CARDIFF NATURALISTS' SOCIETY.

FIRST

ANNUAL REPORT.

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LONDON:

WATERLOW AND SONS LIMITED, 66, LONDON WALL.

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FIRST ANNUAL REPORT.

1867-8.

SECOND EDITION.

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Cardiff Naturalists' Society.

ESTABLISHED 1867.

OFFICERS: 1867-8.

PRESIDENT.

WILLIAM ADAMS, F.G.S.

VICE-PRESIDENT.

WILLIAM TAYLOR, M.D.

TREASURER.

THOMAS GEORGE SOUTH.

HONORARY SECRETARY.

R. RHYS JONES.

COMMITTEE.

ROBERT DRANE,
PETER PRICE,
J. TOMLINSON,
JOHN MORGAN, Boedringallt,
HENRY GOOCH,
JAMES BELL,

Rev. J. HAVARD PROTHEROE, M.A.

CARDIFF NATURALISTS' SOCIETY, 1867-8.

HONORARY MEMBERS.

Prof. H. T. Stainton, F.R.S., Mountsfield, Lewisham, S.E.
Colonel E. R. Wood, F.A.S., F.G.S., Stouthall, near Swansea.
The Most Honourable the Marquess of Bute, Cardiff Castle.

MEMBERS.

	ELECTED.
Adams, William, C.E., F.G.S., Cardiff	O
Adams, G. F., Tredegarville, Cardiff	O
Aubertin, V., LL.D., Charles Street, Cardiff	O
Bassett, Alexander, C.E., Llandaff	1868
Bedford, Capt., C. J., R.N., Cardiff	1868
Bell, Francis, Cardiff	O
Bell, James, Canton, Cardiff	O
Bell, Robert, Stanmore Lodge, Cardiff	O
Buist, J. J., M.D., Cardiff	O
Bush, James, Cardiff	O
Brown, Edward, M.R.C.S., Mountain Ash	1868
Brown, T. Forster, F.G.S., Cardiff	1868
Dacey, C. A., St. David's, Cardiff	1867
Davie, William, Cardiff	O
Davies, John, Cardiff	O
Dawson, Edward, Cardiff	1868
Deacon, Henry, Roath, Cardiff	1868
Duncan, John, Cardiff	1868
Drane, Robert, Cardiff	O
Evans, E. Hier, M.R.C.S., Cardiff	1868
Evans, Henry Jones, Cardiff	1868
Evens, William, Cardiff	1868
Evens, Thomas, Werfa Colliery, Aberdare	1868
Gagliardi, Rev. Prof. J., Ratcliff College, Leicester	1867
Gooch, Henry, Cardiff	O
Griffith, Robert W., B.A., Llandaff	O
Hemingway, John, Roath	1868
Holst, Johann, Park Place, Cardiff	1868
Hooper, Horatio, Roath	1868
Hybart, J., Canton	O
James, William Parry, Canton	1868
Jenkins, William, Woodfield Place, Cardiff	1868

	ELECTED.
Jenkins, Rev. J. Rees, Cwmbrân Parsonage, near Newport, Mon.	1868
John, Evan, Llantrissant	O
Jones, R. Rhys, Cardiff	O
Jotham, T. W., Cardiff...	O
Kernick, S. P., Cardiff	1868
Lawrence, Arthur, Cardiff	1868
Lean, John, Cardiff	1868
Lewellin, George Young, Cardiff	1868
Lewis, William Thomas, C.E., F.G.S., Mardy, Aberdare	1868
Lewis, Lewis Thomas, Gadlys Uchaf, Aberdare	1868
Lucas, Clement, Cardiff	1868
Milward, J., M.R.C.S., Cardiff	1868
Morgan, John, Boedringallt, Cardiff	O
Morgan, John, jun., Cardiff	O
Morgan, Rev. D. Parker, Cardiff	1868
Paine, Henry James, M.D., Cardiff	1868
Penn, G. W., Cardiff...	1868
Pratt, Bickerton, Cardiff	1868
Price, Peter, Cardiff...	O
Primavesi, Fidele, Cardiff	1868
Primavesi, H., Cardiff	1868
Protheroe, Rev. J. Havard, M.A., Cardiff	1868
Riley, William, Cardiff	O
Robinson, Philip Stewart, Cheltenham	O
Snell, Charles, Canton, Cardiff	1867
South, Thomas George, Cardiff	O
Stephenson, W. P., Cardiff	1868
Taylor, William, M.D., Cardiff	O
Thomas, George F., C.E., Cardiff	O
Thomas, William, Cwamman Colliery, Aberdare	1868
Tomlinson, J., Cardiff	O
Truscott, Charles, jun., St. Austell, Cornwall	1868
Thompson, G. C., Halswell Terrace, Cardiff	1868
Thompson, Henry, ,, ,, Cardiff	1868
Vivian, William, Mwyndy, Llantrissant	1868
Waldron, Clement, Llandaff	1868
Waller, T. J., Cardiff	1868
Wightman, James Temple, Blaendare, Pontypool	1868
Whyte, Peter, Stanmore Lodge, Cardiff	1868
Whyte, George, Cardiff	1868
Williams, E. J., Gellygaer, Pontypridd...	1868
Williams, John, Cardiff	1868

Note.—Those marked (O) were the original promoters of the Society.

CARDIFF NATURALISTS' SOCIETY.

RULES.

1.—That this Society be called the "CARDIFF NATURALISTS' SOCIETY," to consist of Subscribing and Honorary Members.

2.—That ladies be eligible as Members.

3.—That its object be the practical study of Natural History, Geology, and the Physical Sciences, and the formation of a Museum in connection with the Free Library.

4.—That the Society be managed by a Committee, consisting of a President, Vice-President, Treasurer, and Honorary Secretary, and Seven other Members of the Society, and that in Committee Meetings Three form a *quorum*.

5.—That the Annual Meeting be held in the month of September, at which the Committee and Officers be elected for the following year by Ballot.

6.—That the General Meetings be held on the First Monday of every month, in the Museum Room of the Free Library, commencing at Eight o'clock p.m. Committee Meetings at the same hour on the Third Monday of every Month.

7.—That all Candidates for Membership shall be proposed and seconded by existing Members, either verbally or in writing, at any meeting of the Society, and shall be eligible to be balloted for at the next meeting, provided there be Five Members present. One black ball in Three to exclude.

8.—That the Annual Subscription be Five Shillings, payable in advance to the Secretary on the 1st of September each year. Members may commute the Annual Subscription into one payment of Three Guineas.

9.—That specimens collected by the Society shall be deposited in the CARDIFF MUSEUM, and shall become the property of the CORPORATION OF CARDIFF.

Resolved—"That strangers be invited to attend the Meetings of the Society, and to exhibit any Curiosities or Collections which may be in their possession."

REPORT.

THE COMMITTEE beg to present their FIRST ANNUAL REPORT for the year ending September, 1868.

The CARDIFF NATURALISTS' SOCIETY was established in September, 1867, by a number of gentlemen interested in, and desirous of extending the study of Natural History; and it was decided that one of its primary objects should be the formation of a Local Museum.

The idea of such a Museum in connection with the Free Library had long been entertained, and it appearing desirable that the connection should still continue, the Promoters, at their Preliminary Meeting, determined that the small collection of objects of interest then existing at the Free Library should form the nucleus of the Museum, and that all specimens collected by the Society should be deposited there, and become the property of the Corporation of Cardiff. The Committee of the Free Library granted permission to the Members to hold their Meetings in the Museum Room of that building, and the Society thus became fairly established. The number of Members was at the first meeting 24 ; it has now increased to 76.

Mr. Philip Stewart Robinson was appointed Honorary Secretary, and his energy and enthusiasm greatly conduced to the original success of the Society. Mr. Robinson left Cardiff in July last, and was succeeded in the Office by the present Secretary, Mr. R. Rhys Jones.

The ordinary Meetings of the Society have been held every month, for the transaction of business, and the display and examination of the Specimens collected and acquired. Papers on the following subjects have also been read by Members :—

At the November Meeting—On the "Genera of Fishes," by the Rev. Professor Gagliardi, (illustrated by Specimens of *Ganoids*, *Cycloids*, *Lampetra*, *Fluviatilis*, *Cetaceæ*, *Raiadæ*, and Fossil Fish from the Leckwith Lias).

At the February Meeting—On the "Divisions and Orders of the Natural System," by PROFESSOR GAGLIARDI.

And in March—An "Address on the Objects of the Society," by the PRESIDENT.

The May Meeting was devoted to the Microscope. Several Instruments were lent by Members, and a large number of Mounted and Living Objects examined.

The Society has also during the Year held three Field Meetings, which were much enjoyed by the Members.

On May 13th—Under the Presidency of PROFESSOR GAGLIARDI, at Penylan, near Cardiff; when the Silurian Outcrop at the Quarry on the Hill was examined, and some Fossils of interest obtained: (*Brachiopods*, *Annelids*, *Trilobites*, *Coral*, *&c.*)

On June 19th—At Crumlin and Pontypool (in conjunction with the Woolhope Naturalists' Field

Club). At this Meeting some Fossils from the Coal Measures (Fish Remains, Fresh Water, and Marine Shells, Ferns, Reeds and Water Plants), were exhibited by the PRESIDENT, and Papers on the following subjects read :—

The means of "Flight in Birds,"

by JAMES RANKIN, M.A.;

An Address on the "Coal Measures,"

by Dr. BEVAN, F.G.S.;

Some Species of "Mason Wasps and their Parasites,"

by ELMES Y. STEELE.

On July 15th,—At Barry Island.

The ruins of Dinaspowis Castle, and the Grounds of Court-yr-alla (by permission of Colonel ROUS), were visited by the Members, *en route*, and a valuable Paper on the "Geology of the District," illustrated by numerous Fossils, was read by CHARLES MOORE, F.G.S., M.B.A., of Bath.

Reports of these Meetings and of the Papers read are given in the Annual Volume of Transactions.

A considerable number of Specimens have been collected by Members, and presented to the Museum during the Year. A List of the more important, with the names of the Donors, is appended. The Cabinet and Collection of General STUART, at Cardiff Castle, purchased by the Free Library Committee, at the request of this Society, should be especially noticed as a most valuable acquisition.

Collections of much value and interest are promised to the Society as soon as space can be obtained to display them. At present the main difficulty the Society has to contend with is the very inadequate accommodation for the reception of specimens at the Museum Room of the Free Library. That valuable Institution has increased so rapidly in utility and popularity, that a larger building has become almost imperatively necessary to afford the accommodation required for the Library, Schools of Science and Art, Museum, and our own Society. It is, however, to be hoped that the Town Council will shortly consider the matter, and decide upon providing the Buildings so urgently needed.

At the September Meeting it was resolved that an Address be presented to the Marquess of BUTE, requesting him to become an Honorary Member of the Society. This Address was presented on the

17th September, at the Castle; a copy of it, and of his Lordship's reply, will be found at the end of the Report.

The Committee desire to acknowledge the courtesy evinced to them on all occasions by the Committee of the Free Library, who have rendered the Society most material assistance throughout the year. They also tender their thanks to those Gentlemen who have been Donors to the Museum, and would impress upon the Members the desirability of their informing the Honorary Secretary of any specimens or occurrences of interest that may come under their observation, in order that a record may be preserved.

Free Library, Cardiff, October, 1868.

W. ADAMS, President.

R. RHYS JONES, Hon. Sec.

COPY OF THE ADDRESS PRESENTED TO LORD BUTE.

To the Most Honourable John Patrick Crichton Stuart, Marquess of Bute, Earl of Dumfries, and Baron Cardiff.

We, the President and Members of the Cardiff Naturalists' Society, desire, in common with all Inhabitants of the County of Glamorgan, to tender to your Lordship our most cordial congratulations on the attainment of your majority, and our best wishes for your future happiness and prosperity.

We anticipate that your Lordship's tastes will lead you to emulate in devotion to and encouragement of the cause of Science those Members of your Lordship's order who have become most distinguished for their furtherance of Scientific Learning. Believing, therefore, that your Lordship's approval would be given to any endeavour to promote the spread of knowledge, as well as relying upon your deep interest in all that may conduce to the improvement of this Town, we venture to request that your Lordship will become an Honorary Member of this Society, which has been established for the Practical Study of Natural History, and for the formation of a Local Museum for the Town of Cardiff.

We desire your Lordship's perusal of the accompanying more detailed Statement of its objects and proceedings.

Dated, Free Library, Cardiff, the 16th day of September, 1868.

W. ADAMS, President.

R. RHYS JONES, Hon. Sec.

His Lordship replied that he received the address and congratulations from them with the greatest pleasure, because there was a certain kind of unity existing between them and him. It delighted him to find in them a congenial spirit with his own. The study of Natural History was with him a favourite pursuit, and he accepted with great pleasure the offer they had made him of becoming an Honorary Member of their Society. He highly approved of the scheme of forming a Local Museum in Cardiff, and he hoped they would allow him to contribute towards it what might now be in his possession or what he might acquire, and which they might deem worthy of their acceptance.

LIST OF PRINCIPAL ADDITIONS TO THE MUSEUM, 1867-8.

	DONORS.
Fossil Calami, Ferns and Reed Plants	Mr. Robert Drane.
Stuffed Birds—British, 29 specimens, including Machetes pugnax (3), Ædicnemus crepitans, Totanus glottis, Rallus aquaticus, Mergus merganser, Anas acutus, Podiceps auritus	Mr. Robert Drane.
A Collection of British Butterflies	Mr. P. S. Robinson.
Collection of Birds' Eggs, taken in Glamorganshire (including those of Oriolus galbula, Garrulus glandarius, Regulus cristatus, Fringilla montana, &c.)..	Mr. R. Rhys Jones.
Balanus (Sea Acorn)	Mr. Jackson, Whitchurch.
Fossil Ferns, from Coal measures in Rhondda Valley	Mr. John Morgan, Boedringallt.
Semi Fossil Antler of Cervus elephas and Fossil Fish, from Leckwith Lias......	Prof. Gagliardi.
Collection of British Birds' Eggs, including Perdix coturnix, Scolopax rusticola, S. gallinago, &c.	Mr. P. S. Robinson.
Egg of Ardea cinerea (Heron), taken from the body	Mr. R. Drane.
Echinus Lividus (Purple Sea Urchin)	Captain Bedford.
Charts of British Coasts	"
Zoöphytes	"
Collections of Lepidoptera and Coleoptera	Mr. P. S. Robinson.
" " "	Mr. R. Rhys Jones.
Nebria complanata, a rare Beetle (ord.: Carabides) taken at Barry	Dr. Taylor.
Collection of Neuroptera (Dragon Flies, &c.)	Mr. P. S. Robinson.
" Neuroptera and Diptera	Mr. R. Rhys Jones.
" Birds' Eggs (including those of Gallinula crex, Totanus hypoleucos, Alauda arborea, Hirundo riparia, and Caprimulgus Europeus), and of Coleoptera and Lepidoptera, taken at Gellygaer, Pontypridd	Mr. E. J. Williams.
Fossil Plants, Ulodendron majus (rare) and Calamus, from Coal Measures, Nantmelyn Colliery, Aberdare	Mr. Watkin Morris.

Foreign Shells (Coasts of India)	Mr. P. S. Robinson.
An Otter	Purchased.
Fossils, from Lower Oolite	Mr. P. S. Robinson.
Fossils, various	Prof. Gagliardi.
Stuffed specimens of the Hobby (Falco subbuteo), and Kittiwake Gull (Larus tridactylus)	Mr. John Williams.
Fine Specimen of Common Snake (Coluber natrix)	Mr. J. D. Thomas.
Cryptogams and Coleoptera	Mr. P. S. Robinson.
Plate of Sheet Iron, rolled for Tinning at Melingriffith Works	Mr. W. Adams.
Jar of Sulphate of Iron from ditto	"
Specimen of Gryllus viridissimus (Great Green Grasshopper) female, taken at Caldicott, Mon. ...	Mr. R. Rhys Jones.
Specimen of ditto, female, taken at Porthcawl......	Mr. Franklen G. Evans.
A Large Collection of British Marine Shells.........	Capt. C. J. Bedford, R.N.
A Large Collection of Fossils, from the Coal and Iron measures, comprising :—	Mr. W. Adams.

