use in assisting the creature's movements than the only partially developed legs of the Blindworm are.

Another mark of distinction between the Blindworm and the serpent tribe is, that there is by no means that comparatively large head and fine neck which are universal with the serpent family. It may be observed also, that Blindworms (and Vipers also) do not lay eggs like the Grass-snake, but bring forth living young ones. Eels, which are supposed to have a viparous nature, do the same, and do not spawn, as others of the fish tribe do.

I remember, years ago at Eaton, seeing a Blindworm opened, and within it there was quite a ball of young ones, all rolled up together; and this circumstance of their lying in a roll together, may have given rise to the idea asserted by some naturalists, that Vipers do lay eggs the same as other serpents, only that they are hatched within the animal's stomach immediately previous to the birth of the young ones.

I will only observe further that the name "Blindworm" is a misnomer, as they have unmistakeable eyes, and see quickly enough with them too. The term Slow-worm is more appropriate, as they are somewhat sluggish in their movements. Slugs form their chief food, though they feed also, I believe, upon the common earth-worm, and (like Snakes and Vipers) upon some insects.

These few remarks are written simply to point out, should we meet with these animals on another excursion to a wild district, that there is really no difficulty in distinguishing between them, and that a very moderate examination of either will be sufficient to convince any one as to which of the three classes of British serpents it may belong.

Mr. RANKIN said that the amphibious powers of snakes depended on their possessing hearts of single action, that is with only two cavities. There was no separate respiratory circulation, the change in the blood being much less than is usually required by land animals.

Mr. HOUGHTON said that the *Coronella lævis* had been recently captured again in England, and was now an admitted British snake. With regard to both the Blindworm and the Viper being viviparous, they were ovoviviparous, the eggs being hatched as they are brought forth, and if either were killed and opened just as they were fit to hatch, the inclosing membrane would be found so thin and transparent and fitting so closely the young snakes that it might readily escape observation. That eels brought forth their young alive was an old error. They offer no exception certainly to the rule, "omne vivum ex ovo," since they spawn regularly, and those who have thought they have seen young eels inside old ones have been mislead by the presence of entozoa with which they are sometimes affected.

Dr. BULL said they were much obliged to Mr. Phillipps for the trouble he had taken in drawing their attention to the differences between the Snakes in so interesting a manner. He could not help regretting that the young snake he had captured had been allowed to escape. He was quite sure it was not a Viper, although it resembled one so closely that Mr. Phillipps, knowing them as he does, evidently thinks still that it was one. He had, however, opened its mouth carefully as he held it by the neck, and looked for the poison fangs in vain, and had they been there he must have seen them. Now, he had since seen the *Coronella lævis*, mentioned by Mr. Frank Buckland in "Land and Water," as "that curious, nonpoisonous, but yet Viper-like snake," and he rather regretted the mercy that its innocency had obtained for the little one he had caught, since if it had turned out to be the *Coronella lævis* it would have been a most interesting discovery. There are at present but three British localities known for it—one is "the New Forest," another on "the heaths which lie between the river Stour and the sea," and the third, where it exists pretty plentifully, is on "the heaths near Poole."

Mr. Buckland sent White, the professional Viper catcher, into the New Forest, and in a week he returned with a bag full of snakes. "I took him into an empty barrack-room," he says, "and we shook out the snakes. There were twenty-two Vipers, four common Snakes, and one Coronella, which, to my delight, afterwards gave birth to several young ones." The Coronellas live upon lizards, and where these abound Mr. Buckland recommends an active search to be made for the Coronella; and he also goes on to say: "White believes there are two species of poisonous snakes, vipers, and adders. I cannot make up my mind whether the little red spiteful viper is the young of the common viper, or, in fact, whether vipers and adders are identically the same species, or merely varieties altered by local circumstances. The red-coloured chocolate-like viper of Scotland is certainly a different looking beast externally to the green-tea-coloured viper of the south of England."

In a recent number of "Land and Water," is a letter from Mr. Penney, of Poole, detailing the capture of several Coronellas by Mr. Wilcox, Mr. F. H. Peck, himself, and his son, and Mr. Penney gives the following very interesting extract from Mr. Peck's journal:—

"Sept. 4th, 1868.—Caught a very fine *Coronella lævis.* I was running down a steep narrow path in one of the chines between Poole and Bournemouth, close to a round tower on the cliff, when I saw a large snake right across my path. I stopped as soon as I could, and ran back. The snake was just entering the heath. I put my umbrella across him, as he looked suspiciously like a viper. At first I was rather afraid to handle it, but having read an account of this new snake a few days before in the *Intellectual Observer*, I knew the markings, and making out the crown-like mark on this one's head, and the double row of round dark spots down its back, I felt a desire to make a closer acquaintance with him, so took him up in my hand. He did not seem to like it, and bit me most savagely several times. The teeth were very sharp and small. It held quite firmly to my finger, but did not draw blood."—Mr. Penney and Mr. Peck then carefully examined it, and having ascertained it to be the true *Coronella lævis*, it was sent to the Zoological Gardens. Mr. Penney then says, "I caught another soon after, but let it go again. . . . . . . The *Coronella lævis* is far more pugilistic than the common ringed snake. I found another Coronella asleep under a bush, not coiled up, but tied in a knot. I watched it a few minutes. It was all alive then, and I had hard work to hold it. It emitted a fluid with a disagreeable odour like the common snake. I never noticed this in the viper;" and he adds afterwards that "the *Coronella lævis* is quite as, if not more common, than the viper on our sand-banks and neighbouring heaths," and he has no doubt but that it has existed for years on the Poole heaths without being detected by the naturalists."

Dr. Bull said his little friend certainly gave out a most horrible stench, as many of them had proved. He had himself only killed one large Viper, and that was a female, who was basking in the sun on some stones in the forest of Fontainbleau. On opening the body, he took out sixteen eggs attached to each other, as if strung together, each one containing an embryo snake half grown.

He then proceeded to read

A BOTANICAL STROLL THROUGH THE FROME AND BROMYARD DISTRICTS OF HEREFORDSHIRE.

By Mr. B. M. WATKINS.

"Beautiful children of the woods and fields!
That bloom by mountain streamlets 'mid the heather,
Or into clusters 'neath the hazels gather;
Or where by hoary rocks you make your bields,
And sweetly flourish on through summer weather,
I love ye all."

On behalf of the Woolhope Club I proceeded on the 28th of May last to visit the Frome and Bromyard botanical districts of the county, for the purpose of making a list of the wild plants growing there.

Leaving Holm Lacy Station for Mordiford, where I observed the *Lathyrus sylvestris* growing plentifully, I went through Dormington to Weston Beggard, at which place I commenced my observations, in the Frome district. On Shecknal Hill I gathered the hard grass, *Glyceria rigida*, and the silvery hair grass, *Aira caryophyllea*, and passing by its quarries of Upper Ludlow rock, so interesting to geologists, but giving nevertheless a dry and arid aspect to that side of the hill, I entered a wood which afforded a rich contrast. The vegetation was luxuriant, and the ground covered with flowers.

"It was, I ween, a lovely spot of ground,
And there a season atween June and May,
Half prankt with spring, with summer half embrowned."

Here was the bugle, *Adjuga reptans*, and the self-heal, *Prunella vulgaris*, in fine growth; the silverweed, *Potentilla anserina*, with leaves eighteen inches long, bright and silvery beneath, was very elegant and beautiful; the St. John's wort, *Hypericum perforatum*, and *H. pulchrum:* and an abundance of that bright, cheerful flower of spring, the lesser celandine, *Ranunculus ficaria;* but by far the most charming of all was the pretty Germander speedwell, *Veronica chamædrys* in some places called "birds' eyes," and by some one, probably an ardent admirer of feminine beauty, not inappropriately, "angels' eyes." Its fine spikes of dazzling blue flowers were in splendid profusion.

Passing through some old orchards, the canal of Westhide was soon reached. Here was a species of water ranuculus, which was the *Ranunculus trichophyllus*, if the rigid (not collapsing) submerged leaves and the absence of floating leaves may be sufficient to determine it. The water milfoil, *Myriophyllum spicatum*, was plentiful, and so too was that pest, the American water-weed, *Anacharis alsinastrum.* This plant first detected in this country about twenty years since, is now generally destributed and but too well known throughout the kingdom.

Here too I found a plant that has not been hitherto recorded as growing in this county, the flat-stalked pondweed, *Potamogeton compressus.* From its grass-like appearance in the water it has probably been hitherto overlooked, and may possibly be found in other parts of the county. Near it another pondweed was growing, *Potamogeton pectinatus* ; and on the canal banks the tufted and hairy carex, *Carex vulgaris,* and *C. hirta.*

The hop, *Humulus Lupulus,* is very common in this district, and is generally considered an escape from cultivation ; but the late Dr. Bromfield has, in the "Phytologist" and in his "Flora of Hampshire," endeavoured to prove, and with some semblance to reason, that the hop *is* indigenous to this country, notwithstanding what may be inferred from the following lines, that

"Turkey, carp, *hops,* pickerel, and beer,
Came into England all in one year."

Noting plants by the way, I continued my route through Ocle Pitchard and the Cowarnes to Stoke Lacey. In the meadows between the latter place and Bromyard I observed the meadow orchis, *Orchis morio,* in many shades of colour, from pure white to lilac and purple. *Myosotis cæspitosa; Genista tinctoria;* the common salad burnet, *Poterium sanguisorba,* the rest-harrow, *Ononis arvensis;* the milkwort, *Polygala vulgaris,* in pink, white, and blue ; and many other plants.

The "shades of evening" ushered me into the town of Bromyard, and having arranged my plans for the morrow's wanderings, I quietly awaited its appearance—and with it came disappointment, in the "lightning's vivid flash," loud peals of thunder, and torrents of rain, a sad contrast with the beautiful glowing sunset of the previous evening. The delay thus occasioned necessarily altered my arrangements ; however, I did a fair amount of botany *in the streets* of Bromyard, in the intervals between the storms, and before the unpropitious aspect of the weather had completely passed off I ventured on to Bromyard Downs, and gathered some carices, the *Carex præcox, C. panicea* and *C. flava,* and a few fronds of the spleenwort, *Asplenium Trichomanes.* I had reached the confines of the parish of Tedstone Delamere, whose charming dingles and sequestered glades offer such an attractive field to Botanical research, when I found that the heavy rains had so completely saturated the district, that I was compelled, most reluctantly, to return viâ Whitbourne, without investigating them. I found here the great horsetail, *Equisetum Telmateia,* very fine and plentiful, the marsh horsetail, *Equisetum Palustre,* and in a wood I passed through I saw again the narrow-leaved woodrush, *Luzula Forsteri,* the broad-leaved woodrush, *Luzula pilosa,* and another supposed to be a variety of the latter, called the *Luzula Borreri,* Borrer's woodrush, which was first pointed out by Dr. Bromfield in the Isle of Wight. With reference to this last plant

I am led to believe that it does not deserve the consideration which has been given to it, that it is only a "variety," and not a separate species. I have observed it growing in several woods in this and the adjoining county of Monmouth, and have never once seen it but in company with both *Luzula Forsteri* and *L. pilosa*. In Rigswood, on the Kynastone estate, all three, with the addition of *Luzula sylvatica*, may be found growing together abundantly in April and May. From these observations, from the results of very interesting experiments, shewing the variety and uncertainty of forms produced from the growth of seeds in many other plants, the *Primulæ* for example ; in accordance with opinions recently expressed by several scientific botanists ; and from the additional fact that *Luzula Borreri* rarely produces perfect fruit, I have come to the conclusion that it can only be considered as a hybrid between *Luzula pilosa* and *L. Forsteri*, and not therefore a true species in itself.

In meadows between Whitbourne and the Downs I met with the Frog Orchis, *Habenaria viridis*, very plentifully and very fine ; and here began a hurried walk—with hardly time to record my observations now and again—by Avenbury and Bishop's Frome to the Ashperton Station, where I just caught the train, and closed a pleasant ramble in a part of the county of Hereford I had never before visited.

The incidents of the journey were somewhat of the usual character. I have nearly always found that the botanist, or as he is sometimes called, the "Yarb gatherer," is looked upon as a strange, eccentric character. In conversation with people I meet with, I am often asked numerous questions relative to the medicinal uses of the "Yarbs" I gather, and as they find that I am not a modern Æsculapius, and make no pretensions to prepare "simples" for the cure of "all the ills that flesh is heir to," their curiosity is still more excited. A commercial idea rises uppermost in their minds, and they are sometimes impertinently inquisitive as to the exact monetary value, and the best and nearest market for the disposal of the plant, perchance, which has just been secured in their presence. It seldom occurs to them that the love of plants, for the plants themselves, could render the pleasure of collecting them equal to the fatigue of doing so. Then again, that useful appendage, the vasculum, excites deep interest, not unmingled with awe. It is utterly beyond the comprehension of the uninitiated, and did they but know something of the writings of Hesiod, Pandora's box might have suggested itself to their perplexed brains. In the matter-of-fact minds of country folk, however, a candle-box is more often thought of ; but on one occasion your unlucky reporter met with a still more humiliating incident. Thoughtfully wending his way with vasculum in hand, as is his wont, he was suddenly accosted by a blooming damsel, who in "accents mild" and with "imploring looks" politely requested him to——mend her parasol ! The indignation which instantly arose was, however, as quickly repelled, as his eye fell on the well-worn tin box, the evident cause of the mistake, not to mention the simple inncocent look of the girl herself; and thus with some satisfaction your correspondent recalls the ready politeness with which he examined the poor parasol, and discovered a compound fracture of one of its ribs.

The result of the observations recorded in my note-book during the ramble are as follows :—

In the Frome district the number of plants observed was 227, and of these 82 are not marked in the first part of the County Flora as growing in this district.

In the Bromyard district 221 plants were catalogued, of which 127 are not marked as growing there.

The total number of plants observed in the two districts was 251, and nearly all were in bud, flower, or fruit (applause).

The next paper read was the following :—

NOTES ON A SUPPOSED ROMAN ROAD FROM BRAVINIUM TO CIRCUTIO.

By JAMES DAVIES, Esq.

Those members of the Woolhope Naturalists' Field Club who attended the meeting on the 22nd of May last, will doubless recollect the very able paper on Risbury Camp, by Mr. Flavell Edmunds, and the discussion npon some of the details which afterwards followed.

Amongst other commendations of this ancient earthwork, Mr. Edmunds stated that the care bestowed on it arose from the fact that it commanded the Roman Road (to adopt the author's own language), "which left the Magna and Circutio roads where Shelwick toll-bar now stands, passed N. by the Withergins (or Wergin's) Bridge, Sutton, Bodenham Moor, Risbury, Humber, to the ford of the Hennor Brook at the Streetford (now Stretford), and thence by Gorsey Hill Camp to Cainham and Ludlow."

In the year 1849 attention was drawn by the late Mr. Cherry, of Buckland, to this supposed Roman Road under Risbury Camp, and the subject mooted in a paper read at one of the *soirées* of the Hereford Philosophical and Antiquarian Society, by the author of this paper, and recorded in the proceedings of that Institution.

There is, however, a considerable disagreement between the two antiquarians in the details, although the portion running under Risbury Camp, and for a great extent both northwards and southwards, is identical.

Mr. Edmunds's theory has been already stated in his own words. Mr. Cherry was of opinion (and he appears to have carefully studied the matter and had a good geographical and practical knowledge of the district), that a road or portway connected the Roman Stations of Bravinium (at Brandon, near Leintwardine) with Circutio (at Stretton Grandison), but that instead of running southwards towards the road from Magna (at Kenchester), and entering it at Shelwick, as theorised by Mr. Edmunds, it branched off near Bodenham in a south-easterly direction to Circutio.

The best description which can be given of the road indicated by Mr. Cherry, will be to take his own words, as we have done in reference to Mr. Edmunds. He says:—

"Refer to a good county map, and look at the turnpike road from Leominster to Bromyard. At three miles and a half from Leominster you will see a road running north and south. At the point of junction is a house called The Trumpet. To begin with the northern portion, you will see that it runs through Stretford to Cwmfort, where there was formerly a fortress, to Caer-Rhos (now corrupted into Croose), thence by Stockton, Ashton, and finally it either went by way of Croft to Wigmore, or it fell into the Roman Portway running east and west near Orleton to Wigmore. I am disposed to think that this was an old Roman road, formed probably on a British trackway.

"Returning again to The Trumpet, on the Leominster and Bromyard road, the cross road runs south, and from The Trumpet for some distance it bears the name of Blackwardine Lane. Many years ago an old man, living at one of two cottages now called Blackwardine, pointed out to me a spot behind his house where he said was formerly a town called Blackwardine, and that in ploughing about that part curious implements and pottery, unlike English, used often to be found.

"Of this town or settlement there is now no vestige, but I am disposed (and always was) to think it had been a Roman station. In the first place I believe the whole of Blackwardine lane was a Roman road, and that it led from Stretton Grandison to England's Gate, thence by Bowley Lane, Black-caer-dun, Stretford, to Croft or Orleton as above.

"It runs close under the Great British camp at Risbury, still nearly perfect. The word Stretford alone would indicate this, and the position of Black-caer-dun would enable Ostorius to pass to Wigmore by the route I have pointed out above, viz., Stretford, Cwmfort, Caer-Rhos, Stockton, &c."

This extract shows that Mr. Cherry's opinion was that the road in question was originally a British trackway, and afterwards served the purposes of the Roman invaders in their movements from one station to another. A theory which we shall see was highly probable.

From Ashton, near Orleton, to Bodenham Moor, a distance of ten or twelve miles, this road is identical with that alluded to by Mr. Edmunds in his paper on Risbury Camp; but that gentleman's theory is that this road continued in a direct line northward from Ashton to Cainham and Ludlow, and southward from Bodenham to Shelwick-gate, where he supposes it joined the well-known Roman road which to this day for a distance of about four miles forms the northern boundry of the city of Hereford. Mr. Cherry's supposition was that from Ashton this road branched off to Bravinium, near Leintwardine, and from Bodenham to Circntio, at Stretton Grandison.

It is an interesting feature in connection with the early history of any district to be able to establish by traditional and physical evidence any new theory; but where there is little affirmative, and on the other hand strong negative testimony to contend with, the difficulties increase, which is just the case in the present instauce. Most of the principal Roman roads in this country, at least all the military ways, are pretty well defined in the Itinerary of Antoninus, and although the authors cf the Iters are unknown, still the records have been transmitted and are acknowledged as traditional evidence.

Now in the Itinerary there is no record of any road connecting the stations of Bravinium and Circutio, or of any road such as Mr. Edmunds has described in his paper, connecting Ludlow and the northward with the Portway which led from Magna to Circutio. The probabilities are unfavourable to Mr. Edmunds's theory; there being no necessity for such a route, because there was the well-known military way—the 12th Iter of Antoninus, the Via Orientalis of Sir R. E. Hoare—running almost parallel with it, at a few miles westward—upon which Magna and Bravinium were situate; and which connected Venta Silurum (at Caerwent) and Isca Silurum (at Caerlleon) with Burrium (at Usk), Gobannium (at Abergavenny) Magna and Bravinium, as already noticed, and ended at Uriconium, near Shrewsbury.

It is very improbable too that a Roman road led to Ludlow where there was no Roman station of which we have any historical record.

The eminent antiquary, Sir R. C. Hoare, in his "Map of Antient Wales," before and after the invasion of the Romans, does not include the road in question, but only those three portways which communicated from Magna with Bravinium, Ariconium, and Wigornia (at Worcester) respectively. The small station of Circutio is also unnoticed in his "Cambria Romana," which shows that it was not a place of much note, and therefore not likely to have such frequent intercourse with an inforior station like Bravinium as to have caused the construction of a regular military road. We must, therefore, not be surprised that the trackway is now difficult of identity, and in many places physically lost from local circumstances.

It must not be forgotten that the Romans constructed many of their roads upon ancient British trackways; thus, according to Sir R. C. Hoare, the Via Julia Maritima which skirted the South Wales coast of the Bristol Channel (after the manner of the South Wales Railway) occupied the site of the British Akeman-street; the Via Julia Montana, that of the British Ryknield-street; the northern and southern Watling-streets, originally British roads, were also adopted by the Romans as military ways communicating between the several stations which they established in North Wales, and which are mentioned in the Iters with their respective distances from each other with surprising accuracy.

That portion of the Via Orientalis from Magna to Bravinium and thence to Uriconium appears to have been a branch of the British Southern Watling-street. It bears that name in the vicinity of Stretford and Kingsland at the present day, and is noted on Sir R. C. Hoare's map of Cambria Romana as an original British trackway.

These British trackways were of great importance, and show a more civilised condition of the aboriginal Britons than has been generally assigned to them. It is true that their towns or stations generally occupied the summits of low hills, were fortified by earth embankments or loose walls, and their dwellings little more than circular huts; yet, they seem to have established communications from one town to another, and, in the absence of more direct evidence, such was, in all probability, the original trackway traced by Mr. Edmunds from the Dinas, at Ludlow, to the very interesting British station at Risbury.

To draw a practical conclusion, it may be remarked that it is not improbable that there was a cross road, or vicinal way, branching off from the greater portway, the Via Orientalis, near Wigmore, which led from Bravinium to Circutio as supposed by Mr. Cherry; and that the British trackway from Ashton to Bodenham was a portion of that road, which had been adopted by the Romans and Romanised Britons when they extended their communications upon the more complete subjugation and civilisation of the country.

Like many of our old Roman roads the effects of agriculture and local alterations have destroyed its identity during the whole course, but a reference to the ordnance map will enable us to form a very good idea of the district through which it ran.

There is nothing in the local nomenclature that will affect the present question, and therefore to some extent we must rest upon the deductions to be fairly drawn from inference and probability, where traditional and physical evidence are absent. And here it may not be out of place to hint that much good may be done if residents in this county would take notice of circumstances in their localities—such as the nomenclature of villages, houses, cross roads, or even fields, with a view to a more certain development of the geography of early ages. It would be acting upon the principle of an eminent geologist when he identified nature's ancient changes with the district of an ancient people under the name of "Siluria." A well-known classic author informed us in our school days—

"Ingenuit notitias parvas rerum maximarum natura."

Mr. Edmunds observed that the only point of difference between his friend and himself appeared to be as to that part of the road which leads southward from Bodenham Moor to Shelwick bridge. Very possibly that part *was* British; in fact, he was inclined to concede very much more, as his belief had long been that most of the Roman roads were constructed on the basis of British tracks. In many instances, indeed, nature had pointed out the line of communication between different points, and uncivilised man had literally no choice but that of the celebrated "Hobson," "this or none." The comparatively civilised Roman came hither, and taught the people how to fill up hollows, cut down elevations, smooth down roughnesses, build bridges, and thus make roads where there had been only trackways leading to fords; but in many cases the line taken was necessarily the old one, while in the rest it was the best that could be chosen. Upon full consideration, he was quite inclined to regard the road past Risbury Camp as a case of a British trackway adopted by the Romans, and made into a road. It may be that they bestowed less attention on the part south of Bodenham-moor, since it did not lead to any of their stations, and that they made a road from that point to Circutio. Had the Romans made an altogether new road, it is difficult to see why they did not make it direct from Bravinium to Circutio, in which case it would not have been necessary to mount the hill plateau on which Risbury stands. That the part of the road which proceeds S. from Bodenham-moor is really an ancient road was not disputed. It seemed to be a portion of the *hen-ffordd* or "old way" of the Britons, which led over Athelstan-hill, through the marsh at its foot, and thence past the huts of Caerffawydd, "City of the beech trees," the British name for Hereford, down to the ford between the present Castle-green and the Infirmary, and there crossed the river into Irging, the British province since called Irchingfield, stretching from the Wye at Hereford to Ross. When Magna Castra was destroyed by the Saxons, the surviving inhabitants probably took refuge at the nearest British town, then called the City of the Beech-trees, and there a mixed population of Romano-Britons and Saxon settlers grew up, the Saxon element gradually predominating until the British Caer-ffawydd was softened into the Saxon Harifort and Hereford. When the Roman city of Magna disappeared, the Roman road from Bravinium to Gobannium was rendered useless, and the traffic, such as it was, had to take the road which led to Caer-ffawydd. The "old road" thus necessarily came into fashion again; and, as Magna was never restored, the new or Roman road was left to chance and the brinkers, who did with it as local convenience or individual interest dictated. The Saxons were not civilised enough to make the care of the roads a national business; and indeed we, their posterity at a distance of a thousand years, are still behind the Romans in this respect.

JASMINUM REVOLUTUM VARIEGATUM.

A very interesting feature in vegetable physiology was then brought forward. It consisted of a specimen of the variegated leaves of the *Jasminum revolutum*, kindly sent by C. Lingen, Esq., showing the effect of budding this shrub with a variegated form of *Jasminum officinale*.

This specimen was obtained from Mr. Godsall, florist, of this city, who, wishing to produce a variegation of the *Jasminum revolutum* (at that time known only to him of the ordinary green colour), about twelve years ago inserted into it twelve buds of a small plant of the variegated *Jasminum officinale*.

Though each of these buds at first seemed to live, *they all died off within fourteen days*, and Mr. Godsall thought his experiment had failed; but on the following year, when the new shoots and leaves came forth, both were found to be abundantly variegated, and this variegation has since continued in the plant, which has furnished now numerous cuttings.

The point of especial interest was the fact that, although retaining life for so short a time, a permanent effect was produced by these buds on the plant in which they were imbedded.

A very animated discussion arose as to how the variegation described had been produced, in which many gentlemen took part. Some thought that though the buds had died, a portion of the bark introduced with it might have lived; others that the stock was inoculated as it were by the sap of the buds though they had died themselves; and some even fancied that the result might have been the effect of simple mechanical injury.

Time, however, was running on, and the President was obliged to cut short the discussion by calling upon Mr. Salter to read his paper on

SOME NEW POINTS IN THE GEOLOGY OF THE USK DISTRICT.

By J. W. SALTER, Esq., F.G.S., &c.

Unlike the neighbouring Woolhope elevated valley, miscalled a valley of elevation, the Silurian district of Usk presents an irregular set of hills and vales, forming it is true, on the whole an elevated district, but without any of the picturesque symmetry of the Woolhope amphitheatre. The cause of the difference lies wholly in the different nature of the rocks, for the outburst is essentially of the same kind, and has many features in common.

In the Woolhope district, hard May Hill sandstone, capped by a thick band of limestone, is followed by soft Wenlock Shale, Limestone, soft Ludlow Shale, Limestone again, tough Upper Ludlow rock, surmounted by a band of typical Downton Sandstone, and this again by the softer Old Red. The effect is to give successive bands of hard and soft rock, causing alternate ridges and furrows in concentric order, and the elevation is on a North-west line from Linton to Dormington, parallel in a rough way to the main course of the Wye.

The Usk hills range in a north and south line, parallel to the eastern border of the coalfield of Pontypool, &c. The denudation has only exposed the Wenlock Shale. A low valley opening to let the Usk river through, in the northern part, but high ground toward Cilfigan Park and Prescoed, where the Wenlock Shale changes to hard Sandstone, so like the May Hill rock as to have originally deceived the Geological Survey, who called it Caradoc. It is also so called in the Silurian System, but not in Siluria.

Outside the ring of Wenlock Limestone, again, the Ludlow rock consists in part of hard Sandstone, and there being no Aymestry to divide this from the Upper Ludlow the latter tough rock combines with the Wenlock to form a ring of solid hills around the Wenlock shale. The concentric character, therefore, of the Woolhope elevation is lost here entirely, and models of the two districts would have hardly a feature in common. The difference is the more remarkable, inasmuch as the chief faults of the district are parallel and similar. The course of the Usk through this district is marked by a line of fault in a

N.W. direction, *i.e.*, in the same direction as the principal axis of the Woolhope Valley; and the cross faults which transverse this are N.E. by E. nearly the same lines as those of Mordiford, Putley, &c., in the Woolhope district, There are also E. and W. faults in both of small amount, and some North.

The chief difference then is due to the great change in mineral character, Throughout the greater part of South Wales the Wenlock rocks are of a sandy nature, becoming indeed quite hard sand rock in places. The Silurian districts, Woolhope, Malvern, Dudley, &c., during the same period were covered by deeper and more tranquil water, depositing limestone and shale in succession. Now the change from one of these to the other commenced in the Usk district, and hence it is that while in the valley of Woolhope there is soft shale full of ordinary Wenlock fossils, at Cilfigan park and Glascoed common, Usk, it was all strong sandstone (with such shells as loved shallow water and a sandy bottom) in Wenlock times. The lower Ludlow indeed is somewhat more of the ordinary kind, but only in the northern parts of the district. At Glascoed common and further south it is a sandy rock also, unless there be strange faults not yet discovered. The limestones are thin, as we might expect, in deposits nearer shore. There is a further difference in the top of the Ludlow rock. The Downton sandstone is represented by a thin grit and shale at Woolhope, but it is a thick series of grey and purple grits round Usk, a rock so hard as to form higher ground than the neighbouring Ludlow beds. Its thickness is not yet known; but must be considerable near Llandewifach and Llandegfydd, where Mr. J. E. Lee first discovered it. It is met with along the northern edge at Clytha House. Its thickness there is not known, nor is it to be seen in its place at the Chain bridge, though there is clear evidence of its having covered the upper Ludlow rock there, at a place where the Ludlow rock has no business to be except for a great fault. To this fault I wish to direct attention presently. But it is to be observed that the hard gritty rock which represents the Downton sandstone, though here and there showing traces of land plants, was deposited on a more open shore than the true Downton sandstone of Ludlow, Malvern, and Woolhope: The great number of Lycopodiaceous seeds, named *Pachytheca* by Hooker, or *Pachysporangium* (for both names are extant), must have been drifted down by rivers, for there is no appearance whatever of this plant, whose form indeed is unknown, having grown in the sea-water, as the plants of the coal did. The typical Downton sandstone, then, is an estuary bed, and the fine sediment supports this idea. But the red and purple grey rock of the Usk hills is not only much thicker than the Downton sandstone, but is decidedly coarse and conglomeratic, frequently a grit, always a roughish sandstone, and not unfrequently coarse conglomerate. The spines of shark-like fish occur in it on the west side of the district, trilobites and shells on the south border. It is traceable even as far as Cardiff, but of that we need not speak here, except to show the prevalence of faults of great extent all over South Wales. It is more to the point to notice that this red grit, which contains only Ludlow rock species, fish and shells, is to be traced from this point all along the edge of the Silurian country to Llandilo, and is known as the "Tilestone" in many places. We have not traced the existence of this peculiar rock on the east side of Usk. No doubt it occurs from Clytha to Usk and Llangibby. Roughly speaking, a quarter of an inch to half an inch selvage or border ought to be run round the area now coloured as Silurian on the geological charts, and this amount taken from the Old Red. But it must not be drawn in a continuous equal belt all round for reasons which will presently be shown.

FAULTS IN THE USK DISTRICT.

These faults are much easier described than investigated. It is but blind work, with the obstinate agriculture which covers every rock exposure, the depth of the drift, and the soft nature of the Old Red Marls and shales; and Dr. M'Cullough and myself, in some persevering work, found it all but impossible to get a clear section.

One clearly recognised fault, and some past experience that our faults do not occur singly, has enabled me to lay a foundation which I trust some future workman of the club will extend and build upon. The great master "faults" of the neighbouring coal field run N.N.W. and *this is parallel to the course of the Usk* through the district in question, from the Chain bridge right down to Usk and Llanllowel. Now if we can find a fault of importance along this line, commensurate with the line of excavation of the valley, we may have confidence in inferring others parallel to it; and if we can prove even one crossing the district in a direction a little N. of East, such line will also give us confidence in others less conspicuous in the same direction. There is a well-known brook which drains the hills about Mamhilad, and which runs past the Tucking Mill. The valley formed by this brook answers the purpose, and it is quite easy to prove that the rocks which border the Silurian district from Panteg to Glascoed do not correspond in direction or composition with those on the north side of the brook. The red and purple grit which takes the place of the Downton Sandstone is plain enough in the hilly meadows above Llanvihangel, but it suddenly ceases and is met by soft old Red Sandstone which comes up quite abruptly against a low cliff of Ludlow rock at Cwmhir, and the high lane above Glascoed farm is excavated in Aymestry Limestone, while itself stands as a ridge above ground which is blood red by the decomposition of the Old Red. Here we have plain evidence that the sudden change in the features of the ground is traceable to the cause which has notched one formation deep into the other: and following up this hint we infer another fault along the line which has divided the hard sandstones of Glascoed Common by a deep depression. We can understand, by means of these faults, why the hard sandstones of Cilfigan-park and Prescoed should form so straight a terrace, and why there should be such deep indentations of the border, and sudden protrusions of Silurian rock among the Old Red, at Llanvrechfa on the south side of the district.

The first-named fault along the Usk is no less a key to others. It happens to be well seen exactly opposite the chain bridge. For there, while the general lie and trend of the rocks is such as that all the strata about Kemey's Commander should be Wenlock shale and sandstone—dipping east under the limestone which comes up from Trostrey—we suddenly find ourselves in Upper Ludlow rock, dipping N.N.W., the corresponding rock to which lies miles to the north, at Trostrey Lodge and Clytha Castle.

This place is a capital example of the visible and invisible elements of fault lines—for nine-tenths of the fault here so plain lies concealed in the alluvial valley of Usk. It could never be traced, but for this little section, not half a mile long, and so narrow a strip, that when you mount the hill you find yourself immediately on Wenlock sandstone in its proper place. But, using experience, we might *infer* the fault from the outline of the country. It is not easy to see otherwise why Usk Castle should be on Upper Ludlow rock, and Llanbaddock Church across the river stand on Aymestry limestone,—why the river should have chosen to break through limestone and sandstone, in an approximately straight line, when it might have turned east or west if it were only seeking an easy passage. And for a like and *strictly parallel* reason, why the brook which drains Glascoed Common should choose, after running south for a mile or two, suddenly to turn S.E. by S. and run in a straight course, regardless of the direction or hardness of the beds, for a distance of three miles, exactly parallel to the Usk fault. But if I believe in faults, and look northward to the great gash which has severed the rival mountains above Pontypool, I have no difficulty in continuing that line by Llanfihangel and Panteg, and the hills about Llandegfydd; and in understanding by parallel and similar faults why the Silurians are thrown up, and the Cornstones are cut asunder, before the Afon Llwyd flows into the Usk.

In conclusion, I have the honour of Siluria at heart; and I hope that the Woolhope Club will not forget that, while the charming Woolhope anticlinal is the prettiest and grandest exposition of the Upper Silurian Rocks in the eastern region, the Usk district is that which will enable them to connect the Shropshire deep-water type with the shallow-water rocks of South Wales; that the study of the faults will greatly help them in tracing the beds they are endeavouring to make out; that the parish maps are the best for putting down observations on; and that the true way to make the club useful in forwarding our geological knowledge, is to take nothing in the Government Survey for granted, but to use these maps as a mere outline, to be filled up and corrected by the field clubs.