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	Townley colliery, Durham, Gantre, Ebbw Vale.
Old Red fish	
Orthis resupinata	
——— Michelini	Rosser veins, Rhymney.
Productus semireticulatus	Rosser veins, Rhymney and Ebbw Vale.
——— scabriculus	Pontypool; Blaendare; Meadow vein, Pontypool.
——— cora	Rosser veins, Ebbw Vale.
Palæoniscus sp.	Bottom vein, Gantre pits, Ebbw Vale.
Pecopteris abbreviata	Ell vein coal, Beaufort.
——— Höninghausi	Ell coal, Beaufort.
Psammodus porosus	Capel Newydd.
Rhizodus Hibberti	Black band; Bottom vein, Ebbw Vale.
Sphenopteris linearis	No. 6, coal, Prince of Wales pit, Abercarne.
——— elegans	
——— artemisiœfolia	Northumberland.
Spirifer Urii	Rosser veins, Rhymney.
——— striata	Capel Hengoed.
——— ?	Capel Newydd.
Sigillaria	Ell vein coal, Beaufort.
Ulodendron minus	Ditto ditto.
Xenacanthus	Bottom vein, Ebbw Vale.

The occurrence of the following rare Birds in the County during the past year is worthy of mention :—

"The Hobby" (*Falco subbuteo*), shot at Whitchurch;
"The Kittiwake Gull" (*Larus tridactylus*), shot in the Channel;
"The Buzzard" (*Buteo vulgaris*), captured alive in the Vale of Neath, by Mr. Wakeford, of St. Mary Street, Cardiff.

The two former are now in the Museum, the latter is still in Mr. Wakeford's possession.

Another specimen of B. vulgaris is reported to have been shot near Pontypridd, some short time since.

NOTE.—Up to the year 1862, the common buzzard bred in a wood near Llantrissant.

Cardiff Naturalists' Society.

TRANSACTIONS,

1867-8.

Cardiff Naturalists' Society.

At the General Meeting of the Society, held on February 3rd, the following Address, giving a general view of the Natural System, was delivered by the Rev. Professor Gagliardi :—

Mr. President and Gentlemen,

> "Each moss, each shrub,
> Each shell, each crawling insect, holds a rank
> Important in the plan of Him who form'd it;
> This scale of beings holds a place, which, lost,
> Would break the chain, and leave behind a gap
> Which Nature's self would rue." * * * *

When I first heard from our worthy President of this Cardiff Naturalists' Society, I felt really pleased, and hailed it as the dawn of a brighter day which was to shine upon the youth of Cardiff, who, naturally fond of learning, as the managers of this truly beneficial Institution may be witnesses, and full of that native simplicity and unaffected ingenuousness, which the French term *naïveté*, feel, as it were, an instinctive love for anything that is natural, and, consequently, for any branch of Natural History. These youth wanted just a start to come forth and take in hand the business which is so congenial to their taste, and suits them much better than any man of riper years; they wanted, I say, "that start of first performance, which is all," as Bacon wisely said; and I rejoice, seeing that this start is given, that the seed has been sown, and requires only to be fostered, quickened, and grown.

Surely it will not be the task of this Society, I know, to teach anybody by rules or precepts which she does not profess to have thoroughly mastered herself; but, her objects being "the practical study of Natural History (thus reads the second rule of the Society), and the formation of a Museum in connection with the Free Library," she will no doubt have a great influence upon the forthcoming generation by exhibiting, particularly, before the eyes of the people the very objects they wish to study; for this, I think, is the great object of those scientific establishments, which are increasing every day all over this country, after the pattern of that greatest in your metropolis—nay, I dare say, in the world—I mean the British Museum. By such means, which will be a great help to our youth in the cheerless studies of the schools, and by encouraging brave and clever boys, who have any taste for natural sciences, which should be another object of your benevolent consideration, you will be truly beneficial to your fellow-citizens, who will keep long after your blessed memory at heart.

And as you have allowed me the honour of addressing this meeting, which address, I feel sure, would have been given in a much better style by any other member of the Society, I will try, in giving you this general view of the Natural System, to be as brief as possible, if I cannot else succeed in satisfying your expectation, and in obtaining your kind approbation.

The main object of this Society is evidently the study of Nature; the very name of *Naturalists'* Society implies it. But Nature, one might ask—what is it? Nay, what is there that one might say that does not belong to Nature? True. Nature, as the etymology of the word tells us, is all that is born (*quod est natum*), all that is produced, all that has been created. Hence the study of Natural History, in its most extensive sense, would be the study and the description of the whole world, spiritual as well as material, earth as well as heaven; but, of course, our Society does not intend to spread her wings so widely. There are many others especially engaged in heavenly things—astronomical societies most particularly; to them we shall leave the surveying of the stars of heaven, glad ourselves to expiate on the very surface of this little globe of ours, admiring amongst its manifold productions those garish flowers which a Latin poet was pleased to call "the stars of earth" (*sidera terræ*). But this very small, and I may say quite insignificant, portion of the celestial system—this very small ball of earth, which we, poor Naturalists, often boastingly call "the terrestrial globe," will appear, no doubt, to be still too much for our scientific consideration. Indeed, if we consider it, as the ancients did, simply in its four elements—*fire, air, water and earth*—we perceive at once that the three first will not concern, at least for the present, our Society, which will leave the first to *pyrologists*, whose province is to deal with fire and heat, latent or sensible; the second to *meteorologists*, whose business is to treat of the atmosphere and its phenomena; and the third to *hydrologists*, who must be especially skilled in the laws and properties of water. Thus *earth* alone—the property so called elementary earth—remains at last at our disposal, with both its vegetable and animal productions, which I have no doubt will appear still so extensive to each of us, that, far from being able to bring them all under the control of our experience, we shall scarcely be able to conceive them in our mind. Hence the necessity of order—the necessity of arranging and classifying the objects we mean to study—the necessity of *method* in distributing the different kinds of earth and its productions. "Method (was great Linnæus' saying to a student of Natural History) is like the clue of Ariadne, without which he would soon be lost amid the mazes of a labyrinth, and all his science would become a chaos." Now, gentlemen, method you know is a Greek word, which means a *way after*, which one may proceed in classifying natural objects according to their common characteristics; and there have been, and there are still, in vogue and in repute many methods, both ancient and modern, such as the old ones of Theophrast, Ray, and Linnæus, and the new ones of Dana, Gray, Owen, and Huxley. I do not mean here to choose among them, or to bring forth any reason why we should give the preference to this rather than to that; this would lead me too far; neither do I think it necessary for our purpose just now. What I wish simply to state at present is this: that there are two very common and very practical ways which we may equally follow in arranging our future Museum—a way *up*, and a way *down*; the one beginning from the very first elements steps up to the most perfect natural productions; the other from these, step by step, goes down to the elementary substances. Which of the two would be the best, I can hardly say, seeing that there are advantages and drawbacks on both sides. At any rate, a sketch of both might be useful to our purpose; and the sketch I'll give you is this:

I view all earthly substances and all earthly productions—*minerals, vegetables*, and *animals*—as forming one single huge pyramid, the base of which is occupied by the mineral, the centre by the vegetable, and the uppermost part by the animal kingdom; so that the way up, beginning with the mineral substances, and passing through the vegetable to the animal beings, reaches the very top of the pyramid, where man, to whom all these natural productions have been made subservient, stands alone; and from that very summit he treads, we may say, under his feet all those lower creatures, raising his thoughtful head to heaven. Such is the way up. Now, the way down starts from this very high point, and taking up every generation of animals, telling every tree of the forest, describing every plant of the field, counting every blade of grass that shines on the meadows, never stops till it reaches that very *dust* out of which man has been taken. Such is the admirable scale of creation, and such would be the line of our proceedings, either way we are determined to choose.

Supposing now we choose the first, and start from the base of our supposed pyramid. The first things we meet with are the minerals—that is to say, that *insensible world* which constitutes the *materia prima* of both the vegetable and animal kingdoms, and which is properly called the *matter*, the nature of which is equally mysterious and nearly as deep and unfathomable as that of the *mind* itself; but we shall leave it to the consideration of higher philosophical societies, such as they are, or ought to be, in London, Cambridge, and Oxford, and content ourselves with merely picking up such material as it chances to fall into our grasp, setting each one in order, and giving all a suitable and convenient arrangement.

When I began studying Mineralogy, I endeavoured to arrange my collection according to the then famous theory of Beudant, based on that property that each mineral possesses of being reduced either to *gas* or to *white* or to differently *coloured* solutions; and therefore I ticketed my three first divisions, with the titles of *Gazolytes* (where the rock crystals were the leaders), *Leucolytes* (where silvery ores had the principal part), and *Chroicolytes* (where a few particles of native gold were shining, and keeping the most eminent place). The last two divisions were especially, you see, for *metals*, and only a chemist might deal properly with them; but Chemistry, I think, is not our present department, so that we may leave aside Beudant's theory, which, by the way, did not hold good out of France, where it was brought to light. We may also leave aside for the present the other not less famous theory of Dufresnoy, totally based on crystallization. A more simple and popular division seems to me that which looks at each mineral according to its ordinary components—*silex, lime*, or *clay*. A very few straggling pieces might occur which could not be brought under these three categories, seeing that every soil, every rock, nearly every stone, is composed more or less of one, two, or even of all the three said elements—viz., *silicious, calcareous*, or *argillaceous*. Such elementary substances are seldom found in a purely elementary state. You may meet sometimes with the purest colourless rock crystals of the mountain of Cairngorm, in Scotland, where it is called the Cairngorm stone. This would be pure *silicon*. You might be witnesses of that bright light which is given out from the incandescence of a ball of lime in the flame of combined hydrogen and oxygen gases, there would be pure *calcium*. At last you may possess *chez vous* some of those "sparkling orient gems"

(Milton), such as ruby, topaz, emerald, and sapphire, which are commonly called *precious stones*, but are really mere alumina, or *argilla*, pure bright clay (as diamond is bright coal), stained often, and variously coloured by metallic substances (the emerald, &c., by the oxide of glucinum, which is a very rare earth, the beryl by the oxide of iron, and so forth).

These three pebbles I show you are the purest and most commonly met with types of the said three first mineral divisions.

No. 1.—This flinty one represents the *silicious*.

No. 2.—This chalky one the *calcareous*.

No. 3.—And this clayey the *argillaceous* substances.

Then you see here the nearest gradations in different silicious patterns brought under No. 4. This No. 5 is a liassic pebble from Penarth, composed of both lime and clay. No. 6 is the commonly called alabastrum, a sulphate of lime or hydrated gypsum, containing sulphur instead of *carbonium*, which constitutes the common limestone or carbonate of lime, and thus you may go on with the following, Nos. 7, 8, 9, &c.

The metallic ores themselves, as they are given us by Nature, may be arranged under one or other of the said categories, since they are very often combined with silicious, calcareous, or argillaceous substances, as you may see from the heaps of iron ores at the docks, giving out, on rainy days, plenty of clayey mud.

Mineral coal, of course, does not enter into any of these categories; it is a vegetable substance, which comes after.

Thus much, then, I think, may suffice to settle our little stock of purely mineral and inorganic substances. The fossils which we intend to study more particularly, are all *organic*, and, consequently, belong to either the vegetable or animal kingdom, according to their having been merely organised, or endowed, moreover, with *sensitive* life.

And here, passing over the centre of the pyramid where we intend to arrange our vegetable productions, I shall not entertain you to-night about it, seeing that time is short, and that we have not got as yet a sufficient supply of specimens to deal with. As soon as spring comes, and the flowers begin again to display their colours, we may go out to witness with our own eyes the riches and beauty of our Cardiffian Flora, and then we shall have a suitable occasion to examine and go into this vegetable kingdom. And, coming now to the *animal*, the first and all-important question which presents itself to a considerate and thoughtful mind is—how mere atoms of dull matter, after having received a fit *organization* (which is another mystery we shall look into whenever we come to speak of the passage from the mineral to the vegetable kingdom), begins to receive animation; in other words, what is the origin of that *life*, by which the animal is so widely separated from the vegetable, as well as from the mineral kingdom. Here is a question I should like particularly to examine thoroughly in all its parts—here is food for minds like yours. But all that I can say now (and I say it with the most strong persuasion and conviction) is, that though I am neither a supporter of the new-fangled theories of the *magnetic* or *odylic* forces, by which matter bridges over mind, nor a partisan of the mere automatic machines of Descartes, I firmly believe that life, or the vital principle that moves and rules the most wonderful organisms of animal bodies, is in no way to be discovered with bodily eyes, or through any microscopical glass, how powerful soever it may be, but is to be searched for among the world of *spirits.* If anyone has an objection to the word he may change it, but the thing must rest, it cannot be changed.

But, leaving aside the question of life for the present, and viewing our animal specimens, *dead*, as they generally are kept in museums, in their mere organization, either internal or external, they are generally divided into two sub-kingdoms, *vertebrata* and *invertebrata*, the former having an internal framework or endo-skeleton bound and kept together by the so-called *vertebræ*, or back-bones; the latter having no framework of this kind, but at most an internal envelope, a hardened superficial tissue, a kind of dry body, such as we may see looking at the hard skins of insects, or at the chitinous coverings, which are improperly called *shells*, of crabs, lobsters, prawns, &c. As to the mollusks, which have not even this external framework, or *exo-skeleton*, to protect their *soft* and naked bodies, they have been lately arranged by Dr. Gray in a special sub-kingdom, which he calls *Mollusca*, and which he considers more perfect animals than the *Articulata* (annulose or articulated animals), which come the last, forming thus his three sub-kingdoms as follows;—I. Vertebra. II. Mollusca. III. Articulata. Of these two latter sub-kingdoms we shall have occasion to speak when we have received the very important collection which I hear that the intelligent officers of the committee have lately purchased. I should like very much to treat on a similar occasion of another, by far the largest of the above-mentioned animal sub-kingdoms, which I had nearly forgotten; I mean the *Protozoa*, that unsoundable galaxy of the so-called *infusorial animalcula*, nearly unknown to our forefathers, and only lately revealed by means of that wonderful instrument, the microscope, which I wish our committee should not forget. But, fearing I am annoying and surfeiting you with this, I will not say *rigmarole*, but unlanguaged prattle of mine, I must hasten to the conclusion, or rather to that culminating portion of the pyramid where the vertebrata are to be disposed in their well-known series of *Fishes*, *Reptiles*, *Birds*, and *Mammals*, and after having thus reached that vertex upon which man ought to stand alone as lord of creation, as a surveyor and uncontested king of the three kingdoms of Nature, we may now betake our *way down*, which is the second method I proposed at the outset, and which is likely to prove suitable to the purpose we have in view, of arranging our Museum.

Beginning now our way back with the Mammalia, I am sorry to say that man himself, this noble, rational, human nature of ours, has been lately, I think, very badly associated with brutes and beasts by some very clever writers, whom I must highly praise in other respects, but who seem to me to have very slightly, if at all, considered the whole of human nature, viewing simply its organization and outward frame of the body, or at most, at those merely instinctive powers which man has in common with irrational animals, and thoroughly overlooking that very best part of his own, which is that intelligent and rational soul upon which is stamped in glowing characters the perfect resemblance of his Divine Creator, and by which he comes to be absolutely separated from any kind of monkeys and brutes.

A great American Naturalist (Dana), in his very recent classification of Mammals, gives his Ord. I. the Greek name of *Archonts*, which word means indeed the same thing as the word *Primates* in Dr. Gray's arrangement; but whilst this latter embraces in this order six families, which he distributes as follows:—1.—*Hominidæ* (men).—2 to 5, Monkeys and apes, tailed, tailless, and flying lemurs. 6. Vespertilionidæ, the ancient *chiropters* or bats; the former speaking of his *archonts* says: "This (order) includes Man alone, distinguished from other mammals, not only by his spiritual nature, but also structurally," and then goes on showing how "his system is made directly subservient to the purposes of the head." And after having thus disposed of man, whose nature should be the greatest, the paramount object of study for everybody, according to the wise saying of your poet, "the proper study of mankind is man" (and for this purpose we do not want to have here displayed on our tables dead people's skulls, as I have seen them arranged in the Museum of Swansea), Dana divides his mammals into two typical groups, two very large and nearly all-comprising groups: Megasthenes and Microsthenes. By the first Greek word, which means beasts of *great strength*, he means the largest and most perfect animals, such as lions, tigers, elephants, horses, &c., &c., with which we are, or may easily become acquainted without need of storing their huge skeletons within the precincts of this modest establishment. A tooth, like this you see here, of a tiger, a tusk, as that of the elephant, or any other portion, especially fossil, of the bodies of megastheria or megritheriod mammals, will be all we need to remind us of this first group of Megasthenes. The other word, Microsthenes, equally Greek, means animals of *small strength*, and embraces nearly all the mammals of a smaller life-system, and this yet very small collection of ours may chiefly be comprised in Dana's two orders of *Insectivores* and *Rodents*. To his other two orders of Chiropters (bats) and Edentates (sloth, armadillo, and the like, all foreign mammals), we shall scarcely have need of recurring, much less to his last group of *Ooticord* (oviparous or semioviparous Mammals), such as the kangaroos, the opossums, &c.

Thus much, I think, may suffice for our first arrangement of mammals, and coming a step down the pyramid we meet with the feathered tribes of Birds, of which I am glad to see a fine and pretty large collection already carefully and scientifically disposed of by Mr. Rhys Jones; and I hope that he himself, or our honorary secretary, Mr. Robinson, will be ready to entertain us at the next meeting with a far better speech about these feathered tribes.

Perhaps I may be ready, too, to say something about the following orders of Reptiles and Fishes when our Museum shall be better furnished with these interesting scaly and finny tribes.

And now, before leaving, I wish to express to you my heartfelt gratitude for the kind reception you have given me in your learned Society, and bidding you adieu, I'll do it in the words of an old English writer: "The blissful dew of Heaven may arrose you" that you may look through Nature up to Nature's God.

A vote of thanks was then unanimously passed to the learned Professor.

At the MARCH MEETING the following "Address on the Objects of the Society" was delivered by the PRESIDENT :—

Gentlemen,

Having done me the honour of electing me your President for the present year—the first of the existence of the Society—I feel the duties of my office have been hitherto much neglected, and chiefly through circumstances beyond my control. I promise you, however, that every occurring opportunity shall have my attention in furthering the objects for which the Society was instituted. I have been asked, will the Society be of any service to the people of Cardiff and the neighbourhood, and what are its objects? My reply has been, "I hope and fully believe the Society will be of benefit to some few at least of our 50,000 fellow-men of Cardiff and its suburbs;" and, from Rule 3, I quote its objects to be "the practical study of Natural History, Geology, and the Physical Sciences, and the formation of a Museum in connection with the Free Library." And have we not here a field of sufficient scope for all to work in perfect harmony? to first build up the pyramid so eloquently described at our last monthly meeting by my friend and fellow-member the Rev. Professor Gagliardi, and each having added their mite in the construction thereof, labouring diligently and lovingly until the summit is reached, and the banner of the Cardiff Naturalists' Society planted thereon; then as assiduously wandering down its sides, searching out and learning from the book of Nature such of its many truths as is permitted to man to inquire into.

The County of Glamorgan is richly endowed in all those matters our Society professes to become acquainted with. To the Botanist, what a fine field is open! What a variety of plants, flowers, grasses, shrubs and trees will he meet with in his rambles from the level of the sea here at Cardiff to the highest mountain rising nearly 2,000 feet above it, and within a day's reach of the place we assemble in! The Entomologist too will be equally gratified and interested within the same range, and so also the Archæologist. And the Geologist and Mineralogist will revel in delight in opening the book of Nature, on which has been imprinted the records of a time long gone by, and in bringing to light of day the fossil Flora and Fauna of ancient days. The Archæologist will also find this goodly land of Glamorgan, where our predecessors fought many a hard day's battle, a land rich in historic records, and with its many castles, baronies, halls, monasteries, and abbeys, and its seats of learning, from one of which, numbering at one time 2,000 pupils on its roll, over fourteen centuries ago, issued men of note as historians, theologians, bards, and men having, it is described, "instruction given them in useful art, as well as theology," and by the instructor of the day was invented the common plough, known as "St. Iltyd's." During these fourteen centuries what eventful changes have taken place within this county, and even this town and neighbourhood. Then there was no Marquis of Bute, nor docks constructed to welcome and float upon its waters the noble ships bearing the flags of many nations; no canal—no railway, to carry to the sea that material used over the wide, wide world, forming the iron road, that great civilizer of the human family; nor yet to bring down that priceless treasure—that mineral *coal*—of greater value to our land than the riches of Peru, and of which there was shipped from the Port of Cardiff last year no less a quantity than 2,902,473 tons, including coke and patent fuel. Then there was no Cardiff Free Library, with its Museum, and Schools of Science and Art; at least no advance in Arts more than the invention of St. Iltyd's plough. Neither had there yet been thought of, that we know of, a Cardiff Naturalists' Society.

The Society's foundation being laid—the pyramid's base founded—how now is the structure to be raised? Rule 3 states a Museum is to be formed. Professor Gagliardi has hailed with pleasure the dawn of a brighter day to shine upon the youth of Cardiff, who, naturally fond of learning, feel as it were an instinctive love for anything that is natural, and consequently for any branch of Natural History; and who is there of us who will not heartily join in that pleasure? And not only is it the youth who has this love of Nature, but the adult also, both man and woman. Therefore, if you please, we will now consider how the Museum is to become useful to its members, and the frequenters of the Free Library also; and I think I cannot do better than quote from a lecture of that eminent man of scientific attainments, the late Professor Edward Forbes, a man who loved to devote his powers to the improvement of the working man, many of whom I hope to see enrolled as members of our Society, especially when it is considered that our annual subscription is so low as to place it within the power of all to do so. The Professor's Lecture was delivered at the opening of one of the courses at the Government School of Mines, in Jermyn Street, "On the Educational Uses of Museums." He says: "Museums of themselves alone are powerless to educate, but they can instruct the educated, and excite a desire for knowledge in the ignorant. The labourer who spends his holiday in a walk through the British Museum cannot fail to come away with a strong and reverential sense of the extent of knowledge possessed by his fellow-men. It is not the objects themselves that he sees there and wonders at that make this impression so much as the order and evident science which he cannot but recognize in the manner in which they are grouped and arranged. He learns that there is a meaning and value in every object, however insignificant, and that there is a way of looking at things, common and rare, distinct from the regarding them as useless, useful, or curious—the three terms of classification in favour with the ignorant. He goes home and thinks over it; and when a holiday in summer, or a Sunday's afternoon in spring, tempts him with his wife and little ones to walk into the fields, he finds that he has acquired a new interest in the stones, in the flowers, in the creatures of all kinds that throng around him. He can look at them with an inquiring pleasure, and talk of them to his children, with a tale about things like them that he had seen ranged in order in the Museum. He has gained a new sense—a thirst for natural knowledge—one promising to quench the thirst for beer and vicious excitement that enticed of old. If his intellectual capacity be limited and ordinary, he will become a better citizen and a happier man; if in his brain there be a dormant power, it may waken up to make him a Watt, a Stephenson, or a Miller. It is not the ignorant only who may benefit in the way just indicated. The so-called educated are as likely to gain by a visit to the Museum, where their least cultivated faculties—those of observation—may be healthily stimulated and brought into action. The great defect of our system of education is the neglect of the *educating* of the observing powers—a very distinct matter, be it noted, from scientific or industrial *instruction.*" He again says: "In this Institution (Jermyn Street) an endeavour has been made to render its contents subservient to the cause of education and instruction, and the course which is here taken may be imitated with advantage in the provinces, where there are not unfrequently collections of considerable extent turned to small account for the benefit of the residents, a large proportion of whom in many instances are ignorant of their very existence. Yet it is to the development of the provincial Museums that, I believe, we must look in the future for the extension of intellectual pursuits throughout the land, and, therefore, I venture to say a few words respecting what they are, and what they should be. When a naturalist goes from one county into another, his first inquiry is for local collections. He is anxious to see authentic and full cabinets of the productions of the region he is visiting. He wishes moreover, if possible, to study them apart—not mingled up with general or miscellaneous productions—and distinctly arranged, with special reference to the region they illustrate. For all that concerns the whole world, or the general affinities of objects, he seeks the greatest national collections—such as the British Museum, the Jardin des Plantes, the Royal Museums of Berlin and Vienna. But that which relates to the particular county he is exploring he expects to find either in a special department of the National Museum, or in some separate establishment, the purpose of which is, in a scientific sense, patriotic and limited. So also with the students of history and antiquities: they are often disappointed, and in the end find what they require here and there, bit by bit, in the cabinets of private individuals. In like manner, when the inquirer goes from one province to another—from one county to another—he seeks first for local collections. In almost every town of any size or consequence he finds a public Museum; but how often does he find any part of that Museum devoted to the illustration of the productions of the district? The very feature which of all others would give interest and value to the collection—which would render it most useful for teaching purposes—has in most instances been omitted, or so treated as to be altogether useless. Unfortunately, not a few country Museums are little better than raree shows. They contain an incongruous accumulation of things curious, or supposed to be curious, heaped together in disorderly piles, or neatly spread out with ingenious disregard of their relations. The only label attached to nine specimens out of ten is, 'Presented by Mr. or Mrs. So-and So,' the object of the presentation having been either to cherish a glow of general self-satisfaction in the bosom of the donor, or to get rid—under the semblance of doing a good action—of rubbish that had once been prized, but latterly had stood in the way. Curiosities from the South Seas, relics worthless in themselves, deriving their interest from association with persons or localities, a few badly-stuffed quadrupeds, rather more birds, a stuffed snake, a skinned alligator, part of an Egyptian mummy, Indian gods, a case or box of shells, the bivalves usually single and the univalves decorticated, a sea urchin without its spines, a few common corals, the fruit of a double cocoa-nut, some mixed antiquities, partly local, partly Etruscan, partly Roman and Egyptian, and a case of minerals and miscellaneous fossils. Such is the Inventory, and about the scientific order of their contents." The Professor goes on to say: "There are, however, admirable exceptions to this censure. It would be invidious to cite examples, and yet the principles, in each case distinct, adopted in those of Ipswich and Belfast, ought especially to be noticed. In the Belfast Museum the eminent naturalists and antiquarians, who have given celebrity to their town, have made its contents at a glance explanatory of the geology, zoölogy, botany, and ancient history of the locality and neighbouring province. It so happens, however, that the value and excellence of almost every provincial Museum depend upon the energy and earnestness of one, two, or three individuals, after whose death or retirement there invariably comes a period of decline and decay. Now, this should not be, and would not be, were the facilities for scientific and literary instruction in the provinces greater than they are. In very few instances do we find the collections freely open to the public. In most cases they are unassisted by local or corporate funds, and dependent entirely upon the subscriptions of private individuals." I am glad to say that, happily for the success of our Society, these strictures of the Professor's will not apply to the town of Cardiff, thanks to the liberal sentiments of the body corporate.

Professor Edward Forbes further says:—"In every Museum of Natural History, and probably in those devoted to other objects, there gradually, often rapidly, accumulate a store of duplicates that if displayed in the collection render it more difficult to study than if they were away altogether. Yet out of these duplicates more or less perfect sets of specimens might be made up, of very high value for the purposes of instruction. A well-organised system of mutual interchange and assistance would be one of the most efficient means of making Museums generally valuable aids to education. Much money, when money is at the command of curators or committees, is spent in purchasing what might be obtained for asking or through exchange. The larger institutions might supply the smaller, and out of the national stores numerous examples, to them almost worthless, but to provincial establishments highly valuable, might be contributed with facility and greatly to the public benefit. It is in this way, viz., by the contribution of authentic and instructive specimens, that the Museums supported by the State can most legitimately assist those established from local resources in the provinces. Money grants would in many cases do more harm than good, destructive as they are of a spirit of self-reliance, and apt to induce a looseness of expenditure and habits of extravagance. At the same time every shilling granted judiciously by the State for purposes of education and instruction, for the promotion of schools, libraries, and museums, is a seed that will in the end generate a rich crop of good citizens. Out of sound knowledge spring charity, loyalty, and patriotism—the love of our neighbours, the love of just authority, and the love of our country's good. In proportion as these virtues flourish, the weeds of idleness, viciousness, and crime perish. Out of sound knowledge will arise in time civilization and peace. The arts, the sciences, tastes, literature, skill, and industry seem to have thriven amongst us in spite of ourselves—to have come among mankind like good spirits, and by main force to have established themselves on earth. They struggle with us and conquer us for our welfare, but are not yet our rulers. Sent from Heaven, aided by the few, not by the many, they have made firm their footing. If the Monarchs and Presidents of the States of the earth knew wherein the best interests of themselves and their people lay, it is in these intellectual invaders they would confide. I cannot help hoping that the time will come when every British town, even of moderate size, will be able to boast of possessing public institutions for the education and instruction of its adults as well as its youthful and childish population. When it shall have a well-organized Museum, wherein collections of natural bodies shall be displayed, not with regard to show or curiosity, but according to their illustrations of the analogies and affinities of organised and unorganised objects, so that the visitor may at a glance learn something of the laws of nature. Wherein the products of the surrounding district, animate and inanimate, shall be scientifically marshalled and their industrial application carefully and suggestively illustrated; wherein the memorials of the history of the neighbouring province and the races that have peopled it shall be severally assembled and learnedly, yet popularly, explained; when each town shall have a library, the property of the public, and freely open to the well-conducted reader of every class; when the public walks and parks (too many as yet existing only in prospect) shall be made instructors in botany and agriculture; when it shall have a gallery of its own, possibly not boasting of the most famous pictures or statues, but nevertheless showing good examples of sound art—examples of the history and purposes of design, and, above all, the best specimens to be procured of works of genius by its own natives who have deservedly risen to fame. When that good time comes, true-hearted citizens will decorate their streets and squares with statues and memorials of the wise and worthy men and women who have advanced their province—not merely of kings, statesmen, or warriors, but of philosophers, poets, men of science, physicians, philanthropists, and great workmen. How often, in travelling through our beautiful country, do we not feel ashamed of its towns and cities, when we seek for their ornaments and the records of their true glories, and find none? How ugly is the comparison that forces itself upon our minds between the conduct of our countrymen, in this respect, and that of the citizens of continental towns? A traveller need not go far through the streets of most foreign cities without seeing statues or trophies of honour, serving at once as decorations and as grateful records of the illustrious men they have produced—reminding the old of a glorious past, and inciting by example the young to add to the fame of their native soil. My picture may seem a dream, but I have faith sufficient in England and Englishmen to believe that in the course of time it will come to pass. Had the foresight of the present crossed the imagination of an ancient Briton, he might have hoped for its realisation in another world, scarcely in this. But a simple belief in the probability of a State and people advancing in intellectual aims and true civilization, and working them out through the length and breadth of the land, is essentially too wholesome and compatible with the progress of the Christianised human nature not to find an embodiment in a coming reality."

Much that this good and useful man hoped for has happily been carried out already in Cardiff, in its Sophia Gardens, its Free Library, its Science and Art Classes, and a foundation laid for a Museum; and upon this foundation we, the Naturalists' Society, are expected to build. But that our labours may not be of no avail, we must earnestly appeal to the liberal-minded and enlightened members of the Town Council to strengthen our hands, by giving us room and glass-cases that shall be open to the public, as are the Reading-rooms, wherein to place the objects we collect from time to time. If not exposed to view, they may as well remain in the bowels of the earth, the river's bed, or their native soil; and may our hopes not be unfulfilled for long!