PTERYGOTUS TAURINUS.—*Salter.*

Mr. SALTER afterwards proceeded to give an account of a most interesting discovery made by the President and himself of a new *Pterygotus* in the quarry at Ewyas Harold, near Pontrilas. Dr. M'Cullough has been at work for some time in beds which were known to be low down in the Old Red Sandstone, and which both he and Mr. Salter now believe to belong to the "Ledbury Shales." Here, in this district, occur crowds of the little seeds or spore-cases of Lycopodiaceæ (*Pachytheca sphærica* of Hooker), fragments of leaves, roots, and apparently of stems that may belong to the same plant. All this of course led them to expect remains of the great crustacea which invariably occur in this formation, and the President's hammer, fortunate already in new species and genera of fish, first struck upon the *Pterygotus* in this quarry. At first only a large head was found, which was rather squarer than that of most species; but afterwards some fragments of the jaws, swimming foot, and chelate antennæ successively fell to the same hammer. Mr. Salter's acquaintance with the other species of this remarkable tribe, enabled him to recognise these fragments as belonging to a new species. Judging from them, the creature could scarcely have been less than six feet in length. From its great size, and also in honour of one of the most active members of the Woolhope Club, he had given it the name of "*taurinus*" (applause). The *Pterygotus taurinus* has a squarish head-piece, nearly a foot wide, squamate at the margin, and tubercular over the surface. In this specimen the eyes are not preserved, though their place is seen.

The *antennæ* are preserved, and are provided with sharp, cutting, lance-like teeth. The tips are much more hooked at the end than is usual in other species of the genus. The *palpi*, two of which are preserved, show abruptly smaller terminal joints. The articulations of the great swimming foot are also so broad as to be peculiar. From the position of the foot under the carapace, there is little doubt but that it belongs to the head with which it is associated. A part of one of the hinder body-rings, and a fragment of a short roundish ovate tail-piece, is also preserved.

In nearly all points of structure this species [which rivals in size the great Scotch "Seraphim," the *Pterygotus Anglicus*] differs specifically from it; and it is to be remarked here, that of the fifteen or twenty species known in Britain, none on the two sides of the border agree well with one another. This is the case with the Silurian species, as with those of the Old Red. But the maximum of size, and, apparently, of number of species, of this wonderful group of crustacea was at the base of the Old Red Sandstone, and notably in the Ledbury shales, attaining some of them the length of seven feet, and varying from this to a few inches. The genera *Pterygotus*, *Himantopterus*, *Slimonia*, *Stylonurus*, *Eurypterus*, differ widely in details; but all agree in having the head distinct from the moveable 12 or 13 body segments, and in their being all furnished with limbs. The only limbs belong to the head. The *antennæ*, furnished with claws, apparently provided the more active species with food.

The mandibles and maxillæ, each with *palpi*, are terrible organs of attrition, with their close set teeth. And even the great swimming foot only represents the last pair of jaw-feet, for it is closely covered by the lower lip. There is no instance in living adult crustacea, of all the appendages being those of the head. In *Limulus*, their nearest ally, the limbs represent both head and thoracic-appendages.

(Mr. Salter, as he described this new *Pterygotus*, sketched upon the black board the portions discovered, and then supplied the outlines of the missing parts in a very interesting and instructive manner.)

The President then exhibited a case containing a splendid specimen of the moth of the *Bombyx Yama-Maia*, near four inches broad, whose deep orange colour, with peacock eyes in the back wings, relieved by touches of lilac in the front ones, produced a very striking effect. Its *antennæ* were very bold and beautifully cut. By its side was the empty cocoon it had left. The case also contained several interesting moths and cocoons of the American species of Bombyx, the *Lophocampa Caryæ.* The hairs of this caterpillar sting like cowage, and as they are used up in the formation of the cocoon, they require to be handled with care.

Dr. M'Cullough then read a paper entitled

NOTES ON SOME XYLOPHAGOUS BEETLES.

By T. A. CHAPMAN, Esq., M.D., Abergavenny.

CRYPHALUS BINODULUS.—*Ratz.*

On some Aspen trees growing near Abergavenny I have detected certain beetles, which are interesting, not only on account of their rarity, but also on account of their habits. Last spring, I observed that two of these trees, which are from 20 to 30 years old, had been blown over in a manner similar to that in which poplars often suffer, viz., they had been snapped across at about the level of their lower branches; one of them fell last winter, the other during the previous one. On both I found evidence of their having began to decay before they yielded to the storm, but the more recently fallen one was still so far alive as to be attempting to throw out leaves, yet many of its branches had been long dead, and one side of the stem was so also; this I soon found to be caused by a small beetle belonging to the family Hylesinidæ. This beetle, *Cryphalus binodulus* (Ratz.), had previously scarcely occurred in England, except on one occasion, when a few were taken near London. It is named *binodulus* from the female beetle possessing two spines at the apices of the elytra; but those which I have found vary from the type in so far that very few specimens present these spines at all. I have placed a series of the beetles in the box now before you and also some living specimens.

Hylesinus crenatus, a tree destroyer which we examined in the spring, commences his attack close to the ground; *Cryphalus binodulus*, on the contrary, first attacks the branches, and then advances downwards. A colony is probably commenced by one, or by a few, pairs, but they rapidly multiply. There are about a dozen of the young Aspen trees *(Populus tremula)* on which I find them, and of these, besides the two already mentioned, they have this season killed a third tree. The leaves which it threw out abundantly last spring (1868) are now all black and dead, and I suspect that this is entirely the work of the present season. A fourth tree is far gone, and several others are invaded. Like most of the *Xylophaga*, it attacks the bark only. In the genus Hylesinus and others of this family, the parent beetles make a long straight burrow, and the eggs are deposited more or less regularly along either side. Unlike these, *Cryphalus binodulus* makes what may be called a little irregular cavern rather than a burrow. This is always immediately beneath the outer bark, and does not penetrate to the wood. I find invariably a pair of beetles in each cavern, even when nearly all the eggs are deposited; these are laid in little confused heaps in the recesses of the cavern, sometimes all in one heap, generally in three or four, and to the number of from 30 to 60. The larvæ when hatched burrow without any regularity, but tend to travel in a vertical direction. They are footless grubs, with strong jaws, and a distinct head like the larvæ of the other Xylophaga. I find that the eggs laid in May have already (August 14) produced some perfect beetles, though many of them still remain in the larval and pupal states. This has also been the case this season with various Hylesinidæ I have been watching; and I suspect that this species, like the others, does not usually come to maturity until a month or two later, and then hybernates before emerging. This species appears to attack living trees only, and though so minute, is from its numbers able to cause the destruction of any tree it colonises. A branch is usually first attacked by several pairs, whose progeny, laying their eggs in it, complete its destruction. Wherever a brood has been reared, a wide rough crack is observable in the bark, and a destroyed branch presents the same appearance in an exaggerated form: the whole bark looks bloated and cracked, and is pierced by the exit holes of the beetles. A branch is probably often attacked in sufficient force to destroy it in one season, and I have already mentioned my belief that the destruction of a whole tree has been accomplished during the present season. The trunk is rarely attacked till most of the branches are dead, and its vitality is then so much reduced that no distortion occurs from their ravages, except of course that it soon becomes quite decayed. In the box, there is a typical example of a destroyed branch, also a portion of fresh bark with several fresh caverns in process of construction, and a branch in which the caverns contain eggs, some of them already hatched; in each cavern, even where the eggs are hatched, there is still a pair of beetles.

HYLURGUS PILOSUS.—*Ratz.*

On the same aspen trees that were blown over there was a quantity of ivy, and the bending of its stems, where it was torn down, had proved as injurious to it as if it had been cut across. This had consequently fallen a prey to another little Xylophagon (*Hylurgus pilosus*—Ratz.) The British species of *Hylurgus* are *piniperda* and *pilosus*, the former a common species and often very destructive to pine trees. Its preference is decidedly for fallen timber, but in default thereof it takes to the living tree, and is very injurious. To complete our view of the British species of *Hylurgus*, I have placed with the others several specimens of *piniperda*, and also a piece of bark from a fir tree (*Pinus sylvestris*) felled last spring (April 1868). There are six or eight parent burrows in it, with the galleries formed by the larvæ; the young beetles have already completed their transformations and have emerged, their exit apertures on the outside being numerous. This species *(H. piniperda)* is, however, much too large a subject for the present occasion. *Hylurgus pilosus*, the ivy species, is rare as a British insect. Odd specimens often occur; but as no one has observed its habits, it has never been found in any quantity. I have found it in almost any ivy that was in proper condition for its attack. Neither healthy living ivy, nor faggots cut from the tree, suit its taste, but ivy, when sickly and dying, is at once attacked. There is a fashion observed in many districts, of simply cutting ivy across or removing an inch or two from its stem, the result of which, as is well known, is not the immediate death of the plant; it usually survives for a year or two. The back of either the upper or lower (but usually the upper) section of ivy so treated is a favourite habitat of *Hylurgus pilosus*. In this the parent beetle makes a burrow of about an inch in length, often half round the stem, and the eggs are laid rather irregularly along its sides and covered over with frass. The larvæ eat galleries at right angles to this, sometimes as regular and symmetrical as those of *Hylesinus fraxini*. When examining ivy for this beetle last spring, I found one of its habits very disappointing. It eats shallow grooves on almost any ivy, though usually on such smaller stems as do not suit it for oviposition, and along the side in contact with the supporting tree; and I often found abundant traces of this sort without any beetles—they were obviously merely eaten as food by the beetles, who had temporarily sheltered themselves behind the ivy, and abandoned it for more promising material at the first opportunity. All the Xylophaga eat largely while in the perfect state, and unless they find a nidus for oviposition at once, they commence to browse on any food at hand.

I have found that during the present warm summer many species have emerged at the end of July, which do not usually become perfect until September, and then do not emerge before spring. Every season, probably, a small proportion is perfected early; just as this season, a few, following their usual habit, remain until spring. What do these prematurely-developed specimens do? *Cryphalus binodulus* I find (August, 1868,) busily engaged in oviposition just as they were in May. *Hylurgus pilosus*, *Hylesinus crenatus*, and *H. fraxini*, I find eating galleries, in each of which there is only one beetle, and as the bark is not such as they usually choose for oviposition, and there is no sign of that process being carried on, I conclude that they intend to hybernate in these burrows and to postpone oviposition until spring. Though *Hylurgus piniperda* and *Scolytus destructor* have almost all emerged, I have had no opportunity of tracing them further.

In the genus *Hylesinus* and in *Cryphalus binodulus*, I always find a pair of beetles in each burrow during the entire period of its construction. *Hylurgus pilosus* is often found in pairs, but the male usually leaves before oviposition is complete, though with this, as with the former species, pairing occurs in the burrows, and probably only there. The economy of *Hylastes palliatus* is similar. In the burrows of *Hylurgus piniperda*, I have rarely found both beetles, and then only when the burrow was just commenced. Of *Scolytus destructor*, I have found a pair in a burrow on only one occasion, and am inclined to doubt whether the male often enters the burrow at all.

This paper was illustrated very admirably by specimens of the creatures themselves, and their borings. The Beetles alive and at work could be readily seen by cutting into the bark ; and they could also be examined with still greater ease, alive in bottles, and when dead, as they were carefully arranged in an accompanying case. It created great interest, and drew forth a very high compliment from J. W. Salter, Esq., on the great acumen which it showed, and the persevering and painstaking care with which the results given had been observed. He considered it a happy provision of nature, that wherever a close observer was found there the objects that attracted his especial interest flocked around him. If he were a botanist, rare plants would turn up in the most unexpected way, and we had the opportunity of seeing how beetles flocked round Dr. Chapman at Abergavenny. He could not help congratulating the club on having so careful an observer in its ranks (great applause).

Other objects of interest were also exhibited by the President, but our space is exhausted, and in concluding the report of this very successful meeting, we are glad to be able to console ourselves with the President's remark that "they would turn up again another day."

The Woolhope Naturalists' Field Club.

MEETING AT HEREFORD,

FRIDAY, OCT. 9, 1868.

A FORAY AMONG THE FUNGUSES.

"When Flora's lovelier tribes give place,
The mushroom's scorned but curious race,
Bedstead the moist autumnal earth ;
A quick but perishable birth."—*Bishop Mant.*

So few people take any real interest in the beautiful tribe of Agarics—autumn's flowers though they be — and all the other varied and interesting funguses which abound in our fields and woods at this season, that it seemed questionable whether any attempt to promote their study and their usefulness would meet with success. The subject had been taken up, however, by a few of the leading members of the Woolhope Club for some time past, and the very interesting papers read to the club last year, with the beautiful illustrations that adorn the last volume of the club's Transactions had no doubt prepared the way for their further consideration. Be this as it may, whatever doubt may before have existed, the "Foray amongst the Funguses" carried out by the club has most satisfactorily removed it. There was a good attendance of members, the weather was favourable, the grounds visited were picturesque, and more than all perhaps the presence at the meeting of Mr. Edwin Lees and Mr. Worthington G. Smith to name all the funguses found, and answer all questions put to them, which they did with a readiness and kindness deserving all praise, combined together to make the excursion one of the most profitable and pleasant that the club has ever made. It was a day of real work in the field, a day in which more progress could be made in the practical knowledge of the fungus tribes than could be obtained from weeks of work with books alone.

The members met at the Mitre Hotel a little after nine o'clock for the purpose of arranging and naming the several specimens brought by the different members.—There was a *Polyporus hispidus*, large as a pack saddle, and the hard rounded *Polyporus igniarius* sent with some other kinds of tree funguses from Sufton Court, by R. Hereford, Esq. ; a basket containing a series of mushrooms, from the ordinary one, *Agaricus campestris*, through intermediate varieties to the large field mushroom, the *Agaricus arvensis*, and some others, from Mrs. Key, of Stretton ; a box brought by Arthur Armitage, Esq. ; a small hamper from Whitfield ; and above and beyond all, a collection of the varieties shown at the beginning of the week at the Fungus Exhibition of the Royal Horticultural Society, at South Kensington. These will be specially alluded to hereafter, and for the present, therefore, must be passed by.

The Club elected unanimously the Rev. Archer Clive and Thomas Turner, Esq., members, and, having transacted the ordinary business, they left about 10 o'clock in a well-filled coach for Holm Lacy Park, where the first hunt was to be made, by the kind sanction of Sir Edwin L. S. Scudamore Stanhope, Bart. At the entrance of the grounds the Club was met by the Rev. Berkeley, L. S. Stanhope and the Rev. William Stanhope, two of its members, and at once proceeded under their guidance. A beautiful group of the maned Agaric, *Coprinus comatus*, quickly attracted attention. It took almost the form of a circle, though not one of those that usually do so. It is very common and as interesting and handsome in appearance as it is good to eat, if people in general did but know it.—The pretty crested Agaric, *A. cristatus*, also edible, and the *A. (Mycena) vulgaris* were next gathered, and on the bank under the Scotch fir trees several specimens of the not very common *Boletus granulatus* were found, and as a matter of course some bunches of the common poisonous *A. fascicularis* were observed. A portion of the gardens were passed through. One of the flower beds had a fine crop of the *Agaricus infundibuliformis* in it ; and a cluster of the *Boletus subtomentosus* was gathered below the terrace walk. This Boletus was also seen many times during the day.

On entering the park the magnificent oak "The Trysting tree" *(Quercus pedunculata)* came into sight, and into full admiration at once. One gentleman stopping too long in the garden to admire some of the fine bedding plants had been nearly fined for causing unnecessary delay, but this noble tree arrested universal attention. It is a fine wide spreading well shaped tree. The trunk quickly separates into branches, which drop almost to the ground, and indeed are only kept from it by numerous props. The circumference of the trunk (in 1866, it was not measured at this time) was 26ft. 11in. at three feet from the ground, and 25ft. 7in. at five feet. The diameter spread of its branches was 44 yards N. and S., and 41 yards E. and W. Its exact height by Mr. Wells' clinometer is 83 feet, and from his calculations the tree contains 1,400 cubic feet of timber. The tree is past its prime, and the trunk is beginning to get hollow. It still swells at the rate of rather more than an inch per annum from observations made by Sir Edwin Stanhope himself over a period of more than twenty years.

The work of the day soon commenced again in earnest. The Club had part of their dinner to procure in the park—not in the shape of vension from the deer—but as vegetable beef-steaks from the trees. Whilst some of the gentlemen were admiring the picturesque blasted trunk of an oak hard by, a joyful cry from Master Houghton, "Here's the beef-steak !" "Here's the beef-steak !" was gladly welcomed, and the two specimens—his quick eyes had detected of the *Fistulina hepatica*, the "Liver fungus," or "vegetable beef-steak" as it has been termed were soon gathered. Several other specimens were afterwards met with—one nearly two feet in diameter, and weighing 10 or 12lbs.—on nine different trees, and had the search for it been continued many more might doubtless have been found.

Scattered about in proper hunting order the members climbed the hill. They were specially directed to look out for the very rare grey Chanterelle *Canthcrellus cinereus*, which was found here three years since, but which Berkeley marks in his book as "not found since the days of Bolton." It was not found, however, but many other agarics were gathered. The delicate *Agaricus prunulus* or *Orcella*, "vegetable sweetbread," as it has been termed, was met with, also one of the agarics destined for the day's dinner; the common mushroom *A. campestris*, the horse mushroom *A. arvensis*, and its smaller and more delicate variety the *A. cretaceus*, all of course edible; as was also the small puff ball *Lycoperdon gemmatum*, the large rough stemmed *Boletus scaber*, the buff gilled *Russula alutacea*, the less common *Russula vesca*, and the Parasol Agaric *A. procerus*. Some others, however, were collected here not quite so good in character. There was the button of an agaric, which was thought to be a brown variety of the Fly Agaric the *A. verrucosus* of Bulliard; the small *A. Alcalinus;* the *Lactarius subdulcis;* the *A. fumosus;* the *A. radicatus;* the *A. laccatus;* the *A. lacrymabundus;* the small *Xylaria Hypoxylon:* some rotten wood stained green by the mycelium of a Peziza, (*Helstium æruginosum*); the *Coprinus micaceus;* and the "deadly Agaric" *Lactarius torminosus* or *necator*. Some fine pale orange looking specimens of this last poisonous agaric were gathered, which at first sight certainly resembled the delicious edible "orange milk agaric" so highly recommended, and figured in the Club's Transactions last year. It had, however, a shaggy woolly margin, it had not the orange gills, nor had it the striking orange coloured milk, and it ought not therefore ever to be mistaken for it.

By this time the members had reached the crest of the hill and stood before another well-known example of the most noble oaks this county can produce, the celebrated "Monarch" of Holm Lacey park. This magnificent tree has already been described in the published records of the club, and it need only be repeated here that it has a diameter of 21ft. 10in. at 5ft. from the ground, that it has a spread of foliage 38 yards in diameter, has a central trunk two-thirds of its height, and is a very handsome well-balanced tree.

The route was continued along the hill, where the views of the undulating grounds of the park, of the mansion itself, and the neighbouring hills are very diversified and beautiful on all sides, and round back again by that beautiful walk called Price's walk—from its having been laid out by Sir Uvedale Price—a walk that takes you past such a series of noble, picturesque old oaks that can seldom be met with. They are at once the glory of Holm Lacy and the pride of the county, and to all lovers of forest scenery the memory of a visit to Price's walk is an abiding pleasure.

Mais revenons à nos "mouccrons." Numerous other agarics were gathered in this route. There was the pretty bright yellow *Boletus elegans*, which may be eaten if you please; the *Agaricus fusipes*, good, when cooked, in many ways; immense clusters of *A. melleus*, beginning to decay; the *Hygrophorus pratensis;* the *H. virgineus*; the *H. niveus;* the *H. eburnus;* the elegant *H. chrysodon;* and the rare *H. calyptræformis*, so rare that it has never yet been figured; and the little paroquet agaric, with its greenish stems, the *H. sittacinus*, all edible. Their congeners, however, the beautiful scarlet-topped *Hygrophorus coccineus;* the closely-allied *H. miniatus;* the yellow and rare *H. cerasinus;* and the strong-scented *H. cossus* are all poisonous. So, too, is the beautiful green *Agaricus æruginosus*, with the pretty white spots from its flocculent veil. Then there was the *Polyporus suaveolens*, and the *P. ulmarius;* the *Agaricus appendiculatus;* the pale blue *A. purus*, and the pretty *A. (Lepiota) granulata*, both edible, if you wish, and can find enough of them; the brilliant orange *A. spectabilis;* the poisonous *Lactarius turpis;* and, lastly, numerous rings and patches of one of the very best of all edible agarics, the fairy-ring champignon *Marasmius oreades*, which were abundant enough on the lower grounds.

Munching sweet chestnuts picked up from beneath the trees on the hill—and so abundant and well filled were they from the brilliant summer we have had, that every prickly seed-vessel had its ripened kernels, and in many were three nuts of very good size—the Club passed the pond with the tame black swans upon it, and found the coach at the entrance of the park.

Having sufficiently beaten the umbrageous preserves of Holme Lacey, and carried off piles of vegetable beef-steaks, one grand specimen of which would, with accessories of *Hydnum* for oyster sauce, have made a dish enough for a dozen aldermen, the retreat was sounded, the carriages remounted, and a move made by the bridge over the Wye through Fownhope to Caplar Hill and Camp. Suddenly the coach pulled up before reaching the bridge. The President thought he saw the oyster agaric *A. ostreatus* on a gate post. It was only a *Polyporus squamosus*, however,—good for making razor strops—so the journey was quickly resumed. Hanging groves cover the sides of Caplar, but its flat summit still remains as greensward, and bare as when left by the rude warriors who once defended the deep fosse that encompasses it. As was written by Shenstone of a somewhat similar fortified hill,—

> " 'Twas on those heights, by Roman hosts annoy'd,
> Fought our bold fathers; rustic, unrefined;
> Freedom's plain sons, in martial cares employ'd,
> They ting'd their bodies, but unmask'd their mind."

So here antiquarian reflection may carry back the mind into the dubious mists of conjecture, and bring back Britons, Romans, or Saxons, to stand again in fancy on the edge of that steep vallum which, in hostile garb, it would have been once dangerous to attempt the ascent of. But time has smoothed all asperities from the way—all foemen are dead—and the thickly serried trees are the only defenders of the ground. An interest of another kind, and one dear to botanists, now attaches to the spot, and tempted the Woolhope Naturalists there on the present occasion. In the pages of Withering, the best expounder of British botany late in the last century, are recorded the gatherings of various curious Funguses in Caplar Wood, and these made by a Herefordshire observer, Mr. Stackhouse, a former resident near the spot, and Lord of the Manor. Mr. Stackhouse deserves an honourable niche in the Woolhope Transactions, for the first synoptical arrangement of British Agarics, as given in Withering's "Botanical Arrangement of British Plants," was made by him, and some of his divisions, easy to be made out, might be advantageously used by students in the present day. Caplar Wood and hill seems to have been his favourite haunt, and here no doubt the prying old gentleman, in the costume of his day—cocked hat, knee breeches, and great silver buckles in his shoes—and perhaps with gold-headed cane in hand, might have been seen prying among the dead matted leaves under the trees of the wood, his eyes sparkling with pleasure as the elegant *Nidularia campanulata*, or a specimen of the great "Club of Hercules" (*Clavaria herculanea* of Withering), both of which he gathered here, met his delighted view.

Stimulated by the thought of Mr. Stackhouse's researches at this famous locality, the fungologists, having left their vehicles, slowly urged their way up the steep hill, for a time involved in deep sylvan shadows, till at last emerging where the vallum of the camp rose in its bare verdure before their view. Doubtless some alteration in the aspect of the ground has occurred since Stackhouse faced the glades with good success both for Withering and himself, for an intricate net-work of brambles now covers the ground beneath fir trees generally most productive in local funguses, and it was difficult to search beneath these without more trouble than the time permitted. The returns to the collector were not therefore quite so good as was fondly expected, and perhaps also many agarics had died off. Still a few specimens were added to the roll of the day, as will be seen in the appended list of spoils, and amongst these was the deadly *Lactarius torminosus*. Very fine specimens of *Ag. procerus* on the grassy vallum of the camp, and in the hanging woods the *Agaricus tener;* the *Coprinus nivalis;* the *A. (Mycena) epipterygius;* the *A flaccidus*; the *Marasmius Urens;* the *M. peronatus;* the *Hymenochæte rubiginosa*, and some few others.

From the summit of the hill the party enjoyed a contemplation of the distant view of the valley of the Wye below them and the wooded and bare hills beyond that filled up the charming landscape, while a sober few traced the trench surrounding the summit of the hill. The name is evidently of

British origin, and in the absence of the relics of any other people, it seems most probable that this fortified spot, well adapted by its isolation for defence, and naturally very steep, was occupied by one of the original British tribes in or before the Roman times. Whether it was ever made battle ground, or subsequently occupied by invaders, rests entirely in the realm of conjecture. The entrance is on the eastern side, and the vallum here is greatly elevated, so that the occupants completely commanded it against any attempt to gain an entrance by an enemy. The camp itself, or rather the flat top of the hill, surrounded by a single vallum and trench forms a long oval, and in an obscure place below the vallum, on the south-east, was the water supply, in a long narrow pool probably supplied by a perennial spring, and apparently in its dark hollow never likely to be dry. From this permanent water supply close at hand a permanent occupation of the camp by those who made it may be inferred. But time now permitted no further observations, for the dinner hour was drawing near, so hastening down through the thickets to the base of the hill, the naturalists remounted, and quickly returned to Hereford.

The season for ordinary botanizing was past, and yet the number of wild plants observed in flower was eighty-six, and of these the most remarkable, considering the time of the year, were, *Fragaria vesca*, *Chlora perfoliata*, *Erythræa, Centaurium*, *Stachys Betonica*, and *Anagallis arvensis.*

The following gentlemen took part in the day's proceedings:—The President, Dr. M'Cullough; Vice-President, Thos. Blashill, Esq.; Edwin Lees, Esq., F.L.S., &c., Vice-President of the Worcester and Malvern Field Clubs; Worthington G. Smith, Esq., F.L.S., London; the Rev. W. Houghton, M.A., and Master Houghton; Dr. Bull; the Rev. B. L. S. Stanhope, and the Rev. W. P. Stanhope; Arthur Armitage, Esq.; John Lloyd, Esq.; Capt. Pateshall; the Rev. Thos. Phillipps; J. Griffith Morris, Esq.; the Rev. J. E. Jones; the Rev. R. H. Williams; W. Aston, Esq.; the Rev. E. Du Buisson; T. Maling, Esq.; Rev. R. D. Hereford; R. D. Harrison, Esq.; T. Curley, Esq.; Flavel Edmunds, Esq.; Rev. A. G. Jones; Mr. B. M. Watkins; and Mr. Arthur Thompson.

Having again had a look over the collected funguses, the time for dinner arrived, and nothing daunted, twenty-one of them sat down to the feast. They could not quite say with the fairies—

> "We'll make a feast in our mossy dell
> Of infant puff-ball and rare morel,
> And many a favoured guest shall sup
> On lily dew from a siller cup"—*(Wicliffe Lane.)*

and it is lucky they could not, for they were much better off in the comfortable quarters of good Mrs. Roberts, who had many agarics of high edible merit for their delectation, and besides, moreover, to be precise, the season for puffballs and morels had gone by.

With the fish and the soup came the first novelty in the form of "Oreades ketchup." It was good with either, and as guest after guest helped himself to an experimental taste—pooof of a discriminating judgment!—it was curious to hear one after the other ask again for "that bottle." It was a brilliant success. Hie every one with a regard for table luxuries, and that should include all sensible people, hie to your lawns and grass-plots and gather while still you may, the pretty little Fairy-ring Champignon *(Marasmius Oreades)*, and make for yourselves a ketchup, that is as superior to the ordinary vile black compound you meet with, as champaigne wine is to gooseberry. Don't you know it? Then get a member of the Woolhope Club to point it out to you, or better, still, borrow the last volume of the Club's Transactions, and there you will find a pretty coloured picture of it, and receipts, moreover, for cooking it in many ways. Have a care to keep down the spice, however, for if in too great abundance it destroys the true delicate delicious flavour of the Agaric itself.

A side dish of stewed kidneys narrowly escaped being mistaken for a dish of sliced Agarics, and another of sweetbread with buttons of the horse mushroom *(Agaricus arvensis)* was too good to travel far. Next followed a dish of beefsteak, animal and vegetable, deliciously mingled, to the advantage of both; and at the same time a dish of the *Fistulina hepatica*, the "Liver fungus" or "vegetable beefsteak" by itself was handed round. The slices were cut from the large one gathered in the morning, and was generally pronounced a success, albeit the gravy was rather too highly salted and spiced.

The next Agaric to appear was the *Hydnum repandum*, "the spiked mushroom," from Haywood forest. It was stewed and broiled, and those members of the club who had resolved themselves into a committee of critical taste, and to whom therefore all dishes were immediately brought fresh and hot, quickly separated the Agarics from their gravy, and found them excellent, and particularly the broiled ones, not at all unlike the oysters to which they have been compared.

The next Agaric presented was the Parasol agaric, *Agaricus procerus*, of which the less said the better on the present occasion. The delicious flavour of this Agaric, which is perhaps the lightest and best of all of them, not excluding the common mushroom, was simply drowned in its over-condimented gravy.

The Fairy-ring Champignon (*M. oreades*) appeared then broiled on toast after the admirable receipt of Soyer. We give it here in full, for it is the very best receipt for broiling agarics or mushrooms of every kind.

"Place young fresh agarics, or mushrooms on toast freshly made and properly divided. Salt, pepper, and place upon each one a small piece of butter (or a little scalded or clotted cream). Put one clove on the toast, then cover with a bell-glass and bake for a quarter of an hour, or broil before a quick fire for twenty minutes. Do not move the glass until it is served up, by which time the vapour will have become condensed and gone into the toast, and when the glass is removed a fine aroma of mushroom will pervade the table." (N.B.—A common kitchen basin will answer the purpose of the glass as a cover for baking equally as well, though it is by no means so elegant).

Observe here, a single clove is directed for the whole dish, our *artiste de cuisine*, put in a clove for every agaric! We pass it by in silence. "How provoking it is to see the receipts so badly carried out" said one agaric amateur at the table to another. "Oh, it is more or less inevitable" was the answer, "the cook has evidently been afraid to taste himself the dishes he made, but never mind, the agarics are too good not to rise triumphant over unbelieving and unwilling cooks, as they are rapidly doing over ordinary prejudice."

As if to reward the philosophy of the reply a dish of *Agaricus prunulus*, or *Orcella* was served simply stewed. The agaric had fair play—salt and spice were kept in due abeyance—and "delicious" was the unanimous verdict. This dish never reached a third of the way down the table!

Of the Chanterelles, salt as brine and with burnt gravy we say nothing. Accidents will happen, and though disappointment in these specialities was very unfortunate, in all other particulars the dinner was so excellent and so well served, that the cook rather deserves condolence than scolding.

Many other agarics might have been dressed but it was thought best not to tax too highly the patience of the cook; and so with the distribution of dried specimens of the Fairy-ring Champignon to all who wished it, the feast of agarics was over for the day. This excellent agaric will keep well when threaded on string and dried, and kept dry through the winter, readily imparting its flavour to soups or made dishes as required.

One other novelty to most gentlemen present yet remained to be tried—and that was the purple Granadilla, or little Pomegranate *(Passiflora edulis)* at dessert; a large dish of which had been most kindly sent to the club by Thos. Geo. Symons, Esq., Mynde Park. The fruit has been long known. The plant is a native of the Brazils, and was introduced into this country from Portugal in 1810. If grown in a house with sufficient heat, a single plant will produce 300 or 400 fruit between August and January. On Mr. Symons' plant at this time about 50 fruit are approaching ripeness. The flavour is excellent, a strong acid with a *sentiment*, as the French would say, of the promegranate, the pine apple, the raspberry, and the black currant, all blended with the art that Nature only can supply. "The very best medium for eating white sugar I have ever met with" was a criticism that seemed to meet the general feeling.

Immediately after dinner, the President said that many of them were aware that Dr. Bull had represented the Woolhope Club at the exhibition of funguses at the general meeting of the Royal Horticultural Society at South Kensington. Two special prizes had been offered for the best collection of edible funguses, and Dr. Bull had won the first prize (great applause). Taking precedence of all other business, he would, therefore, call upon him to give a report of that meeting (applause).

Dr. Bull said that the circumstances of the past week had certainly thrust upon him an amount of honour that had surprised no one more than himself. He would show them at once what he felt, and that was that he had received a good deal of credit which did not altogether belong to him. The

Woolhope Club, as you know, took up last year the subject of Edible Funguses, and when at the instigation of our great mycologist, the Rev. M. J. Berkeley, special prizes were for the first time offered for them at the Royal Horticultural Society on Tuesday last, it was felt by the Central Committee that our own meeting could not be satisfactorily held to-day without a full knowledge of what had been shown and what had occurred there. To decide upon going there was, of course, to decide upon competing for the prizes; and to compete meant equally as a matter of course to win the very first prize if possible (applause). As plans fell out, it became his lot to represent the Club on that occasion; and he would tell them where the funguses came from. Mr. Griffith Morris helped him to get one good basketful. Two other large ones were most kindly collected and sent by Mr. Symons, of Mynde Park. At the station a good hamper from the Rev. Archer Clive, of Whitfield, met him, and three more hampers from our President, collected by himself, Dr. Chapman, and Mr. Elmes Steele, all most carefully packed; and lastly, at Holme Lacey Station, Mr. Wells kindly sent him a hamper from Holme Lacey Park; and thus with eight hampers full, the result of other people's diligent, energetic search, he went in and won. And since these are the simple facts, it really seemed to him that if all had their due our President's name should have been in front (applause). Indeed, if success had not really taken him by surprise, he would have taken care not to have had so great an amount of honour all to himself (applause).

REPORT ON THE EXHIBITION OF EDIBLE FUNGUSES

AT THE

ROYAL HORTICULTURAL SOCIETY, SOUTH KENSINGTON, OCT. 6, 1868.

BY DR. BULL.

On the recommendation of our great mycologist, the Rev. M. J. Berkeley, with the object of bringing the subject properly before the public, two special prizes of £3 3s. and £2 2s. were offered by the Lady Dorothy Nevill and Mrs. Lloyd Wynne for the best collections of Edible Funguses, shown at the General Meeting of the Royal Horticultural Society on Tuesday last, and an intimation was also given to exhibitors to bring with them Poisonous and other kinds of funguses, but to keep them guardedly separate. Four collections were sent in, and that there were not many more was probably due to the peculiarity of the season. For a week or ten days before the meeting the crop of funguses had become less and less until but few could be found where they usually grow in abundance, and to those who exhibited, knowing well this fact, the surprise was rather that there were so many than that so few were shown.

The collection to which the first prize was awarded—the collection of the Woolhope Club—consisted of very numerous species arranged in four classes :—1st, those confessedly Edible; 2nd, those which were Edible but not usually eaten; 3rd, those Not Edible from a variety of causes; and lastly, the Poisonous.