I now beg to propose for your consideration my views of what should be our course of proceedings. At our monthly meetings we should endeavour to procure papers and lectures on the various subjects mentioned in our rules, when an interchange of much interesting information would necessarily ensue. We should also, I think, endeavour to have perhaps three field days during each year—whether more or less can be hereafter determined upon after due consideration, and to lay down a plan for operations in this respect, I think the one lately introduced by the Woolhope Naturalists' Field Club a most useful one to follow. The operations of their club embrace the whole county of Hereford, comprising an area of 863 square miles, which they have divided into fourteen well-defined districts. This was done more especially for botanical purposes, but attached to the description of each district are also appended notes on its geology. To take in the whole county of Glamorgan will, in my opinion, be too great an area for us to at present embrace; and having considered the matter, I propose that we commence our operations at the mouth of the river Rumney, the South-eastern boundary of the county, follow down the coast line by Cardiff, Penarth, Lavernock, Barry, Aberthaw, Llantwit-Major, Dunraven, to the mouth of the Ogmore river; then follow up the Ogmore, through Bridgend to Aber-Llynfy, follow the Llynfy past the Tondu Iron Works, various collieries, the Maesteg and Llynfy Iron Works, up to Blaen-Llynfy, here cross the Foel-Fawr Hill, a distance of about one and a half mile, to Cwmmer, in the Afon Valley, follow the Corrwg-Fawr, passing Glyn-Corrwg village, Blaen-Corrwg, and to the source of the Corrwg-Fawr, up to the hill summit of Carn-Fach, which is, I think, about the highest ground in the country—1,971 feet above sea level. From here a glowing and picturesque view is obtained of the Vale of Neath, immediately below, and continued northwards, crossing hills and dales, with the never-failing whitewash of the Welsh farm houses, until the eye rests on the bold mountain ranges of Carmarthenshire and Breconshire; the beacons of the latter being the highest ground in South Wales—2,910 feet above the sea. But to return again to the old coach road from Merthyr-Tydfil to Swansea, at the Western end of the Hirwain Common, we now take an easterly direction, the road and the county boundary, which is also about the north outcrop of the coal-field, and run nearly together, and we pass the Hirwain Coal and Iron Works on to Cefn-Coed-y-Cwmmer, just north of Cyfarthfa Castle, the seat of Robert T. Crawshay, Esq., the Cyfarthfa Iron Works being close at hand; pass up the Taff-Fychan, below Morlais Castle, a fine old ruin built upon a rock—mountain limestone—pass the village of Vaynor for a mile and a quarter. Here leave the Taff-Fychan, proceed eastward again to Blaen-Rumney, the source of the river Rumney, following this southwards, passing the Rhymney Iron Company's Works and Collieries, and numerous collieries belonging to other proprietors, to Maes-y-Cwmmer, where the Taff Vale Extension Railway crosses the river Rumney by a fine stone viaduct at the Hengoed station of this line, and the new Rhymney Railway, distant from Cardiff about 15 miles, and the Maes-y-Cwmmer station of the Brecon and Merthyr Railway, a distance of about 16 miles from Newport, still following the Rumney we see the village of Bedwas on the east, and a mile to the west stands the town of Caerphilly, with its fine old castle, now in ruins. Again, passing on we come to the Machen forge, and tin-plate works of the Messrs. Woodruff—the village of Machen—Ruperra Castle, the seat of the Hon. Colonel Morgan—Cefn Mably, the seat of Colonel Tynte—the village of Llanedarn—Llanrumney Hall, the residence of G. C. Williams, Esq.—and to our starting point at the mouth of the river Rumney, and the junction with the Severn. We have thus embraced an area of about 530 square miles, which, if well worked, will require a considerable time; the total area of the county is about 790 square miles. Of our 530 square miles we have over 260 in the coal measures, the remainder consisting of the Farewell Rock or Millstone grits, with the mountain limestone below, forming the carboniferous series, the old red sandstone, or Devonian rocks, with a little of the upper Silurian formation found at Penylan near the south-eastern boundary of our district—the magnesian conglomerate—new red marls—Penarth beds—lower lias, and the alluvial clays and gravels in the plains, as you will notice by referring to the geological maps of the district. The area is again well intersected by valleys through which railways run, making all points readily accessible, and by which we have every facility for carrying on our work; and if each member will take up one or more of the numerous objects we have in view, I think we shall not be long ere Cardiff will have displayed in its Museum a valuable and instructive collection of the products of the county. I desire to bring under your notice the necessity for purchasing for the use of the members a good microscope, and as an "Evening with the Microscope" will be both interesting and instructive, until our funds will enable us to provide an instrument, if any member will be good enough to undertake to deliver a short lecture, I think we shall have no difficulty in getting a few microscopes lent us. I have one of Ross's which I shall be happy to bring here any evening, and I feel sure other members will do so also.

As the new Docks are now progressing the members fond of geology will find matters of much interest there in passing down through the alluvial clay. There are several layers of shells met with, and the manner in which they are found will be interesting to record, if any member living near there will visit the works as frequently as possible, and make notes thereof. I noticed a week ago a bore hole being carried down; a workman had just penetrated before I reached there the new red marl, at a depth from the surface of about 35 feet; above the marl were four feet of gravel, apparently Pennant sand stone, the remaining feet being the alluvial clays. I was informed that in constructing the East Bute Dock, at some depth from the surface, and under blue clay, a bed of peat was met with, and large quantities of trees, many lying closely together, others scattered about; and below them was found clay again before reaching the gravels and new red marls. As there are further borings to be made, I hope some member near the spot will take up the matter, frequently watch the progress, make notes thereof, and collect samples of the ground passed through. I have brought to the town this evening, for the use of the members, a copy of the district plan, made by Mr. Waring, C.E., the town surveyor, on which can be marked any number referring to a note made. The number should of course be placed on the spot to which it has reference; for instance, No. 1 refers to the bore-hole put down by the Trustees of the Marquis of Bute, near the north end of the East Bute

Docks, a section of which was kindly given me by Mr. J. McConnochie, C.E., who is the chief engineer for the Trustees. There are numerous places about the town where pits are sunk for waterworks purposes, house foundations, &c., and if each member passing made a note thereof and recorded it here, a valuable amount of information might be collected, both geologically and for sanitary purposes. To do these things takes up very little time, when once one gets into the habit of collecting. I have also brought this evening for the society a useful little work just published, written by Mr. J. G. Symons, F.M.S., its title being, "Rain, how, when, where, why it is measured." Records of the rainfall of the town and district of the county we purpose investigating will be of much interest too. Some members might undertake to make collections of our various industrial products from the raw material to the finished article, showing the latter in its different stages. This will embrace coal and iron stones of the district, with limestone, first-class building stones, foreign iron ores, iron and steel, boiler, sheet, and tin plates, chemical productions, paper manufactures and other matters. Others to collect mineralogical, geological, entomological, botanical, conchological, and other specimens of natural history, so that we find ample work for all to do. Our members have already added some new facts to our Natural History, and the specimens are placed in the Museum. First, a rare Beetle (Nebria) taken at Barry, by W. Taylor, Esq., M.D., and hitherto known as existing in only one locality in Britain. Also, a new species of "Ostrea (Exogyra) virguloides," discovered by Professor Gagliardi, in the Lower Lias of Leckwith, which has been figured and described in the "Geological and Natural History Repository," by Ralph Tate, Esq., A.L.S., F.G.S. And to conclude, let us hope that the month which is the first anniversary of the Cardiff Naturalists' Society, and also that in which the Most Noble the Marquis of Bute attains his majority, will be hailed by us with much joy and pleasure on being told by the Members of the Corporation that they will find us rooms for the Museum fitted for such a thriving town and port as Cardiff.

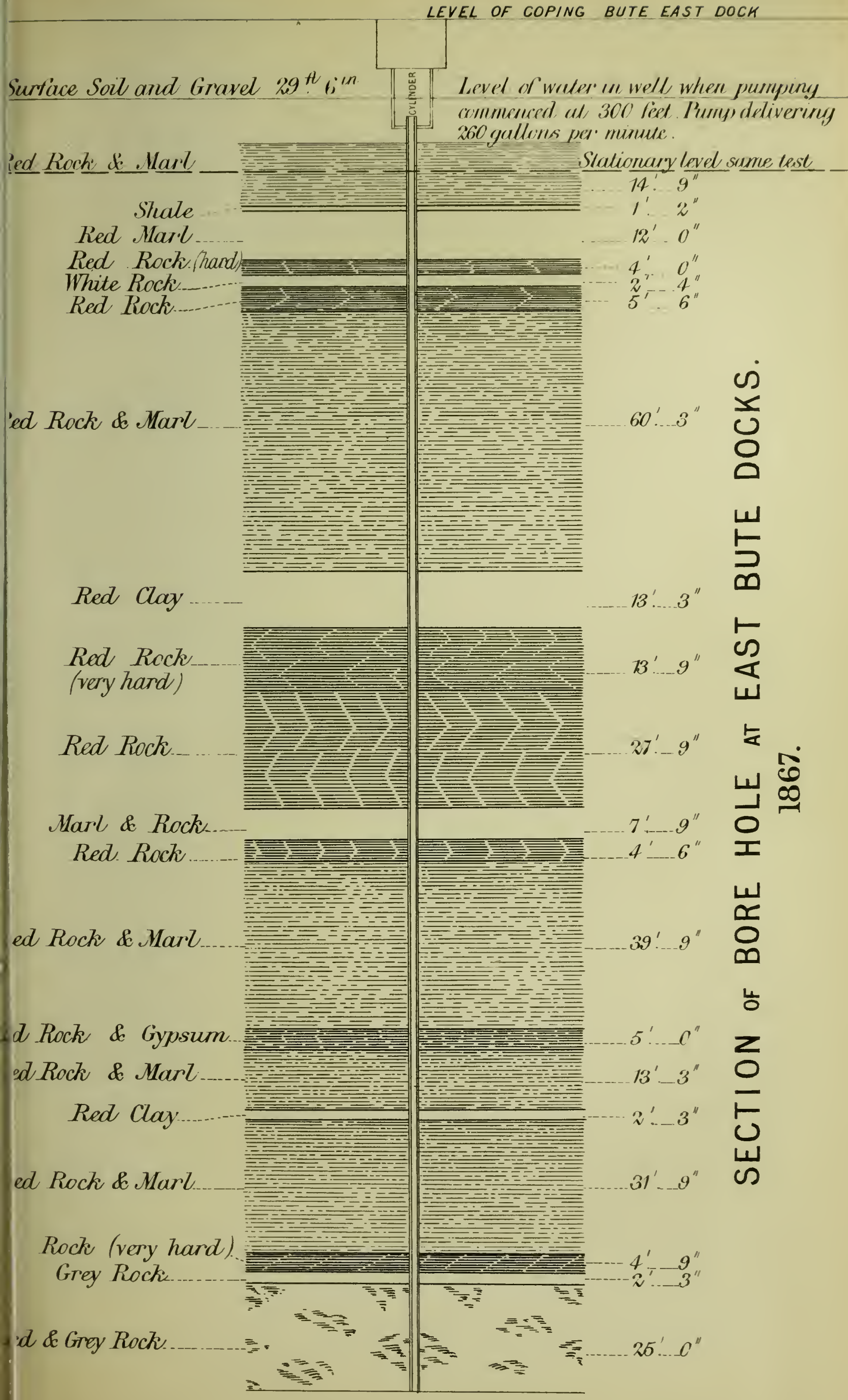
SECTION OF BORE HOLE AT THE EAST BUTE DOCKS 1867.

LEVEL OF COPING OF EAST BUTE DOCK.

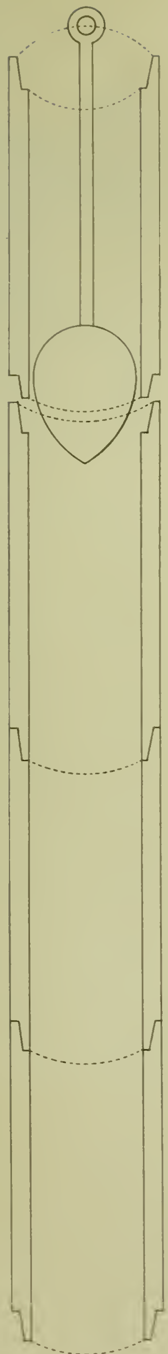
	feet	in.
Surface Soil and Gravel	29	0
Red Rock and Marl	14	9
Shale	1	2
Red Marl	12	0
Red Rock (hard)	4	0
White Rock	2	4
Red Rock	5	6
Red Rock and Marl	60	3
Red Clay	13	3
Red Rock (very hard)	13	9
Red Rock	27	9
Marl and Rock	7	9
Red Rock	4	6
Red Rock and Marl	39	9
Red Rock and Gypsum	5	0
Red Rock and Marl	13	3
Red Clay	2	3
Red Rock and Marl	31	9
Rock (very hard)	4	9
Grey Rock	2	3
Red and Grey Rock	25	0
Total depth of Bore Hole	320	0

This is the Section furnished by Mr. McConnochie referred to by Mr. Adams in his paper.

Mr. McConnochie has also kindly supplied the following information as to the construction of the Well.



SECTION OF BORE HOLE AT EAST BUTE DOCKS.
1867.



ARTESIAN WELL.

BUTE DOCKS, CARDIFF.

The depth of the well, bored by MATHER & PLATT for the Trustees of the Marquis of BUTE, is 340 feet below the surface of the ground.

The supply of water is about 200 gallons per minute.

The diameter of the bore is 18 inches, the upper portion for a depth of 60 feet below the surface is tubed with cast-iron pipes 16 inches internal diameter, this brought us to the hard rock, and excluded all surface water.

Sometime after the boring had been completed, it was found that the hole got filled up to the extent of 20 feet from the bottom, from the layers of soft material, through which the bore was made, washing into it: it was then tubed through the whole depth, with cast-iron tubes 14 inches internal diameter. These tubes were turned at both ends and made to fit tight into each other, they were lowered one at a time, and were made to fit at the bottom by a very ingenious contrivance.

There was a piece of hollow metal cast in the shape of an egg, and made to fit nicely in the pipes, with just sufficient clearance to pass through them, and having attached an iron rod with an eye at the end for lowering it down, this was lowered with a pipe, and when it came to the top of the portion of pipe already down, it found the end of it and guided the lower end of the pipe then being lowered on to the upper end of the one below, the whole of the pipes, forty-five in number, were fixed in this manner; the sides of the pipes were perforated with holes of one inch diameter. There is a pair of engines of 20 H.P. for pumping the water to the tank, thirty-five feet above ground, for supplying the ships in the dock; also, there is a valve connection by which the water from the well can he turned on and used for fire purposes; a large jet of water was thrown over the B warehouses at the end of the Bute East Dock.

The Trustees are now laying mains along the whole length of the East Dock (both sides), for the supply of vessels and fire purposes.

The cost of the sinking of the well, tubing to sixty feet below surface, two nine inch pumps, one rotary pump, double cylinder engine, boilers, fittings, &c., air vessels, gauges, and everthing connected with the same, was £1,950. Cast-iron water tank and the tubing were extra.

At the April Meeting of the Society,

The Honorary Secretary, Mr. P. S. Robinson, exhibited a very interesting fragment ef Rhizomorpha subcorticalis (root-like Fungus, which grows under the bark of trees). This is a byssaceous substance (byssus-like fibres or filaments) found in damp cellars, in mines, or under the bark of decayed trees. Very likely it is no perfect plant, but a mere mycelium or sclerotoid state of an unknown fungus. The growth of this Rhizomorpha should be carefully watched, in order to find out its fructification, which would be a really interesting discovery to British Cryptologists.—(Greville Scot. Crypt., flor. iii, pl. 154; and Berkeley's Introduction to Cryptogamic Botany may be consulted on this subject.)

The other members of the Naturalists' Society, too—those particularly who have anything to do with the mining department—ought to ascertain whether in any of the Welsh collieries has ever been witnessed that wonderful phenomenon of the phosphorescence of Rhizomorpha subterranea, which often occurs in the coal mines of Dresden, and which gives the natural arches of certain mines in Germany the appearance of enchanted vaults, teeming with indescribable splendour.

Mr. Robinson showed at the same meeting a fine specimen of the not very common thyme threadlike moss (*Mnium undulatum*), in perfect fructification, besides a rich clump of cord-moss (*Funaria hygrometrica*), and a very rare flower, unknown to British Indigenous Flora, the Honesty or Lunary (*Lunaria biennis*), so called from the silvery dissepiments of its pods, which resemble the moon in form. This plant was found by Mr. Rhys Jones and Mr. Robinson, near the river Rumney, at Cefn Mably. To the observation made about its probably originating from ballast deposits, it was answered, no such thing was to be suspected about the spot where the flowers were gathered; still it remains to be proved that no garden seed had been brought there by chance or other means.

At this Meeting, also, Prof. Gagliardi stated, that he had lately received three specimens of Golden Lady-bird, found under a stone in a Furze Thicket in the Sophia Gardens, and gave the following particulars as to these rare Coleoptera:—They do not belong to any of the twenty-two genera of the family of trimerous Coleoptera which bears the scientific name of Coccinellidæ (among which is conspicuous above all C. septempunctata, the very common Lady-bird, with which every boy is familiar), inasmuch as the Coccinellidæ are all carnivorous, though for this very reason they are serviceable to the farmers, destroying those troublesome plant-lice that are known to the scientific world under the name of aphides; whilst the Golden Lady-birds of which we are speaking, and which belong to a family of pseudo-tetramerous Coleoptera, called Chrysomelidæ, are all phytophagous, or vegetable feeders, adorned with the most gorgeous colours—gold, red, green, blue, violet, silver, &c. Their naked larvæ are commonly fixed upon the leaves of plants or trees on which they live, but in their perfect state of beetles they conceal themselves at the foot of plants, under the bark or beneath stones, as it was just the case with our Golden Lady-birds (*Chrysomela staphylæa*, Linn., two Greek names, by the way, that mean "golden apple," and "grape berries," both nicely appropriated to the lovely appearance and round blooming face of our little creatures).

At the General Meeting of the Society, on May 4,

after the Election of New Members and the transaction of the ordinary business, several Microscopes lent by Messrs. F. W. Joy, Kernick, Milward, Brown, Adams and others were set at work; amongst which a fine Binocular, brought by Dr. Brown, proved especially serviceable, and would have been still more so, had there been a better arrangement of light and stands. As it was, however, a good many curiosities were examined, such as Pollen or fecundating dust of Flowers, Organic remains of Coal, sections of objects illustrative of Comparative Anatomy, Blood Crystals, Human Calculi, &c. One or two living objects, Frogs, were also placed on the object-glass and afforded a very perfect view of the circulation of the blood. But the special attraction was a drop of fresh water recently taken from a pool at Pen-y-lan, in which Desmides and Confervæ—very minute vegetables of the algæ tribe—were to be seen growing, and numbers of the most strange animalcula floating and sporting about, like dwarf monsters of the deep in a puny ocean. The largest of the lot was a brisk little thing, scarcely visible to the naked eye, generally known in Great Britain by the name of Water-flea (*Daphnia pulex*); next to it came that pretty shrimp-like wight that Dr. Baird calls *Canthocampus minutus*, along with it several newly-hatched larval cyclopes. Then came the Rotifers or wheel-animalculæ, the bristly fish-like chætonotus, and a sort of planaria, not uncommon in microscopical seas, but with this peculiarity of its own, that a parasitical group of Vorticellinæ was growing on its back. There were also among the find, now rushing in, then jerking over, gliding along, or boldly dashing across the field, several other kinds of infusoria, such as *Paramecium*, *Coccudina*, and the like. Amusing above all was a top-like Cercaria (*Urocentrum turbo*), incessantly reeling and staggering

"In tipsy dance and jollity."

And in the very same drop of water was the famous Trichodiscus, of Ehrenberg, better known by its English name of Sun-animalcula. Lastly, from the same water—though out of another drop—sprang forth that puzzling jelly-thread (*Gloionema paradoxum*) which Agardh, the Swede, first mistook for a Diatom, but which was afterwards proved to be a mere nest of gnats (*Tipulidæ*). It appears to the naked eye like a green little spot, and it is only by the aid of the microscope that you may descry its bright emerald eggs beautifully arranged in a transparent gelatinous row, like a precious cascanet.

PENYLAN FIELD MEETING.

The First Field Meeting of the Society

Was held on Wednesday, May 15th, at Penylan, and was greatly enjoyed by the whole party, who, though not very strong in numbers, showed themselves by their zealous work thoroughly in earnest.

The President, Mr. Adams, F.G.S., was on the spot at half-past two o'clock, and several members reached the quarry about the same time, and, hammer in hand, began to spread themselves over the rocks in search of the expected fossil treasures. Mr. Price, Professor Gagliardi, and other gentlemen arrived rather later, whilst the hammering of the rock was going on briskly; and after a welcome and a hearty greeting on both sides, the first comers began to show their lucky findings, among which were already to be noticed some good specimens of Trilobites, *Phacops caudatus* being pre-eminent; several species of brachiopoda, and many less perfect samples of a singular worm-like organism, which nobody could explain, and which have, therefore, been sent to the Museum of Practical Geology in Jermyn-street, London, to be named. There were also several fragments of coral, some tracks of annelids, and a few very faint traces of carbonised vegetables, but not a single perceptible mark of that silvery sheen of fish, "armour plate," which is so characteristic of the Devonian or old red sandstone. A new proof, observed the President, of the upper Silurian origin of this rock, which Sir R. Murchison and Mr. Salter, after having examined its fossils, declared *par excellence* of Wenlock age; and here the President showed the members of the society a number of the "Geologist" he had brought with him, where an interesting note of the Rev. Norman Glass stated that "the same kind of rocks extend for some distance round the side of the hill." This opportune hint emboldened the parties further progress on—up the hill, and down to the river Rumney—in search of further outcrops, and consequently of some probably new treasures. The lane leading up to the quarry and thence down towards Coed-y-goras farm (along which they proceeded), formerly abounded in ferns, and was said to be a locality for some of the rarer species—the Parsley fern (*Allosorus crispus*), and green and lanceolate spleenworts (*Asplenium viride et lanceolatum*) are reported to have been obtained there, none of them, however, are now procurable. Possibly they have been exterminated by over-enthusiastic collectors. The only plants at all deserving mention noticed at this meeting were the sweet Orchis (*Oconopsea*), and the bright rose-coloured flowers of *Pedicularis sylvatica*, and amongst the ferns a variety (*cristata*) of male buckler fern (*Lastrea filix-mas*), and a fine variety of the black Spleenwort (*Asplenium Adiantum nigrum*).

From the brook running under the road were obtained numbers of Caddis-worms—the cadbaits of the angler—whose wriggling larvæ seemed to be impatient of further "durance vile," and ready to come out perfect May-flies. Some good specimens of Trichoptera, too, were secured by one of the party, who treasured moreover a very fine Gold-tail moth, and went on gathering Nebria, Bembidium, Cicindella Germanica, and Clirna fossor. This last—which might be called in English the Digger, because it burrows in the earth with its palmated tibiæ—is a very amusing creature, and the British representative of the exotic Scaritidæ.

On the way towards the Rumney, two or three hundred yards beyond the main quarry, in a narrow sequestered nook of the road, the President pointed out a "fault," in the strata, and further on, several intercalated zones in a disturbed state of stratification, forced up by the folding and dislocation they had undergone. Several pertinent remarks were made on the spot, and specimens both lithological and palæontological were carried away.

It is hoped that these minor out-crops, which may be called the Silurian colonies of Penylan, may soon be thoroughly examined, and an account of them given by one of our practical Geologists.

After the party had reached the Rumney, the proceedings of the day were brought to a close.

Note.—Some time after this Meeting, Mr. Adams discovered the exact point of junction of the Silurian rocks, with the Old Red Sandstone, at a point some 80 yards W. of the S.W. corner of the house in course of erection by Mr. Parfitt.

Meeting at Crumlin Bridge and Pontypool.

June 19th, 1868.

A joint meeting of the Cardiff Naturalists' Society and the Woolhope Naturalists' Field Club took place on Friday, at Crumlin, in the Ebbw Vale, and passed off very successfully. The day was fine and clear, and most favourable for the objects of the gathering. Shortly before nine o'olock a.m., the representatives of the Cardiff Society met at the Rhymney Station, and by a quarter past ten o'clock reached Crumlin.

The Woolhope members having picked up their President at Abergavenny, soon 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 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, 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 the 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 mag nitude, are fallacies. Nevertheless, there are those who cannot be happy without facts and 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 ironwork, 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 ironwork 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 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 Sundew 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 COALFIELD.

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 coalfield; 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 coalfields? Even if stratigraphical geology did not prove these facts, and even if it 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 coalbeds, 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 reconstructing 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 coalfield 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 coalfield 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 coalbeds of the Swansea district being exposed on the shore and running under the bay; but from Mumbles to Pembrokeshire the Limestone re-appears in great force, forming the magnificent coast-line fcr 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 Carboniferons 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 Llynfy 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 concluion, 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 Coalfield.

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 Coalfield. 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 dying 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 Measure 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 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 was 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 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 9,000 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 9,000 feet of Upper Measure. 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 realised, 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 Mynyddwslyn vein and the Troedyrhiew 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 horizon 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, contains 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 Troedyrhiew 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; the supply is, instead, kept up by foreign ores, such as the Hematite from Cumberland, Oolitic ore from Northampton, Magnetic ore from the 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 coalmasters, 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 Abercarne 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 extraordinary 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 121.

4. Big vein coal.
5. Big vein mine; iron. Shells, *Anthracosia.*
6. Three-quarter coal.
7. Three-quarter mine; iron. Shells, *Anthracomya.*
8. Fydylog 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 thirty-three 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 in 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 irresistible, 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, were 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 *Lastrœa 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. Idœus*) 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," mentions 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 Cwmffrwdor joins lower down the "Cwm-nant-ddu," or 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. Milward, 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 Naturalists' 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 Coalfield 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 Coalfield," 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.

Fragment of fish bones and scales	Bottom vein, Ebbw Vale.
Head bones 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	Townley colliery, Durham Gantre.
Old Red fish (?)	
Orthis resupinata	
——— Michelini	Rosser veins, Rhymney.
Productus semireticulatus	Rosser veins, Rhymney and Ebbw Vale.
———— scabriculus	Pontypool; Blaendare; Meadow vein, Pontypool.
———— cora	Rosser veins, Ebbw Vale.
———— Honinghausi	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, Abercarne.
———— 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 in 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 are 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 ophthalmoscope 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 bi-ventriculate and bi-auriculate, 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 backbone; 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 *Exocetus* 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 external 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 mark of 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 bronchi, 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 conduct 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 flight.

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 adaptability 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 importance 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 put 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 muscles 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 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 continual 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, 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 the 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 exceed 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 in the 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 immovable 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 compressibility 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 on 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 s a lever of the third kind, where the power and the weight act in opposite directions but on the same side of the 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 as 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 Albatross, the Swallow, and among the Hawk tribe.

Those birds which fly fast but seldom fly far have usually rounded 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 instant, 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

* Since this paper was written the subject has been further investigated by Dr. Chapman, President of the Woolhope Naturalists' Field Club, an account of which will be found in Vol. IX.

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 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. 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

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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 hind legs, to prevent them catching over the edge of the tube.

the egg the mother packs in, one after another, from 20 to 35 larvæ, maggots 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.

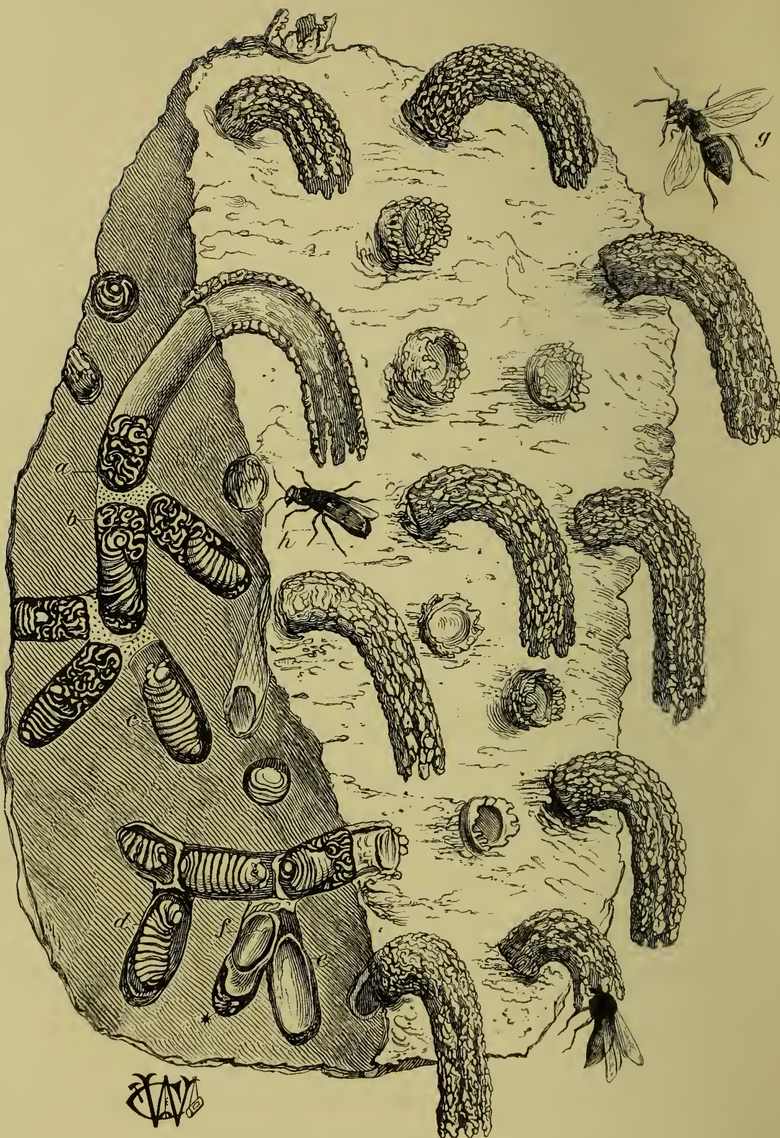
Poisoned by the sting it becomes torpid, however, and lies quietly inhumed in the tomb-like cell ready to become food for the larva of the wasp as soon as this latter shall be hatched, which, from our observation, must occur in a few days in such warm and genial weather as the present month has afforded. 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 in 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 a section (*Pupivora*) of the same great *Hyme-*

nopterous 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 species. The two latter are the special parasites of *O. spinipes*, *ignita* is only occasionally so; it is a very common insect and is parasitic on many different species of wasps and even bees. 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*.

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-gauge in the garden of our President. This happened two or three weeks ago, and, of course the first storm would have swamped the insect habitation, 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 earthworkers, 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.



ODYNERVS SPINIPES.

ODYNERUS SPINIPES.

A Colony of Odynerus spinipes, with the tubes of open filigree work, where the wasps are still working, and the closed mouths of completed burrows. A section of some of the burrows shows 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, showing the contained grub awaiting its change to pupa.

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

f. A cocoon of *Chrysis neglecta*—it does not fill the cell of *O. spinipes* in which it is made.

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

BARRY FIELD MEETING.

The members assembled for this meeting at their accustomed rendezvous, the Free Library, on Wednesday, July 15th, at 9 a.m. The day was what would have been considered in any year until the present as exceptionally fine, though the heat became towards noon and afterwards excessive. The Society mustered in tolerably good force—twenty-six—and were conveyed in breaks viâ Ely, to Court-yr-alla, the grounds of which, considered amongst the most picturesque in the county, were by the courtesy of Col. George Grey Rous thrown open to the party.

The tasteful arrangement of the parterres bordering the mansion attracted much attention, and the bright bloom of that pretty blue flower now so much used as an edging plant, the Lobelia (so named after M. Löbel, of Lisle, Botanist to James I.), the variegated Pelargonium zonatum, and the dark purple leaves of the Nanksia perilla contrasting with, and giving relief to the lighter combinations of flowers, were generally admired. Proceeding thence through a secluded and embowered dingle, realizing almost the Thessalian Tempe of Horace, there were noticed vigorous bushes of Broom (*Cytisus scoparius*), and tall shrubs of that Fuchsia (*Coccinea*), so well known as an ornament of the green-house, but in this favoured spot arborescent in the open air. The Enchanter's Nightshade (*Circœa lutetiana*), grew here very abundantly. Its slightly pink flowers, and the bristly inversely egg-shaped capsules of its fruit, formerly used in incantations, were growing on the same stem. Of course, in so sheltered a spot, Ferns were not wanting to add to the beauty of the scene. Very many species were growing luxuriantly. Those specially noticeable were the ever-graceful Lady Fern (*Athyrium Filix fœmina*), the male fern (*Lastrea Filix-mas*), Shield fern (*Polystichum aculeatum*), and the bright, glossy fronds of the Hart's tongue (*Scolopendrium vulgare*). There were also to be seen two rather scarce varieties of this last (*S. crispum* and *S. marginatum*), and on the Limestone cliff which borders the valley for some distance were several light tufts which were thought to be those of the Bladder Fern (*Cystopteris fragilis*). The Spleenworts were numerous, for on one bit of roadside wall were growing the Black Maidenhair Spleenwort (*Asplenium Adiantum nigrum*), and the pretty *A. trichomanes*, whose black rachis contrasts so pleasingly with the light green of the pinnæ. Close by, too, were the Scaly fern (*Ceterach officinarum*), and the Wall Rue (*A. ruta-muraria*). The long crinkled fertile fronds of the Hard Fern (*Blechnum spicant*), and a pretty, almost bipinnate variety of Polypody (*P. Cambricum ?*) were also noticed.

Probably, indeed, many Botanical treasures might have been obtained in that charming valley; but, time pressing, the party hastened on

"By hedge-row elms, and hillocks green"

to Dinaspowis; just noticing by the way, first the glossy evergreen foliage of the Periwinkles (*Vinca major et minor*), then a continuous stream, as it were, of Meadow sweet (*Spirœa ulmaria*), relieved here and there by the crimson flowers of the Willow herb (*Epilobium angustifolium*), popularly known as "Codlings and Cream."

At Dinaspowis a halt was called, and the carriages were left, for an examination of the ruins of the old Castle. The remains, however, are too slight to afford much idea, except to experienced archæologists, of the original appearance of the fortress, and the lichens and mosses proved of greater interest than the walls on which they grew. Amongst the *débris* the Hemlock (*Conium maculatum*) was growing luxuriantly, and in the clefts and crevices of the walls the Navelwort (*Cotyledon umbilicus*) and Wall Pellitory (*Parietaria officinalis*), a species of nettle, contrived to exist, despite the scorching sun. In pulling out some roots of the former plant, two good specimens of the elegant Circle Shell (*Cyclostoma elegans*), and one of Helix Aspersa (var. *scalaris*), were procured.