The Edible classes for competition were arranged in moss. In the first class were three specimens of *Fistulina hepatica ; Hydnum repandum* in excellent growth; several specimens of *Cantharellus cibarius*; and two of *Lactarius deliciosus*, but not in good condition—none of these appeared in the other collections. There was a fine group of *Coprinus comatus*; and another of *Agaricus (Lepiota) Procerus*, but chiefly of the smaller variety; two varieties of the *Ag. campestris*; and shewn in rings were the *Ag. (Clitopilus) prunulus*, *Marasmius oreades*, and *Ag. (Psalliota) arvensis.*

In the second class of Funguses Edible, though not usually employed as food, a very beautiful group of *Lepiotas, Ag. Excoriatus*, in admirable condition occupied the centre, and were sent by the President from Abergavenny. On each side, standing back, were groups of *Ag. (Armillaria) melleus* in several forms, and *Coprinus atramentarius*; and in front were *Ag. (Lepiota) rachodes*;

A. (L.) Mastoideus; A. (L.) Acutesquamosus; Ag. (L.) Cristatus; Ag. (Clitocybe) odorus; a very fine specimen of *Ag. (C.) nebularis; Ag. (Tricholoma) nudus; Cantharellus aurantiacus; Gomphidius viscidus*; *Boletus scaber; Lycoperdon cœlatum; L. gemmatum*; *L. pyriforme;* and *Scleroderma bovista.*

Amongst the Non-Edible class were many very interesting species. One was an Agaric from Haywood forest, with a brown, or rather mouse-grey, silky pileus, pink gills, and a brittle mouse-grey stem, covered with fibrils. It proved to be a species new to this country, the *Agaricus (Entoloma) jubatus.* The *Agaricus (Tricholoma) cartilagineus* in its normal form, a species which Mr. Berkeley had only seen once before, when it was shewn to him by Dr. Badham. This specimen was gathered in the woods of Mynde Park. The *Ag. (Tricholoma) rutilans*, from Abergavenny; *Ag. (T.) grammopodius;* the brilliant scarlet *Peziza aurantia;* a very magnificent specimen of the *Polyporus giganteus*, from Whitfield; a fine example of *P. radiatus;* and another very beautiful of *P. rufescens;* the *Lenzites flaccida;* and a good display of the interesting *Bulgaria inquinans*, growing on oak bark, from Abergavenny; a well-grown *Panus torulosus;* the *Auricularia mesenterica; Ag. (Pluteus) umbrinus;* some of the very interesting *Nidulariæ*, which attracted much attention, the *Cyathus striatus*, the *Crucibulum vernicosus*, and the *Spœhrobolus stellatus;* with many other of the more ordinary kinds.

Amongst the Poisonous Funguses exhibited by the Woolhope Club were two fine crowded bunches of the beautiful *Agaricus (Pholiota) squarrosus;* the brilliant *A. (P.) spectabilis;* several splendid specimens of a *Lactarius*, which was thought to be a variety of *vellereus*, but which afterwards proved to be of a kind new to Britain, the *Lactarius controversus;* the *Ag. (Amanita) muscarius; Boletus luridus; Russula rubra; Ag. (Hypholoma) fascicularis*, and *Ag. (H.) sublatcrities; Ag. (Collybia) dryophilus;* the *Scleroderma vulgaris; A. (Tricholoma) sulphureus;* and some others.

The collection which received the second prize was exhibited by Worthington G. Smith, Esq., F.L.S., and was very fine. It was not so large as that from the Woolhope Club, and fell somewhat short in the point of Edible Funguses, but to the eye of a mycologist it possessed peculiar interest, and showed that it had been collected with much scientific care. The fine specimen of the *Lentinus vulpinus* at once attracted the eye of the Rev. M. J. Berkely. It is one of the rarest of British, or indeed of European funguses. There was a very beautiful and interesting group of the *Ag. (Armillaria) melleus* in its rare and ringless form, presenting indeed so unusual an appearance as almost to require the assistance of the taste to prove its identity.

A brilliant yellow variety of *Agaricus muscarius* and a collection of Starry puff-balls, *Geaster fimbriatus;* this species is exceedingly curious and when examined looks like a star-fish. In this collection also were exhibited a group of the curious *Clavaria stricta* and the singular gristly agaric, *Agaricus (Pleurotus) subpalmatus* that may now and then be found growing on old timber; with a group of *Paxillus involutus*, and *Phallus impudicus* in its egg state. Not the least important was a single specimen of *Agaricus (Lepiota) holosericeus*; this plant, we believe, has only once before been found in Great Britain, and then by the Rev. M. J. Berkeley. We observed a few edible species, as *A. prunulus*, *A. procerus*, *A. nebularis*, *A. dealbatus*, *Boletus impolitus*, *A. campestris*, *Hygrophorus virgineus*, *Coprinus comatus*, and several other of the more ordinary species.

The other two collections were so much smaller that it needs only to be said, that the one exhibited by J. R. Reeves, Esq., F.R.S., was shown to much greater advantage than any other. The funguses were arranged in the baskets in which they came, which of course could be easily done with a small number. It contained some very fine specimens of *A. nictitans*, *A. subinvolutus*, *Agaricus procerus*, and *A. rachodes;* some brilliant Fly Agarics, *A. muscarius*, and a very interesing specimen of the *Cordiceps ophioglossoides* growing parasitically on an *Elaphomyces*. There were also one or two specimens, far advanced in decay, of the Giant puff-ball, *Lycoperdon giganteum*, not shown in the other collections.

It was very remarkable, and proves in itself the great peculiarity of the season, that there was not a single specimen exhibited either of the common *Agaricus (Amanita) rubescens*, *Ag. (Trichloma) personatus*, or *Boletus edulis;* and *Russula rubra* alone represented the large family to which it belongs.

Mr. J. Aubrey Clarke, however, sent one species (and a very handsome one, too) quite new to this country, viz., *Hydnum nigrum*. It is allied to our common *H. repandum*, but is purple in colour, and confined to fir woods. The latter gentleman also sent a collection of spores of funguses preserved upon paper in a very copious and beautiful manner, for future reference. They looked like admirable photographs, but on being placed under a powerful lens the spores were quite distinct, preserved, as they were, under a thin film of collodion.

Mr. English, of Epping, also exhibited a group of preserved funguses, gathered in Epping Forest. The fresh plants are coated with an exceedingly thin film of virgin wax, and then coloured to imitate nature. Opinions differ a great deal in respect of the value and efficiency of this process, as the characters of many funguses are so fugitive as to be entirely destroyed by either wax or paint: it does well to preserve some of the more rigid and course species, but is, of course, useless with all our fragile and ephemeral funguses.

Around the room were displayed 40 large water-colour drawings of Edible and Poisonous funguses, very beautifully executed by Worthington G. Smith, Esq., F.L.S., from the South Kensington Museum, and on the tables were placed copies of many beautifully illustrated books on Fungology.

Many of the rarest of the Funguses shewn in London are exhibited here to-day and have doubtless attracted your attention. (Applause).

The next paper was

ILLUSTRATIONS OF THE EDIBLE FUNGUSES OF HEREFORDSHIRE.

BY DR. BULL.

(Continued from Page 167 of the Volume of Transactions for the Year 1867.)

READ MAY 22ND, 1868.

Since our last meeting in March, the Rev. M. J. Berkeley, the distinguished mycologist, has attended a meeting of the "Food Committee" of the Society of Arts for the purpose of giving information on the subject of Funguses as an article of diet. A full report of his observations and the discussions upon them, is given in the *Journal of the Society of Arts*, for last Saturday, May 15th, to which I beg leave to refer you with much satisfaction. His opinion is most favourable. "In many cases," he says, "funguses will make a very good substitute for meat," and he "thinks there is no doubt that a great deal of very valuable food is wasted and neglected." Throughout his observations he endeavours to combat the very great prejudice existing against them, especially, he says, in Scotland and Wales, and then comments at some length on the several species which he considers most useful and valuable. Prominent amongst these, you will be glad to know, are the three which appear in the volume of the Woolhope Club's Transactions for 1867, the *Marasmius oreades*, or Fairy-ring Champignon; the *Lactarius deliciosus*, or Red-milk Agaric; and the *Agaricus procerus*, or Parasol Agaric.

Amongst the instances given of the usefulness of agarics as an article of diet, Mr. Berkeley says on the good authority of Dr. Curtis, of South Carolina, that "during the late unfortunate war between the Northern and Southern States of America, when in the latter part of the time the people of the Southern States were very much pressed for food, they found Funguses of very great importance to them." He mentions again the case of a schoolmaster, a man of intelligence in his own village, who informed him that at a time when he could not afford to buy meat he kept his family for several months upon different species of mushrooms.

The subject has been so recently entered into at length before the Club that it is not necessary at this time to make any further quotations from this interesting paper. As our "Illustrations" of the several Edible Funguses are carried on it will be very serviceable as giving the valuable opinion and experience of so high an authority.

Agaricus gambosus.
april 23rd — St George's Mushroom.

FAMILY I.—HYMENOMYCETES.

ORDER I.—AGARICINI.

SERIES I.—LEUCOSPORI (Spores white).

GENUS I.—AGARICUS. SUB-GENUS IV.—TRICHOLOMA.

Stem fleshy; gills with a sinus behind. Veil obsolete, or if present floccose, and adhering to the margin of the pileus,

Moist or watery (hygrophanus) veil, if present, fugitive, pulverulent.

AGARICUS (TRICHOLOMA) GAMBOSUS.—*Fries.*

THE TRUE ST. GEORGE'S MUSHROOM.

BOTANICAL CHARACTERS.

Pileus, thick and fleshy, convex at first often lobed, becoming undulated and irregular, expanding unequally—the margin more or less involute, and at first flocculose; from three to four inches across; of a light yellow colour in the centre, fading to almost opaque white at the edges; it is soft to the touch—more or less tuberculated, and often presenting cracks.

Gills, yellowish white, watery, narrow, marginate, annexed to the stem with a little tooth; they are very numerous and irregular, with many smaller ones interposed, "lying over each other like the plaits of a frill" (from 5 to 11 Vittadini).

Stem firm, solid, and white swelling at the base in young specimens; but in older ones, though usually bulging, they are frequently of the same size, and when in long grass they occasionally even taper downwards.

They grow in rings; have a strong smell; and appear about St. George's day (April 23rd), after the rains which usually fall about the third week in April. They continue to appear for three or four weeks, according to the peculiarities of the season. They are usually to be found on hilly pastures in woodland districts.

The *Agaricus gambosus* has been known by other names. It is called *Ag. prunulus* by Dr. Badham and other authors; the deep coloured variety is called *Ag. graveolens* by Sowerby and Withering; *Ag. mouçeron* by Bulliard; *Mouçeron gris* by Paulet and Persoon; and the *strong-scented Agaric* from the strong odour it exhales. Our general term "mushroom" is derived from the French name for this particular agaric, *Mouçeron* (originally spelt *Mousseron*), from its growing so frequently amongst moss on the continent.

The illustration given represents a fungus of the ordinary size, although every ring will probably contain larger specimens. It gives exactly the colour of the agarics sketched, but it is not light enough perhaps for its general appearance. This agaric, indeed, is usually nearly white, smooth, soft, and firm, like kid leather to the touch, and, as Berkeley has happily said, "in appearance it very closely resembles a cracknel biscuit," The spray of *Veronica chamædrys* is indicative of the season of the agaric's growth.

The St. George's mushroom cannot well be mistaken for any other. The fact of its appearance at this early season, and growing so freely in rings, when so very few other funguses are to be found, is almost enough to distinguish it. It has, however, very distinctive characters in itself in the thickness of its pileus, the narrowness of its gills, which are very closely crowded together, and the solid bulging stem.

The St. George's mushroom is not an uncommon agaric in this county and where it does appear, it is usually plentiful—a single ring affording generally a good basket full. It should be gathered when young, or it will be found grub eaten, for no fungus is more speedily and more voraciously attacked by insects than this one.

OPINIONS ON THE MERITS OF AGARICUS GAMBOSUS AS AN EDIBLE FUNGUS.

"This rare and most delicious Agaric, the *mouçcron* of Bulliard, and the *Agaricus prunulus* of other authors abounds on the hills above the valley of Stafora, near Bobbio, where it is called *Spinaroli*, and is in great request; the country pepole eat it fresh in a variety of ways, or they dry and sell it from twelve to sixteen francs a pound" (Letter from Professor Balbi to Persoon).

"Ces mousserons ont une chaire blanche, epaisse, ferme, d'un gout, et d'un perfume délicieux. On les conserves, desséchés, et il s'en consomme à Paris une assex grande quantité sons le nom *mousserons de Province*. On les appelle aussi *mousserons blancs, champignons muscats*" (M. Roques).

"The most savoury Fungus with which I am acquainted . . . . and which is justly considered over almost the whole continent of Europe, as the *ne plus ultra* of culinary friandise" (Dr. Badham).

"The Prunulus (Gambosus) is much prized in the Roman market, where it easily fetches, when fresh, thirty baiocchi, *i.e.*, fifteen francs per pound; a large sum for any luxury in Rome. It is sent in little baskets as presents to patrons, fees to medical men, and bribes to Roman lawyers" (Dr. Badham).

The *Agaricus Gambosus* "is one that a person cannot very well make any mistake about. It sometimes attains a large size, is excellent in flavour, and particularly wholesome." (Rev. M. J. Berkeley).

"Although this cannot be considered one of the most delicate flavoured of funguses it is nevertheless welcome at such an early period of the year when the more desirable kinds are not to be obtained" (M. C. Cooke).

"Few species are more substantial and delightful for the table. I (with many others) look upon it with unusual favour, as one of the rarest delicacies of the vegetable kingdom" (Worthington G. Smith).

"I am inclined to give it the *highest place as an agaric for the table.* There is nothing about its appearance to displease the most fastidious. It has an amiable and clean look, grows in pastures of fresh springing grass, and has an *ambrosial* smell—an aroma different from and more pleasant than the strong catsuppy odour of the common mushroom. It has a delicate appearance when served up, and an agreeable taste. Whoever has partaken of the *Gambosus* once, wishes to do so again, as far as my observation goes" (Edwin Lees).

When quickly grown after the rains of early spring, and before it is attacked with grubs, the *Agaricus Gambosus* is certainly an excellent agaric. It has a very delicate flavour and is very light and wholesome. When gathered in dry weather it is more firm in texture, and not so good in flavour,

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MODES OF COOKING AGARICUS GAMBOSUS.

"The best mode of cooking *Agaricus Gambosus* is either to mince or fricasee it with any sort of meat, or in a *vol-au-vent*, the flavour of which it greatly improves; or simply prepared with salt, pepper, and a small piece of bacon, lard, or butter, to prevent burning, it constitutes of itself an excellent dish."

Dr. Badham.

"Served with white sauce, it is a capital appendage to roast veal."

Edwin Lees.

It may be broiled, or stewed, or baked.

23. BREAKFAST AGARIC.

Place some fresh made toast—nicely divided—on a dish, and put the agarics upon it; pepper, salt, and put a small piece of butter on each; then pour on each one a tea-spoonful of milk or cream, and add a single clove to the whole dish. Place a bell-glass (or inverted basin) over the whole, bake twenty minutes, and serve up without removing the glass until it comes to the table, so as to preserve the heat and the aroma, which, on lifting up the cover, will be diffused through the room.

It dries very readily when divided into pieces, and retains most of its excellence. A few pieces added to soups, gravies, or made dishes, gives a delicious flavour.

Genus II.—Coprinus.

Gills membranaceous, deliquescent. Spores black.

SERIES, I.—PILEUS NOT PLICATO-SULCATE.

COPRINUS COMATUS.—*Fries.*

THE MANED AGARIC.

BOTANICAL CHARACTERS.

Pileus, cylindrical, obtuse, campanulate, fleshy in the centre, but very thin towards the margin. The external surface soon torn up into fleecy scales, with the exception of a cap at the top.

Gills free, linear, and crowded. Quite white when young, becoming rose-coloured, sepia, and then black, from the margin upwards. They then expand quickly, curl up in shreds, and deliquesce into a black inky fluid which stains the ground.

Stem is a pure white, 4 to 5 inches high, contracting at the top, and bulbous at the base ; hollow, fibrillose, stuffed with a light cottony web. The bulb is solid and rooting ; the ring is moveable.

This very elegant agaric has also been called *Ag. cylindricus*, Schœff ; *Ag. typhoides*, Bull. ; and *Ag. fimetarius*, Bolt. It is common throughout the summer and autumn months on road-sides, pastures, and waste places. It is extremely variable in size : the illustration given is rather smaller than the average size. Its general appearance is so distinct and striking, that it cannot possibly be mistaken for any other agaric. It grows so abundantly on waste ground in the neighbourhood of dwellings and farm-yards that it may be called the Agaric of Civilization ; and for both these reasons it is most valuable as an edible agaric. If its merits were known, it would be eaten as freely as the common field mushroom.

"The Maned Mushrooms" Miss Plues has well said "grow in dense clusters, each young plant like an attenuated egg, white and smooth. Presently some exceed the others in rapidity of growth, and their heads get above the ground, the stem elongates rapidly, the ring falls loosely round the stem, the margin of the pileus enlarges, and the oval head assumes a bell shape ; then a faint tint of brown spreads universally or in blotches over the upper part of the pileus, and the whiteness of its gills changes to a dull pink. A few more hours and the even edge of the pileus has split in a dozen places, the sections curl back, melt out of all form into an inky fluid, and on the morrow's dawn a black stain on the ground will be all that remains. And so on with the others in succession."

Coprinus comatus.
The Maned Agaric

OPINIONS ON THE MERITS OF COPRINUS COMATUS AS AN EDIBLE FUNGUS.

"Esculent when young."—*Berkeley.*

"Young specimens only should be selected."—*Badham.*

"No despicable dish, though perhaps not quite equal to the common mushroom."—*M. C. Cooke.*

"If I had my choice, I think there is no species I should prefer before this one; it is singularly rich, tender, and delicious."—*Worthington G. Smith.*

Dr. M'Cullough, Dr. Chapman, Elmes Y. Steele, Esq., and some other members of the Woolhope Club, hold Mr. W. G. Smith's opinion as the result, of considerable experience. It must be noted, however, that when too young this agaric is rather deficient in flavour, and its fibres tenacious. Its flavour is most rich and its texture most delicate when the gills show the pink colour with sepia margins, as is well represented in the illustration.

MODES OF COOKING THE COPRINUS COMATUS.

The best and simplest method is to broil it on toast in the ordinary way. It may be added also with great advantage to steaks and made dishes to give flavour and gravy.

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24. COMATUS SOUP.

Take two quarts of white stock and put in a large plateful of the Maned agaric roughly broken np; stew until tender; pulp through a fine sieve; add pepper and salt to taste; boil and serve np hot. Two or three table-spoonsfuls of cream will be a great improvement.

The agarics for this soup should be young, in order to keep its colour light and good.

The Maned Agaric is recommended on all sides for making ketchup, but here also it should be quickly used and the ketchup quickly made.

Veil universal, distinct from the cuticle of the pileus. Hymenophorum distinct from the stem. Ring distinct.

AGARICUS (AMANITA) RUBESCENS.—*Pers.*

BROWN WARTY AGARIC.

BOTANICAL CHARACTERS.

Pileus convex, then expanded. Cuticle brown, scattered with warts varying in size. Margin striate.

Gills white, reaching the stem and forming very fine decurrent lines upon it.

Ring entire, wide and marked with striæ.

Stem, often scaly, stuffed, becoming hollow, when old bulbous. Volva obliterated. The whole plant has a tendency to turn a sienna red, or rust colour. This is very distinctly shown some little time after it has been bruised.

This agaric has also been called *Ag. pustulatus*, or *myodes*, Schœff ; *A. verrucosus*, Fl. Lond ; *Golmelle*, by the French ; and the *Red Fleshed Mushroom*, by some English writers, from the tendency of the whole plant to turn a rich brown red when bruised or broken.

It is very common all through the summer and autumn months ; indeed one of the most abundant mushrooms ; "and it is one of those species that a person with the slightest powers of discrimination may distinguish accurately from others."—*Badham.*

OPINIONS ON THE MERITS OF AGARICUS RUBESCENS AS AN EDIBLE FUNGUS.

"Non altrimento del Cesareo delicato e sano."—*Vittadini.*

"One of the most delicate mushrooms of the Lorraine."—*Corda.*

"Quality doubtful. My friend, Dr. Hogg, eats it and considers it extremely good."—*Berkeley.*

"A very delicate fungus, which grows in sufficient abundance to render it of importance in a culinary point of view."—*Badham.*

"From long experience I can vouch for its being not only wholesome, but as Dr. Badham says, 'a very delicate fungus.'"—*F. Curry, Editor of Dr. Badham's Esculent Funguses.*

Agaricus (Amanita) rubescens.
Brown warty agaric.

"Cooked in the same way as the ordinary mushroom, it forms a dish highly relished by epicures, and we ourselves have partaken of it as freely as of the common mushroom."—*Miss Plues.*

"This species is one of the most beautiful, as well as valuable, of all the British agarics; when prepared for the table, if care be taken to select young and fresh specimens only, it will prove a very light and delicate addition to any meal. * * As far as my own experience and that of many friends go, *I well know it to be delicious and perfectly wholesome*, as I have not only eaten it myself, but have known it to be eaten largely by many amateurs."—*Worthington G. Smith.*

MODES OF COOKING THE AGARICUS RUBESCENS.

It may be toasted, boiled, or stewed in the ordinary way.

25. FRIED RUBESCENS.

Place the full grown agarics in water for ten minutes, then drain, and having removed the warty skin, fry with butter, pepper, and salt.

The ketchup made from *Agaricus Rubescens* is rich and good. "As it grows freely, and attaining a considerable size, it is very suitable for that pur-purpose, quantity being a great desideratum in ketchup-making."—*Plues.*

The next paper read was

WHY WE SHOULD *NOT* EAT FUNGUSES.

By the Rev. J. D. LA TOUCHE.

[The following paper, which may be termed "A Counterblast to Funguses," was sent to the Central Committee with a half-expressed apology for sending it, and a modest wish that it might be allowed to be read. The Committee gladly welcomed it. The Woolhope Club advocates the edible virtues of agarics with an amount of zeal which is, perhaps, always required, when prejudice has to be overcome, and yet, a zeal tempered with caution. The Club has ever held that it is with funguses, as it is with other plants, some are edible and some are poisonous; and the same knowledge to distinguish between the wholesome and the deleterious which is in daily use with other plants, is required also for funguses, and nothing more.]

It is said that at Rome, when a mortal is about to be raised to the dignity of sainthood the precaution is taken of providing a "devil's advocate," who, by pointing out as strongly as he can, all the faults of the candidate secures the fair discussion of both sides of the question, and is a guarantêe, moreover, that no unworthy aspirant to such exalted honours should be rashly admitted to them.

On the present occasion I make bold to present myself in this unamiable capacity. No member, indeed, of this respected Club is seeking canonization, yet, a step, not perhaps less important, is contemplated in the enrolment of a hitherto despised and even abhorred member of the vegetable kingdom among the list of its edible products; indeed, some may consider such a step as of *more* importance to our race than the apotheosis of a peccant mortal; and therefore it would appear that, if in the one instance it is desirable that all the peccadilloes of the candidate should be exposed, *a fortiori* it must be so in the other.

Let me, then, first observe that these gentlemen at the bar have actually a very bad character, and that it is not likely that this would be the case unless they were really great sinners.

Here, some will exclaim, no doubt, "Prejudice, my dear Sir! vulgar prejudice, is capable of the grossest injustice—ignorant prejudice has driven from our tables a delicious article of food and deprived the poor of a wholesome diet." It is often said that he was a brave man who first eat an oyster, and truly a more uninviting mouthful than it was, could scarcely be imagined; and yet the fact that it *is* good and wholesome, soon disposed of any prejudice against it. And is it not likely that such would be the case were the fungus tribe fit for human food? Can we suppose any prejudice arising from their leathery looks would not evaporate like mists before the morning sun, were they really the nutritious and delicious dainties they are described to be by their enthusiastic advocates.

I think it may be observed that the general character which a man bears is, on the whole, a true one. That big school, the world in which we live, contrives, in some way or other, to hit off pretty accurately our average merit and take our measure, and though it may make a mistake now and then in some particular instance, its general estimate is a fair one—and so with funguses. There may be a too sweeping condemnation of all kinds of them, nay, it may even be proveable that *Agaricus campestris* is not the best that grows, and yet, after all, the prevalent distrust of the tribe is well founded.

When *e. g.* some family in a parish is known to have been poisoned by eating a wrong sort it is not surprising, nor can it be called stupid prejudice if their neighbours are ever after rather shy of the article of food which produced that result. But it will be said that the mischief arose from ignorance—had that family known the marks and distinctions between the wholesome and poisonous kinds, this disaster would never have taken place. If ever there was a case in which ignorance was bliss, surely this it is. A short time ago I accompanied a scientific friend in a foray among the fungusses which we made with a special view to the improvement of our intended repast, and was on that occasion much struck by the elaborate precautions which seemed to be necessary to observe in discriminating the good from the bad—it would almost seem that nature had purposely contrived a labyrinth of ingenious stumbling blocks to guard this mysterious product from the insatiable appetites of mankind, and so it came to pass that after all, my good friend—who really seemed well up in the subject, and who found at every turn some well-known test of wholesomeness or otherwise to guide him in the specimens we collected, wound up the day by very nearly poisoning a member of my family—for he had, it appears, mistaken *Boletus flavus* a violent poison, for the very similar but wholesome and excellent *Boletus luteus*—the only difference being that the pores of the one are somewhat smaller and less angular than those of the others. Surely in this instance, knowledge (and it was not in his case a little knowledge either) was a dangerous thing.

But still it may be said that there are species the characters of which are sufficiently well defined, and that from these at least the stigma ought to be removed. But even so, I would submit one or two questions to those who may be inclined to admit this.

1st. Is is so clear that a fungus which agrees with one person may not be very injurious to another. One man has—to use a vulgar expression, the stomach of a horse—can I, an average mortal, calculate on possessing such a treasure? I saw with my own eyes my scientific friend eat and swallow an entire *Boletus flavus*, raw, without any apparent bad effects either that evening or the following day, whereas a small portion of the same kind, cooked too, (I cannot, however, say *secundum artem)* produced violent sickness on another individual, who, moreover, had never before experienced sickness—indeed this fact would seem to suggest that the stomach may be "educated" by long habit to bear this noxious food, and therefore that its effect upon organs well trained and highly accomplished in digesting it, would be no criterion of what might happen when the *experimentum in corpore vili* is tried. My friend assures me that he has eaten the highly poisonous *Boletus Satanas* with no worse effect than a little indigestion the next morning. Can, I would ask, the experience of such a seasoned digestive apparatus as his be any guide to those who have not gone through the course of training which he has.

Again, may it not be possible that the same kind of fungus which in some instances is wholesome may if grown under different circumstances, and supplied with different nutriment, assume very different properties? And again, are we competent to judge of the wholesomeness of a particular article of food unless it is tried by a very large number of persons—unless it be "exhibited," to use a medical term, on a great variety of constitutions, indeed, is there not some ground for thinking that such an exhibition would be in many instances far from satisfactory.

On the whole, it would appear that the advice of an eminent physician, an ardent admirer of the fungus, was good and sound. When he heard of the escape my family had on this occasion, he said that this article of diet should be partaken of with "great caution." And, by the way, is not this itself a very suspicious expression?—"great caution!" If I am introduced to a gentleman and told at the same time that I must conduct myself towards him with "great caution," or he will probably do me some deadly mischief, it would hardly be thought a very hearty and promising introduction; yet here we are told that this excellent family to which we are so warmly introduced has some members belonging to it so villianously disposed that, possibly, we may pay for our acquaintance with them with our lives. This is not very encouraging; and so the course adopted by a young lady who indulges in these experiments, to whom I was speaking the other day, would seem to be a very prudent one. She says she never partakes of these dainties till she has seen the effect they have had upon somebody else. But, even so, only picture the ghastly scene which a banquet of this kind would present — each guest looking anxiously into his neighbours face, awaiting in terror the contortions which are to show that he has partaken of the fatal dish!

My task is done. Perhaps a good and conclusive argument may be found to each of the objections I have brought forward, and that the ingenious and accomplished members of the Woolhope Club who have promoted this present entertainment may, from their wide experience, be able to demolish them altogether. I can only add the earnest hope that neither at that repast nor in "the to-morrow morning," which, according to good authority, is the bane of many a pleasant thing, any member of this distinguished club will have reason to repent of their foray among the fungusses (applause).

Dr. Bull said he must lift, without hesitation, the gauntlet thus thrown down, and he did so with good faith in his cause. He would at first say that the scientific gentleman, to whom this mischance befel, called at his house the next morning in a state of great anxiety. Dashing down on the table some half dozen Boleti, his first words were: "Tell me, for Heaven's sake, tell me what these are?" with the air of a man who had poisoned a whole family at least! The Boleti themselves looked tolerably innocent, and, indeed, he would at once take exception to both epithets used in the clever paper he had just read. He knew *Boletus luteus* was not "excellent" to his taste, however wholesome it might be, and he did not believe that *Boletus flavus* was "a violent poison," though somebody has said as much On making more exact inquiries, it seemed that three kinds of funguses had been partaken of, but that a portion of this Boletus had produced violent sickness on a lady present. He wrote himself immediately to Mr. La Touche, and they would be glad to know that the ill effects had quickly passed off. He would make no further reference to this misadventure in any way, but would endeavour simply to meet the arguments so well and pointedly brought against "the gentlemen at the bar."

"They are noted bad characters," it is said. Doubtless this is so in our own dear little prejudiced island, where riches abound and good food is plentiful; and be it added, where that which is most costly is sometimes the most highly esteemed; but throughout all Europe the character of many of them is most excellent. They form the staple article of the food of the people for weeks and months in the year, and millions of witnesses would raise their voices in their favour, Some of them are equally well known for their bad qualities, and the effort to remove this local prejudice, to render justice to the good, and to point out the evil, was a matter of duty to a Naturalists' Field Club. The mixture of good and bad belongs to all societies and tribes. To learn to distinguish them is ever an object in life, and the introduction to an individual "of doubtful character" be he man, or be he fungus, ought only to be used as a means of avoiding him for the future. For example he begged for himself most decidedly to decline the acquaintance of *Boletus Satanas* as an article of diet; as he did also with equal determination that of *Boletus luridus;* yet for their own brother *Boletus edulis,*—delicate in flavour, sweet, nutty and good—he had a high esteem. Broiled or fried with butter, pepper and salt, he would say to this one "Yes, if you please, I am delighted to fall in with you at breakfast, at luncheon, or at dinner" (laughter).

All edible funguses are certainly more or less rich, and delicate stomachs had better avoid them, but it would be rather hard lines, nevertheless, for delicate stomachs to lay down the law for those that are not so. If salmon and cucumber, or nuts and port wine don't agree with you, my dear sir, pray don't take them; but surely that is no reason why we should not enjoy them who can do so with equal pleasure and safety.

He thought the word "caution" had been rather misused. If you know what is good and wholesome, be "prudent" and eat moderately, and then there is no necessity for any "caution." And so, too, he thought the word "poisonous" was often misapplied, especially with reference to funguses. For example, if after dining with my Lord Mayor, you get a sick headache, or a diarrhœa, or a fit of indigestion, you at once set it down to the proper cause, without writing off forthwith to declare that you were "poisoned" by the salmon (though we all know how deleterious that fish is often said to be under such circumstances!) But if either of these grievances occurred after eating "agarics," no other word than "poisoned" seems to be thought of. As in Ireland, to be "kilt entirely, your honour," was by no means inconsistent with being perfectly well the next morning; so to be "poisoned with mushrooms" simply implied, as a general rule, some passing discomfort more or less troublesome.

The same knowledge to distinguish the good from the evil was necessary with other plants in ordinary use. People don't refuse to eat Horse-radish because a whole family is now and again poisoned (unto death, be it observed) by eating scraped Aconite root which has been mistaken for it. Nor do they refuse Watercress because the poisonous Brook-lime, very like it, grows in similar places. In a recent number of "Land and Water" is a receipt for making the "Herb pudding" which is so much used in the north of England during spring time. It is written by Mr. Jackson Gillbanks, and though somewhat long is quoted in the exact words used for obvious reasons.

For the "Herb pudding."—"The staple article, according to all the good housewives I have consulted, seems to be Eastern (alias easterman) giants, the provincial name for *Polygonum bistorta*, great Bistort, or Snakeweed, and those gathering it must take care not to get hold of the second branch of this family, such as the biting *Persicaria*. Next in order comes Comfrey, Deadnettle, and the shoots of Hops, Sorrel and Sourdock, to which many add a small portion of Chive, Elecampane, and several of the Parsley tribe, and the *Arum maculatum* or cuckoo-pint, the last with doubtful propriety, though its root makes excellent flour. I must not omit a large proportion of *Chenopodium Bonus Henricus*, the Mercury goose foot, or good King Henry. There is great danger in entrusting the gathering of some of these herbs to ignorant people: for instance, country people here call "Mercury goosefoot" simply "Mercury" for brevity; now if any of you were to apply to a herbalist for this, he would probably give you what you asked for, *Mercurialis perennis*, a deadly poison. Many mistakes also may arise in the Parsley tribe, which is also much used." Then directions are given for chopping up together, adding pearl barley and an egg or two with pepper and salt, and boiling; and it is added, "There is no doubt it is an excellent and wholesome dish." Then speaking of a garden herb pudding, he says, "I never tasted one myself but once. We had a bouncing Scotch lassie as cook, and she reckoned she would astonish us with a 'yarb pudding,' which she did with a vengeance, for many of the family had a narrow escape after eating it. On the subject being investigated, and taking her round the grounds to show what she had gathered from, it turned out that her main ingredient was

Æthusa cynapium, Fools' parsley, a deadly poison. I have heard of several similar instances since."—*Jackson Gillbanks.*

What! is so much "caution" required in the manufacture of a simple herb pudding? Surely this is as bad as Funguses. Let us hope that Mr. La Touche won't for ever hereafter forswear parsley stuffing (applause).

The Woolhope Club says plainly and openly let no one eat either of wild plants, or of funguses, until they know what they are about, and it will do its best to give the information (applause).

Had his friend Mr. La Touche been there, he thought he would admit that his arguments had been fairly met, and that having conscientiously done his duty as advocate against Funguses, he would gracefully retire, prepared, as such advocates must always be from the commencement, to give way. However, since Mr. La Touche was not there, nothing could be taken for granted; and setting argument aside, he must, therefore, in a few words, proceed to put him out of court altogether.

The Funguses eaten were not such as the Woolhope Club has ever recommended, or ever will recommend, and cannot therefore be in any way answerable for.

Let Mr. La Touche for the future take the Club's Transactions in hand, and follow the directions there given, and he may eat without fear. The Club will only recommend such as are good and wholesome, and which, moreover, can be readily recognised without deep scientific skill (applause).

Dr. Bull concluded by moving a vote of thanks to Mr. La Touche, for his well-timed and entertaining paper, which was carried by an acclamation of applause.

Three days after the feast.—Pleasurable recollections only remain from the feast of Funguses; and let it be added in a whisper, "from information received," there is no doubt but that the author of this "Counterblast" himself, has eaten with much satisfaction some of the veritable and vegetable beefsteak, gathered on the very day of the "Foray amongst the Funguses."