After leaving Dinaspowis, the fearfully sun-beaten road to Barry Island presented but few features of interest. The Entomologists certainly saw, but in most cases had to be content with seeing, numbers of the *Vanessidæ* (*V. Io. Atalanta Urticæ*, *C. Cardui*, and one *Grapta*, *C. album*), displaying their richly-coloured wings on the bramble sprays of the hedgerows. Some of the Polyommati, too, and the Small Copper (*C. phlæas*) were fluttering everywhere; and one specimen of the Marbled White (*Arge galathea*) was captured by Mr. Rhys Jones—proving that Barry, as well as Penarth, may be considered a locality for this pretty butterfly. The same gentleman also obtained a fine Oak-egger Moth (*L. quercus*), flying, butterfly-like, in the sun.

The Teazel (*Dipsacus silvestris*) and several species of Thistle (*Carduus acanthoides*, *C. Marianus*, *Cnicus arvensis*, and its dwarf variety *C. acaulis*) appeared here in great profusion. Cudweeds (*Gnaphalia*) and Knapweeds (*Centaurea*) were also noticed. Boats were in readiness to ferry the party across from the mainland, and the Island was reached at about two o'clock. The members at once dispersed: some to bathe in the cool clear sea; some to collect specimens. Dinner, however, soon brought all together, and justice was done to the good things provided. Immediately afterwards, at the call of the President, the party rose and followed him to the rising ground of the Island, where, seated on a hillock, and with the Ordnance Geological Map spread out before him, Charles Moore, Esq., F.G.S., delivered an interesting and valuable Lecture on the Geology of the district.*

A cordial vote of thanks was passed to Mr. Moore for his Paper, and a discussion on points connected with the Rhœtic beds then ensued between him and the President, Mr. Adams, Mr. Bassett, and Professor Gagliardi. Soon, however, all dispersed for further research after Flora and Fauna. The first greeting the Botanists gave was to a fine but very dwarf species of wild Thyme (*Thymus serpillum*), whose thin trailing branches were lying along the half-parched ground; then came the pretty little red-fruited Rose (*Rosa rubella*), which was there very abundant: its flowers had passed away, but a few round hips were still hanging on its stems, which latter were generally overcharged with a beautiful crimson bedguard—the work of some hymenopterous or cynipterous insect like the common "Rhodites, rosæ." Swordshaped leaves of the yellow water Iris (*Iris pseud-acorus*

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* Mr. Moore's Paper could not be got ready for this Volume of Transactions, but will be included in that for next year.

or fleur-de-luce) were abundant in several parts of the Island, some beautifully variegated, and several in fruit. The Hound's Tongue (*Cynoglossum officinale*) had nearly finished flowering. The Yellow-wort (*Chlora perfoliata*) was growing in profusion at the S.E. of the Island ; and on the rocks within reach of the salt spray were seen the succulent leaflets and yellow flowers of the Samphire (*Crithmum maritimum*), for centuries held in so high esteem as a condiment. Shakespeare, with his univeral knowledge, well knew this plant, and all will remember the oft-quoted passage in "King Lear" (act iv. scene 6.):—

> "The crows and choughs that wing the midway air,
> Shew scarce so gross as beetles. Half way down
> Hangs one that gathers samphire ; dreadful trade !"

Samphire gathering would, however, be no very dangerous occupation at Barry, for the rocks are low and not especially steep and the plants tolerably abundant, though not nearly so much so as on the Holmes or the rocks at Swanbridge and Porthkerry.

One of the party gathered some deep green tufts of slender leaves which were thought to be those of the rather rare Maiden Pink (*Dianthus deltoides*), and Mr. Adams, the President, had a bunch of Wood Germander (*Teucrium scorodonia*) and Elecampane (*Inula Helenium.*)

The Marsh Ragwort (*Senecio aquaticus*) and a very small kind of Bedstraw (*Galium verum*) may also be noticed as denizens of the Isle of Barry. The yellow tufts of this last mingled with a few sprigs of the Wild Thyme and some pale crimson blooms of the Vetchling (*Lathyrus Nissolia*), which Dr. Milward had got hold of, formed a nosegay which might have vied with the best bouquet of the season.

Enough, however, as to the Flora,—the Fauna were very poorly represented, for nothing was obtained beyond a few Zoophytes, (*Actinia mes.* and *Bunodes crassicornis*) and some of the commoner molluscs. Insects of all sorts were scarce ; and search was made in vain for another specimen of the rare Beetle (*Nebria complanata*), which Dr. Taylor had some months before been fortunate enough to capture on the Island.

The Geologists, headed by Mr. Moore, of course found plenty to interest them, and many good fossil specimens were obtained.

Dusk coming on, the party re-assembled at Barry house (which had been kindly placed at their disposal by Mr. R. F. L. Jenner), for further refreshment in the shape of tea, and soon afterwards started for Cardiff, much pleased with the day's proceedings.

The members and visitors present at this interesting meeting were : the President, W. Adams, F.G.S.; the Vice-President, Dr. Taylor ; the Honorary Secretary, Mr. R. Rhys Jones ; the Revs. J. Havard Protheroe, M.A., Vincent Saulez, J. Rees Jenkins, and Prof. Gagliardi ; Messrs. C. Moore, F.G.S., Alexander Bassett, C.E., J. Milward, V. Aubertin, LL.D., J. Tomlinson, J. Morgan, P. Price, P. S. Robinson, W. Jenkins, G. F. Thomas, C.E., J. Williams, D. O'B. Gavin, W. P. James, and W. Barber.

RAINFALL RECORDED IN CARDIFF AND NEIGHBOURHOOD.

1867-8,

	Latitude.	Longitude.
Cardiff Town Hall	51° 28′ 50″	3° 10′ 35″
Mr. F. G. Evans, F.M.S., Ty-nant, Pentyrch ..	51° 31′ 55″	3° 15′ 20″

HEIGHT OF RECEIVER OF RAIN GAUGES.

	Mr. T. Waring, Cardiff Town Hall.			Mr. T. G. South. Ely Water Works.			Mr. T. G. South. Lisvane Water Works.			Mr. F. G. Evans, Ty-nant, Pentyrch.		
		ft.	in.		ft.	in.		ft.	in.		ft.	in.
Above surface of Ground	About	1	1	About	4	0	About	2	0	About	1	0
Above Sea level	„	20	0	„	45	0	„	142	0	„	100	0

	Mr. Waring. Cardiff, Town Hall.				Mr. T. G. South, Ely.				Mr. T. G. South, Lisvane.				Mr. F. G. Evans. Ty-nant.			
	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01 or more fell.
		Depth	Date.			Depth	Date.			Depth	Date.			Depth	Date.	
1867.																
September	1·73	·62	6th	16	2·11	·37	5th	12	2·04	·37	7th	18	3·16	·40	7th	17
October	4·70	·45	17th	22	5·86	·73	19th	23	4·15	·41	22nd	25	6·89	·73	28th	27
November..	1·99	1·25	30th	7	1·61	·88	30th	5	0.99	·50	15th	6	2·49	1·56	30th	8
December..	1·69	·5	1st	14	2·41	1·18	1st	12	3·38	1·37	1st	15	2·9	·52	1st	18
1868.																
January	5·69	1·21	10th	18	5·43	1·43	11th	15	5·05	1·28	11th	19	6·61	1·15	10th	24
February	2·17	·76	2nd	13	2·50	·95	29th	14	2·04	·65	3rd	17	2·96	·75	2nd	18
March	2·64	·5	12th	15	2·65	·48	13th	16	2·42	·53	8th	16	4·12	·78	7th	21
April	2·48	·7	20th	12	2·20	·73	21st	8	2·43	·68	21st	12	2·80	·78	20th	15
May	1·79	·49	27th	9	2·07	·39	23rd	11	1·61	·31	10th & 20th	9	2·51	·79	11th	11
June	0·47	·38	21st	2	0·39	·33	22nd	2	0·30	·26	22nd	4	0·58	·38	21st	6
July	0·38	·23	28th	5	0·34	·31	29th	3	0·22	·06	27th	3	0·37	·21	28th	7
August	5·96	1·4	18th	12	5·70	1·50	22nd	13	5·40	1·02	22nd	19	5·60	1·02	21st	21
Totals	31·69	..	..	145	33·27	..	..	134	30·03	..	..	162	40·99	..	..	193

BAROMETRICAL OBSERVATIONS MADE

	At Tynant, Pentyrch, by Mr. F. G. Evans, F.M.S.						At Tredegarville, Cardiff, by Mr. William Adams.				
	Monthly Mean.	Highest Reading at 9 a.m.		Lowest Reading at 9 a.m.		Mean Temperature.	Monthly Mean.	Highest Reading at 9 a.m.		Lowest Reading at 9. a.m.	
	Inches.	Date.	Inches.	Date.	Inches.	Degrees.	Inches.	Date.	Inches.	Date.	Inches.
1867.											
September	30·16	29th	30·26	8th	29·78	57·2	30·369	25th	30·518	6th	29·690
October	30·01	1st	30·56	27th	29·45	50·7	30·238	1st	30·472	27th	29·406
November	30·37	24th	30·71	15th	29·64	41·9	30·273	8th	30·592	15th	29·566
December	30·12	4th & 27th	30·42	1st	29·25	39·7	30·010	31st	30·294	1st	29·160
1868.											
January	29·94	29th	30·35	22nd	29·03	38·7	29·870	29th	30·268	19th	28·994
February	30·19	10th	30·62	1st	29·37	41·2	30·121	10th	30·562	1st	29·318
March	30·06	29th	30·65	11th	29·25	45·5	29·976	29th	30·562	11th	29·194
April	30·01	1st & 2nd	30·48	20th	28·93	48·8	29·939	15th	30·450	20th	28·948
May	30·06	14th	30·36	23rd	29·55	56·7	29·985	14th	30·298	23rd	29·400
June	30·25	29th	30·47	22nd	29·74	60·6*	30·191	24th	30·500	22nd	29·628
July	30·19	24th	30·50	29th	29·81	66·6	30·115	22nd	30·500	29th	29·650
August	29·98	1st	30·40	22nd	29·32	62·3	29·915	1st	30·366	22nd	29·224
Yearly Mean	30·11	Nov. 24th	30·71	April 20th	28·93	..	30·083	Nov. 8th	30·592	April 20th	28·948

* *This is nearly 5 degrees higher than the average heat of July for the last 50 years, as determined by* Mr. Glaisher.

RAIN FALL *registered by* Evan David, *of Fairwater, near Cardiff, Glamorganshire, in the following years:*

1824.	1825.	1826.	1827.	1828.	1829.	1830.	1831.	1832.	1833.	1834.	1835.	1836.	1837.	1838.	1839.	1840.	1841.	1842.	1843.
inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches
53·80	38·50	30·25	49·40	51·80	44·65	44·30	50·85	40·70	51·45	37·10	45·80	48·80	55·15	40·50	61·40	41·10	56·60	45·40	36·70

	inches.
Total for 20 years	924·25
Average annually	46·21

Quantity of Rain which fell in each Month during the 20 *Years ending* 1843, *registered by* Evan David, *of Fairwater.*

	January.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Totals.
	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.
Total.............	66·75	78·25	63·5	52·15	45·95	63·95	73·95	79·55	92·35	95·45	116·55	96·30	924·25
Average per month..	3·33	3·91	3·15	2·60	2·29	3·19	3·69	3·97	4·61	4·77	5·82	4·81	46·21

Dr. The Treasurer in Account with the Cardiff Naturalists' Society, for the year ending September, 1868. *Cr.*

	£ s. d.
To Subscriptions:	
,, 1 Life Member	3 3 0
,, 42 Annual Members	10 10 0
Balance	1 8 11
	£15 1 11
Subscriptions outstanding,—8 Members...	£2 0 0
	£2 0 0

T. G. SOUTH, Treasurer.

		£ s. d.
By Printing and Stationery:		
,, Lewis and Williams ...	1 5 0	
,, Ditto do. ...	1 12 6	
,, Guardian Company ...	2 1 8	
,, Duncan (Cardiff Times) ...	0 18 0	
,, Account Book	0 0 6	
		5 17 8
,, Messenger for delivering Circulars ...		0 5 0
,, P. S. Robinson, Hon. Sec.: Disbursements		1 8 6
,, Expenses in connection with Barry Field Meeting		2 4 6
,, P. S. Robinson, Hon Sec.—Testimonial		5 0 0
,, Sundries		0 6 3
		£15 1 11
Due Treasurer		£1 8 11
Balance to Credit of Society		0 11 1
		£2 0 0

CARDIFF NATURALISTS' SOCIETY.

REPORT & TRANSACTIONS.

1868-9.

CARDIFF NATURALISTS' SOCIETY.

REPORT & TRANSACTIONS.

VOL. II.

1868-9.

HERTFORD:
PRINTED BY STEPHEN AUSTIN, FORE STREET.

MDCCCLXX.

CARDIFF NATURALISTS' SOCIETY.

ESTABLISHED 1867.

OFFICERS, 1868-9.

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WILLIAM ADAMS, F.G.S.

Vice-Presidents.

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THOMAS GEORGE SOUTH, C.E.

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CARDIFF NATURALISTS' SOCIETY,

1868-9.

HONORARY MEMBERS.

Professor H. T. Stainton, F.R.S., Mountsfield, Lewisham. S.E.
Colonel E. R. Wood, F.A.S., F.G.S., Stouthall, near Swansea.
The Most Honourable the Marquess of Bute, Cardiff Castle.

MEMBERS.

NOTE.—*Those marked* (O) *were the original promoters of the Society.*

Adams, W., C.E., F.G.S., Cardiff . . . . O
Adams, G. F., Cardiff . O
Aubertin, V., LL.D., Cardiff O
Alexander, W., Cardiff . 1869
Adams, Miss E. M., Cardiff 1869
Adams, Miss A. M., Cardiff 1869
Armstrong, F. W., Cardiff. 1869
Angel, W., Cardiff . . 1869
Alexander, R., Cardiff . 1869
Bute, Marquess of . Patron
Brown, T. F., C.E., F.G.S., Cardiff 1868
Bassett, A., C.E., Llandaff. 1868
Bedford, Captain E. J., R.N., Cardiff 1868
Bell, F., Cardiff . . . O
Bell, J., Cardiff . . . O
Bell, R., Cardiff . . . O
Bird, G., Cardiff. . . 1869
Bird, Miss, Cardiff . . 1869
Buist, J. J., M.D., Cardiff . 1868
Bush, J., Cardiff . . O
Brown, E., M.R.C.S., Mountain Ash. . . . 1868
Bedlington, R., Aberdare . 1868
Birbeck, G., Tondu, Bridgend 1868
Billups, J. E., Cardiff. . 1868
Bland, J., Jun., Sully. . 1868
Biggs, R., Cardiff . . 1869
Biggs, J., Jun., Cardiff . 1869
Bird, J., Cardiff. . . 1869
Boyle, Captain J., R.A., Llandaff. . . . 1869
Boyle, R. W., Cardiff. . 1869
Burnett, W., Cardiff . . 1869
Bush, Mrs., Cardiff . . 1869
Bradley, C., Cardiff . . 1869
Badge, Dr. Noto., Cardiff . 1869
Barrow, J., Maesteg . . 1869
Briscoe, W., Cardiff . . 1869
Brogden, J., Tondu, Bridgend 1869
Brewer, J. W., Cardiff . 1869
Boulanger, Geo., Cardiff . 1869
Boulanger, Mrs. A., Cardiff 1869
Blake, R. A., Cardiff . . 1869
Blessley, W. D., Cardiff . 1869
Carne, J. W. N., D.C.L., St. Donatt's Castle . . 1868
Cox, J., Cardiff . . . 1868
Coe, J. D., Cardiff . . 1869
Claudy, E., Cardiff . . 1869
Cowell, J., Cardiff . . 1869
Cory, J., Cardiff. . . 1869
Cory, R., Jun., Cardiff . 1869
Cross, T., Cardiff . . 1869
Cross, E., Cardiff . . 1869
Davie, W., Cardiff . . O
Dawson, E., Cardiff . . 1868
Deacon, H., Cardiff . . 1868
Duncan, J., Cardiff . . 1868
Drane, R., Cardiff . . O
Downing, E. C., Cardiff . 1868
Duncan, D., Jun., Cardiff . 1869
Davis, L., Cardiff . . 1869
Dalziel, A., Penarth . . 1869
Dyke, T. J., M.R.C.S., Merthyr Tydfil . . . 1869
Davies, D. W., Cardiff . 1869
Davies, W., Penarth . . 1869
Davies, D. H., Eglws Brewis 1869
Daniels, B., Cardiff . . 1869

Evans, E. H., M.R.C.S., Cardiff 1868
Evens, W., Bristol . . 1868
Evens, T., Wyrfa, Aberdare 1868
Evans, H. J., Cardiff . . 1868
Edwards, W. T., M.D., Cardiff 1869
Evans, J. H., Pengam . 1869
Edwards, F., Cardiff . . 1869
Evans, F. G., M.R.C.S., Ty Nant, Radyr . . . 1869
Emery, H. C., Cardiff . 1869
Elliott, H., Cardiff . . 1869
Evans, W. H., Pengam . 1869
Elliott, J., Jun., Cardiff . 1869
Evans, Mrs., Ty Nant, Radyr 1869
Fisher, H., Cardiff . . 1869
Fiddian, A. P., Cardiff . 1869
Freeman, W. S., Cardiff . 1869
Fraser, J., Cardiff . . 1869
Fedden, N., Cardiff . . 1869
Flint, J. N., Cardiff . . 1869
Gagliardi, Rev. Professor J., Ratcliffe Coll., Leicester. 1867
Gooch, H., Cardiff . . O
Griffith, R. W., B.A., Llandaff . . . . . O
Green, Rev. E. A., M.A., Cardiff 1868
Gavin, D. O. B., Cardiff . 1869
George, W., Ely . . 1869
Glass, T. G., Cardiff . . 1869
Gerhold, J. M., Cardiff . 1869
Gunter, J., Cardiff . . 1869
Gunter, Mrs., Cardiff. . 1869
Goodchaux, H., Cardiff . 1869
Guerit, L., Cardiff . . 1869
Griffiths, W., Cardiff. . 1869
Hemmingway, J., Macclesfield 1868
Holst, J., Cardiff . . 1868
Hybart, J., Cardiff . . O
Harrison, C., Cardiff . . 1868
Howells, E., Cardiff . . 1868
Hooper, J. A., Cardiff . 1868
Hill, E. S., Llandaff . . 1869
Hopkins, Miss E., Cardiff . 1869
Hopkins, Miss S., Cardiff . 1869
Hopkins, Miss N., Cardiff. 1869
Hopkins, F. H., Cardiff . 1869
Hullett, A., Cardiff . . 1869
Hooper, T., Cardiff . . 1869
Hollier, J. S., Cardiff. . 1869
Howells, J., Blackwood, Newport, Mon. . . 1869
Harvey, W. R., Cardiff . 1869
Harris, W. H., Cardiff . 1869
Hacquoil, J., Cardiff . . 1869
Harwood, P. C., Cardiff . 1869
Hughes, W. C., Cardiff . 1869
James, W. P., Cardiff . 1868
Jenkins, W., Cardiff . . 1868
Jenkins, Rev. J. R., M.A., Cwmbrân, Newport, Mon. 1868
John, E., Llantrissant . O
Jones, R. R., Cardiff . . O
Jotham, T. W., Cardiff . O
Joseph, R., Ely Rise . . 1868
Jones, D. W., Cardiff . 1869
Jacob, J., Cwmbrân, Newport 1869
Jones, J., Cardiff . . 1869
Ince, F., Cardiff. . . 1869
Joy, F. W., Cardiff . . 1869
Insole, J. H., Cardiff. . 1869
Insole, J. W., Cardiff . 1869
Jefferies, H., Pentyrch . 1869
Jones, Rev. E., Cardiff . 1869
Kernick, S. P., Cardiff . 1868
Kernick, R. P., Cardiff . 1869
Lawrence, A. Cardiff. . 1868
Lean, J., Cardiff . . 1868
Llewellyn, G. Y., Cardiff . 1868
Lewis, W. T., C.E., F.G.S., Aberdare . . . 1868
Lewis, L. T., C E., F.G.S., Aberdare . . . 1868
Lucas, C., Cardiff . . 1868
Luard, W. C., Llandaff . 1868
Linden, A., Cardiff . . 1869
Llewellin, D., C.E., F.G.S., Pontypool . . . 1869
Langley, R. F., Cardiff . 1869
Le Boulanger, J. A., Cardiff 1869
Lamb, J. G., Cardiff. . 1869
Lundie, G., Cardiff . . 1869
Millward, J., M.R.C.S., Cardiff 1868
Morgan, J., Cardiff . . O
Morgan, Rev. D. P., Cardiff 1868
Morgan, Rev. W. L., M.A., Pengam 1868
Maconnochie, John, C.E., Cardiff 1868
Menelaus, W., Dowlais . 1868
Mitchell, A., Cardiff . . 1869
Morgan, Miss, Cardiff . 1869

Morris, J. A., Plymouth, Merthyr Tydfil . . 1869
Matthews, D., Cardiff . 1869
Morgan, F. H., Cardiff . 1869
Marks, N. D., Cardiff . 1869
Nicholl, R. J., Cardiff . 1869
Napier, W., Cardiff . . 1869
Napier, Mrs., Cardiff . . 1869
Nance, H., Cardiff . . 1869
Nixon, T., Cardiff . . 1869
Oliver, J. C., Cardiff . . 1868
Ormiston, Geo., Cardiff . 1869
Phillips, W., Cardiff . . 1869
Paine, H. J., M.D., Cardiff 1868
Penn, G. W., Cardiff . . 1868
Price, P., Cardiff . . O
Primavesi, H., Cardiff . 1868
Primavesi, F., Cardiff . 1868
Protheroe, Rev. J. H., M.A., Cardiff 1868
Phipps, W., Cardiff . . 1868
Payne, E., Cardiff . . 1868
Price, P., Cardiff . . 1869
Parry, R. W., Jun., Cardiff 1869
Parkyn, J., Cardiff . . 1869
Pratt, Mrs. M. A., Cardiff. 1869
Parfitt, G., Cardiff . . 1869
Peake, W., Cardiff . . 1869
Phillips, Griffith, Dinas Powis 1869
Riley, W., Penarth . . O
Riley, Mrs. M., Penarth . 1869
Roberts, W., Cardiff . . 1869
Roper, R. S., F.G.S., Newport, Mon. . . . 1869
Rees, J., Cardiff. . . 1869
Rowland, J., Bedwas . . 1869
Snell, C., Cardiff . . 1867
South, T. G., C.E., Cardiff. O
Stephenson, W. P., Cardiff 1868
Spencer, R. E., Llandough . 1868
Scott, P. B., Cardiff . . 1868
Swabey, W. O., Tondu, Bridgend . . . 1868
Saulez, Rev. V., Cardiff . 1868
Spiridion, W., Cardiff . 1868
Sankey, C., Cardiff . . 1869
Sankey, J., Cardiff . . 1869
Strawson, G. W., London . 1869
Stow, A. S. F., Cardiff . 1869
Stevens, A., Cardiff . . 1869
Sankey, Mrs. J., Cardiff . 1869
Solomons, S., Cardiff . . 1869
Spiridion, J., Cardiff . . 1869
Sloper, J., Cardiff . . 1869
Taylor, W., M.D., Cardiff . O
Thomas, G. F., Cardiff . O
Thomas, W., Aberdare . 1868
Tomlinson, J., Cardiff . O
Truscott, C., Jun., St. Austle, Cornwall . . . 1868
Thompson, G. C., Preswylfa, Cardiff 1868
Thompson, C., Preswylfa, Cardiff 1868
Thomas, J. D., Cardiff . 1868
Taylor, Mrs. W., Cardiff . 1869
Thomas, A. D., Cardiff . 1869
Thomas, W., Cardiff . . 1869
Thomas, D. L., Cardiff . 1869
Taylor, J. P., Cardiff . . 1869
Thomas, A., Cardiff . . 1869
Vivian, W., Llantrissant . 1868
Vachell, E., Cardiff . . 1869
Vachell, W., Cardiff . . 1869
Vaughan, W. E., Cardiff . 1869
Waldron, C., Llandaff . 1868
Waller, T. J., Cardiff . . 1868
Wightman, J. T., Pontypool 1868
Whyte, P., Cardiff . . 1868
Williams, E. J., Pengam, Newport, Mon. . . 1868
Williams, J., Cardiff . . 1868
Watkins, W. B., Cardiff . 1868
Williams, L., Cardiff . . 1868
Williams, J., Cardiff . . 1868
Williams, T. R., Merthyr . 1869
Wilson, J. H., Cardiff . . 1869
Waite, Rev. J., Cardiff . 1869
Webber, T., Cardiff . . 1869
Williams, J., Cardiff . . 1869
Williames, C. F., Cardiff . 1869
Watson, D., Cardiff . . 1869
Waring, T., C.E., Cardiff . 1869
Williams, T., Cardiff . . 1869
Wrenn, H., Cardiff . . 1869
Wills, G., Cardiff . . 1869
Yellowlees, Dr., Bridgend . 1869
Yorath, T. V., Cardiff . 1869

CARDIFF NATURALISTS' SOCIETY.

RULES.

1.—That this Society be called the "CARDIFF NATURALISTS' SOCIETY," to consist of Subscribing and Honorary Members.

2.—That Ladies be eligible as Members.

3.—That its objects be the practical study of Natural History, Geology, and the Physical Sciences, and the formation of a Museum in connection with the Free Library.

4.—That the Society be managed by a Committee, consisting of a President, Vice-Presidents, Treasurer, and Honorary Secretary, and Twelve other Members of the Society; and that in Committee Meetings Three form a *quorum.*

5.—That the Annual Meeting be held in the month of January, at which the Committee and Officers be elected for the following year by Ballot.

6.—That the General Meetings be held on the First Tuesday of every month, in the Museum Room of the Free Library, commencing at Eight o'clock p.m. Committee Meetings at the same hour on the Third Tuesday of every month.

7.—That all Candidates for Membership shall be proposed and seconded by existing Members, either verbally or in writing, at any meeting of the Society, and shall be eligible to be Balloted for at the next meeting, provided there be Five Members present. One black ball in Three to exclude.

8.—That the Annual Subscription be Five Shillings, payable in advance to the Secretary on the 1st of January each year. Members may commute the Annual Subscription into one payment of Three Guineas.

9.—That Specimens collected by the Society shall be deposited in the CARDIFF MUSEUM, and shall become the property of the CORPORATION OF CARDIFF.

Resolved,—"That strangers be invited to attend the Meetings of the Society, and to exhibit any Curiosities or Collections which may be in their possession."

REPORT.

The Committee have much pleasure in presenting their Second Report of the Transactions of this Society for the period ending 31st December, 1869.

Since the establishment of the Society, in September, 1867, the interest felt in its welfare by the Public generally has been much increased, and it is with gratification your Committee have to report to you, that on the 31st December last the number of Members amounted to 244.

In November, 1868, a Conversazione was held at the Town Hall, when the various Fossils and other interesting objects of Natural History were exhibited gratuitously to the Public. There was also a varied display of microscopes and microscopic objects, which excited great interest. The Meeting was well attended, and although the Society had been established but fourteen months, the number of specimens offered for inspection was more than sufficient to fill the Assembly Room, and much regret was expressed that no proper accommodation could be afforded to the Public for the daily inspection of the articles exhibited, in consequence of the town not possessing a building adequate for that purpose.

During the past season papers on the following subjects have been read by Members, viz. :—

1869. Jan. 4th.—A Paper on the application of the Microscope to the study of Mineralogy and

Metallurgy, by Mr. William Vivian, of Mwyndy, Llantrissant. Illustrated by several very beautiful mineral and metallic specimens.

March 1st.—A Paper by Mr. G. C. Thompson (read by the Hon. Sec.), on Notes and Suggestions on the Objects of the Society.

May 3rd.—A Paper by the President, William Adams, Esq., F.G.S., on the Formation and Progress of the Society.

July 6th.—A Paper by Mr. Vivian, Mwyndy, (read by the President), on "Ancient Copper"; and also a Paper on "Birds' Nests," by Mr. Vivian, showing peculiar characteristics.

Aug. 10th.—A Paper on "Silkworms," by Mr. Vivian.

Oct. 6th.—A Paper on "Intelligence and Intellect" (read by Mr. F. G. Evans), by Dr. Taylor.

Oct. 6th.—Mr. Edmund Brown, M.R.C.S., exhibited some Interesting Experiments with the Galvanic Battery and Induction Coil, and Introduced the Electric Light.

LECTURES.

1869. Feb. 1st.—By Charles Moore, Esq., F.G.S., on the "Ancient Natural History of the Earth." Illustrated by some excellent diagrams of the stratification of the rocks, and very valuable and rare specimens of Fossil Fish.

A paper of great value and local interest by Mr. Moore, F.G.S., &c., is in a forward state of preparation, but its completion for this volume has unfortunately been prevented by a serious attack of illness under which that gentleman has laboured.

April 5th.—By the Rev. J. T. Campbell Gullan, on "The Ant, its habits and its teachings"; with pictorial illustrations.

Dec. 1st.—By Edmund Wheeler, Esq., F.R.M.S., on "The Curiosities of Insect Life"; the second part.

FIELD DAYS.

1869. June 22nd.—At the Cefn On Tunnel of the Cardiff and Caerphilly Railway, with a visit to the "Van," and to the Ruins of Caerphilly Castle, where appropriate extracts from Mr. G. T. Clarke's Works were read by Charles Luard, Esq., relating to the ancient state of the Castle.

July 20th.—At Southerndown, with a visit to the Ruins of Ewenny Abbey, and the Church of St. Bride's Major, in the beautiful valley of the Ogmore; and an inspection of Dunraven Castle and Grounds, by kind permission of the Dowager Countess of Dunraven. A Lecture was given on the beach by T. Rupert Jones, Esq., F.G.S., on "The Primeval Rivers of Britain"; also, a Paper by F. G. Evans, Esq., M.R.C.S., F.M.S., &c., on some silicious stones found in the Coal Measures, and on a white fatty substance, found in the Cardiff Moors, during a recent excavation.

Aug. 31st.—At Caerleon, with a visit to the Parish Church of St. Melans, and St. Woollos Church, Newport. The antiquarian remains in the Town of Caerleon and the local Museum were examined, and the party was kindly conducted to the principal points of interest by J. Edward Lee, Esq., F.G.S., &c., of the Priory. A Paper was read by the Rev. W. Leigh Morgan, M.A., on "Geology and Scripture." A vote of thanks was unanimously passed to Mr. Lee for his very kind and cordial reception of the Society.

ADDITIONS TO THE MUSEUM, 1868 & 1869.

A Collection of British Birds' Eggs, and of Lepidoptera and Coleoptera. Presented by Mr. E. J. Williams.

A Skull of a Fox (*Cânis Vulpes*). Presented by Mr. John Williams.

A Centipede from Bombay, taken alive on board a ship in Bristol. Presented by Mr. Horatio Hooper.

Snakes from the East Indies. Presented by Mr. H. Hooper.

Portion of a Ship's Stern, perforated with the borings of the Shipworm (*Teredo Navalis*). Presented by Mr. H. Hooper.

A Male Otter (*Lutra Vulgaris*), taken in the river Ely. Presented by Mr. T. G. South.

A Jay (*Garrulus glandarius*), shot at Sully; and a Sparrow-Hawk (*Accipiter Nisus*), also shot at Sully. Presented by Mr. J. Bland, Jun.

Ammonite, from the Lias Bed at Knowle, near Bristol. Presented by Mr. H. Hooper.

A Heron (*Ardea cinerea*), caught at Ely. Presented by Mr. Gooch.

A Cube of Stone, from the New Red Sandstone Bed at Bridgend. Presented by Mr. J. E. Billups.

Ditto Penant, from Pontypridd. Ditto.

A Nest of the Long-tailed Tit (*Parus caudatus*), containing three eggs. Presented by Mr. E. J. Williams.

Two Stones, found in the No. 3 seam of Coal in the Rhondda Valley, from the Great Western Colliery. Presented by Mr. E. H. Thomas.

A Series of Mosses, 68 in number, gathered between the Rivers Rhymney and Llynvi, by Professor J. Gagliardi.

A curious specimen of the growth of a Potato, a portion of which had become enclosed in a Lemon; the latter being fossilized. Presented by Mr. J. Williams, Stationer.

A Silver Coin, reign of Queen Elizabeth, found during alterations in Gelly Gaer Church. Presented by Mr. E. J. Williams.

A Case of Stuffed Birds. Presented by Mr. Cording.

The Skeleton of an Owl. Presented by Mr. Ed. Baugh.

The Blade of a Sawfish and some Fossils. Presented by Mr. R. Griffiths.

An Australian Heron. Presented by Mr. Bush.

WILLIAM ADAMS, *President.*

THOS. G. SOUTH, *Hon. Secretary.*

TRANSACTIONS,

1868-9.

A meeting of the Society was held at the Town Hall on Monday, January the 4th, 1869.

The President, Mr. ADAMS, in the Chair.

TWENTY new members were elected. Dr. Paine was appointed Vice-President; and Captain Bedford and Messrs. C. Lucas, G. C. Thompson, Robert Bell, and T. J. Waller were placed upon the Committee, to fill up vacancies existing. The Hon. Secretary to the Society, Mr. R. Rhys Jones, being about to leave Cardiff for a few months, Mr. South volunteered and was accepted to fill his place during his absence. An excellent paper was then read by Mr. Vivian, and listened to with attention by the meeting. Microscopic objects, illustrative of the paper, were exhibited to the members.