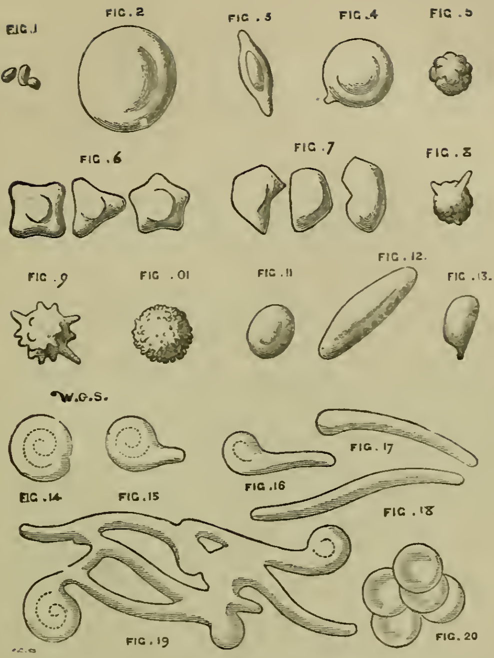
Mr. Worthington Smith, F.L.S., then made a few observations regarding the necessity of attending to the colour of the spores in determining the different species of Funguses. He said that unless the colour of the spores was first ascertained, it was next to impossible for a beginner in this study to name a fungus. After glancing at the salient points, of the white, pink, brown, purple, and black spored groups, he referred to some of the allied genera noted for their waxy, vesciculose or milky structure, such as the genus Hygrophorus, Russula, or Lactarius, illustrating his remarks with coloured diagrams of a variety of spores magnified 20,000 diameters. To see the spores, he said, the stalks of the agarics were to be detached, and the tops laid gills lowermost on a sheet of paper when the spores would become detached and soon be deposited in a coat of coloured dust upon the paper. The next thing to be attended to, he said, was the section of the gills; this he illustrated on the black board, showing that if the spores were white and the gills ran down the stem the fungus belonged to one group, if the spores were pink and the section remained the same, to another group; if red, purple, or black, to others, provided the section of the gills remained the same; thirdly, he said, by attending to the structure of the stem, whether ringed or ringless, and to the top whether smooth, dry, or viscid, a genus of some 600 species might readily be reduced to a dozen or less plants to choose a name from.

He then spoke of the size of some of these minute seeds or spores, and said that in one species, the spores were so small as to require 200,000,000 placed side by side to cover a square inch, and that the largest he had ever measured were so small as to require 2,000,000 to cover the same space; these seeds he said varied in shape and colour in the most remarkable manner, some being round, others oval or spindle-shaped, some pentagonal or very irregular and shapeless. Some of these he said were dry, others viscid, some opaque, others transparent, some smooth and plain, and others again elaborately sculptured and ornamented.

He then briefly spoke of the varied habitats and qualities of different funguses, saying how singular it was that certain species would only grow in meadows, others in woods, some upon the *debris* of one tree, some upon that of another; some being harmless, and others poisonous; but the most wonderful consideration of all, he said, was that each sporule, each inconceivably minute atom, possessed a spark of life, capable of reproducing its parent,—this he had proved by setting the spores of some of the evanescent species of *Coprinus* upon dung, where they readily germinated, at first producing a floccose spawn and then reproducing the parent fungus (applause).

[These remarks were admirably illustrated by coloured drawings of spores on a very large scale.]

An excellent paper was then read



ILLUSTRATIONS OF THE SEEDS OR SPORES OF FUNGI, MAGNIFIED 1,000 DIAMETERS.

Fig 1.—Shows the pale blue spores of *Polyporus cæsius*, common on old larch wood: it would require 200,000,000 of these spores, one deep, to cover a square inch superficial.

Fig. 2.—Spore of *Agaricus (Armillaria) mucidus*, parisitic on old beeches.

Fig. 3.—Spore of the curious *Boletus parasiticus*, parasitic on *Scleroderma vulgare*.

Fig. 4.—Spore of *Agaricus (Amanita) vaginatus*.

Fig. 5.—Spore of *Hydnum imbricatum*.

Fig. 6.—Spores of *Agaricus (Nolanea) pascuus*.

Fig 7.—Spores of *Agaricus (Entoloma) nidorosus*.

Fig. 8.—Spore of *Lactarius blennius*.

Fig. 9.—Spore of *Lactarius fuliginosus*.

Fig. 10.—Spore of *Lactarius quietus*.

Fig. 11.—Spore of *Agaricus (Psalliota) campestris*. The Mushroom.

Fig. 12.—Spore of *Gomphidius viscidus*.

Fig. 13.—Spore of *Coprinus micaceus*, common on old stumps everywhere.

Fig. 14.—Spore of *Spathularia flavida*.

Figs. 15, 16, 17, 18.—Spores of *Spathularia flavida*, in the act of germination.

Fig. 19.—Mycelium of *Spathularia flavida*, produced under the microscope from the confluent germinating spores.

Fig. 20.—Discs from human blood, drawn to the same scale, 1,000 diameters, to give an idea of the exceeding minuteness of the objects, especially of Fig. 1, which, however, is by no means unique for smallness.

ON THE FORMATION OF FAIRY RINGS AND THE FUNGI THAT INHABIT THEM.

BY EDWIN LEES, ESQ., F.L.S., F.G.S., &c., Vice-President of the Malvern and Worcestershire Naturalists' Clubs.

Particular attention has been lately called by Dr. Bull, in the Transactions of the Woolhope Naturalists' Club, to the species of edible Fungi inhabiting Herefordshire, and the learned doctor has also kindly given recipes for cooking them, with the tasty zeal of an Apicius. I shall not emulate my recondite friend in the gastronomical department, though collaterally the subject I have taken in hand bears upon it; but, leaving him to his stews, broils, and omelettes, take a philosophical and contemplative view of those Agarics that (arranged in remarkable curved lines) adorn the verdant fields, and, finding *the ring* ready formed, I shall invite you to conclusions within it, showing sport in as many *rounds* as you please.

My object then, in the present paper, will be to describe those appearances in pastures that commonly bear the name of FAIRY RINGS, and to notice the various Fungi that occasionally dot their circumference. The inquiry will thus dovetail into the subject of edible Fungi, for nearly, if not quite all, the Agarics that grow in or about Fairy Rings, may be regarded as innocuous or edible.

I shall divide the subject into four parts, for the sake of perspicuity, and mention—

1st. *The Rings themselves, and their varied appearance.*

2nd. *The Mythology and Folk Lore of the subject.*

3rd. *The Theories that have been entertained with regard to them.*

And 4th. *Give the correct explanation of their formation.*

The fact of rings existing in pastures and occupied at times by various kinds of Agarics, will be admitted by every inhabitant or even wanderer in the country. But ideas on the subject are not very exact, and it is generally stated that the rings are green. But in fact these rings exhibit different aspects at different times, though the fungologist is only interested in them when Agarics or other Fungi appear round the border of the rings, which is by no means always the case.

Rings may be brown, forming a band of up-turned soil, or of a greener hue than the pasture in which they appear, or they may present a hairy or rough aspect like the tails of some animals, from a dense mass of tall grass growing in them, and the latter I call *comet-rings.* It is only in the spring and autumn under meteorological circumstances that the rings become conspicuous from Agarics either scattered about or in a dense mass spreading around their circumference.

Now let us attend to the exact formation of the Fairy Ring, for on this depends the interpretation of a passage in Shakspere that is well known and often quoted :—

> "You demy-puppets,
> That do by moonshine green sour ringlets make,
> *Whereof the ewe bites not.*"

Here our great bard alludes to the current belief of the times in which he lived, and also mentions a rural fact that we may suppose came under his particular observation. Ewes, he states will not bite the grass of a fairy ring. Now this is not true with regard to the *area* of the circle, but it is correct when the expression is limited to its *circumference*, which is truly *the ring that the ewe will not bite.* This I once satisfactorily proved by observation in the vicinity of Stratford-on-Avon, and probably in a field that Shakspeare had himself trod. In this pasture, through which was a footpath, there was a flock of sheep grazing, and several rings of *Agaricus gambosus.* The exterior circle of each ring was occupied by a tall growth of the coarse grass called *Brachypodium pinnatum*, among which lay nestled and concealed the savoury agaric. The sheep had close grazed most of the herbage of the field, but the grass occupying the circumference of the rings was *entirely untouched*, It was then, doubtless, the *vernal* fairy rings to which the immortal bard alluded.

The ring itself, which bounds the area, is often divisible into three bands, of which the outer one is the most distinctly marked, and the ring spreads and dilates in this direction, while its inner margin joins with and is scarcely distinguishable in places from the area. But though the term "ring" is generally applied to these appearances, it must be borne in mind that a perfect circle is rarely formed, and mostly only *arcs, portions of circles*, or *long waving lines* are presented to the view. Some of these rings or arcs remain with little alteration for years, while others slowly increase till if uninterrupted they assume vast dimensions, for my friend Professor Buckman has mentioned some on Salisbury Plain that were more than fifty feet in diameter. Finally they die out after a longer or shorter continuance.

Various fungi occasionally dot or fill up the circumference of the rings, and these are either *vernal* or *autumnal*, but chiefly the latter. The first rains of May bring up the common Fairy Ring Agaric (*A. Oreades*), and also the less common but larger *Agaricus gambosus*, which has been called St. George's Agaric, as appearing about the time of the feast of St. George. Few other fungi appear so early in the year, the majority preferring the misty season of autumn, and then, besides Agarics, Puffballs and other funguses adorn the rings. These latter soon disappear from decay, but a green conspicuous band marks where they grew. But the rings occupied by *gambosus* and *Oreades* mostly remain brown and bare through the summer. These circles in the grass are not confined to any particular district, but pastures are necessary to their production, and my friend Dr. Bull has met with many about Hereford, and I have seen some in this vicinity abundantly crowded with agarics myself, as well as in other counties. They are not so common on the Continent as in England, though I have noticed some in Switzerland. In an article upon Fungi in the "American Naturalist" (1868) it would appear from a remark of the writer, that they are unknown in the United States of America, where, however, Agarics are very abundant.

With regard to the mythology and folk-lore of the subject, much may be written, and very curious matter collected, but I shall select chiefly what bears upon the appearances presented to view, and which led people in olden times to believe that fairy dancing had taken place where these circles met their view. Up to the middle of the 17th century, and perhaps nearly to the end of it, there was a general belief in the existence of a race of unsubstantial pigmy elves commonly called fairies, to whom various good as well as malicious qualities were attributed; but on the present occasion I can only notice their dancing, a pastime to which they were said to be addicted, especially when the moon illuminated the midnight scene. An old poet alluding to this says:—

"Dance like fairies a fantastic round,
Who neither change their motion or their ground."

It was this keeping to one place in the fairy dance that made the impression in the grass visible to the rustic eye the next day, as Michael Drayton observes in his "Nymphidia," thus endorsing the popular belief—

"And in their courses make that round,
In meadows and in marshes found,
Of them so called the Fairy-ground,
Of which they have the keeping."

Now this was not a mere poetical idea, but the general belief, and the fairies and their love of dancing being believed in, it seemed not unlikely that traces of their light revelry should be left in the spots they frequented, which was an easy solution of the phenomenon presented to view, and kept up the credit of the fairy people as ever at work although invisible to mortal eye. Chaucer has intimated the existence of the belief in Fairies as universal before his time, though in his satirical way he suggests that "limitours" and "holy freres" had increased to such a degree that by "blessynge halles," bowers, and all other places, they had frighted the Fairy people away from their accustomed haunts; and where before was "walken an elf," the intrusive *limitour* alone on the scene now presented *himself* only. But they were still in existence if not so manifest as formerly.

"In the olde dayes of the King Arthour,
Of which that Britouns spoken gret honour,
All was this land fulfilled of Fayrie;
The elf-queen with her joly compaignye
Daunced ful oft *in many a grene mede,*
This was the old oppynyoun, as I rede.*"

---

* Chaucer—in the opening of the "Wyf of Bathes Tale."

But evidence was not unfrequently obtained from some "belated peasant," as Milton intimates, that the Fairy people were still to be seen at their dancing pastime if a man was out wandering in the moonshine late in the night, and had the eyes of his imagination sufficiently *ethurielized*. Such appearances even learned divines professed to have seen, as appears from the following relation in the Miscellaneous Wiltshire Collections of Aubrey, preserved in the Library of the Ashmolean Museum at Oxford. Aubrey wrote a "Natural History of Wiltshire," and lived in the latter part of the 17th century. He says—

In the year 1633-4, soon after I had entered into my grammar at the Latin School at Yatton Keynel, our curate, Mr. Hart, was annoyd one night by these elves or fayries comming over the downes, it being near darke, and approaching one of the fairy dances as the common people call them in these parts, viz., the greene circles made by those sprites on the grasse, he all at once sawe an innumerable quantitie of pygmies or very small people dancing rounde and rounde, and singing and making all maner of small odd noyses. So being very greatly amaz'd, and yet not being able, as he says, to run away from them, being as he supposes kepte there in a kinde of enchantment. They no sooner perceave him but they surrounde him on all sides, and what betwixt feare and amazement, he fell downe scarcely knowing what he did; and thereupon these little creatures pinch'd him all over, and made a sorte of quick humming noyse all the time; but at length they left him, and when the sun rose he found himself exactly in the midst of one of these faery dances. This relation I had from him myselfe a few dayes after he was so tormented; but when I and my bedfellow Stump wente soon afterwards at night time to the dances on the downes, we sawe none of the elves or fairies. But indeed it is saide they seldom appeare to any persons who go to seeke for them.

Even in the early part of the present century in the remoter parts of Wales the peasantry if they did not fully believe in the existence of Fairies had a great dread of Fairy Rings, and the writer on the "Popular Superstitions of Wales" in the "Graphic and Historical Illustrator" (1834) quotes a correspondent of Mr. Croker, as thus writing to him on the subject:—"Many old persons have told me that when they were young, and had occasion to go to the mountains to look after their sheep or to fetch the cows, their parents always cautioned them to avoid treading near the Fairies Rings, or they would be lost." This is alluded to by a modern poet as not yet forgotten:—

"Some say the screech-owl at the midnight hour
Awakes the Fairies in yon antient tow'r;
Their nightly dancing ring I always dread,
Nor let my sheep within that circle tread;
Where round and round all night in moonlight fair,
They dance to some strange music of the air."

The same writer on Welsh superstitions asserts that still in Sweden if a peasant sees a circle marked out on the morning grass he attributes it to the midnight dance of the Fairies.

Barham might have made a good Ingoldsby Legend out of Aubrey's narration, which I adduce without attempting to account for the curate's bewilderment, but only to show at how late a date such a narrative could be received as a veritable fact.

Aubrey, at a later period of his life, when he wrote his "Natural History of Wiltshire," discarded the fairies, assumed the philosopher, and was, I believe, the first to suggest a natural cause for the rings, though his supposition of "a fertile subterraneous vapour which comes from a kinde of conical concave," and assumes a circular shape at the surface of the ground, was rather too recondite to be generally received.

This notion of Aubrey's, however, brings me to the third division of my paper, as to the *Theories* adduced by philosophers and naturalists to account for the appearance and continuance of the rings so common in pasture land.

Dr. Darwin, the botanical poet of the last century, was of opinion that *electricity* gave the form to the fairy ring, and in a note to his poem of "The Botanic Garden," contends that "flashes of lightning attracted by the moister part of grassy plains, are the actual cause of fairy rings," and in the poem itself, he says :—

> "So from the clouds the playful lightning wings,
> Rives the firm oak, or prints the Fairy Rings."

But if so, these rings would be evident to some eye or other immediately after a thunder storm, and the blackened grass would be an incontrovertible witness; but there is no reliable evidence that I know of as to lightning making such circular marks on grass lands, while trees and prominent objects are generally the subjects of electric strokes. Mr. J. F. Dovaston, at a later period, in *Loudon's Magazine of Natural History*, like Darwin, ascribed the exciting cause of the formation of rings to "strokes of electricity," which laying bare the ring the first year, by "the fertilization of combustion," gave rise the second year to a crop of grass "with highly increased vigour and verdure." This fertilization, however, Dovaston remarks, though violent, is of very short duration, and thus the circles soon disappear. It may be well to remark that both Aubrey, Darwin, and Dovaston, all believed the rings *to be formed of their full size at once*, and *by a sudden act*, without which, indeed, the idea of dances in the moonlight, made evident when the sun rose, would have been unsustainable.

But as Agarics often fill the outer margin of a Fairy Ring, a question arose as to how *they* came to be there, and this has led to the supposition that the *Fungi* were the efficient cause and origin themselves of the circles in the grass. This was first suggested by Dr. Wollaston, and has been since admitted as a *vera causa* by the Rev. M. J. Berkeley, Dr. Greville, Mr. Cooke, and almost all British Fungologists. It is therefore necessary to examine it in detail, and see if this theory really agrees with careful observation.

Mr. M. C. Cooke, adopting the explanation of Dr. Wollaston and Mr. Berkeley, thus expresses himself in an article on Fairy Rings in Hardwicke's *Science Gossip** :—"There are green circles of luxuriant grass on pasture lands, sometimes of immense size, and to be seen from a considerable distance. Romance ascribes their origin to the dances of fairies by moonlight; science to a much more matter-of-fact cause. These circles are the result of Fungi, originating at first from a single mushroom. This parent mushroom exhausts the soil beneath it, and nearly destroys the grass by the spawn or mycelium which insinuates itself among their roots. When matured, the spores of this mushroom are shed at an equal distance all around the plant, which latter dies, decays, and manures the soil around it. The next season *a circle of Fungi* spring up about the spot occupied by the mushroom of the preceding year, but all within the circle is barren. These shed their spores and decay, as their parent had done, and thus year by year the circle increases until rings are formed in some cases three feet, and at others thirty yards or more in diameter. The turf cut from within the ring exhibits a network of spawn, interlaced amongst the roots of the grass. Thus the fairy palace is demolished, and the airy dancers dispersed by the hard-hearted and unpoetical mycologist."*

Berkeley, the great expounder of Fungology in the present day, takes the same view, and after remarking upon the tendency of minute Fungi to "assume a circular disposition," he goes on to say: "In the fields we see this tendency illustrated by the *formation of Fairy Rings*, which have for a long time puzzled philosophers, and are not without their difficulties now. These rings are sometimes of very ancient date, and attain enormous dimensions, so as to be distinctly visible on a hill-side from a considerable distance. *It is believed* that they originate from a single Fungus, whose growth renders the soil immediately beneath unfit for its reproduction. The spawn, however, spreads all round, and in the second year produces a crop, whose spawn spreads again, the soil behind forbidding its return in that direction. Thus the circle is continually increased, and extends indefinitely till some cause intervenes to destroy it. If the spawn did not spread on all sides at first, an arc of a circle only is produced."† There is some confusion among authors in this theoretical explanation, some saying the *spores* fall in a circular form, while Berkeley gives this power to the *mycelium*.

It is extremely easy for a theorist to sit in his easy chair and propound a bold hypothesis, which he fondly hopes may solve a difficulty and obtain for him a reputation; but if truth is the object in view, it does seem astonishing that people when out in the country look upon objects with such a careless eye, and will not closely examine things before they come to a rash conclusion. Poor Peter Bell, of Wordsworth's imagination, has been often held up to reprobation, because, like hundreds of the unthinking multitude,—

"A primrose by the river's brim,
A yellow primrose was to him,
And nothing more."

But perhaps the majority of persons in walking through a meadow, if asked about a green circle, or an agaric-filled circle there visible, would say—"Ah! only a fairy-ring!" and see "nothing more in it," and care nothing more about it than Peter Bell did about the primrose! Even Mr. Berkeley takes the supposition about the single Fungus forming the circle for granted, without due examination himself, and says:—"It is *believed*" that such is the case. Now, after attentive observation, I myself do *not* believe it. No one appears to have tried to make a Fairy Ring on this principle, and it is clear that if this was the *modus operandi*, instead of one large circle only, a number of small circles would appear intersecting the original one, because if the first fungus could

* *Science Gossip*, October 1, 1866.
† Berkeley's "Outlines of British Fungology," p. 41.

form a circle by its sporules falling around it, every other offspring of the family could do the same in its turn. But such an appearance is never presented to view, and the supposition is therefore fallacious. This may be made clear to the eye by reverting to a diagram. For thus numerous intersecting circles would be of necessity formed, and the pasture, if the agarics were not too numerous and close, might look like an orrery.

Let me now, then, attempt the elucidation, as the last part of the subject I have undertaken to discuss. Discarding then the mythological Fairies, as well as the various hypotheses that have been eliminated to account for the commonly-called "Fairy Rings," let us look at the matter in a common-sense but botanical point of view, remembering that we have here to deal not with flowering, but *cryptogamous plants.* Yet the same law of Nature will apply. Turn up a mass of soil in any place, make a bank of manure, or leave the cultivated soil of a garden to itself, and what are generally called weeds soon congregate. So in a wood, if the wind upsets a tree, or scatters dead branches about, Fungi quickly find them out, feed upon them, and flourish on a pabulum congenial to their nature.

All fungi, whether Agarics, Boleti, or Polypores flourish on decaying substances, and rotting matter of some kind they require as a pabulum of support. Whatever, then causes the withdrawal and death of grasses in pastures, or displaces the soil, enables the sporules of fungi floating in the air to settle down, and Agarics or "Toad-stools" to appear, and thus we notice them scattered about, without much wonder at their appearance, in the autumnal season, for, as Shelley says—

> "Agarics, fungi, mildew, and mould,
> All start like mist from the wet ground cold."

But they do not start without some predisposing cause, or without something or other has caused decay where they arise.

That circles or arcs, forming rings of Agarics or other fungi, should appear in meadows must be admitted to be curious, and require explanation. For this purpose two things are required—the forms which attract the eye, and incipient decay. The marked green or brown rings in the grass was the ground of popular appreciation, and gave rise to the supposed fairy dances—

> "The nimble-footed fairies dance their rounds
> By the pale moonshine."—*Fletcher.*

and hence a cause must be shown for the sudden appearance of a round in the grass, and the decay that, allowing fresh grass to spring up in the track made, gives a new verdancy to it that keeps the circlet visible for a considerable time. Shakspeare says—

> "And nightly meadow fairies, look you, sing
> Like to the garter's compass, in a ring;
> The expressure that it bears, green let it be,
> More fertile fresh than all the field to see."*

* Shakspeare—"Merry Wives of Windsor."

The theory of Berkeley and other modern fungologists by no means explains the phenomenon that has attracted popular notice; for on the idea of an origin from a single fungus, it would be two or three years before sufficient space was made for a proper dancing ring, and, the fairies with their nimble feet would not trouble themselves with such a slow process, nor would the clown be attracted by it. We must have a *suddenly formed circle* in the first instance, to show the fairy dance made in the night, and exhibit their pastime as Shakspere intimates, "to make these midnight mushrooms." No supposed centrifugal growth of spores scattered round from a single agaric will make the large circles that have been noticed in pastures occupied by the mushrooms, for, theoretically there ought to be *a number of small circles.* Now let us look at what is really done, and inquire *what will do it*, and then we shall see that the observation of Nature's operations carefully made repays any trouble the enquirer may have, and gives interesting facts instead of unsubstantial theories.

Though these pasture-marks, the subject of my paper, are commonly called rings, they are by no means as a rule regular circles, but in fact for the most part incomplete circles, arcs, and wavy lines of variable and undefined dimensions. Their primary aspect is *brown with upturned soil*, then they become either greener than the pasture in which they appear, or, as circumstances happen, brown and scorched from decaying vegetation, or at times throughout one clustering mass of Agarics, so close and firm that a light-footed girl might really dance upon them all round.

Now having paid close attention to these appearances for many years, and not merely looked to the fungus growing in the circle, but the circle itself, this close observation tells me that in the great majority of cases the original disturbance of the soil in a circular or semicircular form is due to that little mining animal the Mole (*Talpa Europæa).* His gyrations close under the surface of the ground are very remarkable. In making his runs he disturbs the roots of the grass, and the grass itself withers and dies in the round that he has made. This offers a pabulum to the wandering sporules of Fungi not to be neglected, and they seize upon these rounds accordingly, and once there make an occupation of the ground for as long a time as favourable circumstances allow, and then fly off elsewhere. For an uncertain time their occupation increases the size of the ring, but they *do not originally form it.* The ring is increased too, not by the sporules of the plant scattered about, but by the perennial underground *mycelium*, which slowly spreads until it is killed by meteorological causes, or like other plants dies out from exhausted vitality.

By reference to some of the diagrams I have made from actual field observation, you may see that in numerous cases I have established not merely the presence of the Mole near the circles, but *the certainty of his formation of them.* (See Plate of fairy-ring circles and arcs p. 224.)

But so far from Fungi in their growth forming these rings, some of them are never attacked by Agarics at all, and here it is that from grass first withering, and fresh grass afterwards springing up over the run of the Mole, the ring formed appears greener than other parts of the pasture that have not been thus revivified. Tennyson noticing this, refers to

"A foot* that might have danced
The greensward into *greener* circles."

The decay of agarics about a ring will also cause a fresh and greener appearance of the turf in autumn, but more frequently in this case a taller and coarser grass is stimulated to grow in the ring at the vernal season, and I have observed the circles in which *Agaricus gambosus* flourished in May to be surrounded with a tall grass hiding the fungus completely from view, while the turf in the area of the ring was quite of a different character. This luxuriant growth of tall grass often reveals a ring in a meadow at some distance, and where the circle is incomplete it bears some resemblance to the tail of a comet, a molehill representing the comet itself.

Then again I have observed long wavy lines in flat meadows, undoubtedly the work of moles, and these at irregular distances were spotted with individuals of the large cup-shaped *Agaricus gilvus*, which certainly had nothing to do with the formation of these long sinuous lines.

But let me here particularize one case from my journal, to show the close observations I have made, and fifty more might be adduced if necessary.

"May 16th, 1848. I observed at Salwarp, Worcestershire, a large ring, though not a perfect circle, full fifteen yards in diameter. It commenced in a molehill, and then proceeded to another, and finally took a semicircular sweep nearly back to the molehill from whence it started. The circular track was evidently the underground work of a mole, although very near to the surface, and this track was now *brown and bare* from the very hot weather of the last fortnight. Now, a few weeks ago, I saw in Spetchley Park a similar large ring covered with rank grass much superior in height to the herbage within it. This rough grass which thus springs up so luxuriantly in the track of the mole, and which does not appear to be eaten, soon withers away, leaving a bare place, on which, after rain, Agarics mostly of one particular species appear in each ring, though various species and even genera of fungi, are adapted to grow in such rings."

To any one only looking upon some neglected meadow or wide-extending heath, where hundreds of molehills appear scattered about in the most irregular manner, it may appear a strain upon credibility to suppose the mole to form arcs and circles in anything like a regular way; but these common heaps are only thrown up in the process of searching for and feeding upon worms; and there are times when the little burrower yields to that overpowering principle that impels all animals to the process by which their numbers are increased in the world, and the species they belong to maintained. By recurring to this phase in the mole's history, we shall see how the various phenomena of nature are connected and dove-tailed into each other.

* This "foot" is that of the little unseen burrowing Mole.

Both English and French writers have given an account of the gyrations of the mole in the soil when love inspires his movements, and when the nest is formed where the young moles repose and have to be fed. Sir Charles Bell in his "History of British Quadrupeds," says, when alluding to the habits of the mole,—"The tracks by which the mole pursues his mate are curiously divaricating; they are very superficial, and are made with great rapidity; they are termed by the French '*traces d'amour*;' and by our English mole-catchers 'coupling-runs,' or 'rutting-angles.'" Persons engaged upon other pursuits may tread upon a thing and not see it, for unquestionably we here find the *primum mobile* or originator of our old friends the Fairy-Rings in these *circles d'amour*. Mr. Jesse, also, in his Natural History "Gleanings," has alluded to these curious "rutting-angles," which he says are formed by the male mole, and "are as near the surface as possible."* In fact they often break up the surface. M. de St. Hilaire, a French naturalist, who has gone into details of the mole's history, taken from practical persons who were familiar with the operations of the mole, shows fully how the sportive animal is incited to these amatory runs; and I am inclined to believe that Miss Mole at these times takes a "run" also, and from the form of some double circles that I have seen, I should conclude that the runners run into each other's arms! Of course many of these courses would be of a sinuous character, but as to perfect and complete circles, which are occasionally met with, M. de St. Hilaire states that when the mole has made a nest for its young, which is under a hillock much larger than the ordinary mounds, he is careful to surround it with a *circular path of communication*, from whence other passages divaricate deep into the soil, and when these circular walks of which M. de St. Hilaire has given a plate, are near enough the surface to break the soil, the grass is disturbed, a circle is apparent to the eye, and finally this becomes of a vivid green from young and fresh grasses springing up. All this is plain and natural, and we may therefore dispense with the theoretical idea that the sporules of the Fungus are obliged to "spread centrifugally" in every direction to produce Fairy Rings, which is as much an illusion as the dances of the Fairies themselves.

If one species of Agaric alone occupied Fairy Rings, it might be imagined that the growth of this Fungus was peculiar, but when not only numerous kinds of Agarics but even Puffballs and the Chanterelles are at times found in the rings, it is clear that the circle has been formed in some other way than by centrifugal propulsion.† In some cases, I have reason to believe, that a small ring has been formed by wire-worms, but any action that breaks the soil or burns up the grass, will tempt a Fungus or colony of Fungi to take up a position

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* Jesse's Gleanings, p. 136.

† Mr. Berkeley has in one of his works, ascribed the formation of the ring to "the radiation of the mycelium" from the first central Agaric, and says that the space within the ring has "been previously exhausted by the demand of the former crop;" but this is so far from being the case that the area of the ring is often green with grass equal to any in the meadow, while *the circumference is brown and bare.*

there, and if this takes a circular form *there is a ring marked in the grass,* or *the portion of one.*

In conclusion I will only remark upon the continuance of the rings and their mode of increase. Rings occupied by *Agaricus Oreades* seem more permanent than many others, and may be of considerable age, and in this case all traces of the primary work of the Mole is lost, but he was not the less there originally. For the most part, however, as Mr. Dovaston has remarked in Loudon's Magazine of Natural History, the rings are not of very long continuance, and I can testify to the evanescence of many that I have known and sought for in after years in vain. In truth, Linnæus correctly gave the name of *Nomades,* or wanderers to the *Fungi,* and their sporules fly off to settle again miles from their original location. The *mycelium*, or the underground plant of Agarics, maintains an existence beneath the soil as long as it can find a pabulum for its support, and having exhausted this it dies out. However, as what one robber may leave behind, another may come and think worth having, so a ring deserted by one agaric that has flourished there may be occupied by another in succession, and this is frequently the case. This may account for Mrs. Key's observation in the last volume of the Transactions of this Club (1867), without necessarily supposing that two kinds of agarics are varieties of one species, because successively growing in the same ring ; and, indeed, I have been informed of *Agaricus campestris* taking possession of an old ring of *Agaricus gambosus,* without troubling itself to form a circle by means of centrifugal propulsion. On this point I have received a note from my friend Professor Buckman, who has made many experiments on edible Fungi, and on one occasion was almost poisoned by eating too much of one particular kind.

The Professor remarks that from a notice in Hardwicke's Science Gossip, that a lady (Mrs. Key) in the Transactions of the Woolhope Club, supposes that because two kinds of Mushrooms have been observed by her in the same ring, that they are therefore not specific, but varieties of each other. "Now I have found," he continues, "in the same rings *Agaricus gambosus* first, at a later time *Agaricus Oreades*, and later still *Agaricus personatus.* However, I always looked upon it as a fact that most of the Agarics grow in the same way and require like conditions, and so the different species come in their season."

This opinion and observation places the growth of funguses pretty nearly on a par with that of ordinary phanerogamic vegetation, where as we see on rocks, walls, and ruins, and any ground left waste, that some roving seeds find out the vacant spots and colonize them accordingly for a time ; only that in the case of fungi there must be some decaying substance for them to feed upon. The withering of the grass in a meadow where rings have been made by the burrowing mole, invites the sporules of Agarics that are floating in the air to rest, and these produce an underground *mycelium,* from whence the fleshy *hymenium,* which is their fruit, is developed. This in its turn decays, and acts as a manure to stimulate the grass to a greener and ranker growth. But the mycelium, like the roots of perennial plants, lives, and spreads its fibres onwards in search of further nourishment, which if it finds it develops its fruit again, though not always the succeeding year. How long this mycelium may exist is uncertain, and an undetermined point, but in many cases its existence is not carried on for many years, and it dies when exhausted, which is the general lot of all other plants. At any rate when the annual crop of one species has died and rotted on the ground, it is open for any other fungus to occupy the old ring, and Dr. Wollaston was even of opinion that the same Agaric could not grow on the same spot two successive seasons. This may not be exactly correct as to the vernal species of *A. gambosus* and *Oreades*, but I believe it holds good as to the autumnal ones, and thus it is that the old rings are lost, while new ones are developed in fresh places every succeeding year. Dr. Bull indeed has informed me that a fine ring of *Lycoperdon giganteus* that he saw last year has re-appeared this season in a somewhat larger but more irregular ring; but splendid rings of *Ag. geotrupus* that met his view two years since have not appeared again in the same place.

The foreign writers, Dutrochet and Turpin agree upon this continued advance of the Fungi to fresh places, and Sir Humphrey Davy has illustrated the doctrine of the rotation of crops on this very fact of funguses requiring a perpetual change of supporting pabulum.

In fact Fungi and the Agarics especially are urged into active growth by exciting meteorological causes, such as electric rain. Scarcely an Agaric could be met with during the great drought of the last summer, but after the first thunder storms that swept over the country, mushrooms sprang up in astonishing multitudes, the markets were crammed with them, and tons collected. So in like manner, up sprang rings of *Agaricus Oreades*, complete at once as Minerva is said to have risen full armed from the brain of Jupiter; and soon after one of these heavy thunder-showers, my friend the Rev. J. H. Thompson observed three large Fairy Rings suddenly apparent in a croft some time since added to Cradley churchyard, where he feels assured they were never present before, as he was in the habit of noticing this piece of ground almost daily. But, no doubt, I think, *the rings* were really there before, though not made apparent till after the rain by the sudden growth of the Agarics. This may be often the case, for Dr. Bull mentioned to me a ring in a garden grass-plot that appeared in a very similar way.

If then, after all, we find nothing miraculous in Fairy Rings, and require neither fairies or centrifugal propulsion to form the rounds so often perceptible in the meadows, we see at least a law that acts upon cryptogamic equally with phanerogamic vegetation—that *progressive change*, which, with every alteration and disturbance of the ground, has something prepared for the situation, and leaves no spot unoccupied. So that, in conclusion, with a slight alteration only, and having in view the edible utility of the tribe whose growth we have been contemplating, I may say, in the language of the observant author of "The

Seasons," whose descriptions and reflections have never been exceeded—

"These as they change, Almighty Father, these,
Are all thy varied works; the rolling year
Is full of thee; forth in the pleasing spring
Thy beauty walks, thy tenderness and love.—
Thy bounty shines in autumn unconfined,
And spreads a common feast for all that lives."

Thus Nature is ever progressive, and fertile in expedients that every disturbance of the soil shall bring its recompense in fresh vegetation that shall take its turn in the march of utility. The air abounds with the sporules of cryptogamous plants ready, like birds of prey, to pounce down upon any place that will afford them a footing. The mole has his living to get and his duties to perform, and he makes his gyrations in the meadows accordingly; but thus in his train a new creation follows, and though unconscious of the result of his capricious circlings, yet, as was said of the good fairy of old, his track is marked by a sudden effusion of beauty to the eye and a product of utility to the human family.

As a supplement to this paper, it may be well to subjoin a list of those Fungi that have been noticed as inhabitants of Fairy Rings, either by myself, or recorded by other observers.

AGARICS.

Agaricus (Tricholoma) gambosus, Fr.
A. (Tricholoma) personatus, Fr.
A. (Tricholoma) grammopodius, Bull.
A. (Clitocybe) giganteus, Sow.
A. (Clitocybe) infundibuliformis, Schæff.
A. (Clitocybe) geotrupus, Bull.
A. (Collybia) confluens, Pers.
A. (Hebeloma) crustuliniformis, Bull.
A. (Psalliota) arvensis, Schæff.
Hygrophorus virgineus, Fr.
Lactarius piperatus, Fr.
Cantharellus cibarius, Fr.
Marasmius urens, Fr.
Marasmius Oreades, Fr.

OTHER FUNGI.

I observed once in Haywood Forest, Herefordshire, in company with Dr. Bull, a considerable quantity of *Hydnum repandum*, that occupied a long waving line that appeared to be due to the operations of a mole. The Giant Puffball *(Lycoperdon giganteum)*, has also been occasionally found occupying a ring, as well the commoner species *L. gemmatum*. The various kinds of Fungi found in Fairy Rings, surely suggest that they occupy a figure made by some other cause than the supposed centrifugal arrangement of the sporules from a central agaric.

REFERENCES TO PLATE

OF

FORMS OF FAIRY RINGS.

No. 1.—An irregular ring of *Ag. geotrupus*, reduced from a drawing by Dr. Bull, of a ring on Wickliff House lawn, Breinton. Diameter of the lower part 22ft. 6in. In one part within this ring an apple-tree was growing. The spot is marked by a section of the bole.

No. 2.—A very large semi-ring of *Agaricus personatus*, very much like a sickle, no less than 51ft. in diameter. Grass in the ring half concealing the agarics within it. At Norton, near Worcester, in autumn.

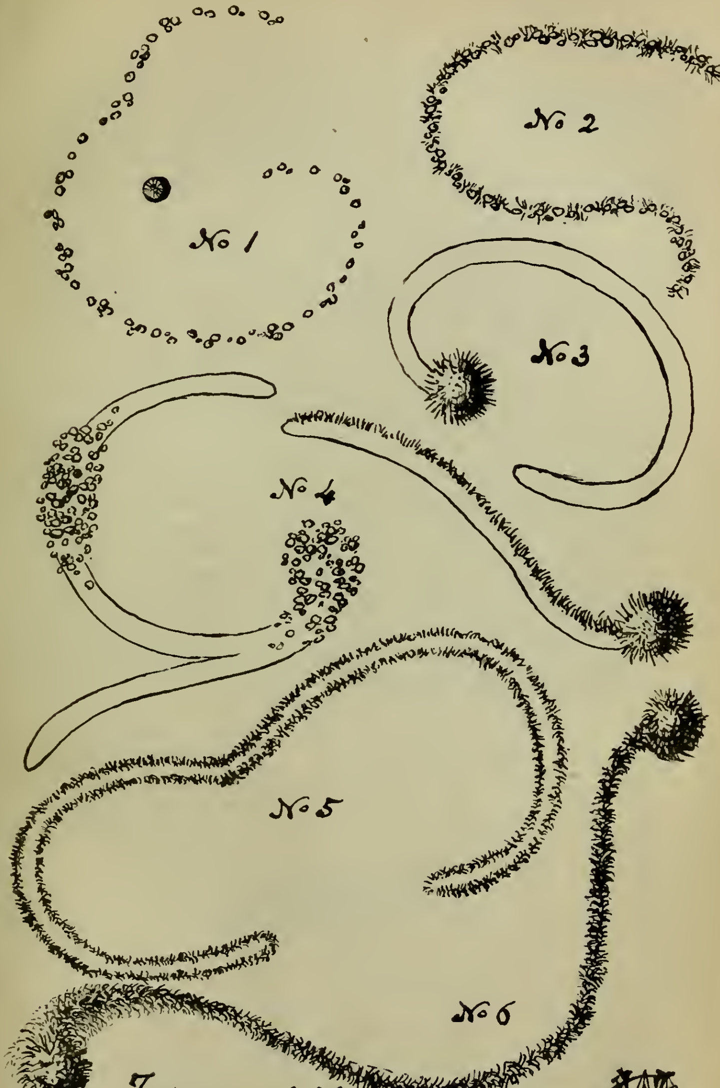
No. 3.—Bare ring of *Ag. gambosus*, after the agarics had died off. A mole-hill evident at one end of the incomplete ring. The area was occupied by the same grass as the pasture around. At Bradford Abbas, Dorsetshire. Longest diameter 15ft.

No. 4.—Assemblage of arcs or portions of rings, two of them bare with groups of *A. Oreades*, and one filled with coarse grass, the latter evidently proceeding from a mole-hill. At St. John's, near Worcester.

No. 5.—Very large double ring of green grass in a pasture at Bransford, Worcestershire. Measured along the exterior, this was 90ft. in extent. Bare of agarics, although early in autumn.

No. 6.—A comet ring or waving line of luxuriant grass, having mole-heaps at either extremity, and no agarics within it.

N.B.—In all the above forms of rings there was evidence of the operations of the mole, except in No. 1, the attention of Dr. Bull not having been then called to molar work.



Forms of Fairy Rings.

A very lively discussion then took place in which Mr. Blashill, Dr. Bull, Messrs. Curley, Flavel Edmunds, Harrison, Haughton, Lloyd, Griffith Morris, Worthington Smith, and Williams took part. The opinion supported in the paper, however, took every one by surprise, and its novelty as a matter of course, created considerable antagonism. It was however thought better to postpone the discussion until the observations of another year had been brought to bear upon it.

Yes, another year, thanks once more to Mr. Lees and to Mr. Worthington Smith, to whom in chief measure, it is due that the present "Foray Amongst the Funguses" has been so eminently successful. As our American cousins would say, it promises to become "an Institution" of the Woolhope Club.

We have yet to add a postcript, and say that another "Foray" was made by Mr. Lees and Mr. Smith for a short time the morning after the meeting to Haywood Forest, with an amount of success which deserves a record since it is not only most interesting in itself, but it shows what a field we have at hand for the interesting study of mycology. The result of this "Foray" was two magnificent specimens of the extremely rare fungus *Strobilomyces strobilaceus;* the uncommon *Nyctalis parasitica* growing upon *Russula adusta;* the *Agaricus bufonius;* the *A. placenta;* the *A. vulgaris;* the *A. velutinus;* the very pretty *A. acutesquamosus* which also is not common, the rare and poisonous *Coprinus picaceus*, the magpie toadstool, and several other species which the hurry of the Foray and their own perishable nature did not allow time to determine. Greatly delighted with their success the Naturalists departed with a high appreciation of the natural products of Herefordshire.

The Woolhope Naturalists' Field Club.

THE ANNUAL MEETING,

MONDAY, MARCH 1, 1869.

The Annual Meeting of the Woolhope Club took place at the Green Dragon Hotel, on Monday last. Dr. M'Cullough, the President, was in the chair, and the following gentlemen were also present: The Rev. H. C. Key, and James Rankin, Esq., Vice-presidents; the Rev. William Symonds, F.G.S., President of the Malvern Naturalists' Field Club; Edwin Lees, Esq., F.L.S., Vice-president of the Worcester and Malvern Field Clubs; the Rev. J. D. Latouche, of the Caradoc Club; Dr. Griffith H. Griffiths, Honorary Secretary to the Worcestershire Naturalists' Club; R. Lightbody, Esq., F.G.S.; Arthur Armitage, Esq.; Dr. Bull; the Rev. J. F. Crouch; Captain Pateshall; the Rev. S. Clark; T. Cam, Esq.; John Lloyd, Esq.; the Rev. F. T. Havergal; C. Lingen, Esq.; the Rev. T. Thistlethwaite Smith; D. R. Harrison, Esq.; T. Curley, Esq., F.G.S.; the Rev. J. E. Jones; C. G. Martin, Esq.; the Rev. J. H. Jukes; J. F. Symonds, Esq.; J. Price Hamer, Esq.; O. Shellard, Esq.; R. H. P. Styles, Esq.; J. E. Smith, Esq.; Mr. Henry Southall; Mr. With; Mr. W. Adams; Mr. J. P. Jones, and Mr. Arthur Thompson.

The first business of the day was the election of the officers for the ensuing year, when the following gentlemen were unanimously chosen:—

PRESIDENT:

JAS. RANKIN, Esq., M.A., Bryngwyn.

VICE-PRESIDENTS:

J. H. ARKWRIGHT, Esq., Hampton Court,
ARTHUR ARMITAGE, Esq., Dadnor, Ross,
The Rev. JAMES DAVIES, Moorcourt, and
Dr. M'CULLOUGH, Abergavenny.

HONORARY SECRETARY:

The Rev. Sir GEORGE H. CORNEWALL, Bart., Moccas Rectory.

CENTRAL COMMITTEE:

Dr. Bull, Hereford,
T. Curley, Esq., F.G.S., Hereford, and
John Lloyd, Esq., Huntington Court.

ASSISTANT SECRETARY AND TREASURER:

Mr. Arthur Thompson.

The thanks of the meeting were given by speaker after speaker, and cordially supported by all present, to the retiring president for his very great and successful exertions in promoting the welfare of the club during the past year.

The Field meetings for the ensuing year were then appointed as follows:—The 1st, on Thursday, May 20th, at Ledbury, to meet the Malvern Club; the 2nd, on Friday, June 25th, at Pontrilas; the 3rd, "the Ladies' day," on Tuesday, July 20th, at Ludlow and the Downton Castle grounds; the 4th, on Friday, September 3rd, at Usk; and the 5th, on Friday, October 1st, at Hereford, for "a Foray amongst the Funguses."

The Financial Statement was then given, the names of several gentlemen were proposed as new members, and other business matters discussed.

The first paper read was

METEOROLOGICAL OBSERVATIONS FOR 1868.

BY E. J. ISBELL, ESQ.

To those who take any notice of the records of Meteorology the past year has been one of singular interest, and will hereafter occupy a prominent place in scientific history as a year distinguished for its very high temperature, extraordinary drought, and abundant rainfall.

The heat of July and the first five days of August, I quite believe, equalled, if it did not surpass, any summer heat ever before experienced in England by any person living. The drought during June and July exceeded that of 1864, its effects upon the depth of the river Wye being decidedly greater.

And yet, strange to say, the total amount of rainfall during the year was above the average by a very considerable amount; the fall of rain being great in August, and quite extraordinary during the month of December.

Some thunderstorms remarkable for extent and severity occurred during 1868.

April, according to Mr. Symons, "had more than its share of electrical phenomena, thunderstorms, large falls of hail, and diminutive but very violent rushes of wind." This description of the weather during April applies to part of Scotland and Ireland, and a very large portion of England.

The extent of the thunderstorm (or storms) on the 29th of May was so remarkable that Mr. Symons has published a map to show how vast a surface of the country was affected by it. He says, "We have very little doubt that not half the accidents are reported, but the following analysis is somewhat formidable:—

Men struck......	16	Churches struck ...	5
,, killed	4	Houses	10
Beasts killed ...	13	Oak tree...............	1
Sheep killed ...	112	Barn	1

Lamp-post 1

This storm reached Hereford, and in fact, nearly the whole of England felt its influence; but although the darkness at 8 a.m. was very remarkable, and the storm lasted about four hours, no harm was done in the city itself. I cannot answer for the surrounding country.

Thunderstorms of extraordinary extent and severity occurred also on the 11th and 12th of July. I am not aware that these storms affected our city at all, at least I have no note to that effect; but we had a thunderstorm on the 15th, when the chimney of the foundry in Bath-street was destroyed by a vivid flash of lightning which appeared to descend in nearly a straight line from the clouds. The great mass of metal in the foundry appeared to determine the course of this flash. The men at work escaped without injury.

During the past year, the volcanic regions of the globe have been fearfully shaken by earthquakes, and a fearful loss of life has been the consequence of these visitations. At least two shocks of earthquake were experienced in

England; one affecting a limited space only, whilst the other was quite as extensive as that of 1863, but much less violent.

The November meteors were again visible in England, but the appearance did not equal in grandeur the wonderful display of 1866.

As I trust the Tables will be found to contain all the information my observations during the past year enable me to offer, I shall not attempt to enter into detail here on other points, but confine myself to a few observations respecting the high temperature of the past year, and a few remarks on the October earthquake.

In the *Times* of Monday, July 27th. 1868, Mr. G. J. Symons has published some very valuable information respecting the temperature of the hottest years of recent date, commencing with 1806; and from his figures I select the following records of the high thermometer readings:—

1806. At Plaistow, in shade, June 10th, 95 deg., and 90 deg. or upwards on three days.

1808. Somerset House, Max., in shade, July 12th, 90 deg., 13th, 93·5 deg., 14th, 91 deg.

Plaistow, Max., in shade, July 12th, 92 deg., 13th, 96 deg., 14th, 94 deg.

1818. Tottenham, July 24th, Mr. Luke Howard registered 93 deg. in the shade.

1825. Stratford, July, Mr. Luke Howard registered 90 deg. or upwards, in shade, on seven days; the highest reading being 97 deg. on the 18th.

1826. Mr. Luke Howard registered, in shade, 92 deg. on the 27th of June, and 91 deg. on the 28th. The mean temperature of the summer months was very high, and the drought excessive.

1846. July was very hot; highest reading, in shade, at Greenwich, 93·3 deg., and 94 deg. at Clapham.

1852. A wet year, but July remarkably hot; "the monthly mean temperature 66·6 deg., having been only exceeded by July, 1778, when it was 67 deg., and July, 1859, when it was 68·1 deg. The extreme heat, however, was only 90·3 deg., in shade, at Greenwich."

1857. Greenwich, June 28th, 92·7 deg., in shade.

1858. Greenwich, June 16th, 94·5 deg., in shade.

1859. "Temperatures of 92, 92·5, and 93 deg., in shade, recorded at Greenwich, and 80 deg. reached on 21 days at that station."

So much for the high temperatures of past years. We see that 90 deg. (or upwards) in shade is occasionally recorded in England, but that it is a very high reading for this country, and always noted as something out of the common.

During the hot weather of 1868 the thermometer registered, at Hereford, 91 degrees or upwards in shade on eight days, and with us July 22nd was the hottest day of the year; but it was not so at all stations, and Mr. Symons observes:—"That the date of the hottest day seems to have travelled certainly in rather a remarkable manner, being the 13th (July) in the West of Ireland and North West of Scotland, 14th in the middle of Ireland, and at one or two stations in Scotland and Wales; 15th on the East of Ireland, generally throughout Scotland and Wales, and at stations in Cornwall and Devon. The next hot day was the 21st in the counties of Middlesex, Oxford, Cambridge, and Stafford; the 22nd was hotter still at all other stations except Worthing and Ventnor, where the maximum, such as it was, occurred on the 23rd."—*Symons' Meteorological Magazine, September*, 1868.

In the same number of his magazine Mr. Symons has published the returns of 94 observers—English, Scotch, and Irish—of whom one, Dr. Fielding, of Tunbridge, registered 100·5 on July 22nd, "*with a verified thermometer box stand, double, with Venetian sides.*" G. Pigott, Esq., of Abington Pigott, Royston, sends a reading of 99·9, July 21st; "*verified thermometer, mounted on a Glaisher stand, in a very open position.*" Mr. Skinner, of East Sutton, Staplehurst, makes a return of 99 deg., but does not state the position or character of his thermometer (no date given). T. Burgess, Esq., of Wigston, Leicester, registered 98 deg. on the 15th and 22nd.

At Evesham 97·3 was recorded by R. Burlingham, Esq., on the 22nd, and 97 deg. by my friend, Mr. Southall, of Ross, on the same day. In both cases the thermometers are verified and well placed.

At Wimbledon Camp, Linton Park (Staplehurst), Greenwich Observatory, Epping (Essex), Hereford, and Belmont Villas (Leicester), the readings on the 22nd of July were above 96, but not quite up to 97 deg. in the shade.

At thirty-six stations the readings ranged from 90 to 96 degrees, and at forty-eight other stations from 71.6 to 89.8 in the shade. The lowest reading in the whole list (71.5) was registered on the 15th at Sandwich, Orkney.

Of the high readings thus collected by Mr. Symons, forty-three were registered on the 22nd; but at two stations, Linton Park (Staplehurst), and Wigston (Leicester), a reading equal to that of the 22nd had been previously registered on the 15th, and at another station (Cranbrook, Hartley, Kent) the readings of the 21st and 22nd were alike.

Speaking generally, we may say that the highest readings were registered in England on the 22nd, in Scotland on the 15th, and in Ireland on the 14th. The whole of the readings given above, however, must be understood to belong to July alone.

But we had, at Hereford at least, very great heat to record up to the 5th of August; indeed the fourth day of this month was the second hottest in the year; but on the 6th rain commenced, and the exceedingly high temperature of the year ended.

During the period of extraordinary temperature I registered, as already stated, 91 degrees, in shade, or upwards, on eight days, viz.:—

July.		August.	
15th	91.6	2nd	91
21st	93.1	3rd	92.4
22nd	96.1	4th	93.1
27th	91.3	5th	91.8

The temperature on the same days as shown by a verified black bulb thermometer placed in the sun, was as follows :—

July.		August.	
15th	132.6	2nd	135.5
21st	128.2	3rd	138.5
22nd	133.1	4th	142.2
27th	126.1	5th	128.7

Upon the whole, we may conclude that the temperature of 1868 will bear comparison with that of any year of which we have authentic information.

The summer was not *tropical* in its temperature ; those who think it was so cannot know what the heat of a tropical summer really is ; but it was excessive for these regions, and had a perceptible influence on health and on the bills of mortality. The grass also was burned up, hills took fire, and thus sheep-walks of considerable extent were destroyed; and the distress in agricultural districts would have been very great indeed had a severe winter followed. But it has been most mercifully ordered, in the providence of God, that a winter unusually mild has followed the heat and destructive drought of the memorable summer of 1868, and thus, up to the present moment at least, the anxious fears of many have been altogether set at rest, and the apparently well-grounded predictions of others have failed of realization and come to nothing.

I have already alluded to the fact that two earthquake shocks were felt in England during the past year. The first was very limited in extent, being confined apparently to a portion only of one county, viz., Somerset. It is thus noticed in "Symons' Monthly Meteorological Magazine" for February :—"On January 4th, at 5.10 a.m., a slight shock of earthquake was felt throughout the southern part of Somersetshire, Taunton, Wellington, Langport, and other places. Beds and houses were shaken, lamps and windows rattled, &c."

The second shock, however (which occurred on the 30th of October), was felt over a very large portion of the surface of our island ; for the movement extended from Plymouth to Liverpool, and from the centre of South Wales to the neighbourhood of London. In fact, as Mr. Symons observes, "its apparent extent agrees very well with that which prevailed in October, 1863." The motion was, to my own feelings at least, very gentle. Those persons who were out of doors or on the ground floors of houses, speaking generally, failed to observe any movement whatever. Persons in bed or in the upper rooms of houses felt the shock very distinctly, and the higher the house the more perceptible was the motion. I was in bed at the time, and my bedroom being tolerably high above ground, the rise and fall of the earthquake wave was very distinctly felt by me, whilst the people down stairs were unconscious of any shock at all.

The movement appeared to consist of a gentle but very perceptible rise and fall, and there was no sound whatever.

Thus the earthquake of 1868 differed essentially from the alarming shock of 1863. Of course I speak only of those two movements as we experienced them at Hereford. In 1863 there was first a trembling of the earth sufficiently strong to make the windows rattle, and with this trembling of the earth there came a sound like that of a train approaching at inconceivable speed. Then the earth appeared to jump up suddenly with a loud crash, and the subterranean thunder was heard dying away in the distance. The shock was violent, and needed, I am quite certain, but a very slight increase of force to have caused a fearful loss of life by the destruction of the strongest houses.

All who felt this shock were assured that the force was travelling in a certain direction, viz., from some point in the west to some point in the east; but I cannot say that any impression of that kind was left upon mind by the earthquake of 1868. The movement appeared to be vertical only, simply up and down. With respect to the moment of the shock there is a slight difference in the statements of various reporters. I believe the true time to have been 10.38 p.m.

The earthquake of 1863 occurred, it will be remembered, on the 6th of October at 3.20 a.m.

THE TABLES FOR 1868.

The tables this year are five in number, our arrangement being as follows:—

Table I.—1st, barometer readings and means; 2nd, the wind.

Table II.—Thermometer readings and means.

Table III,—Rainfall in Herefordshire, as shown by eight rain gauges. For materials for the compilation of this table I am indebted to the following observers:—Rocklands, J. M. Herbert, Esq.; Ross and Leominster, Messrs. H. and E. P. Southall; Sellack, Rev. W. Clement Ley; Stretton, the Rev. H. C. Key; Tupsley, Mr. Ballard; Whitecross-road, Mr. Davison, who has kindly taken charge of the eight inch gauge belonging to the Woolhope Club. The Richmond Place rain gauge is my own.

Table IV.—Rainfall in Herefordshire by ten observers, beginning with the year 1818 and ending with 1868.

Table V.—The Register of the water-level of the River Wye for the year, kindly forwarded by John Lloyd, Esq., of Huntington Court.

We are going forward with our barometrical measurements of the hills in the neighbourhood of Hereford. A fault having been discovered in one of the instruments used last year we have gone over the whole of the work again, and hope to repeat our visits to two or three hills concerning the measurements of which, in consequence of the disturbed state of the atmosphere at the time of our observations, or want of time, we feel there may be some small error.

The following values may be safely taken as very near the truth:—

Above Hereford at Richmond Place.

	Feet.	In.		Feet.	In.
Garway	1013		Backbury	546	
Acornbury	734	6	Credenhill	533	10
Ladylift	732	4	Hough Wood	440	
Seagar	704		Dinedor	423	2
Egdon	660	10			

Hereford itself at Richmond Place is 184 feet above sea level, and this addition to the several measurements here given will, of course, give the heights above the sea.

TABLE I.

1868.	BAROMETER. Highest Reading at 9 a.m., corrected but not reduced to sea-level.	DATE.	Lowest Reading at 9 a m., corrected but not reduced to sea-level.	DATE.	Monthly Means of 9 a.m. Readings.	WIND. N. Days	N.E. Days	E. Days	S.E. Days	S. Days	S.W. Days	W. Days	N.W. Days
January	30·108	2nd, 3rd.	28·799	19th.	29·906	0	10	0	4	3	11	1	2
February	30·376	12th.	29·027	1st.	29·922	0	0	0	0	1	18	5	4
March	30·435	29th.	29·000	8th.	29·783	1	2	1	0	2	12	8	5
April	30·236	2nd.	29·163	19th.	29·759	0	5	1	2	2	9	2	3
May	30·101	14th.	29.235	23rd.	29·800	0	2	1	3	6	14	0	3
June	30·213	29th.	29·481	22nd.	29·983	0	3	2	0	2	6	6	9
July	30·270	24th.	29·457	29th.	20·901	2	9	1	0	2	2	4	7
August	30·130	1st.	29·022	22nd.	29·709	1	1	0	5	3	9	5	4
September	30·216	9th.	29·157	27th.	29·372	1	8	3	6	2	5	0	2
October	30·202	28th.	29·405	17th.	29·777	3	2	0	2	4	14	3	2
November	30·476	13th.	28·868	22nd.	29·825	3	7	1	4	3	3	2	7
December	30·017	9th.	28·495	24th.	29·288	0	1	2	6	4	12	4	1
	Yearly Mean of 9 a.m. Readings				29·752	11	50	12	32	34	115	40	49

Cistern of Barometer 4 feet 10 inches from the ground and 188 feet 10 inches above sea-level.

EDWIN J. ISBELL.
WILLIAM COOKE.

TABLE II.

THERMOMETERS.										
1868.	Highest Reading in shade ; and date.		Lowest Reading of Thermometer in shade ; and date.		Lowest Reading of Thermometer on grass ; and date.		Mean of max. Readiugs.	Mean of min. Readings.	Mean of Night Readings on the grass.	Monthly Means.
January	54·2	14th.	22·5	2nd.	20·3	2nd.	43·4	34·6	32·3	38·82
February	60·9	24th.	25·1	18th.	23	9th.	50·4	38·6	36·9	44·10
March	62·2	27th.	24·3	25th.	21·5	25th.	54·1	37·3	35·1	44·00
April	73·1	16th.	23	14th.	24·7	12th.	60·2	38·3	36·9	47·75
May	83·6	19th.	34·2	2nd.	33·3	7th.	70·8	46·3	44·6	56·90
June	85·9	27th.	39·4	8th.	37·5	3rd.	77·0	48·2	47·0	60·84
July	96·1	22nd.	44·3	24th.	41·5	6th.	81·6	54·1	51·9	65·97
August	93	4th.	44·4	1st.	42·9	25th.	72·8	53·1	52·0	61·29
September	88·3	7th.	41·2	14th.	40·4	26th.	69·7	48·7	46·1	57·94
October	63·8	10th.	30	19th.	23	20th.	56·6	39·0	36·7	46·82
November	62·7	1st.	24·4	7th.	20·5	7th.	47·2	36·0	35·1	41·24
December	57·4	11th.	30·5	12th. 30th.	27·9	30th.	50·9	41·3	39·5	46·14

Mean Temperature of 1868 ………… 50·98.

EDWIN J. ISBELL.
WILLIAM COOKE.

TABLE III.

RAINFALL IN HEREFORDSHIRE.

1868.	Hereford: Richmond Place, 5 ft. 8 in. from the ground.	White Cross, one mile from Hereford, 1 ft. from the ground.	Tupsley, 1 ft. from the ground.	Stretton, 1 ft. from the ground.	Leominster, 1 ft. from the ground.	Sellack, 3 ft. 6 in. from the ground.	Ross, 1 ft. from the ground.	Rocklands, 1 ft. 11 in. from the ground.
January	2·612	2·824	2·460	2·850	2·790	2·940	3·185	4·920
February	1·374	1·325	1·390	1·510	1·430	1·510	1·360	1·910
March	1·403	1·558	1·540	1·650	1·750	1·510	1·620	2·420
April	1·702	1·836	1·900	1·880	2·980	2·290	2·210	2·740
May	1·842	2·606	1·800	1·700	2·460	2·190	1·630	1·390
June	0·455	0·443	0·430	0·340	0·570	0·330	0·330	0·330
July	1·231	1·555	0·960	1·300	1·530	0·470	0·410	0·420
August	5·187	5·387	4·930	4·850	5·640	4·770	4·270	5·520
September	3·526	3·747	3·170	3·650	3·030	3·540	4·420	4·860
October	1·737	1·597	1·750	1·630	2.070	2·010	1·760	2·060
November	1·142	1·472	1·320	1·280	1·330	1·760	1·840	3·050
December	6·320	6·050	5·730	6·340	6·270	6·310	6·010	7·510
Totals	28·531	30·400	27·380	28·980	31·850	29·630	29.045	37·130

For names of Observers see page 232.

EDWIN J. ISBELL.
WILLIAM COOKE.

TABLE IV.

RAINFALL IN HEREFORDSHIRE, 1818 TO 1368.

Year.	1 Pool Cottage, Dewchurch.	St Owen's St., Hereford.	2 Titley, Herefordshire.	3 Rocklands, near Ross.	Infirmary, Hereford.	4 West Lodge, Leominster.	5 Ross.	6 Stretton, Herefordshire.	Blue School, Hereford.	Richmond Place, Hereford
1818	27 29	..	..	..	..	..	..	..	..	..
1819	26 78	..	..	..	..	..	..	..	..	..
1820	22 43	..	..	..	..	..	..	..	..	..
1821	35·21	..	..	..	..	..	..	..	..	..
1822	30·26	..	..	..	..	..	..	..	..	..
1823	33 85	..	..	..	..	..	..	..	..	..
1824	31 76	..	..	..	..	..	..	..	..	..
1825	24 56	..	..	..	..	..	..	..	..	..
1826	25 33	23·378	..	..	..	..	..	..	..	..
1827	26 96	21 930	..	..	..	..	..	..	..	..
1828	38 05	31 239	..	..	..	..	..	..	..	..
1829	28 74	25 498	..	..	..	..	..	..	..	..
1830	32 87	29·319	..	..	..	..	..	..	..	..
1831	34·28	31·033	..	..	..	..	..	..	..	..
1832	26 84	25·234	..	..	..	..	..	..	..	..
1833	28 63	25·338	..	..	..	..	..	..	..	..
1834	29·09	(lost)	..	..	..	..	..	..	..	..
1835	32·13	29·276	..	..	..	..	..	..	..	..
1836	30·59	28·168	..	..	..	..	..	..	..	..
1837	30·14	26·207	..	..	..	..	..	..	..	..
1838	35 64	27 643	..	..	..	..	..	..	..	..
1839	40 63	34·404	..	..	..	..	..	..	..	..
1840	24 70	21·381	..	..	..	..	..	..	..	..
1841	39·78	32·140	35·01	..	..	..	..	..	..	..
1842	29 90	..	33·38	..	..	..	..	..	..	..
1843	..	..	35 47	..	..	..	..	..	..	..
1844	..	..	23·59	..	..	..	..	..	..	..
1845	..	..	29·69	..	..	..	..	..	..	..
1846	..	..	30 77	..	..	..	..	..	..	..
1847	..	..	29·99	..	..	..	..	..	..	..
1848	..	..	37 85	..	..	..	..	..	..	..
1849	..	..	28 38	..	..	..	..	..	..	..
1850	..	..	22 70	..	..	..	..	..	..	..
1851	..	..	24 58	..	..	..	..	..	..	..
1852	..	..	43 53	..	..	..	..	..	..	..
1853	..	..	27 70	30 19	..	..	..	..	..	..
1854	..	..	21·40	19 42	..	..	..	..	..	..
1855	..	..	24 60	25·12	..	..	..	..	..	..
1856	..	..	28 70	32 56	..	..	..	..	..	..
1857	..	..	29 23	25 18	..	..	..	..	..	..
1858	..	..	27·93	24 04	22·040	22·46	..	..	..	..
1859	..	..	34 20	33 53	..	28 64	28·14	..	..	..
1860	..	..	..	40 77	..	29 67	33 01	..	..	..
1861	..	..	..	31·85	19·245	25 50	25 94	23 60	..	..
1862	..	..	..	25 27	19 810	29 09	29·58	28·36	..	..
1863	..	..	..	29·32	17·563	22 15	25 26	22·18	..	..
1864	..	..	..	22 28	..	19·43	19·18	18 65	19 318	..
1865	..	..	..	32·44	..	27·10	28·58	27·38	25 005	..
1866	..	..	..	37·17	..	31·51	29·16	27·57	25 898	..
1867	..	..	..	31·55	..	25 26	29·10	28·17	26·272	28 171
1868	..	..	33 87	37·13	..	31·85	29·04	28 98	25 867	28.531

1. Pool Cottage, 5¼ miles nearly South of Hereford and about 300 feet higher than the level of the High-town. 2. Titley, nearly 16 miles N.W. of Hereford. 3 Rocklands, about 13½ miles S.S.E. of Hereford, and about 100 feet above the sea. 4. West Lodge, Leominster, about 11 miles North of Hereford, 264 feet above the sea, and about 80 feet higher than Hereford. 5. Ross (Archenfield), 11 miles S E. by S. of Hereford, and about 180 feet above sea-level. 6. Stretton, about 2¾ miles W.N.W. of Hereford, and about 170 feet above the sea.

EDWIN J. ISBELL.
WILLIAM COOKE.

TABLE V.—THE WYE.

Register of height of river in the year 1868, taken at Hereford Bridge daily at 9 a.m. The datum point is the Summer level of the river.

1868.	No. of days wet or stormy.	No. of days dry.	No. of days when there was low water.	Total Height of river above Summer level. Ft	Total Height of river above Summer level. In.	Average Height per day above Summer level. Ft.	Average Height per day above Summer level. In	Rainfall in Hereford by Mr. Isbell's Gauge. In.	Rainfall in Hereford by Mr. Isbell's Gauge. Pts.	OBSERVATIONS.
January	12	19	—	113	6	3	7	2	612	Height on the 14th, 10ft.; 19th, 11ft. 6in.; 25th, 9ft.
February	5	24	—	83	0	2	10	1	374	Height on the 1st, 13ft. (Highest flood of the year.)
March	10	21	—	101	5	3	3	1	403	Height on the 5th, 9ft; 12th, 12ft.
April	5	25	11	35	6	1	2	1	702	Height on the 21st, 6ft.
May	6	25	10	8	11		3½	1	842	Height on the 24th May, 2ft. (No rise in the river, except a few inches, from the 24th May to the 24th August—three months.)
June	1	29	28	1	1		0⅜	0	455	Height on the 1st, 8in.
July	1	30	29		5	0	0⅙	1	231	Height on the 13th July, 3in. (On the 20th the river was 5½ inches below Summer level.)
August	6	25	18	19	10		7½	5	187	Height on the 24th, 4ft.
September	5	25	23	5	11		2⅜	3	526	Height on the 30th, 4ft.
October	7	24	—	73	9	2	4½	1	737	Height on the 29th, 9ft.
November	8	22	1	59	11	2	0	1	142	Height on the 5th, 6ft.; 23rd, 4ft. 6in.
December	20	11	—	201	5	6	6	6	320	Height on the 5th, 11ft. 6in.; 26th, 11ft.
Totals	86	280	129	704	8			28	531	

REMARKS.—The past year has been a most unfavourable one for salmon fishing in the fresh water fisheries of the Wye, due to the abnormally low state of the river. On a great many days the river was considerably lower than its usual Summer level. On the 21st of April there was a flood of 6ft., and again on the 24th of May a rise of 2ft.; but from that time to the 24th of August, an interval of three months, there was never sufficient water in the river to enable salmon to ascend from the sea.

Huntington Court, Hereford.
January 20th, 1869.

JOHN LLOYD.

THE CATHEDRAL MAPPA MUNDI.

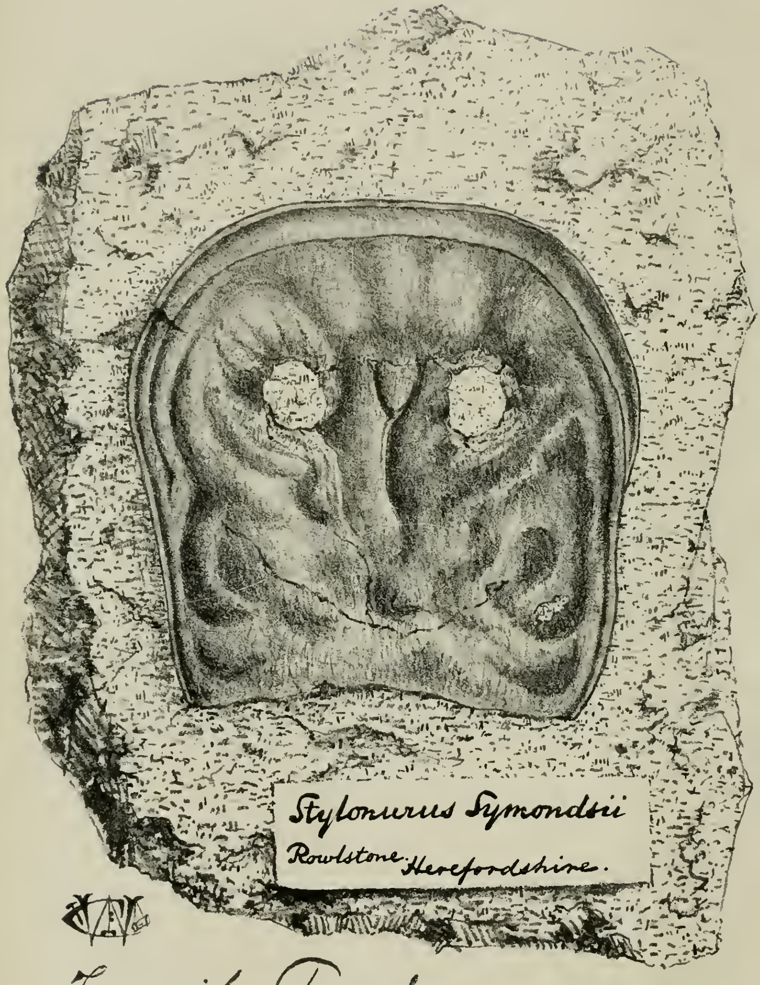
The proposed reproduction and publication of the ancient map preserved in Hereford Cathedral was then discussed.

The Rev. F. Havergal remarked that since the last annual meeting he had devoted some time to the Map, and had made many inquiries with a view to its reproduction in a manner worthy of its great Geographical importance. That it could be done well and faithfully he had no doubt whatever, photography being the basis with the aid of chromo-lithography. He had caused a fac-simile to be taken of a large portion of the African part of the map by Mr. G. C. Haddon and other assistants. With reference to the price at which the whole Map, with letterpress, &c., could be satisfactorily produced, he felt sure that it could not be done at less than two guineas per copy. There is no less than 30 square feet of surface, and, if done at all, it must be well done. This, however, was a matter that further inquiries would show more exactly.

As great geographical skill and knowledge would be required in the compilation of the letterpress accompanying the fac-simile, he wished to have the co-operation of any gentlemen who were familiar with ancient geography. He would be happy to render any further assistance so soon as his work, now in the press, was off his hands, which would very shortly be the case he hoped. He asked for a committee, and eventually the following gentlemen were appointed, with power to add to their numbers :—Sir William Guise, Bart., Elmore Court Gloucester ; the Rev. W. L. Beavan, Hay ; the Rev. Samuel Clarke, Bredwardine ; the Rev. W. Phillot, Stanton-on-Wye ; Dr. Bull, Hereford ; G. C. Haddon, Esq., Hereford ; and the Rev. F. T. Havergal, Pipe and Lyde, Hereford.

A fine photograph of the map in four sections was then exhibited. It was taken last year by Mr. Ladmore, of this city, solely with a view to the reproduction of the Map. His utmost skill was required, for the indistinctness of the faded parchment renders the map an extremely difficult object to photograph at all, and certainly his efforts have been crowned with great success.

The following Fossils have been selected for illustration :—



Fossil Sketches No 4

STYLONURUS SYMONDSII (Woodward).

Eurypterus Symondsii (Salter).

The first notice of this crustacean was given by the Rev. W. S. Symonds, F.G.S., President of the Malvern Natural History Field Club, who read a paper on the *Eurypterus* in the Old Red Sandstone of Herefordshire," at the British Association for the advancement of Science, held at Dublin, August 28th, 1857. Mr. Symonds describes the fossil as having been found in strata of grey building stone above the cornstones on the summit of Rowlestone Hill, near Ewyas Harold and Pontrilas, in this county. He says: "It was discovered by an intelligent labouring man in a quarry near the church at Rowlestone, between Hereford and Abergavenny, where I examined the correlation of the beds, to which I was conducted by the Rev. W. Wenman, who had obtained possession of the Eurypterus."* The specimen was described by J. W. Salter, Esq., F.G.S., of the Geological Survey of Great Britain, in the Quarterly Journal of the Geological Society (vol. 15, No. 58, p. 230). "The specimen," says Mr. Salter," of which we have only the exterior cast of the head perfectly representing the surface is impressed on a slab of brownish-grey micaceous grit. It is 2 4-10th inches long by 2 6-10th inches broad at the wide anterior part, the greatest breadth being at the anterior third; the hinder edge is only two inches wide. The front margin is arched, somewhat truncate in front, and gibbous at the sides. The ridge is continuous all round with the somewhat elevated border of tho sides in such a way that the carapace appears complete without the addition of the anterior border. A deep Y shaped vertical furrow, forked upward, at an angle of 30° divides the space between the eyes and occupies the middle third of the head. The space between the branches is very convex. The eyes are circumscribed by a sunken space; they are placed more than half way up the head and as wide apart as they are distant from the outer margin. As they are abraded in this unique specimen, their shape and convexity are not to be ascertained; they appear to have been large and rounded. The great size of this species distinguishes it from any previously described, except *Eurypterus Sconleri*, the head of which is eight inches wide."

Since the publication of Mr. Salter's paper in 1857, Mr. Henry Woodward, F.G.S., F.Z.S., of the British Museum, so well known by his researches on Fossil and Recent Crustacea, has determined that the fossil under consideration belongs to the genus *Stylonurus*, of the order *Eurypteridæ*, and as such it is figured in the Quarterly Journal of the Geological Society (Vol. 21, No. 84, p. 483), with several other species of *Stylonurus*. It is also figured by Sir R. I. Murchison in his last edition of Siluria, p. 246.

The original specimen is now in the Museum of the School of Mines in Jermyn-street, and is the only specimen of this species as yet discovered, beyond some few fragments which have since been found in the same quarry.

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* Edin. New Phil. Journal, October 1857, vol. 6, No. 2, p. 267.

CEPHALASPIS ASTEROLEPIS (Harley).

By J. W. Salter, Esq., F.G.S.

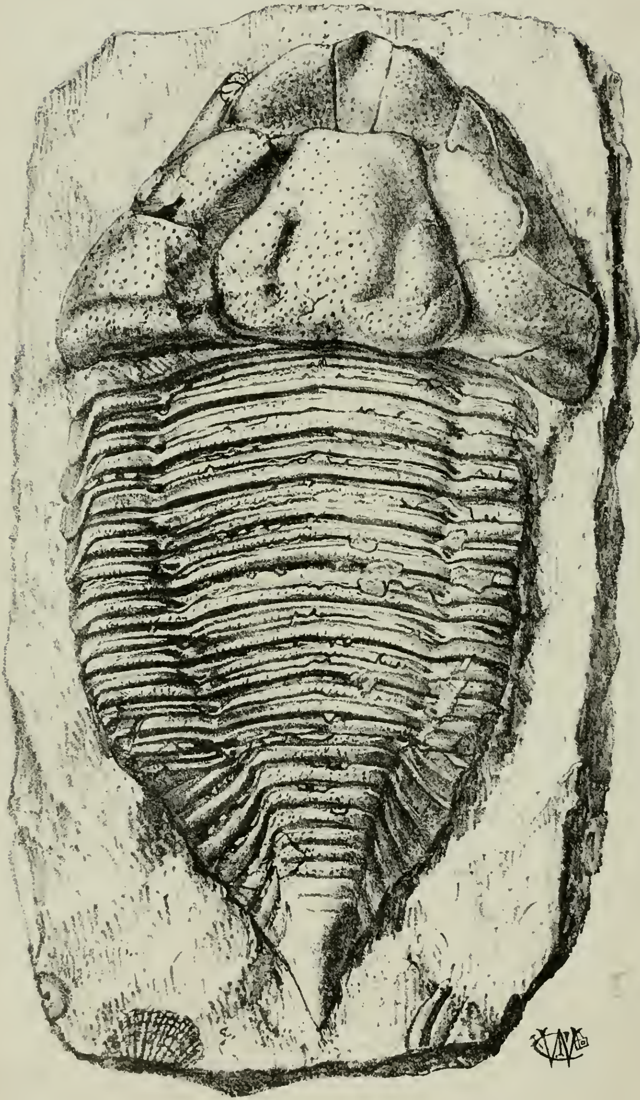
(See the Photograph placed as the Frontispiece to this Volume.)

An oblique view of a large specimen, seven inches broad, found on the east side of Skerrid-vawr, by E. Y. Steele, Esq., of Abergavenny, and now in the cabinet of J. E. Lee, Esq., of Caerleon, Monmouthshire.

The surface is mostly abraded, and the large tubercles of enamel only seen in parts; but the peculiar form of head, a broad and blunt pointed gothic arch is well preserved in this specimen—the largest known. The eyes are small, placed more than half way from the vertex to the front, twice their own shorter diameter apart, a narrow depression between them, with a tubercle behind it, and then a broad oblong flat space $1\frac{1}{2}$ inches long, by $\frac{7}{8}$ of an inch broad, appears to have been bounded by low ridges of enamel. Posterior to this the vertex rises to a sharp high ridge, more elevated than in any other species, but unfortunately imperfect. We do not know the cervical spine. The lateral cornua (in Dr. M'Cullough's cabinet) are 3 inches long, measuring from their contracted base, and are both larger, and more cylindrical, and narrower, than in the typical C. Lyellii. The polygonal vascular areas which cover the head are small in this species. On the under side, the incurved bony margin is broad at the head angles, and as roughly tubercular as on the upper surface. Round the front it becomes semi-cylindrical. The enamel tubercles appear to have been one on each polygonal area. On the spines they are clear, compressed, and all but shortly spinose.

The length is 6 inches, including the extreme cervical point, which is lost in this magnificent specimen.

Fossil Sketches No. 5.



HOMALONOTUS JOHANNIS. (*Salter, Pal. Tr.* 1865.)

a fine specimen from Wenlock Shale, Usk,

in the Cabinet of H. B. Holl, Esq., M.D.

HOMALONOTUS JOHANNIS (Salter).

(A local and rare species of Trilobite from Usk, Monmouthshire.)

BY J. W. SALTER, ESQ., F.G.S., &c.

A finer specimen than any yet collected of this fine species adorns the choice and well-arranged cabinet of Dr. Harvey B. Holl, of Worcester. This accurate and painstaking geologist and naturalist, for he combines both sciences well, is fortunate enough, that is, diligent enough, to secure good fossils wherever his hammer falls. And he permits me to figure and describe this specimen as a supplement to my account of the species in the transactions of the Palaeontographical Society.

Homalonotus, as its name imports, is the least Trilobitic of all the Trilobites, i.e., it has the surface of the body less divided into three lobes than any other genus, certain forms of Illœnus excepted. Unlike the Dudley locust *(Calymene)* in every point of mere habit and appearance, it is yet so strongly related to it, that certain forms in the lowest rocks in which both are found (Arenig or Skiddaw rocks of Sedgwick) may pass one for the other. Yet when we come to Upper Silurian times, or Devonian epochs, no two genera can be more distinct. And while *Calymene*, beautiful as she is, is short of stature, *Homalonotus* is bulky; *Calymene* is smooth, *Homalonotus* often very roughly sculptured. Some of the later species (Devonian) are armed with large spines along their backs, and all about their heads; and even their tails bear great boil-like spines. Usually, however, they are not so ornamented or encumbered, and a roughly granular surface is the general character. The older ones (Arenig and Lower Silurian) are often considerably trilobed. All the more modern ones (Upper Silurian and Devonian) are nearly free from trilobation. All possess a more or less elongate and very convex form, the depth of this genus contrasting strongly with the flattened, shallow forms of *Ogygia*, *Paradoxides*, *Asaphus*, and other large forms, with which *Homalonotus* may be compared in size, though widely different in character.

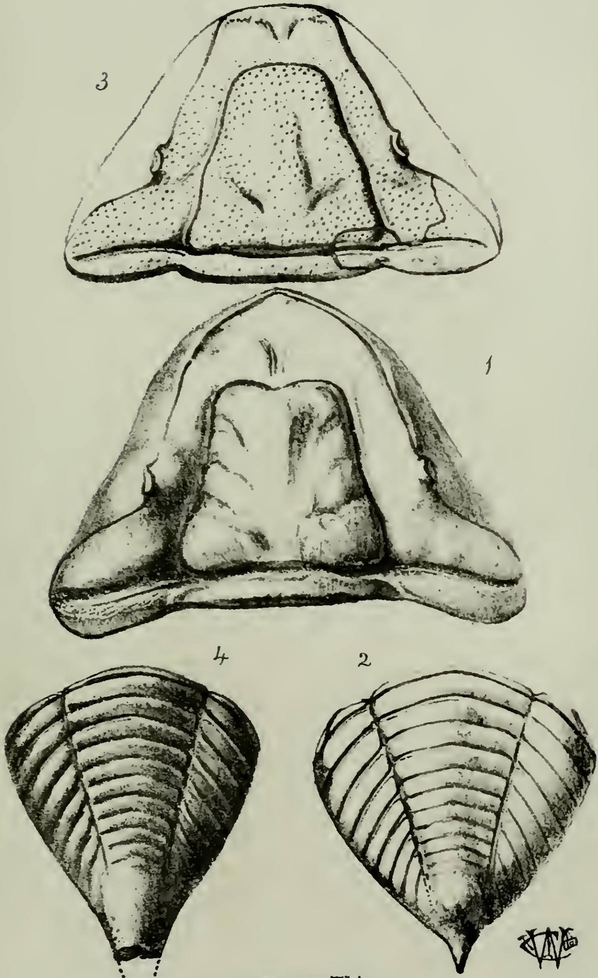
Homalonotus delphinocephalus, of Green, the common and handsome fossil of the Dudley limestone is the species with which our Wenlock shale should be compared (see plate over leaf.) The differences are as follows: Both are nearly of a size, full-grown specimens, measuring six inches, seldom more. But while the Dudley fossil has the Gothic head and triangular tail nearly equal in size, the tail piece of *H. Johannis*, including the terminal spine, is rather longer. One species is more strongly trilobed, especially in the head, the glabella or central portion (stomach) being marked out much more strongly as a trapezium, and having turned sides and well marked lobes, while that of the Dudley fossil is more faintly indicated in all these particulars, and has the hinder portion narrower in proportion, and the lobes very faintly marked. The head too is truly triangular. The thorax (or body, for it includes not only the true thorax, but part of the abdomen in all trilobites) is of 13 rings, but only 10 or 11 show distinctly in our specimen, some being pushed under the head piece. The trilobation is more marked on this part also than in its Dudley ally, and the axis a central portion thus marked out is narrower than in *H. delphinocephalus.* The tail, however, shows the distinction more strongly, the short trigonal tail iece of the Dudley fossil being here replaced by a long triangular organ, produced into a stout thick mucro more than one third the whole length of the tail. It is sharp, but the tip is not recurved. There are about nine furrows on the central axis of the tail, and seven on the sides, and these join on to the furrows on the axis, while they do not do so in the Dudley fossil.

There is a species in the Woolhope limestone which should be diligently sought for by the Club, *H. cylindricus.* Salter (Trans., Pal. Soc. vol. xvii. pl. xi., fig. 12, and woodcuts), which in some respects is more like our *H. Johannis* than the Dudley fossil. But this has a narrower and more cylindrical tail, with a much stronger and longer point; and the back of the creature is flat, with the sides turned sharply down. Its head is more like that of *H. delphinocephalus.* I wish we could get perfect or numerous examples.

Enough has been said to show that while the species of this genus differ from each other sufficiently, they yet are like enough to be readily mistaken for each other. What natural objects are there which may not be thus confused by the careless observer? It would puzzle any body but a close scrutiniser to recognise, under their varieties of colour, the true characters of humble bees, or wasps, or ants; but the practised entomologist knows them well. The business of natural history observation is to detect these differences under the mask of general similarity, which covers the species of all large genera. Whether the species were derived from each other by long selection, according to the true and earnest philosopher, Darwin, or whether created separately, as some would have it (and there is about equal probability for both views, since some forms *must* have been original), the acumen of the naturalist is best brought out, not by confusing himself with theoretical views, however probable, but by close observation of the real differences which exist even between nearly related species.

H, Johannis was named in compliment to John Edward Lee, Esq., of Caerleon, a true man of science and a true friend.

Fossil Sketches No 6.



Homalonotus König.

1, 2, *H. delphinocephalus*, 3, 4 *H. cylindricus*

for comparison with *H.* JOHANNIS. (Salter.)

POLYPORUS ANNOSUS. FR.

Several specimens of a fungus were then exhibited which had been found growing on the shoring timber of an unused gallery in the "Park Slant" coal mine, Tondu Iron Works, near Bridgend. They were kindly sent by Wm. Adams, Esq., President of the Cardiff Naturalists Society.

Mr. Adams was desirous of knowing whether they were the fruit of the *Rhizomorpha subterranea*, as the matted mass of fibres and filaments has been called, which in the coal mines of Germany often shows a beautiful phosphoresence and lightens up with indescribeable splendour the vaulted arches and passages of the mines. Mr. Adams instituted inquiries amongst the miners as to whether this phosphorescent *mycelium* had ever been seen in the Welsh collieries, and he obtained distinct evidence that the appearance of the phosphorescent light was well known to the working colliers. In consequence of these inquiries the funguses now exhibited were brought to him, but there was no evidence of any phosphorescent light about them. They have been carefully examined by Worthington G. Smith, Esq., F.L.S., and pronounced to be specimens of *Polyporus annosus Fr.*, a fungus of very variable appearance, and which usually grows on old larch stumps. Berkeley thus describe it "pileus woody, convex, then flattened, rough with tubercles. In the first season brown and silky; in the second and when old covered with a rigid, smooth, black crust; substance white; margin obtuse, whiteish as well as the middle-sized obtuse pores. Extremely variable, common in some districts."

There is no record of the mycelium ever having been observed to be phosphorescent, and therefore Mr. Adams' question cannot positively be answered. However, from the inquiries he has instituted, he will, doubtless, be told when the phosphorescent light is again observed in the coal mines. Then by a careful examination of its source, and by observing whether it produces any distinct fungus much more light may be thrown upon it.

FAIRY RINGS.

Dr. BULL said he would take that opportunity of reminding the members of the club that at the last meeting of the ensuing year—the one appointed for a "Foray amongst the Funguses"—a discussion would take place on the causation of "Fairy Rings." It was a subject of considerable difficulty, and there could be no hope of any satisfactory result being arrived at unless they would take the trouble to make careful observations through the year. They were aware that the most commonly accepted theory of their formation was what was called the "centrifugal theory," that is, that they sprung from a single fungus, and that the *mycelium* or underground plant would not grow two years on the same ground, and could only grow therefore on the outer margin of the exhausted soil, and so the ring grew larger from year to year. Mr. Lees, on the contrary, in the excellent paper read at their last meeting, maintained that the rings often appeared of large size at once, that the *mycelium* would grow wherever it found a favourable state of the soil and the requisite materials of growth, and that both these conditions were provided by the moles, which usually made their spring wanderings in runs of a more or less circular form. This may be termed the "mole theory" of their formation. He was not going to discuss these theories or any other, for there were several, but he mentioned them because he wished to suggest a few experiments of a very simple nature to such of the members as lived in the country, and had leisure to carry them out.

Directly they observe the rings of the common "Fairy ring fungus" *(Marasmius Oreades)* springing up, first let them cut a square foot of turf and soil out a few yards from the ring, loosen the soil, and add if they please a very little rotten manure, then cut a piece of the same size, including a portion of the ring, and remove it as carefully as possible to the prepared hole; in short, making an exchange.

2ndly. When the ring is large—a ring of the horse mushroom *(Agaricus arvensis)* is particularly favourable for this experiment—let them cut a straight trench at right angles to the ring, say a yard long within the circle up to the ring, and a yard long without from it, raise the turf and loosen the soil to a depth of 8 or 10 inches, add a little manure all along it, and then restore the turf. By this experiment the ring need not be disturbed, nor the *mycelium* injured.

3rdly. A carefully cut, and still more carefully carried, portion of a ring might be inserted into the middle of a mushroom bed purposely made, or of a used-up cucumber bed, where the soil was loose, and the material of growth abundant in all directions.

Other modes of varying these experiments would suggest themselves to any one who thinks over the subject. They would require great nicety in carrying out, so as to be deep enough to get the *mycelium*, and to move it with as little injury as possible. No doubt many of these experiments would fail, and be therefore simply negative, but if any one of them succeeded, it could not fail to be of great interest. He did not believe common observation of the rings themselves would give the solution, or it would have been discovered ere this.

The President supported Dr. Bull in urging the members to interest themselves in this subject, and to make the experiments; but he thought, however, that a good deal might still be learnt by careful observation of the growth of the rings from year to year, marking the size of the rings accurately by fixing pegs into the ground and leaving them for the following year. He was quite sure, if they would take the trouble to make the experiments and observations suggested, that they would become interested in it, and could not fail to gain some useful information.

Dr. Bull said: Gentlemen fond of gathering mushrooms in their own fields might like to know that a dressing of common salt on the grass in spring was the best manure to encourage their growth, and it was also equally good for the pasture itself.

W G Smith del et lith

Vincent Brooks Day & Son Imp

NEW AND RARE HEREFORDSHIRE AND BRITISH HYMENOMYCETOUS FUNGI.

By Worthington G. Smith, Esq., F.L.S.

During the abnormal summer and autumn of last year (1868) a large number of new British species of Hymenomycetous Fungi appeared in various parts of the country: of these few or none were second in interest to those gathered by different members of the Woolhope Club—Dr. Bull, Dr. M'Cullough, the Rev. W. Houghton, M.A., Edwin Lees, Esq., F.L.S., and J. Griffith Morris, Esq., being especially fortunate. Of these species several remain at present un-named, but I select for description and illustration, first,

LACTARIUS CONTROVERSUS, PERS.

This noble addition to our cryptogrammic flora was found by Dr. M'Cullough at and near Abergavenny, and by the Rev. E. Du Buisson, at Breinton, and taken by Dr. Bull to the Exhibition of Fungi at the Royal Horticultural Society last October. The specimens sent from Abergavenny grew under poplars about a mile and a half from Abergavenny, and it also grew in great luxuriance (again under poplars) at Abergavenny, forming a semicircle of some twenty feet in diameter. The specimens were crowded together in great numbers, and several attained a diameter of more than a foot—the specimen selected for illustration was one of the smallest, in order to get it into the plate. In general appearance it considerably resembles other Lactarii as *L. vellereus Fr.*, *L. insulsus Fr.*, &c., but it differs from all in many specific characters; it is highly acrid, and feels and looks *soapy*.

Lactarius Controversus, *Pers.*—Stem stout, swollen, one or two inches long, sometimes eccentric, pruinose at the top, never marked with pits or depressions: gills decurrent, with an obscure tooth: pileus, fleshy, compact, rigid, convex, then depressed and subinfundibuliform: at first dry, but after rain viscid in all its parts: margin at first involute and villous, stem and pileus more or less covered with blood-red spots and smears: flesh very firm, like *L. piperatus Fr.*: milk very acrid, white, plentiful: odour faint, but pleasant: taste exceedingly acrid.

AGARICUS (ENTOLOMA) JUBATUS, FR.

This species was also shown at Kensington last autumn by Dr. Bull. He found it growing in great abundance on Merry-hill Common, and in and near Haywood Forest, near Hereford; it grew in dense clusters, some of them taking a circular form. Young specimens are acutely campanulate, and full grown plants attain a height of five or more inches and a diameter of three or four. A small specimen is however selected for illustration to meet the restricted size of the plate. The taste, like that of many other pink-spored species, is watery and very disagreeable. I am not aware that this species has been before published as British, but I understand it was found by the Rev. M. J. Berkeley a year or two ago, at Ascot; and Mr. Currey informs me he found specimens on October 13, 1868, in a meadow adjoining a house called Twisden, between Gondhurst and Kilndown, in Sussex. Mr. Currey was kind enough to forward me specimens, which precisely correspond with the Hereford plants.

AGARICUS (ENTOLOMA) JUBATUS, F.—Stem fleshy, glossy, striate, and shining, white at the base, stuffed or hollow, clothed with minute sooty fibres. Pileus fleshy, campanulate, at first acutely, then obscurely umbonate, clothed with fibres, glossy, not hygrophanous, gills slightly adnexed, inclined to be ventricose.

HYGROPHORUS CALYPTRÆFORMIS, B. AND BR.

This distinct and beautiful species occurred in abundance in Holm Lacy Park last autumn; where attention was first drawn to it and the first specimens gathered by J. Griffith Morris, Esq.* It grew amongst furze and in open places bordering the plantations. As it has not been figured before, our plate may perhaps lead to its detection elsewhere by other members of the Woolhope Club. It was first found many years ago by Mr. Broome, the eminent mycologist, on Hanham Common, near Bristol, but the habitat is now destroyed, and the plant has disappeared from the district. It is thus described in Berkeley's Outlines of British Fungology, p. 202:—

HYGROPHORUS CALYPTRÆFORMIS, B. AND BR.: Pileus thin, acutely conical, lobed below, minutely innato-fibrillose; stem white, smooth, slightly striate, hollow; gills rose-coloured, at length pallid, very narrow, acutely attenuated behind.

One or two Fungi found by the Rev. W, Houghton, and not before referred, deserve a word here. First, *Agaricus (Flammula) sapineus*, Fr.—a very rare British plant not in Berkeley's Outlines, and *Agaricus (Clitocybe) fumosus* P. var *polius* Fr., in great abundance and luxuriance in the woods round the Wrekin; always on charcoal heaps. These large agarics were black with charcoal dust, which caused Mr. Houghton to refer to them as "the dirty dogs." A splendid and rare variety of *Polyporus perennis*, L. Tinted with rich sienna, chocolate, and black, in great abundance, was also found on the charcoal heaps.

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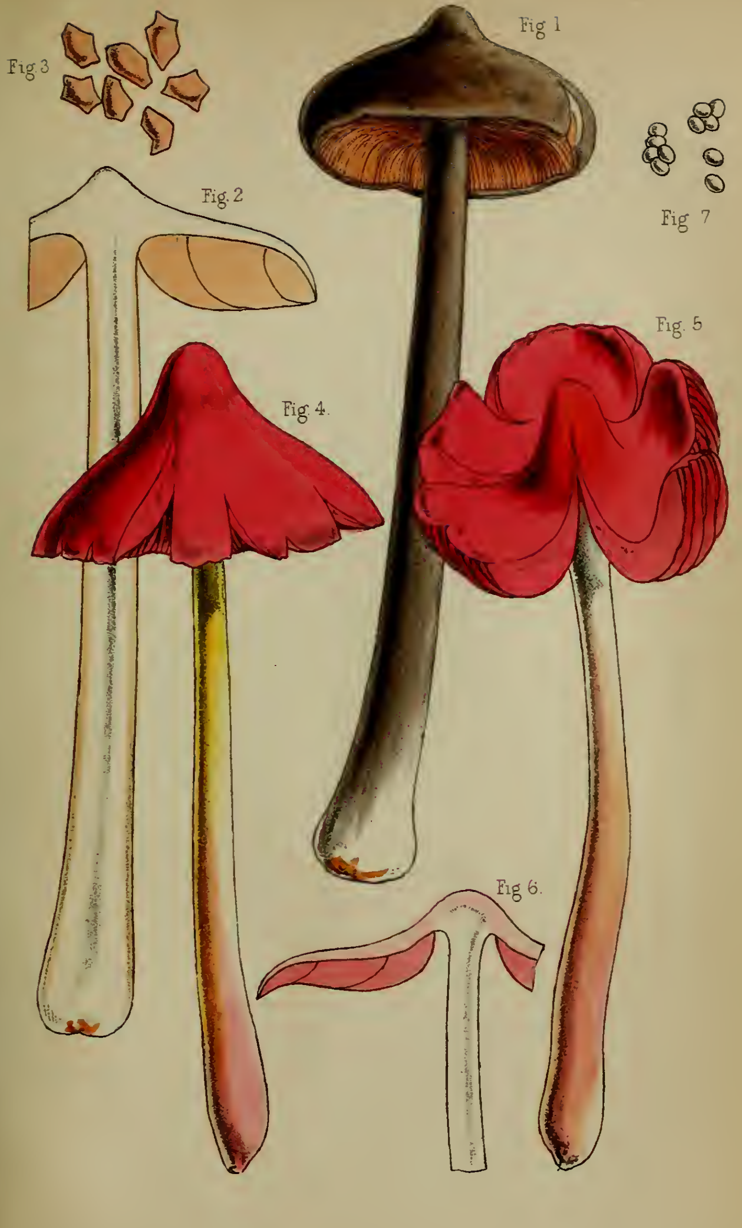
* Thanks are especially due to Mr. Morris for driving Mr. Lees and myself over to Haywood Forest on the following day (Saturday), the 10th October, 1868. Had it not been for his kindness, *Strobilomyces strobilaceus*, B., one of the rarest of British fungi, would not have been added to the Herefordshire list.

Son, Imp



W. G Smith, del et lith.

Vincent Brooks, Day & Son Imp

Fig. 1. 2. 3. Agaricus (Entoloma) jubatus Fr.
Fig. 4. 5. 6. 7. Hygrophorus calyptræformis. B & Br.

EARLY FLOWERING OF WILD PLANTS IN 1869.

The following list of plants were observed in a flowering state on the Doward Hill and its vicinity on the 6th day of February, 1869, by Messrs. H. Southall and Burton Watkins. It certainly proves a considerable acceleration in time of the flowering of many of those plants that form the adornment of the British Vernal Flora, consequent upon the mild temperature that has prevailed throughout the winter. In seasons devoid of snow and not subjected to excessive cold, there are always a few plants of general occurrence to be seen in flower, as the daisy, dandelion, and chickweed, &c. These commoner species, that open to a gleam of solar influence at any time, are marked with an asterisk; but the date at which the others opened their flowers to observation may well be considered worthy of record :—

Ranunculus ficaria
Veronica agrestis
,, *polita*
* *Senecio vulgaris*
Fragaria vesca
,, *Fragariastrum*
Primula vulgaris
* *Lamium purpureum*
,, *album*
Arabis Thalianum
* *Taraxacum officinale*
* *Mercurialis perennis*
* *Ulex Europœus*
Hutchinsia petrœa
Draba verna
* *Bellis perennis*
Daphne laureola
Galanthus nivalis
Viola odorata
,, *sylvatica*
Helleborus fœtidus
,, *viridis*
Cardamine sylvatica
* *Capsella bursa-pastoris*
Fumaria officinalis
* *Petasites vulgaris*
Narcissus pseudo-narcissus
Alliaria officinalis
Spergula arvensis
* *Stellaria media*
Stachys arvensis
Geum urbanum
Anthriscus sylvestris
Tussilago farfara
Pyrethrum inodorum
Crepis virens
* *Viscum album*
Euphorbia helioscopia
,, *peplus*
* *Corylus avellana*
Alnus glutinosa
* *Poa annua*
,, *nemoralis*
Carex clandestina

Caltha palustris (Marsh Marigold) occurred in flower about the 10th, *Veronica Buxbaumii* on the 15th, and *Erodium moschatum* on the 19th, *Gagea lutea* also had expanded flowers at the end of the month.

Perhaps, however, the most remarkable indications of a peculiarly mild winter have been shown in the early flowering of fruit trees. Apricots and nectarines against garden walls were in flower the last week in January, and the almond tree was in bloom as early in favourable positions. The damson exhibited expanded flowers on February 13th, and by the end of the month was generally in flower in gardens, though in ordinary years its flowering time is the first week in April. In many places hawthorn hedges were partially green in the middle of February, and primroses on banks with a northern aspect were generally beginning to put forth blossoms, and by the close of the month, lilacs and apple trees in gardens occasionally displayed expanded foliage. Pear trees also expanded masses of flowers almost ready to open, and the appearance of vegetation in general was more than a month in advance of an average ordinary season. It has been observable also that many of the ferns have kept their autumn foliage perfect through the winter.

By way of actual contrast, the following plants were all that could be found in flower in a similar route on March 4th, 1865 :—

**Lamium purpureum*
**Corylus Avellana*
Fragaria Fragariastrum
**Senecio vulgaris*
Veronica agrestis
**Bellis perennis*

Galanthus nivalis
Tussilago farfara
Primula vulgaris
Hutchinsia petræa
Helleborus viridis

ON THE ALLUVIAL DEPOSITS OF RIVERS.

By the Rev. J. D. LATOUCHE, F.G.S.

One of the most unsatisfactory questions which meets the student in Geology, is the determination of the periods or epochs of which it treats. The mind of any one who studies the rocks must almost necessarily entertain this question. For the most part we do but enter upon it to find ourselves completely baffled. Omitting altogether the enormous thickness of strata which underlie those recent deposits containing shells and vegetable matter identical with what at present exists on the surface of the earth—taking these comparatively modern deposits alone into consideration, the demands made upon our faith in the vast periods of time that even they have taken for their accumulation, may well cause us to despair of estimating within the faintest limits of probability those of the sedimentary rocks beneath them.

As one instance out of many, I may recall the account which Sir C. Lyell gives of Mr. Horner's attempt to determine the time taken to form the deposit of the Nile. "Mr. Horner suggested to the Royal Society in 1850, that they should have excavations and borings made in the alluvial plain of the Nile, with a view of ascertaining the thickness of the mud which had accumulated around the base of the obelisk at Heliopolis and the pedestal of the statue of Rameses at Memphis, the object being to obtain a chronometric scale by ascertaining what thickness of sediment had been formed in a given time and by applying that scale for measuring the antiquity of similar mud previously thrown down on the site of those monuments before their erection. The most important result was obtained from an excavation and boring made near the base of the pedestal of the colossal statue of Rameses, the middle of whose reign, according to Lepsius, was 1361 B.C. A deposit of 9 feet 4 inches was ascertained, which gives a mean increase of 3½ inches in 100 years. It was then ascertained by sinking a shaft near the pedestal to an additional depth, that "the thickness of old Nile mud resting on desert sand amounted to 32 feet, and it was therefore inferred by Mr. Horner, that the lowest layer (in which a fragment of burnt brick was found) was more than 13,000 years old, or was deposited 13,496 years before the year 1850, when the boring was made."

I have alluded to this one instance out of a great many that might be taken out of Sir C. Lyell's most interesting book, as it is closely allied to the subject of this paper. It is quite evident that in the detritus carried down by streams we have a means of measuring to a considerable extent the progress of Geologic epochs.

There can be little doubt that the great agents in moulding the surface of the earth to its present shape, are, the currents of water which are eternally percolating through the soil, detaching particles of solid matter and conveying them to a lower level. If we could but measure and weigh these solid constituents of our rivers we should have an estimate of the rate at which the rocks are being denuded. Allow me for a moment to review the process by which this denudation takes place. When we stand on some rocky mountain and look into the gorges below, the sides of them are seen to be covered with rough blocks hurled time after time from their place in the mountain side. This has been effected chiefly by the action of frost splitting open the stones and separating them into ever diminishing fragments shading off into the soil of the lower parts of the valley. Again, if you examine the section presented by any quarry, you see that the solid and thickly bedded rock beneath as it is traced upwards to a level with the ground is more and more subject to fissures until within perhaps a foot or two of the surface it becomes the fine clay or loom which rejoices the farmer's heart. Every shower of rain then which falls on this finely ground up rock or soil carries off its share to the river below, and then it commences its long journey to the sea, the finest portions being carried rapidly along in suspension, the heaviest awaiting the impulse of some violent flood, and the intermediate pebbles and sand making an occasional journey, sometimes halting long in some retired nooks where they are protected from the force of the current, and anon disturbed and carried a considerable distance ; when, as sometimes happens, the local bars and gravel heaps formed in comparatively quiet times are broken up.

It is with the first of these portions, or the fine impalpable mud which is carried down in suspension, that the experiments I am going to describe have to do. The problem as regards sand, pebbles, and larger stones, pushed and carried down the bed of the river, though not perhaps an insoluble one is certainly much more difficult.

My object then is simply to determine what quantity of solid matter passes down a given spot, on the banks of a river, within a certain time. It is clear that two elements are requisite to estimate this—1st, the proportion of sediment held in suspension in a certain measure of water, and secondly the quantity of water that passes during the flood. The first may be most simply done by collecting at intervals during the flood an ordinary wine bottle full of the muddy water. This holds, on an average, 26oz. of water. If then this sediment is allowed completely to settle (a process which takes some ten to 14 days in the case of the river on which I have been experimenting) and then the clear water poured off and the dregs filtered through a paper, which is carefully first dried and then weighed before and after the experiment, we have the exact weight of mud in 26oz. of water.

The determination of the other element in our calculation, namely, the volume of water which passes down a river in a given time, is a more difficult problem ; indeed, it is evident that a great variety of things must modify deductions from the most carefully constructed formulæ. The shape of the river bed, curves in the stream, the length of the course, when it has free action uninfluenced by rapids, &c., must all be disturbing elements to be taken into account in each instance. I am informed, however, by Mr. Curley that the tables at the end of Neville's Hydraulics may be relied upon as sufficiently accurate. According to these by making a section of the river bed, and knowing the mean hydraulic depth and inclination, the velocity can be determined at any state of the flood, and hence, of course, the discharge. Now amongst these data the only variable one is the hydraulic mean depth, and on this depends the observed height; the problem is readily solved this last being determined. It might be, however, very desirable in any case to check this result by ascertaining the velocity of the current directly in the following way :—

A section of the bed must be made at some place where there is a straight reach of the river unincumbered with rocks and other inequalities. This can be done by taking soundings at equal intervals, whence the area of the section can be easily ascertained ; a gauge then erected in this spot and divided into feet and decimals of feet enables us to note the height of the flood at any time, and a space of 100 ft. measured along the bank enables us to determine the rate of the stream by any floating substance thrown into it; the number of seconds it takes to pass between the two marks giving its velocity. Hence (by Table VII. in Neville's Hydraulics) can be found its mean velocity, which if reduced to feet per minute multiplied into the area of the section in square feet, gives the volume of water in cubic feet per mimute.

The experiments which I have been making on the Onny, a small stream which flows near my house, have not been carried out long enough to afford any very decided or important results, but from what they indicate so far, I have every confidence that if they are continued during the course of a few years they will well repay the trouble. Since the commencement of these observations there have been four considerable floods—on the 20th of December, the 5th and 31st January, and the 12th of February. In these cases it would appear that the greatest deposit occurred towards the commencement of the rainfall, a result which we might easily anticipate, as it is in the first flushing of the channel that the previously deposited mud would be stirred up and carried down. Every little rivulet, as it subsides after a flood, leaves a contingent of finely levigated mud, ready for the next down-pour to carry into the river, and when this supply is exhausted the ratio of the sediment must also necessarily fall off. On the 31st of January the discharge of water was 34,500 cubic feet, and of sediment (dry) 610 lbs. per minute.

It will be seen by reference to the register that the proportion of this sediment varies from about zero to 26 grains in the 100 ounces of water. This latter large result was obtained after the sudden and violent rain of the 5th of January, which, however, was a very local storm, as it appears from the register that the rainfall on the side of the Longmynd on that day, at Woolstaston, was only ·09.

Besides the determination of the mud held in suspension, that of the coarser particles, the sand and gravel, may reasonably be the subject of inquiry —"a velocity of three inches per second at the bottom of a river is ascertained to be sufficient to tear up fine clay, six inches per second fine sand, twelve inches per second fine gravel, and three feet per second stones of the size of an egg." If this be so, some clue might be obtained to this interesting problem by determining the proportion and relative size of the components of the bed of the stream, and the rate at which it moves in different conditions of the flood. It might also be of use to collect water at different depths, especially at the commencement of a flood. But it is evident that this investigation involves questions of great complexity and difficulty, while that of the quantity of mud in suspension is comparatively simple.

There are some very curious and interesting computations in Sir C. Lyell's Principles of Geology on the quantity of mud carried down by the Ganges. From experiments made by the Rev. Mr. Everest at Ghazepoor it was computed that during the 122 days of the rain season from June to September the average quantity of solid matter suspended in the water was by weight 1-428th part, or 1-856th part in bulk, giving a total of 6,082,041,600 cubic feet of solid matter in that time.

"This quantity of mud would in one year raise the surface of 228½ square miles, or a square space each side of which would measure 15 miles, one foot. Now, about 12½ cubic feet of granite weigh one ton, and it is computed that the great Pyramid of Egypt, if it were a mass of solid granite, would weigh about 600,000 tons. The mass of matter, therefore, carried annually down would, according to this estimate, more than equal in weight and bulk 42 of the great Pyramids of Egypt, and that borne down in the four months of the rains would equal about 40 Pyramids." "The base of the great Pyramid of Egypt covers eleven acres, and its height is about 500 feet. It is scarcely possible to present any picture to the mind which will convey an adequate conception of the mighty scale of this operation so tranquilly and almost insensibly carried on by the Ganges as it glides through its alluvial plain even at a distance of 500 miles from the sea." And even at the point where these observations and calculations were made the Ganges has not been joined by its most important feeders. These drain upon the whole 750 miles of the Himalaya, and no more than 150 miles of that mountain chain have sent their contributions to the main trunk at Ghazepoor; taking all which into consideration it is probable that the quantity of water actually carried down to the sea may be four or five times as much as that which passes Ghazepoor.

A very interesting discussion followed the reading of Mr. Latouche's paper. It was commenced by the Rev. W. S. Symonds, who said that he happened to be in London in company with Sir Charles Lyell and Mr. Darwin, when the former referred to a letter he had received from Mr. Latouche on the subject of the deposits of rivers. Sir Charles then expressed an opinion as to the great advantages resulting to science from the observations of members of Naturalists' clubs, and hoped that they would proceed with their enquiries and carefully record the results. In this idea Mr. Symonds heartily concurred, and urged the members present to diligently examine the phenomena of Nature for themselves and thus advance the interests of science.

Mr. E. LEES wished to ask a question as the deposits made by rivers in the present day, which seemed more unequal now than formerly. He had noticed that the meadows on the banks of the Severn near Worcester an alluvial deposit of between six and seven feet, but since these meadows had become permanent pasture covered with grass they showed no appreciable addition except on the bank itself, and the great mass of muddy deposit was carried down into the sea.

The PRESIDENT in reply to this said that the process of deposit described gradually caused its own cessation, as the low grounds adjacent to rivers were raised by successive films of deposit, so they became elevated above ordinary floods, and were covered with water more and more rarely, until at last a point was reached when they ceased to be flooded at all. The alteration of the beds of rivers which, at all events in the upper parts of their course, were slowly cut down deeper and deeper, contributed to the same cessation of deposit. He had recently examined the water of the Kenvy during a high flood, and found that it contained rather more than two grains of matter in suspension in an imperial pint, or about one part in four thousand. The quantity of water flowing at the time was estimated at 36,800 tons per hour, thus this small brook was carrying down during flood nine tons of solid matter per hour, or at the rate of more than 200 tons per day. The greatest proportion of solid matter which was observed by Mr. Latouche was much higher than this, or about one part iu 1700. This probably arises from the difference of soils, as a larger quantity of the fine Silurian mudstones would be carried in suspension than of the coarser deposits of the old red sandstone.

Mr. CURLEY said that he would explain the fact stated by Mr. Lees in this way. The deposit brought down by the Severn was filtered by the grass now covering the meadows and stopped upon the banks, so that the banks of the river were elevated above the adjacent ground, and he knew instances where the banks of a stream were raised as much as two feet by this action, and even the bottom of a stream became higher than the land beyond its banks.

Mr. LIGHTBODY considered that a deposit was still actually made upon meadows when the stream overflowed its banks, but this was absorbed by the roots of the grass which rose higher upon the deposit. Obstructions to the free course of streams arose near their mouths, and here consequently was the greatest amount of debris.

Mr. JOHN LLOYD stated that he had observed the way in which the Po had accumulated soil upon its banks in Italy, so that the banks of that river had become greatly elevated above the surrounding country, and even the bed of the river itself had been thus elevated. Still he thought that in the present day the great mass of transported material was carried on to the sea.

The Rev. J. D. LATOUCHE remarked in conclusion on the great quantity of matter that streams carried down, and recommended additional observations and experiments on the subject, as it might be possible in time by correlating the floods and their sediment with the rainfall to estimate the rate of denudation of the land. Mr. Lloyd's register was very useful, and it would be still more so if it was supported by a careful register of the rainfall in the upper districts of the river.

In accordance with Mr. Latouche's suggestion, two properly certified rain guages were ordered by the Club, that careful observations on the rainfall may be made in the upper districts of the River Wye.

THE REMARKABLE TREES

OF

HEREFORDSHIRE.

THE CEDAR OF LEBANON. WHITFIELD.

APRIL, 1869.

This handsome tree is situated near the entrance to the mansion at Whitfield. It is about 69 years old. At 2ft. 6in. from the ground, before giving off any branches, it measures 12ft. 8in. in girth; and at 3ft. high, 10ft. 9in. in circumference. It is about 63ft. in height, and is now growing luxuriantly.

This Photograph is kindly presented to the Club by the Rev. Archer Clive.

Ludmore and Son, Photographers to the Woolhope Naturalists' Field Club.

A REPORT OF THE REMARKABLE TREES OF WHITFIELD.

BY A COMMISSIONER FROM THE WOOLHOPE CLUB.

[*N.B.—The circumference of the trees is always taken at 5 ft. from the ground when not otherwise specifie l; and the figures given always refer to feet and inches.*]

In the manuscript Diary of Sir Richard Symonds, in the British Museum, printed by the Camden Society, the following passage occurs :—

"1645, May 12th. This night the King lay at Cofton Hall—(query, Corfton Hall, near Ludlow). These Colonels and Governors with the King : Colonel Scudamore, Governor of Hereford, &c., &c., &c. Here in Hereford, a quarter of mutton, 14d. ; Rye, 12d. a bushel. Rye is the best Grayne growen generally in the county, and Oates and Pease. *Little Timber in the Shire.*"

There is no reason to doubt the truthfulness of this last observation. The Court of Charles I. would gladly have seen an abundance of timber, for in those days—much more than in our own—timber meant money, and subsidies, and all other things that money can produce ; and if we inquire a little into the causes of its scarcity then, we shall quickly see that the Court, at any rate, fully appreciated its value.

Timber was at that time the only available fuel, it was largely employed for buildings, fences, and in every other possible way. Still, when the population was so small, this home use, extensive as it might be, could not in itself have produced any deficiency.

A second cause, and one much more powerful, was the use of wood as fuel in the smelting of iron ore, as had been customary from time immemorial. The Forest of Dean has always been noted for its ironworks. The Romans had furnaces there, and an examination of the cinder heaps they left, proves that their iron was all smelted with charcoal. The Forest at one time extended into Herefordshire, and in 1314 the writs for raising soldiers in the Forest of Dean were sent also to the Sheriff of Herefordshire. These furnaces must, therefore, have been partly supplied from this county. The difficulty of transporting timber of any size was then very great, as, indeed is to some extent, proved by its lavish use in the buildings and houses of the period, and therefore, in addition to these furnaces, forges were established at intervals throughout the wooded districts of the country. The iron ore was brought to the fuel to be smelted. Many instances occur where the names indicating the locality of these Forges are still retained, as Old Forge, Goodrich ; Kilforge, Bolston; Strangworth Forge, Pembridge; Llangua Forge, &c., but many of the localities are now known only by some local name, as the "Forge barn," at the junction of the rivers Monnow and Dore, near Pontrilas; the "Forge farm" at Peterchurch, near the rectory; the "Furnace farm," Treago, St. Weonards, and in a field at Llandinabo is a place called "the Furnaces." Doubtless there are many others known only by near residents, but about them all there is evident proof of their having existed, in the abundance of slag and scoriæ left from the furnaces. The refuse heaps from the furnaces at Llangua—which were probably kept up to a late period—were so enormous, that they supplied sufficient ballast for nearly three miles of the Newport and Abergavenny Railway. These furnaces must have consumed great quantities of wood from the adjoining districts of the country. (See Appendix I.)

The iron manufacture in England received a great impulse from the discoveries made in the course of the 17th century, and began to be much more extensively carried on.

In 1640 the King, Charles I., sold the Forest of Dean to Sir John Winter—the great iron-master of the time—for £10,000 down; £16,000 a year for six years; and £1,950 12s. 6d. a year for ever afterwards. Sir John, after he had satisfied his own needs, attempted to preserve what was left of the Forest, but the miners resisted, threw down his inclosures, and went on destroying the timber as usual, by using it in their trade. Sir John Winter states that above 40,000 trees in the Forest were cut down during the Commonwealth by order of the House of Commons.

In 1656 a Bill was passed suppressing iron works in order to preserve the timber. In the same year, much more happily, Sir John Winter invented a plan of "charring" coal by burning it in earthen pots, and thus converting it into coke.* This discovery led the way to the use of coal instead of wood in the manufacture of iron, and thus eventually saved the trees. The Act itself could have had but little effect, nor did the coke come rapidly into favour, for Andrew Yarrington, writing 10 years later (1677) speaks of the sale of timber for the iron works by the country gentlemen, as an established practice. "At the iron works," he says, "the gentlemen and others have money for their wood at all times when they want it, which is to them a great benefit and advantage."

There was yet another and, for a time, a still more powerful cause for the general destruction of timber, and this was the great civil war which began in 1642. Throughout England trees were felled extensively during its course,

* Evelyn says in his Diary:—

"July 11th, 1656. Came home by Greenwich Ferry, where I saw Sir John Winter's new project of charring sea-coale, to burne out the sulphure and render it sweete. He did it by burning the coals in such earthen pots as the glasse-men mealt their mettal, so firing them without consuming them, using a barr of yron in each crucible or pot, which barr has a hook at one end, that so the coales being mealted in a furnace with other crude sea-coals under them, may be drawn out of the potts sticking to the yron, whence they are beaten off in greate halfe-exhausted cinders, which being rekindled make a cleare pleasant chamber fire, deprived of their sulphure and arsenic malignity. What successe it may have, time will discover."

to find money and guns for the combatants, and to pay the heavy contributions imposed successively by the King and by the Parliament. Contemporary testimony asserts that between the cutting of timber by the landowners to raise money for the King's cause, and the repetition of the same destructive process by the sequestrators appointed by Parliament, anxious to realise the amount of the fines imposed on the Royalist delinquents, it came to pass that most parts of the country were very bare of timber trees at the time of the restoration. We have shown that on a visit into Herefordshire 20 years before this time, the sharp eyes of the Royalists could see even then but "*Little Timber in the Shire.*"

The district of the county in which the estate of Whitfield is situated, and, indeed, the estate itself, was at that time for the most part a mere wilderness of brushwood and scrub, fit only for fuel, and which formed hunting grounds for the gentry of the district. A considerable portion of the Whitfield estate was formerly the forest of Trevil, extending as far as Trevil brook, as the small rill is called which rises in the Whitfield lawn, supplies the pool, and joins the Worm brook at St. Devereux; and this tract formerly belonged, by a grant of King John, to the Abbey of Dore. It remained in its forest condition, and supplied its contributions liberally to the furnaces of the district. Doubtless, in their day, it supplied venison to the monks at Dore, but at the time to which it is now more particularly referred, the falcons from Morehampton may have coursed their quarry here, or it may have supplied the stag for a royal hunt. The adjoining estate of Morehampton, three miles away westward as the crow flies, was then in its glory. It is now gone, divided and sold. The mansion itself was a timber structure. The last portion of it was destroyed about twenty years in order to build the present farmhouse on its site. The moat surrounding the old garden alone remains to show its former importance. Here, in the early part of the 17th century, Sergeant Hoskyns entertained King James I. The autograph letter of Mr. Sergeant Hoskyns to his housekeeper, with reference to the preparations for the royal visit, is still extant. It was contained in the collection of the late Rev. C. J. Bird, of Mordiford, and has passed into the possession of W. H. Cooke, Esq., Q.C. It is so little known, and is so singularly interesting, that it is quoted here at full length. It gives incidentally an admirable insight into the state of the country at that time, and the difficulty of travelling:—

Letter from Mr. Sergeant Hoskyns (1), in London, to Mrs. Bourne (2), at Morehampton.

"Dec. 10, 1627.

"Pray God to bless us and yourselves. I think the matter will be so far settled tomorrow that we shall need no other help than God's blessing, which is drawn down by the prayers of those that fear Him.

"Provide all things as well as you can: if it please God, we will be at Ross on Friday night. Thither must be brought some good coach with four horses, for I know not how we shall proceed further. We are in hope of my Lady Cornwall's (4) coach for part of the way. I had brought one down from London had not a foolish report caused a doubtful letter to be written to me, but now I will cut off all possabilitye of rumours, and therefore I must make sudden provision. Sir Samuel Aubrey (5), Mrs. Candish, Sir Giles Brydges (6), and every friend must be tried. My sister Kempe (3) hath a good coach, so hath my Lady Bodenham (7), but who hath horses? If any one knows of any noble gentleman that now would furnish me, I would truly requite him, and in such a case never troble friend more, if it please God: and be ever hereafter able to do the like for another. We have somewhat to do, and I cannot write much. Commend me to Mr. Howarth (8), tell him if he can help us it shall be a worthy friendship. There must be horses sent to Oxford, to be there on St. Thomas' eve to bring down William and Bennet Hoskyns (2). They mean to keep Crismas with us. There must be a hogshead of sacke from Monmouth or Hereford to walke with our coach. Take care for the coach horses to be had at this time, and go presently about it day and night: the rest we have more time to do. *Study the coach way; where to break hedges, and how to avoid deep and dangerous ways.* So God speede you.

J. Hoskyns.

"Mistake me not—no man resisteth me. We want nothing but coach and horses.

To Mrs. Bourne (3),

at Morehampton (9), in the Golden Vale."

(See Appendix II., to which the figures apply.)

Bad as the roads may have been in this district, scarce as was the timber two centuries ago, it is the very reverse in these days—Moorhampton has fallen and Whitfield has arisen within this time; and on the hills and vales that now form the fine estate of Whitfield, the timber is sufficiently abundant and good as to attract thither a Commissioner from the Woolhope Club, and easy and pleasant be it added he found "the ways" of getting there. It is not that there are there as yet any very remarkable trees, though there are some, but that the estate itself has been so well attended to, the ground so well drained, the trees so well cared for, that it has taken upon itself a new character, and only requires time still further to develope itself. A careful survey now cannot fail to be interesting in years to come.

There are three entrances to Whitfield. The south entrance from the Abergavenny and Hereford turnpike road leads to the mansion by a drive a mile and a half in extent. It completely threads the valley and presents scenery well diversified. Beginning with an avenue of mixed trees it becomes more and more parklike as it proceeds until passing the keeper's house it reaches the richly wooded expansion of the vale in which the house stands. This lodge was built in the year 1850, and the trees, which consist of oak and beech trees, many of the latter having been replaced by oak, were planted about 40 years since. A tape thrown around a dozen of the finest gave these dimensions:—Oak, 4.4; 4.3; 4.6; 4.2; 5.3; 5.1; and Beech 4.10; 4.6; 4.9; 4.4; 4.2; 4.8. The second lodge or keeper's house, was built about 1830. This approach is by far the best. It was the original, and indeed the only entrance until 1821. It has since been supplanted by another, but now by the formation of the railway it has again become the chief entrance, and it deserves to be so. It is already very good, but will become still finer as years pass on and as the opportunities for improvement which its great length affords are taken advantage of.

The second or Thruxton entrance affords the most direct approach from Hereford, and since 1821 the bye-roads have become so good (better by far at this time—1869—than the high roads), that it has virtually been the chief approach to Whitfield for many years. The drive is pretty throughout, and from Thruxton takes the character of an approach to a good estate. The view from the first lodge (built 1850) is park-like and pretty, and gives some idea of spaciousness in the arrangement of the hanging woods and the slopes of the hills. From the second lodge (built about 1836) the house and pleasure grounds are approached by a gentle descent, with an open view to the right, though it is contracted by too many scattered trees on the left-hand side (planted in 1821).

The third entrance, the North, or Kingstone Entrance, has only become worthy of the name within the last 22 years, when it was laid out by Mr. Archer Clive in 1848, and the avenue of Scotch firs planted. The trees are growing well, and the entrance is now becoming handsome—albeit a wood that skirts it on the approach to the house, gives it a contracted effect. These firs may be said, therefore, to be 27 years old. The tape thrown round a dozen of the boles gave these results:—2ft. 10in.; 3ft.; 3ft. 10in.; 3ft. 2in.; 3ft.; 2ft. 9in.; 2ft. 11in.; 2ft. 10in.; 2ft. 11in.; 2ft. 10in.; 3ft. 3in.; and 3ft. 1in., at five feet from the ground. The lodge was built in 1857.

There are those who say that the mansion of Whitfield is not in the right place, that it should be situated on the higher ground above the garden, where the views commanded are so much more beautiful and extensive. This opinion may be regarded simply as a compliment to the fine growth of the timber trees there. Without this protection, and with it indeed to a great extent, a house in that situation would be exposed to all the violence of the western gales, which sweep round the Black Mountains with great force, and borrow a peculiar chilliness from the snow whenever it lies there. The house in reality is very well placed. It is on the slope of the hill below; it has a southern aspect, and the ground falls from it on three sides. Though relatively low, it has indeed a very considerable elevation. This has been taken very accurately by E. J. Isbell, Esq., with the instruments of the Club, specially for this paper. The terrace in front of the house is 245 feet above the level of Hereford, and since this is 184 feet above the level of the sea, it follows that the mansion stands on ground 429 feet above sea level, a height that justifies amply enough the protection sought from the adjoining hills.

The home view of the valley the mansion commands is peculiarly rich, and no one can study it without seeing that considerable thought has been given, and great taste displayed to make the most of it. Kent may have been consulted, for the house a century ago stood in a plain lawn. Here certainly are the "clumps" of "Capability Brown" and his hanging woods, and both are here seen to an advantage they do not always present. It was possibly Brown who marked out "the wood walk," which though nearly two miles in length was made so as to wind round the valley as never to lose sight of the house, a peculiarity it has happily long since lost from the better taste of the late Mrs. E. B. Clive who planted out this walk, and by planting up to Brown's Clumps, did much to retain the best features of both, whilst their formality was destroyed. Mrs. Clive was a good amateur artist, and the ornamental trees about the house and lawn were planted chiefly by her.

Sir Uvedale Price, of Foxley, at a later period visited much at Whitfield and aided in its improvement. Sir Uvedale's pleasure in life was landscape gardening, and his excellent natural taste was refined to the utmost by his intimacy with Mr. Richard Payne Knight, of Downton, and by the study necessary for the attacks they both so spiritedly made on the glaring faults of Kent, of Brown,* and of Repton.

The great feature of the Whitfield estate is the abundance of the oak timber it produces. Oak woods hang on every hill; oak trees abound in every vale; they are thickly scattered throughout the lawns; they even invade the pleasure grounds; and as a matter of course give their character to every landscape. Now, on oak scenery, all authorities unite in praise to the uttermost. "It is a happiness," says Gilpin, "to the lovers of the picturesque that this noble plant is as useful as it is beautiful. It is confessedly the most picturesque tree in itself, and the most accommodating in composition. It refuses no subject either in natural or artificial landscape;" and Strutt says, "Foremost in dignity and grandeur, the oak stands preeminent, and, like the lion among beasts, is the undoubted lord of the forest. Beauty united with strength characterises all its parts. The leaves elegant in their outline, are strongly ribbed, and firmly attached to the spray, which, although thin and excursive, is yet bold and determined in its angles, whilst the abrupt and tortuous irregularity of its massive branches admirably contrasts with the general richness and density of its clustered foliage;" and so on, authority after authority might be quoted. But all these descriptions refer to the oak when advanced in age, when size brings out the contortions of its moss-covered branches, and a massive trunk gives a grandeur, indicative of boldness and strength. These splendid word paintings of the supreme picturesqueness of oak scenery, it must

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* Lancelot Brown was a man of the highest reputation as a landscape gardener in the middle and latter end of the 18th century. He had great taste, and though now thought formal himself, was the first to set aside the stiff formality of earlier times. From his frequent use of the phrase "This spot has great capabilities," he got the name of "Capability Brown." It became the fashion to employ him everywhere, and his dictate became law.

The poet Cowper introduces his name ironically in a well-known passage—

"Lo! he comes!
Th' omnipotent magician Brown appears!
Down falls the venerable pile, the abode
Of our forefathers, a grave whiskered race
But tasteless."—*Task III.*

But it was Brown's fate also to go out of fashion, or rather let us say, to yield to a better and still less formal taste.

Sir Uvedale Price never lost an opportunity of attacking him. One amusing instance of his sarcasms may be given. A rumour got abroad that George III. had given Brown leave to crop the oaks in Windsor Park, on which Sir Uvedale wrote the following caustic lines:—

"England thy sons their lessoned freedom mourn,
Windsor thy parks and forests are all shorn,
What various evils from his petty tricks,
Whose taste was formed by Brown, by Bute his politics."

be frankly confessed, do not as yet apply to Whitfield. Some of the knolls, scattered with oak trees, are certainly very beautiful and picturesque. The grove above the pleasure grounds, for instance, presents an admirable example of the superiority of clustered trees over formal clumps. Some one—Sir Uvedale Price probably—has said that trees should be planted as you see a herd of deer arrange themselves on rising ground, picturesquely clustered together, with scattered members here and there, and many examples of this form of planting are to be seen at Whitfield.

The trees generally, as has been said, are more remarkable for their number than for their size. They present the well rounded outline of full-grown trees, but are as yet only just beginning to develope their true picturesque features. Indeed, studying them æsthetically, they are far too numerous. The estate has the happy failing of being overgrown with oaks; for fine and bold and noble as the sturdy oak is in form and outline, it is by reason of these virtues formal and stiff when in vigorous growth. Doubtless, at this age of growth it owes much of the great appreciation it obtains to the knowledge of the value it denotes, and justly so. Still, when it is repeated again and again, when its monotonous outline meets a critical eye at every turn, the very fact of its value becomes almost an objection to it. To use an expressive Americanism, "the almighty dollar" comes oppressively uppermost. This is not as it should be. In the very heart and centre of a noble estate, value should ever be subordinate to beauty and variety of effect, both in colour and outline. In his last visit your Commissioner had the satisfaction to observe that several hundred trees of goodly size were marked for felling. The improvement will be very great, and the operation may still be continued with proportionate advantage

The largest oak is at the entrance of the pleasure grounds from the lawn, and a very fine tree it is, though battered by storms and damaged at heart. It is of the *sessiliflora* variety, and has a girth of 16ft. 8in. The diametric spread of its branches is 25 yards in extent N. and S., and 24 yards E. and W. It lost a very large bough from a storm in the spring of 1868. An ivy tree of considerable size climbs the bole, and adds to its picturesque effect.

About the Wormbridge property are also some fine old oak and other trees, denoting a gentleman's residence. One oak tree, in Wormside meadow, measures 14ft. 8in.; another, in Druid's meadow, 15ft. 2in.; and two others 13ft. 6in. and 12ft. 3in. respectively, all fine growing trees; a pollard oak behind the church 14ft. 6in.; another in the garden meadow of Wormbridge farm house 16ft. 1in. at 5ft. from the ground, with several other good trees scattered about, and most of them in a healthy, growing state.

In the field opposite the church at Wormbridge, which was formerly the garden of the house, are two young oaks and two Wellingtonias, which were planted on the day of the Prince of Wales's marriage (March 10th, 1863) and which are growing well.

A pedunculate oak at the entrance of the fruit garden measures 12ft. 8in. in girth. A very fine picturesque tree, "the weeping oak" in the Bason meadow measures 11ft. 3in., and several others of about the same size are to be found in the walk through the grove or rookery. This grove, by the way, occupies the north side of a steep hill, and affords ample proof that such a position is the best for the growth of oak timber. The boles of all the varieties here, whether *pedunculata*, *sesilliflora*, or *intermedia*, shoot up in the race of rivalry for air and sunshine from 30 to 40 or 50 feet in height, without any appreciable difference between them. There are various causes to which this may be attributed. The sensitiveness of the oak and some other trees to the south-west wind is shown by the leaning of the exposed branches from the south-west to north-east, and by nothing more strikingly than by the healthy and uninterrupted growth of this class of timber on slopes whose Northern aspect would render them most unfavourable for crops of annual growth, or even the more delicate class of shrubs. The N.E. wind, though equally tyrannical in its season, has no such chafing and distorting effect upon our forest kings, and it has the less power of mischief from its rarely finding the trees in foliage. The soil on Northern slopes also retains its moisture unaffected by summer drought, a condition of almost unequalled importance for the growth of timber. The annular deposits of fresh growth of wood will be found to indicate with exact fidelity the character of each successive summer, forming a sort of hygrometric calendar of past years, marked by an annalist that never errs, the hand of Nature.

There is a sketch of the mansion at Whitfield made in the year 1800 by Mr. James Wathen, a well-known Hereford character. It represents the House standing on a plain lawn, and gives very accurately the grass slopes on the North and East sides of it. The sketch is too inartistic to lead one for an instant to doubt its exactitude, and it affords proof, therefore, that all the trees now there have been since planted. Allowing for their nursery life, they may be said to date with the century, and their measurements will therefore show a growth of 69 years.

The finest tree here is the Cedar of Lebanon, opposite the door. It is a very handsome luxuriant tree, still growing fast. It measures, before giving off any branches, at 2ft. 6in. from the ground, 12ft. 8in. in circumference, and at 3ft., 10ft. 5in. It is well represented in the opposite photograph. Another cedar lower down, near the croquet ground, measures only 8ft. 4in. in girth.

The trees, however, which give, and will continue more and more, to give character to the North side of the gardens at Whitfield, are a group of four Silver or Mount Atlas Cedars *(Cedras argentea)*, or as they are sometimes called African, or again, Atlantic Cedars. Their tall, straight stem, their horizontal branches, and their fine grey or silvery foliage are already beginning to be very effective. The trees on the lower North side measure 7ft. 10in. and 7.6 in girth, and those on the higher ground nearest the drive measure 6.1 and 5.6 respectively. They are nearly 60 feet high, and are still growing freely. They have not yet began to show any signs of throwing out those horizontal branches at the top, which make the table shaped head, which is the characteristic of old trees of their kind. The lower foliage of these trees has been injured by others, now happily cut away.

Keeping still to the North side of the house, which we know to have been bare of trees at the beginning of the century, the tape thrown round a very fine growing *Sessiliflora* oak, named "Bolton's Oak," with a straight clear bole, gave the girth of 8.3. This tree is growing luxuriantly. It is now 73 feet high, with a diametric spread of branches of 57 feet. Another well grown *Sessiliflora* oak, farther from the house, measures 6.3 in girth, and a sweet Chestnut, with boughs dropping to the ground, next it, measured 10ft. 9in., and two others 8.9 and 9.3 respectively. Still measuring, because they are there, on the North side of the Croquet ground, a Turkey Oak, ivy grown, and with loose straggling boughs, gave 7.10, and a birch 5.8; and two Hemlock Spruces prettily looked down upon from the drive, 5.5 and 3 feet. Crossing the drive to the house we have a Cedar of Lebanon planted in 1821, which gives a girth of 10.5, as the result of rather more than half a century growth, and another ivy covered near it measures 6.9. Near these cedars are three Scotch Firs, which are very ornamental trees, though of no very great size. They measure 9ft., 7.5, and 6.4 in girth respectively. They present clear straight boles from 30 to 50 feet high, whose characteristic red colour is admirably contrasted with the dull deep green foliage of some evergreen oaks *(Quercus ilex)* near them and the brighter tints of the beech tree (9.3), laurels and hollies in the back ground. One of these evergreen oaks with its dense robes of ivy, clusters very picturesquely. It measures 12.1 in girth. Three others standing forward in the open ground—measuring 5.3; 5.4; and 5.9 respectively—would doubtless be called generally well grown trees of good shape. Your Commissioner thinks them stiff and formal, but then he has no great admiration for this oak, since evergreen though it be, it wears in winter so dull, and sombre, and melancholy an aspect that its foliage might as well be absent for anything it adds to the cheerfulness of the scene when other leaves are away; indeed he values it chiefly for its great usefulness as a perennial screen, and for the deep neutral back ground tint it gives in the shrubbery during summer and autumn. In old age, or after misfortunes these oaks are often very picturesque, and surely the pruning saw might do much to lessen the bunchy formality of younger trees. The acorns of the Ilex Oak have none of the bitter taste of the acorns from our ordinary oaks. Virgil *(Georgics* I. 147) speaks of this fruit as having been eaten by mankind, before they began to raise grain crops:—

> "Prima Ceres ferro mortales vertere terras
> Instituit; cum jam glandes atque arbuta sacræ
> Deficerent sylvæ, et victum Dodona negaret."

Don Quixote lauds these acorns "as a sweet and pleasant fruit which in the golden age man had only to raise his hand and cull."—Pt. 1. c. 11. Possibly in that age they had no objection to the taste of astringency. The Ilex acorns certainly contain too much tannin for degenerate modern palates.

Passing a sycamore, 6ft. 10in., with mistletoe upon it, in itself a rarity, since only two other sycamores in the county are known to bear it, a sweet chesnut, 6ft. 6in., a larch fir, 6ft. 2in., and a beech, 9ft. 2in., or two, a well-contrasted clump of trees appears. A black spruce fir springs out from a mass of oak and sweet chesnut, with a base of yew trees and the ilex oak relieved by tall holly and laurel, through which a laburnum struggles here and there into air and sunshine.

Continuing the shrubbery walk past the garden entrance and beneath the drawn up beech trees, whose stems are ever pretty and picturesque, the first noticeable trees are two wide-spreading sycamores (8ft. and 7ft. 3in.), whose trunks are showing that attractive mottled appearance so peculiar to this tree. They are worth preserving for it, but oh! how littering they are, not merely shedding their leaves in all directions—that is a passing evil and might be got over—but the abundance of their seeds is marvellous, and the way young sycamore plants come up in all sorts of places, at inconvenient times, is enough to try the patience of any......gardener.

A Scotch fir is next passed, 8ft. 5in., very handsome in growth, and a Spanish chesnut, 10ft. 2in., and then some young trees demand attention. There are four handsome Deodar cedars, from 33ft. to 34ft. high. They have been planted 23 years, and are now growing from 18in. to 20in. annually. Further on, a Virginian red cedar makes a very handsome pyramidal column some 46ft. high. At a foot from the ground it has a circumference of 6ft. 1in.

There are here, too, some very fine specimens of the Douglas Spruce Fir (*Abies Douglasii*). The finest tree is 35ft. 4in. in height, and is now growing about two feet annually. This tree is a great favourite at Whitfield, and many young ones are being planted. Well it may be, for it is a graceful fast-growing tree, with a foliage of a bright and cheerful green. It grows to a great height (near 300 feet in California), and yields, it is said, a most valuable timber, "close, and heavy, of the colour of yew, free from knots and not subject to warp. It is superior to the best red deal." So here we have ornament and utility combined with rapid growth, and the tree moreover possessing these virtues thus proved to suit well our heavy Herefordshire soils. Oh, timber growers! Scatter Douglas Spruce Firs thickly in your Larch plantations. Point out to your neighbours how their pretty evergreen foliage will enliven the landscape; tell them how much better they will protect their pheasants; and take to yourself meanwhile the satisfaction that you are growing a very superior timber at an equally rapid rate. Scatter, it is said advisedly, for the young plants are dear yet—too dear to be planted very freely.

Turning now from the shrubbery, and walking if you please through the hot houses—they are always most interesting, and many splendid specimen plants will be found here—let us pass on to examine what may be called

The horticultural gem of Whitfield. It is the *Salisburia Adiantifolia*, the Maidenhair tree, or Ginkgo. It is believed to be the largest specimen in England with one exception. It measures 7ft. 2in. in girth at 5 feet from the ground, is 50ft. 6in. in height, and has a diametric spread of foliage of 40 feet. It is very

THE REMARKABLE TREES

OF

HEREFORDSHIRE.

THE MAIDENHAIR TREE. WHITFIELD.

(Salisburia Adiantifolia.)

SEPTEMBER, 1868.

This very handsome Japanese tree was planted by Lady Catherine Stanhope soon after 1775, and may therefore be considered about 96 or 97 years old. It is now 50ft. 6in. in height, has a circumference of 7ft. 2in. at 5ft. from the ground, and a diametric spread of branches of 40ft. It is situated near the Conservatory entrance to the kitchen garden at Whitfield, the residence of the Rev. Archer Clive.

This Photograph is kindly presented to the Club by Mr. Clive.

Ladmore and Son, Photographers to the Woolhope Naturalists' Field Club.

graceful in form, resembling very much the beech tree in outline, and it is growing very luxuriantly. It is a Japanese tree, which grows in that country to a height of 60 or 80 feet. Its beautiful Adiantum-fern-like foliage and its great size render it very remarkable and interesting. It is conjectured that this tree was planted by Lady Catherine Stanhope soon after the year 1775, when she became possessor of Whitfield. Mr. Clive ascertained from the late Sir Hungerford Hoskyns, who as a boy spent much time with his relative at Whitfield, that in 1785 the Salisburia was growing in the place it now occupies, and, though a small tree then, it was always pointed out as something rare and worthy of notice. The tree may be considered therefore at this time (1869) to be 96 or 97 years old. The Salisburia at Panshanger—the Earl Cowper's—it appears is slightly larger than this one, that is, it measures a few inches more in circumference (8 feet in girth). Mr. Paul, the nurseryman at Cheshunt, who described it recently in the *Gardener's Chronicle*, says it is worth going any distance to see. Mr. Paul might travel into Herefordshire with equal satisfaction —or if he should travel still farther to the Botanical Garden at Pisa, he will see three trees there which are much finer still, and which occupy nearly the whole space, leaving little room for anything else.

Before leaving the pleasure grounds one tree must be mentioned that adds greatly to the effect of the Whitfield home views. It is the only one of its kind there—it is worthless in itself, and it lies under the ban of vulgarity. It is a specimen of the common upright poplar near the stables, of goodly height, and measuring 11.3. At the Vallets there is a group of three of these trees standing together, which are certainly remarkable. These measure 11.3, 11.1, and 8.1 respectively in circumference, and cannot be less than 120 feet in height. They are all richly clothed with ivy, and indeed without it would not look well, since in many aspects they are seen in "full view."

The upright Lombardy poplar *(Populus fastigiata)* scarcely receives the consideration it deserves. Common and light in value though it otherwise may be, it is most useful in landscape. It is to our ordinary round topped forest trees what the spire is to buildings. It gives variety, height, and elegance to the view, and always forms in it a distinct characteristic feature. Its presence must always be noticed, and no other tree can supply its place. For these reasons, whilst it should never be forgotten in ornamental planting, it requires great judgment to use it. It should never stand alone for then its great height and uniform slenderness deprive it of all beauty. Even when planted singly amidst other trees its effect is usually lost, and when standing in straight rows at regular distances, *apropos* to nothing, it is simply hideous. For ornamental purposes, if you want its happiest effects, plant a little cluster of three or five trees together in some out of the way place behind the house—in the back yard, by the dog kennels, or in the drying ground, for a home association attaches to the tree—and scatter one or two trees here and there amidst other trees near, or by the premises adjoining. In this way the lower two-thirds of the trees are concealed, and when they have attained their full height they will give a distinctive character to the home views from every side. They have, too, an additional value in such situations—though the observation, so far as the writer knows, is entirely his own—*they will act as lightning conductors if a storm occurs near them.* It is now some years since his attention was first drawn to this point. He saw three poplars standing singly that had been struck in one week when thunder storms were prevalent. In two of them the top branches were more or less killed, and in two the bark was scored two-thirds of the way down the tree. He has observed its effects on many other trees since this time. This particular tree, and one of the tall trees at the Vallets, seems to have been struck, and thus to have had some of their upper branches killed. Lightning rarely shatters a poplar as it will do a tree of harder wood.

> "Thou rather with thy sharp and sulph'rous bolt,
> Splitt'st the *unwedgeable* and *gnarled* oak,
> Than the soft myrtle."—*Shakespeare.*

There is a very remarkable instance at Whitfield of its wonderful power in this way. In a thunder storm which occurred August 13th, 1857, a fine young oak, on the lawn in front of the house, of some 70 or 80 years growth, was struck and shivered into splinters by it. Its bole was split completely to the ground, and its limbs scattered in fragments on every side. It affords a singular proof of the force of the electric current, and has been left as an object of great interest to visitors ever since. Plant then the upright Lombardy poplars here and there for the benefit of the landscape, and as vegetable lightning conductors, if you please, on the authority of the Woolhope Club.

The Elm tree is but slenderly represented at Whitfield. There are four trees at the end of the north entrance, near the back buildings, but not of a remarkable size. They measure 10ft. 11in., 9ft. 8in., 10ft. 6in., and 9ft. 8in. in circumference respectively, and these are all. A cluster or two would make a pleasant variety at Whitfield, say for example a cluster of seven trees at the far side of the Bason Meadow instead of some of the numerous oaks scattered there. But let them not be bought from a nurseryman, for they should be planted on their own roots, to grow well on this strong soil.* That Elms will grow well on this estate is very abundantly proved by that very fine tree.

The Trevil Elm which is situated on the green at Trelough, close to the high road. It is a very fine picturesque old tree, and although it has lost some of its chief limbs on the north side, and decay has attacked its centre, it is yet very luxuriant. It measures 17 feet 8 inches in girth at 9 feet from the ground, is 90 feet high, and has an east and west diametric spread of foliage of 29 yards. It is a well-known tree, with its rough log benches around the stem. Under its shade the affairs of the district are wont to be discussed, and from time immemorial it has had all the parish notices affixed to it. The accompanying photograph gives a good representation of it.

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* The evils of the system of grafting the English Elm on young plants of the Scotch Elm—now so universally practised by nurserymen—was well brought before the club by Dr. Bull in his elaborate paper on the Elm tree, and it is a practical fact of great importance since the Scotch Elm roots require a light soil, and will not grow well in the heavy loam of Herefordshire. (See page 90.)

THE REMARKABLE TREES

OF

HEREFORDSHIRE.

THE SILVER FIR. WHITFIELD.

(Abies picea.)

APRIL, 1869.

This fine tree is situated on the lawn at Whitfield, the residence of the Rev. Archer Clive. It has a circumference of 15ft. 5in. at five feet from the ground, and has a height of rather more than 100 feet. It was planted by Mr. Booth about 1750, and lost its leader in 1797. It is now, therefore, about 118 years old.

Ladmore and Son, Photographers to the Woolhope Naturalists' Field Club.

The finest trees at Whitfield, however—and the finest of their kind in the county—are two Silver Fir trees *(Abies picea)* on the lawn near the Beech-grove. The best of the two stands alone and has a circumference of 15 feet 5 inches at 5 feet from the ground. At about 40 feet from the ground it has been broken off, and sends off three stems which again quickly divide, the three tallest reaching the height of 115 feet. This tree was probably planted by Mr. Booth who possessed Whitfield from 1755 to 1775, and who planted the Beech trees adjoining. It lost its leader from a storm, in the year 1797, a fact remembered by one of Mr. Clive's labourers (who was born on the estate, and whose father and grandfather had always worked there) from the occurrence of some event which happened to one of his children at the same time. The fellow tree which stands some 60 or 70 yards away amidst some oak trees is also a very remarkable tree. It measures 12ft. 11in. in circumference at 5ft. —has lost its leader at about 50 feet from the ground—and reaches a height of 100 feet. These trees show the same appearance of age in the thinness of foliage, and were doubtless planted at the same time. They are thus, in all probability, rather more than 100 years old. The Beech Grove adjoining was probably planted at the same time. The trees are fine but give no great measurement. A dozen gave these figures, viz., 9.3; 9.1; 9.5; 8.3; 8.9; 9.10; 8.9; 10; 8.8; 9.2; 8.1; and 8.4. On the ground beneath these grew a rich crop of that excellent fungus, the *Boletus Edulis*, which your Commissioner would have rejoiced in the more, if he had but been sure of its identity. He has never seen it growing elsewhere in this county in such abundance.

Beyond the giant Silver Fir and the Beech Trees is a most interesting plantation of young trees—let us term it "THE SEQUOIA GROVE"—for its main and most striking feature is now, and will long continue to be, a group of the *Sequoia Sempervirens*—an old friend with a new name—for its old designation was *Taxodium Sempervirens*. It is a lofty tree from California, the Evergreen Red Wood Tree. The settlers in Upper California call it the Giant of the Forest—and well they may, for it frequently attains gigantic dimensions. It will grow to a height of 300 feet, and many trees have a circumference of about 50 feet at 6ft. from the ground. It is called the Redwood from the fact that its wood has a beautiful mahogany red colour. It is close grained and when once seasoned it will not warp, and is never attacked by insects. These Redwood trees have been planted 17 years, and are now 45ft. high. They are growing with great rapidity, not less than from 3 to 4 feet a year—and five of the best measured 2ft. 11in.; 3ft. 3in.; 3ft. 7½in.; 3ft. 2½in.; and 2ft. 10½in. in circumference. They are most picturesque trees in their mode of growth, and their bright red bark; and the glaucous green of their foliage makes them very striking objects in the landscape. They are now under the protection of the woods beyond them, and yet three of them have lost their leaders and sent up fresh ones again. As they get higher still, they will have great difficulty to contend with the powerful west wind. The Redwood is a brittle tree, and must not be planted moreover in a low or damp situation, or it may be destroyed by a severe frost. The *Sequoia sempervirens* is own sister to the *Sequoia Wellingtonia* (once the *Wellingtonia gigantea*, oh those tiresome botanists !) but it is not so hardy as the latter tree. There is in this grove a *Sequoia Wellingtonia* about 12 feet high, planted in 1856, but though it looks well it has not taken kindly to its situation, and is as yet only growing at the annual rate of about 14 inches. A group of them, in honour of the grove's name, should be planted lower down the bank. It will give a good idea of the rapidity of growth of the Redwood trees here to say that whilst they grow from 3 to 4 feet a year, the Larch firs scattered about them grow barely 2 feet per annum, the Deodar Cedars average two feet, the African cedar 2ft. 6in., and the Cryptomeri 2ft. 6in. These last trees are growing admirably here, and there are several specimens from 30 to 40 feet high. There is a Pinsapo fir *(Abies Pinsapo)* growing very symetrically, with branches brushing the ground. It has been planted eleven years. It is 19 feet high, and its annual rate of growth is about 2 feet.

There are many smaller coniferous plants of great interest here ; but there is, however, one tree which demands a special notice, and that is a seedling oak which is nearly evergreen. It has a large, fine sessilliflora leaf, of a light and cheerful green, and it was first observed in the very severe winter of 1860, when it kept on its leaves with their natural colour until March. This variety is now being propagated for planting.

Whilst approaching this tree to look more closely at it, a splendid cock pheasant flew rocketing up with much more noise and alarm than there was the least necessity for. "A splendid shot," was remarked. "I wish I had a gun," was the answer, "and permission to shoot—not that brilliant bird—but I should like to blow off the leading shoots of five or six of the larch trees hereabouts ; it would make them send out fresh leaders in that picturesque form the larch always puts on when it meets with some such misfortune, and which would be the delight of visitors in years to come."

Those who like trees, may linger long here with much satisfaction and pleasure. It is as quiet as it is pretty and interesting. Let us meditate on the estate in general.

Whitfield, after all, conceals wonderfully well the beauty of its scenery. "Visitors may come and visitors may go" with scarcely an idea of it. They must see to be sure, the abundance of its trees, and the richness of its wooded hills ; and in autumn they cannot but notice the loveliness of its foliage tints ; but then this is not so very uncommon in Herefordshire, and is but one feature at Whitfield. If they take "the Wood Walk" as they will be sure to do, it will probably remain upon their minds as the very model of what a hot summer's day's walk should be, in its airy shade and its delicious coolness—and set too, in this pleasant remembrance as a framework, will be many bright spots—first, a most picturesque group of Scotch firs, with a wild and lovely *entourage* of undulating ground, parklike and wild, of brake, and of scattered trees. Again for a dark picture, the oak before mentioned shivered and blasted in the fulness of its youth and strength, by the lightning :—and then the peep of the distant hills in the high corner will be its contrast. But fine as this is in its way, it is not Whitfield in the varied scenery it really offers—you must stay there, must shoot or hunt—or boldly push your way as fancy takes you—and you will come upon views unexpectedly, rich and varied, near and distant, and breathe an air the while of a purity that tells you itself how high is the situation. Let us, for example show a contrast to the "Wood Walk," it is easy to do it. Instead of turning into the pleasure grounds by the old oak, make your way up the oak-covered knoll, before admired, to the Sheep-cot above, from which you will catch a western view over the gardens at once rich and extensive. Then walk for the Park farm, and as you gradually ascend higher ground still, the trees are left behind, and you are in full view of a wide extent of distant hills, embracing the Saddlebow, the Skyrrid, the Sugar-loaf mountain by Abergavenny, and the nearer range of the Hatterill Hills. If the wind is stirring you will find a breeze to your heart's content! But push on still to the Park farm itself, if you please, for you will find there cattle worth seeing—of a breed and quality dangerous to other competitors in the showyard. If trees and scenery are your objects however, and not cattle, turn at the second gate to your left by the hedge, and as you get over the stile you come at once in sight of the patriarchal tree of the estate—old, perhaps, as the time of the Ancient Silurians, who doubtless put it there—a tree of centuries indeed—the trunk of an old yew tree, of very remarkable interest. It presents an aspect white, weird-like, and barkless. It is hollow on the south side, but on the north side life lingers still. A few green boughs remain. One wonders how any sap can reach them, but a closer examination, however, amidst the netted fibres of the dry and whitened trunk, shows a tortuous stem going down to the soil, the only living portion of the tree and, indeed, its mainstay. The trunk has a girth of 13ft. 10in. It is altogether exceedingly picturesque and interesting. But, indeed, you must be a lover of trees, and of trees only, if you have not been struck at once by the beauty of its site. Looking down between the hanging wood on the left, and that pheasant-haunted wood (Thruxton Vallets) on the right, you command a pastoral scene of great richness and beauty, well worth the whole walk. Return through the hanging wood, a way had been cut there (though not quite broad enough) along the north sheepwalk and by the second lodge to the house. Then, be the weather what it may, you will have an idea of the varied scenery of Whitfield, and may take the walk again and again with renewed pleasure, for in the changing effects produced by variations of sun and sky, there will ever be something fresh to admire.

Whitfield has great natural advantages, and care is being taken to improve them to the utmost. Your Commissioner has only to add in conclusion, that in the last few years the change that has taken place here is most striking; and if he was asked to name the particular spot in the county which had most improved during the last 20 years, he should unhesitatingly answer, "Whitfield." The very colour of its grass has changed, and the trees have grown with a vigour quite pleasant to observe. Time has done much for it, but art has done more, until at length the poet's lines descriptive of the good deeds of the "Knight of Industry" have become fairly appropriate to the work done here :—

> "Nor from this deep retirement banished was
> Th' amusing care of rural industry :
> Still as with grateful change the seasons pass,
> New scenes arise, new landscapes strike the eye,
> And all the enlivened country beautify :
> Gay plains extend where marshes slept before :
> O'er recent meads th' exulting streamlets fly :
> Dark frowning heaths grow bright with Ceres' store,
> And woods embrown the steep, or wave along the shore."
>
> *Thomson's Castle of Indolence.*

(See Appendix III. for an account of the Possessors of Whitfield.)

APPENDIX I.

Herefordshire Forges and Furnaces.—The forges or furnaces, which were established in the different wooded districts of the county, were called "Glomerys" or "Bloomeries." They were simply an ordinary blacksmith's forge, worked by a foot bellows, and they smelted the ore so very imperfectly that in after years the slag was worked over again, and to such profit, that the heaps of cinders left by the "Bloomeries" have been "sold for much more than the land itself on which they were placed originally cost"; and the fortunes of some existing families in the county are said to be due to this source.

The town of Ross is spoken of by Camden as "noted for smiths," a celebrity it has ceased so long to enjoy that it owes to him the credit of it.

In a paper apparently published officially, in answer to one from the Earl of Kent relating to the rivers Wye and Lugg, dated "Wormeloe Hundred, Herefordshire, January 29th, 1695," it is stated, "But there are several furnaces and forges for the spending of woods in Herefordshire; as Peterchurch Forge, Strangwood Forge, Llancillo Forge, Pontrilas Forge, St. Wannard Furnace, Bringwood Forge and Furnace," and it then refers to some others. This paper also estimates incidentally the necessary consumption of wood for fuel for a peasant's family at that time as not less in value than 50s. per annum.

Bringwood Forge.—In 1604 Sir Robert Harley was made Forester of Bringwood *alias* Bornigwood Forest and Custodian of Prestwood Chase, and its management remained in the hands of the Harley family for many years. The following agreement (1663) has been kindly furnished to the writer by R. W. Banks, Esq., of Kington :—"Sir Edward Harley, K.B., and Samuel Baldwin, of the Inner Temple, Esq., agreed with William Lord Craven for a lease for 21 years of the forge and furnace of Bringwood and of several lands theretofore let to Francis Walker, and they afterwards relinquished the agreement in favour of the said Fras. Walker, to whom a lease was granted, and who afterwards assigned the term to his son Richard Walker. By an agreement (10th Sept.,

1663) between Sir Edward Harley and Samuel Baldwin of the one part, and said Richard Walker of the other part, it was arranged that if Sir Edward Harley should during the term have so much to sell on the Manor of Brampton Bryan, Wigmore, Pedwarden, as being cut and corded would amount to the quantity of two coale hearthes of charcoale, or if the said Samuel Baldwin should during the same term have so much wood to sell on the Manor and demesne lands of Stokesay in the County of Salop as cut and corded would amount to the same quantity, the said Richard Walker would purchase wood at 5s. per cord, to be cut and fallen at the expense of Richard Walker. The cord to contain 4 feet in breadth, 4 feet in height, and 8 feet in length. The quantity to be sold by Sir Edward Harley in any year not to exceed 800 nor be less than 400 cords, and the quantity to be sold by Baldwin not to exceed 1,000 cords nor be less than 400 cords. Walker to have 'liberty for the making of cabbins and digging and taking of turf and earth, and other usual necessaries for the making of charcoale of the wood before mentioned.' "

FORGE EXPENSES.—The following details of the expense of the manufacture of iron at the Forges refer to the years about 1640-50. These have also been kindly supplied by Mr. Banks :—

"A corde of wood ought to be 9 foote in length and 4½ foote in height, and ye wood for ye most part cutt 4 foote long.

"3½ cordes of wood (being good wood) will make a lode of coles.

"4 lodes of coles and 4 lodes of iron stone will make a tonne sowe iron.

"3 lodes of coles will serve for ye fyninge and drawinge of a tonne of iron at forge.

"A tonne and halfe of sowe iron ought to make a tonne of barre iron at forge.

"The founders' wages is about 5s. for ye castinge of a ton of sow iron.

"The fyner and hammerman's wages is 20s. for every tonne of wrought iron."

THE CHARGE FOR MAKING A LOADE OF COLE.

3 cord of wood, at 5s. per cord	00	15	00
Cutting and cording, 18d. per cord	00	04	06
Coling	00	03	06
Carriage, 4 miles	00	04	00
	01	07	00

THE CHARGE FOR MAKING A TONNE OF RAW IRON.

2½ loade of cole, at ye rate above said	03	07	06
3 doz. and 3 strike of stone, at 17s. per doz.	02	15	03
Founders' wages per tonne	00	03	06
	06	06	03

THE CHARGE OF MAKING A TONNE OF BAR IRON.

3 lode of cole	04	01	00
28 cwt. of raw iron at ye rate above mentioned	08	16	06
Fyner's and hammerman's wages, per tonne	01	00	00
	13	17	06

The Llandinabo Forge, or Furnace, affords a marked example of a complete change in the character of a district. Its very name has passed into oblivion. In the middle of an open arable field near the little church of Llandinabo,—from which over a wide expanse of country, looking west, every thicket, four-fifths of the hedges, and almost every tree has been grubbed away, and the whole district given up to the plough, there is a portion of ground, consisting of several acres, to this day distinguished by the title of "The Furnaces." Not a vestige meets the eye, even by the usual tell-tale mounding of the earth, to explain the name which thus capriciously distinguishes an uninclosed and otherwise unmarked spot. But on looking closely into the soil underfoot, an ample explanation of the traditional title reveals itself. Innumerable masses of furnace slag and half smelted iron ore, from the size of a man's two fists down to that of a walnut, lie amongst the clods, at first undistinguishable owing to the coating they have acquired of the red soil of the field, but so thickly mixed with it as to be sensibly felt by the foot, and by the additional weight and toughness of the furrow-slice as the plough passes over that part of the field. An ancient road now entirely obliterated, but existing in the recollection of the writer, passed through the field dividing it in two, close by "The Furnaces." The spot is itself the apex of an angle made by two roads—the one leading towards the Forest of Dean, and the other towards Gloucester and London. The district in question is spoken of in Domesday book as having been a dense forest waste. Judged by the remains, the smelting works must have been extensive. And here in a wide smooth tillage field with others equally bare around it as far as eye can reach, must once have been a busy mid-forest scene of smoke and glare and noise in all its picturesque wildness. Truly the face of mother earth witnesses some strange mutations.

APPENDIX II.

1.—Serjeant Hoskyns and the Personages mentioned in his Letter.

Amongst the characters who figured in the reign of James I., few enjoyed a wider reputation amongst their contemporaries than Serjeant Hoskyns. A good scholar, a clever lawyer, ready in speech, and bold withal, he could neither fail to be a man of mark himself, nor to incur the risk which distinguished talents brought down upon all who possessed them in those tyrranical times. In 1614 the national feeling ran strongly against the intrusion of the King's Scottish followers and favourites into all the offices of the state, and it found an uncompromising exponent in the member for Hereford.

Serjeant Hoskyns represented the City of Hereford for many years. He was returned in the 1st and 2nd Parliaments of James I. 1603 and 1613. In his place in the House of Commons he was amongst the foremost to denounce the conduct of the Court. In a speech of great boldness and daring, he even hesitated not to allude to the "Sicilian Vespers," as the great political massacre of 1280 was called. (Frenchmen had then been thrust into all State offices of Sicily, until the Sicilians rebelled, and a general massacre of 8,000 Frenchmen, it is said, took place as they were at vespers on Easter Sunday or Monday, for accounts differ as to the exact day.)

The immediate consequence of the Sergeant's rashness will be best shown by some quotations from a letter written by Sir Henry Wotton to Sir Edmund Bacon (June 8th, 1614) :—

"It pleased his Majesty the very next morning to call to examination before the lords of his council divers members of the House, for speeches better becoming a senate of Venice, where the debaters are perpetual princes, than where those who speak so irreverently are so soon to return to the natural capacity of subjects. Of these, four are committed close prisoners to the tower. First Sir Walter Chute, secondly John Hoskyns, thirdly one Wentworth (ancestor of Earl Fitzwilliam), a lawyer, and fourthly Christopher Nevil (second son to my lord of Abergavenny)." . . . . . "John Hoskyns having been questioned whether he well understood the consequence of that 'Sicilian Vesper' whereunto he had made some desperate allusion in the House, made answer that he had no more than a general information thereof, being but little conversant with those histories that lay out of the way of his profession." . . . "Thus you see, Sir, the natural end of a great man, and the accidental ruin of others, which I had rather you should see in a letter than as I did, for it grieved my soul to behold a grave and learned gentleman of good hopes and merits carried away in the face of the whole court, and such a greediness at all windows to gaze at unfortunate spectacles."

He had, however, noble companions in misfortune. A recent historian ("Knight's Pictorial History of England," vol. III., p. 72), with reference to the imprisonment in the Tower of Sir Walter Raleigh, writes as follows :—"He found several men fit to be his mates, and these were increased year by year by the absurd tyranny of the Court, till it seemed almost to be James's intention to shut up all the genius, taste, and enterprise of England in that great cage. Henry Percy, the accomplished Earl of Northumberland, the friend of science and scientific men; and Serjeant Hoskyns, the scholar, poet, wit, and critic, the admired of Camden, Selden, Daniel, Walton, and Donne, the friend and polisher of Ben Jonson,* were among the distinguished co-mates of Raleigh; and these men constantly attracted to the Tower some of the most intellectual of their contemporaries, who enlivened their captivity with learned and pleasant discourse."

Serjeant Hoskyns was, however, released after twelve months' confinement, and was subsequently held in high estimation by the King, who appointed him a Judge for the Welsh Circuits, and one of the Council of the Marches.

On the list of contributors towards the building of the College quadrangle at Hereford, the name of "John Hoskyns, serjeant-at-law," is placed second, next to Sir Samuel Aubrey, and he is followed by "Fulk Walwyn, of Marcle,

* "I do confess it, Father Hoskyns hath made me speak clean."—*Ben Jonson.*

Esq., the Right Hon. John Lord Viscount Scudamore, the Right Worshipful Fitz-William Coningsbie, of Hampton Court, Esq., and Cecilia his wife, daughter of R. H. Henry Lord Bergavenie," &c., &c.

In Nichols' "Progresses of King James the First" Morehampton is spoken of as the place where the King paid a visit to his quondam prisoner, "that being the seat of the witty Serjeant Hoskyns." If local tradition may be credited the "Merry Monarch" (he was so called before Charles II.) was entertained not only by the performance of the masque, which seems to have been a regular and necessary thing, but also by a morris-dance noted for its dramatis personæ. It is described as follows by Dr. Fuller in the introduction to his "Worthies of Herefordshire."

"There cannot be given a more effectual evidence of the healthful aire in this Shire than the vigorous vivacity of the inhabitants therein: many aged folke which in other counties are properties of the chimneyes, or confined to their beds, are here found in the fields as able (if willing) to work. The injenious Mr. Sarjeant Hoskins gave an entertainment to King James, and provided ten aged people to dance the morrish before him, all of them making up more than a thousand yeares, so that what was wanting in one was supplied in another —a nest of Nestors not to be found in another place."

The dance nevertheless was not the real Nestorian dance of Herefordshire, though it doubtless might have taken place in imitation of it. The real assemblage of veteran morris-dancers took place at the Hereford races 18 years before this time. In the "British Bibliographer," (vol. iv. pp. 326, &c.), will be found an account of "Old Meg of Herefordshire for a mayd-marian, and Hereford town for a morris-dance; or twelve morris-dancers in Herefordshire, of twelve hundred years old," London, 1609.

The visitors of rank present were there recorded to have been "Lord Herbert, of Ragland; Sir Thom. Somerset, Cha. Somerset, Count Arundel's two sons, Sir Edwd. Swift, Sir Thom. Mildmay, Sir Rob. Yaxley, Sir Ro. Casey, Sir John Philpot, Sir Ed. Lewes, Sir Fr. Lacon, Sir James Scudamore, Sir Thom, Cornwall, Sir Ro. Bodenham, Sir Thom. Russell, Sir — Bascarvile, Sir Thom. Conisby, and Sir Geo. Chute."

Tradition and history believes in these centenarians and they probably believed in themselves. But there were no parish registers in those days, and our matter-of-fact Registrar-general might possibly be somewhat sceptical on the point. It is true he makes Herefordshire still one of the counties most noted for longevity. But though octogenarians are numerous, and nonagenarians not uncommon, centenarians in our time are certainly but rarely to be met with.

Serjeant Hoskyns died in the year 1638, and was buried in Dore Abbey, where there exists in the chancel a remarkable monument, on which is inscribed a variety of epitaphs and memorial verses, by Dr. Sharpe, Donné and other of his surviving friends, but so elaborately and delicately worked on the stone and so richly ornamented as only to be legible here and there.

2. "William and Bennet Hoskyns" were the Serjeant's son and nephew. Sir Henry Wotton writes to Bennet Hoskyns, in allusion to the circumstance which caused his father's imprisonment:

> "Sweet Benedict, since thou art young,
> And hast not yet the use of tongue,
> Make it thy slave, while thou art free,
> Imprison it, lest it do thee."

And the same circumstance gave rise to the family motto:

> "*Vincula da Linguæ, vel tibi Lingua dabit.*"

Bennet Hoskyns represented the city of Hereford in the two first Parliaments of the Protectorate, and he was returned for the county in the two last Parliaments.

3. "Mrs. Bourne" was probably sister-in-law to the Serjeant, as "my sister Kempe" is known to have been.

4. "My Lady Cornewall" was probably Katherine, daughter of John Harley, of Brampton Bryan Castle, widow of Mr. Cresset, of Upton Cresset, who married Thomas Cornewall, Baron of Burford. He also died in 1615, so that at this time she would have been again a widow.

5. "Sir Samuel Aubrey," of The Aubreys, of Grendon and Clehonger. Sir Samuel Aubrey was High Sheriff of the county in 1622. He lived at Grendon, near Ross, and married a daughter and coheiress of Sir William Rudhall of Rudhall. A black marble tablet in the Cathedral records their many virtues after the manner of the period. Lady Jocosa Aubrey died first, July 12th, 1638, and Sir Samuel lovingly wrote:—

> "Could dull words speak what buried here doth lie,
> 'Twould raise both envy and idolatry.
> 'Twas an exchequer throng'd with so much good,
> The age that lost it never understood;
> Just Heaven, finding 'twas but envied here,
> Left us the casket, fix'd the jewel there."

Sir Samuel Aubrey died May 19th, 1645, and of him it is said:—

> "He who did never lodge within his breast
> Dishonour, baseness, or self-interest;
> The just man's friend, the poor man's treasury,
> The oppress'd man's patron in extremity,
> Lies here.—Reader! if now thou grudge a tear,
> Find some more worthy object—spend it there."

6. "Sir Giles Brydges" was High Sheriff for the county in 1625. He was created a Baronet May 17th, 1627. He lived at Wilton Castle, Ross, and would thus be well situated to afford help on the route.

7. "My Lady Bodenham" was probably the relict of Sir Roger Bodenham, who is said to have been cured of some grave disorder by a pilgrimage to Saint Winifred's Well, in Flintshire, now called Holywell; and in consequence of his miraculous restoration, he and his family returned to the fold of the Roman faith, which they had previously left.

8. "Mr. Howarth" was a neighbour residing at the Whitehouse, near Turnastone. The last of the family was a daughter, who married a Mr. Wood, of Leominster, and his grandson, Mr. Herbert Howarth Wood, now lives at the Whitehouse.

9. The Morehampton Estate was sold by the late Sir Hungerford Hoskyns, Bart., to the late Mr. Hamp, and is now again in the market.

APPENDIX III.—THE POSSESSORS OF WHITFIELD.—In the 17th century Whitfield was in possession of the Pye family of the Mynde, and was sold in 1754-5 to Mr. Booth, a conveyancer of eminence, and a friend of Lord Mansfield (see Campbells Lives.) He first made Whitfield into a residence, lived there for some time, quarrelled with his neighbours—and especially with Scudamore of Kentchurch—about roads, and eventually sold the place in 1775 to Lady Catherine Stanhope, daughter of the last Duke of Chandos, and grandmother of Sir Edwyn F. S. Stanhope, and of the late Sir Hungerford Hoskyns, Bart., of Harewood. In 1798 the late E. B. Clive, Esq., bought it, and at once removed there.

The estate of Wormbridge came into the possession of the Clive family by the marriage of George Clive, of Stych (Salop), in 1656 with the heiress of Martin Husband. He was grandfather of Judge Clive and great grandfather of the first Lord Clive. Wormbridge House was pulled down in 1798. A part of the offices only remain, and are now made into a school and school-house. The stables on the opposite side of the turnpike road—(now happily just freed from turnpikes !)—have been converted into a farm-house. The church at Wormbridge contains the monuments of most of the possessors of the property. It was cased with stone, the tower rebuilt, and the inside repaired between the years 1850 and 1860 as recorded on a painted window in the vestry.

STATEMENT of ACCOUNTS for the YEAR ENDING DECEMBER 31st, 1868.

Dr.	£	s.	d.
To Balance in National Provincial Bank	0	19	1
,, Ditto in Treasurer's hands	1	0	1
,, Subscriptions received for 1868	54	0	0
,, Entrances received from 20 new members	10	0	0
,, Arrears of Subscriptions received for 1867	12	10	0
,, Ditto ditto ditto 1866	1	0	0
,, Ditto ditto ditto 1865	1	0	0
,, Cash received for spare copies of Transactions ...	6	0	0
,, Amount received for Illustrations	4	6	3
,, Hereford Savings Bank	30	0	0
,, Balance due to Treasurer	3	4	4
	£123	19	9

Cr.	£	s.	d.
By Reports and copies of Annual Meeting, &c. (200), *Hereford Times*	12	6	6
,, Ladmore & Son, Photographs for Transactions, 1867	12	18	9
,, Binding 202 volumes of Transactions, and carriage	10	9	11
,, Circulars, Mounts, Stationery, Stamps, &c. (Phillips)	18	3	6
,, Reports of six Field Meetings for 1868 (225), *Hereford Times*	24	16	0
,, Ladmore & Son, Photographs (Geological and trees) 1868	10	12	10
,, Expenses of Botanical Excursion—B. M. Watkins...	1	12	3
,, Purchase of Murchison, Lyell, &c.	4	5	6
,, Sketches on wood and stone (J. W. S.)	4	19	0
,, Woodcuts of Insects (Lee)	6	17	0
,, Palmer & Son, Lithographic Printing, &c.	8	11	0
,, Meteorological Instruments, repairs, &c.	3	7	6
,, Assistant Secretary	5	0	0
	£123	19	9

Deposited in the Hereford Savings Bank, with the Interest, £34 17s. 7d.

ARTHUR THOMPSON,
Treasurer.

Examined and found correct, { HENRY G. BULL, M.D.
T. CURLEY, F.G.S.

Hereford, February 27th, 1869.

OFFICERS FOR THE YEAR 1869.

President:

JAMES RANKIN, Esq., M.A., Bryngwyn, Hereford.

Vice-Presidents:

John H. Arkwright, Esq., Hampton Court.
Arthur Armitage, Esq., Dadnor, Ross.
The Rev. James Davies, M.A., Moor Court, Kington.
Dr. M'Cullough, Larchfield, Abergavenny.

Honorary Secretary:

The Rev. Sir Geo. H. Cornewall, Bart., Moccas, Hereford.

Central Committee:

Dr. Bull, Hereford.
T. Curley, Esq., F.G.S., Hereford.
John Lloyd, Esq., Huntington Court, Hereford.

Assistant Secretary and Treasurer:

Mr. Arthur Thompson, King-street, Hereford.

FIELD MEETINGS APPOINTED

1869.

1.—THURSDAY, MAY 20TH. ....Wall Hills and Ledbury.
(To meet the Malvern Club.)

2.—FRIDAY, JUNE 25TH. ....Pontrilas.

3.—TUESDAY, JULY 20TH ... (Ladies' Day) ... Ludlow, its Castle, and its Church; and the Downton Castle Walks.

4.—FRIDAY, SEPT. 3RD...Usk.

5.—FRIDAY, OCT. 1ST .... Hereford, for "A Foray Amongst the Funguses."