MR. VIVIAN'S PAPER.

THE APPLICATION OF THE MICROSCOPE TO THE STUDY OF MINERALOGY AND METALLURGY.

Although the subject which I propose to bring before you to-night is one which might well be treated in connection with the study of the physical sciences, I hope to be able to treat it in a manner that shall not altogether be unsuitable to the objects of this Society. In the study of nature we have two objects in view—namely, the knowledge of the beautiful and useful. Everywhere in the material world these two seem to be intimately blended, so united that it may indeed be doubted whether, at the Creation, these distinctions existed at all. Undoubtedly, when, at the end of the six days' work, the Divine Author pronounced everything that he had made to be "very good"—good in itself, and good in relation to every other thing—that verdict included all that we now understand by the words "beauty" and "utility." "Replenish the earth and subdue it," said God; and an ever-expanding intelligence, with the constantly-recurring wants of our existence, urge us to obey the Divine injunction—to explore for beauty, and to appropriate for utility all that is within our reach, or can be made available for the future. It seems to be a wise arrangement that the ideal and practical should be inseparable, for by it the explorer is refreshed in his arduous toils, and is ever allured on in advance by the exquisite pleasure which is thus afforded him. The thought may sometimes cross the mind that there is not now much new to be explored—that the field of nature has been well cultivated and exhausted. Is it? Nay; on the contrary, it is scarcely yet entered upon in comparison with what lies in the unexplored beyond us. The world teems with new objects of beauty and interest, and all that is needed is, that we explore for ourselves, and we shall be sure to find them. In this respect it is one open, unsullied Paradise, where no forbidding angel, with flaming sword, keeps the gate. I do not refer to any particular spot on the world's map, or the gems which are collected and are treasured up in the cabinets and caskets of the wealthy, but to the innumerable objects of beauty which are sown broadcast over nature—around, above, below—even in the arid desert, in the depths of the mighty ocean, and down in the dark recesses of the mine. We may sometimes have thought the glowing imagery of the poet to be fanciful when he sang—

> "Full many a gem of purest ray serene
> The dark unfathomed caves of ocean bear."

But the truth is, that in his most ecstatic vision he could only have had imperfect glimpses of the glorious reality which his lines indicated. In the study of any department of natural history, then, it is essential that the love of the beautiful be cherished and cultivated. As men's ideas may sometimes differ as to what is really beautiful, it is not always easy to define it so as to suit the tastes of all; but in the beautiful everywhere there seems to be these two great divisions, namely, form and colour, and these two, so varied, are so arranged that the object appeals to our senses and impresses the mind with a feeling of delight and pleasure. It is a curious and interesting inquiry in philosophy, how that one object should thus impress one individual with pleasurable feelings and produce no response in the heart of another. What then is the secret chord of sympathy between the external and internal—the material and intellectual? Our perception and appreciation of the beautiful may, probably, depend to some extent upon our mental constitutions inherited from our parents, the first unfoldings of which are seen in the crowing of delight of a child as he sees the gorgeous colours of the delicately formed flower; but this faculty is expanded infinitely by education, and this education may be carried on, amid all the cares and anxieties of life, from its fresh morning dawn down to the quiet evening of shadowy age. Like the eye of the night bird, the faculty will dilate by practice, to catch the minutest emanations of beauty which flicker before the vision in any part of the universe of God. This education consists mainly in cultivating for ourselves habits of observation, rather than in leaning upon the assistance of others. Of course, we should not ignore the helps which may be obtained from the study of the works of the mighty dead as well as the living. The Greeks and other nations of antiquity have left monuments of excellence that may aid us in the study of the beautiful in art, but in the pursuit of the beautiful in nature there is not much definite knowledge left us. We look to them in vain for waymarks to guide us far into the regions of nature. This, however, need not be regretted. To succeed well, we should not be careful to follow the footsteps of any one in nature. It is sometimes amusing to see people of wealth taking a hand-book and going over to exhaust the beauties of the Continent in a summer's tour. They never think of searching for themselves other than the things specified for them. Our path should rather be into the dark recesses of the unexplored. Take what helps we can, as the traveller would take his staff and accoutrements to assist him to penetrate the unknown. One of the most valuable helps afforded us in the study of nature is the microscope; indeed, in this study it is beyond value, and we may well congratulate ourselves that we possess such a boon. This instrument we owe to the united labours of ardent votaries of science through the long period of two hundred years, so that here, as in the moral world, the words of our Saviour are verified:—"Other men have laboured, and ye have entered into their labours." By the aid of the microscope we are enabled to reach the details of an object, of which we should otherwise be totally ignorant, and by it the material world is practically enlarged for study a hundred or a thousand times. It will not be my province to dwell on the revelations which the microscope makes in the departments of animal and vegetable physiology—the varied combinations of tissue and cell which exist; but I will now proceed to that department of nature in which I am most interested, namely, the inorganic, hoping to excite or cherish a desire to explore the vast fields of mineralogy and metallurgy which in this district there are such good opportunities and facilities for doing. You will remember that by working with the microscope you will be able to deal with nature in very concentrated and portable forms. A cabinet no larger than a lady's workbox may blaze with beauty, and may contain vivid illustrations of the ever active laws of the universe. In the choice of an instrument, while guided somewhat by the nature of your intended studies, you should aim to have a good one. This is most desirable. A small low-priced one may reveal wonders to the inexperienced eye, but after all it will come to be regarded rather as a toy than adapted to serious work. A good instrument cannot be had for much less than £12, and for the study of inorganic forms it should be as simple as possible in its construction; expensive accompaniments are not necessary; but it should be strong, simple, and steady in its mechanical parts, and fitted with the best made English glasses, with a polariscope for transparent objects. For nightwork, a small lamp, or a composite candle is needed, which will admit of being brought very near the object; and to condense the light to a strong focus, a good hand double lens is all that is necessary. I have found these simple contrivances in practice better than more expensive and complicated reflectors, in securing a powerful light, which may be kept in motion to aid the penetrating power in working.

It is not necessary always to have high magnifying powers ; on the contrary, a low power is generally best to begin with, as it insures better definition and penetration, with a larger field of view. A young beginner may not always succeed to his satisfaction at first ; a current of air may cause the light to flicker, or a motion in the room may cause the instrument to vibrate; but ordinary tact and perseverance will overcome all these difficulties, and the student will then be able to revel in one of the highest intellectual emjoyments, without the feeling of dealing in minute things at all ; he will realise perfect beauty without the sense of disproportionate size. In the study of the inorganic in nature there is this great distinction between it and the organic—while the forms of the latter are more or less curved, those of the former are all angular and straight. Costly gems and brilliants are naturally all straight-lined structures, and so also is the light by which they are seen —that is, the pencils or rays of light are transmitted in straight lines.

A word about gems. There are but few people, comparatively, in the world rich and fortunate enough to secure them. I do not speak of artificial things, of course, but of real gems, and every one who is able to catch a sight of these may derive additional pleasure from a knowledge of their composition and structure—by knowing how their brilliancy depends upon their molecular structure, and their richest colours on the intimate diffusion of a few simple substances through them. The law of affinity, known as the crystallizing force, which is universal in its operation on matter under favourable circumstances, is beautifully illustrated by the instrument—how atom adheres to and is built up on its kindred atom, producing the infinite variety of mathematical and modified forms which we behold. In referring you to some of these, it should be remarked that no words I can command will convey an adequate idea of their full beauty. I will not attempt to classify them either, but direct you to a few of the objects which the inorganic world presents, such as have come under my own notice.

In minerals, in looking at a good public or private collection, our first thought as we proceed is—what a vast variety of beauty is here collected ! with, perhaps, the feeling that the collector had ransacked and exhausted half the world for them ; whereas the truth is, that a few only, comparatively, of these beautiful things are found at all, and to every single specimen thus obtained and preserved, hundreds or thousands, equally or more beautiful, from the same mine or locality, are piled into the refuse hillock, or pass into the furnace unobserved. But for the most beautiful specimens we must look into the minuter forms, or, at least, these most often combine a variety of species in the same field of view. If you go into an iron mine, or along by the heaps of iron ore at the Docks, look for some of the sparkling gems which the sun betrays in cavities not larger than a pea or even a pin's head would fill, you may find there in the black velvety appearance scalene crystals of iron, grouped into cluster-like roses half unfolded, and intermixed with some of the varieties of lime, of which it is said that 800 modified forms have been counted. Or into a copper mine : go to the ore yard or to the refuse heap, and with a hand magnifier search for a few of the rich bits of colour derived from the oxides, carbonates, blue and green, and silicates and other ores of copper, which, blended or single, lie intermixed with crystals of non-metallic substances around, and you will be abundantly rewarded. Native copper, though more rarely, is sometimes found of the most exquisite dentritic forms, built up on their axial lines like beads on a string, and the whole standing up self-supporting like trees, throwing out ramifications like branches. Lead ores show a rich variety in the sulphides, phosphates, arseniates, with other rarer combinations, diversified and modifying each other's forms. Silver, tin, blende, bismuth, nickel, manganese, molybdenum, vanadium, antimony, and other rare metallic ores, interspersed with the crystals of lime, silica, alumina, and other non-metallic substances, in almost endless variety of form and colour, offer themselves to the person who will look for them. Gems of surpassing beauty are sometimes to be seen in the merest fracture of a stone. One can thus look down into a cavern of such enchanting loveliness as can fall to the lot of but few persons to witness in a lifetime. But it is not for the sake of beauty alone that the instrument is to be used. Problems in science of great import and value may be solved by it. The constituents of rocks and minerals may be ascertained by the labours of the chemist, but they may often be detected also in much less time by observing their structures attentively in this way.

Sir Humphry Davy, the great philosopher and chemist, devoted much time and attention to find out the nature of those cloudy appearances which are sometimes seen in transparent crystals of quartz and lime ; whereas our improved microscopes show that the cloudy fleecy appearances so seen are nothing but innumerable minute cavities dispersed through the crystals. The question has often been asked, how is it that the slate which covers our houses splits so rapidly, although the fissile structure is mostly oblique to, or different from, the line of deposition ? Now, the microscope reveals the fact that the splitting tendency of slate rock is derived from its minute structure, that the whole of the rock is composed of one entire mass of microscopic, foliated crystals, lying one over the other like loose sheets of paper, and that when the thin edge of the wedge is inserted at one end, the cleavage line runs along the surfaces of these crystals easily : this is what the quarryman calls the "grain" of the stone. This is well seen by reducing a fracture of the rock down to a thin section and then transmitting polarised light through it, and the common grey roofing-slate of our houses will present a beautiful object under this mode of treatment. Substances which are often considered to be chemically combined, are not chemically combined at all, but under the microscope it is seen that the union is purely a mechanical one ; for instance, I can show you iron and lime combined in this way, the lime being translucent, the iron is diffused through it in exquisite forms ; it seems as if it were floating in the lime, just as some of you, who have been to sea, may have seen the "Gulf weed" in tangled masses floating in the Atlantic Ocean. To account for this phenomenon we must suppose the iron and lime to be both in solution together, yet each crystallizing on its own affinity, atom seeking its kindred atom and adhering to it, independent of the other substance. It may be that in their efforts to combine they have pressed into and modified each other's forms. We have sometimes frolics in stones presented to us in this way. Moss agates, fortification agates, cornelians, jaspers, and many others of this class of stones, owe their peculiarities to this cause. If you wish to know what is the cause of the concentric rings and zones in malachite and stones of similar form, the microscope will show you that these are all caused by the crystallization having commenced at several centres simultaneously, the crystals radiating outwards and extending until they pressed into each other's lines, and thus are formed the zones and rings seen. Wood-iron and wood-tin have never had any connection with wood, neither are they fossilized minerals, but are simply these minerals crystallized on the radiate system referred to. What a rich display we have in the serpentines of Cornwall ! These stones are not so well known as they deserve to be, for they are exceedingly beautiful to the eye, but when seen under a microscope they show the finest combinations of lime, silica, felspar, alumina, and magnesia, distributed in lines and dots, portraying the phenomena of mineral veins, with heaves and slides, and reflecting a play of colours that is truly astonishing. I hardly know a more pleasing and instructive winter evening's employment—at the same time it throws much light on the operation of the laws of crystallization—than to prepare solutions of the soluble salts, quinine, salicine, sulphate of copper, antimony, and any other of the fifty salts which are soluble in boiling water—rain or distilled water should be used—and then take a drop of the saturated solution on a slip of clean, warm glass, place it under the instrument, with the polariscope adjusted for observation, and there, under the most gorgeous colours of the decomposed light, the crystal will be seen to grow from a mere speck until complete. Some salts will isolate their crystals ; others will group and cluster. Some will radiate from centres ; others will run in straight parallel lines ; and this pleasing study, while it interests, will give a large insight into the laws which operate in the formation of rocks. If we apply the microscope to the study of rocks, pure and simple, we shall find that it will aid us immensely, and will greatly expand our conceptions of the grandeur of the science of Geology. We may do this by working on fractions of rocks as opaque objects, or we may observe their structure by reducing these fractures to the merest films, and then transmitting light through them in the way before described. It may not be known to all of you that besides the larger fossils, which are found in some beds of the stratified rocks, there are countless myriads of other kinds contained in some beds, too small to be seen by the naked eye. Certain beds of our carboniferous limestone, and others which cover vast areas, are thus almost made up of minute chambered cells and fragments of other organisms, too numerous to count even in a piece not more than an inch square.

I will now briefly refer to Metallurgy, and I can do no more than indicate a few subjects of study, for this field is also illimitable. In the process of smelting any of the metals, how little is really known of the mode of operation in which the changes take place! We put the ore, fuel, and flux into the furnace, apply the blast, and thus get up the heat until fusion is effected, and then draw off the metal, without perhaps reflecting that we thus call into operation some of the mightiest agencies which Nature has at her command. Now, to throw some light on the process of copper smelting, take a small splint of malachite, with a bit of borax or charcoal, use the blowpipe, and then, at the different stages of the process, place the bed thus formed under the microscope, and observe how wonderful and beautiful are the successive changes which take place before the reduction is complete. Are you aware that all the copper of commerce is perfectly cellular, or porous? and that after it is drawn into wire, these cells, though elongated, still remain? and that, consequently, a common dress pin, with which a lady fastens her dress, is full of holes?—that the conducting wires of the Atlantic cables have not one solid inch in their whole length, but are permeated throughout by numerous cells, so that if it were possible to make a section from any part of them, the one millionth part of an inch in length, these cells would still be seen to be innumerable? These are facts which I am prepared to substantiate, and show you, if not from a section of the Atlantic cable, from any of the copper wire or cake which may be presented to me. The same general porous structure applies to iron —to all good iron—from a horse-shoe nail to a chain cable or a ship's anchor. It is all full of holes, only these differ somewhat from those of copper, because in the case of iron the cells are modified by the iron being worked in a plastic state while hot, whereas copper is ladled out into moulds, and is then allowed to cool, but it is porous as a sponge without exception; and were it possible to compress good iron into a perfectly solid state, its density would be doubled, and its bulk diminished fully one-half. The difference of structure between good and poor iron is well defined, and how good iron may be made poor by improper treatment is also shown. These studies, which are practical, I have only been able to indicate to you, but they are of great interest in scientific inquiry and practice, and are undoubtedly the result of the operation of some of the laws of nature. In the inorganic world there is a vast field of knowledge yet unexplored before us, and which the microscope enables us to enter upon. The mighty forces of nature, themselves invisible, can only be judged of by their effects ; and in the great border-land, lying between the point where our unaided vision fails, and that point where the microscope will take us, there lies an infinity of beauty and interest awaiting the explorer, and it is hard to say how much may thus be learnt of the laws of affinity, electricity, and heat, and probably of other yet unknown forces of Nature. Some people, not naturalists, are disposed to reject as useless all knowledge of which they themselves do not see the practical bearing; but the answer to these is, that it is impossible to determine what has, or what has not, a practical bearing. All the blessings of our advanced civilization, and the great advantages which we possess over our rude forefathers, are the results of small beginnings in labour and discovery. One man invents the alphabet of a science, another labours at its terminology; one man tells the world that he has navigated his bark on a voyage of observation into an unknown sea of science ; a few only may believe him, but by and bye, perhaps after he is dead, another follows him and tells the world that he has seen some land-birds and driftwood—indications of something practical ; a third goes out and discovers a real continent of substantial good for all mankind in after ages. But suppose that the results of these pursuits can never be brought to bear upon the demands of practical life, there is yet abundant reward in these studies for their own sake, a distaste is given for the gross and sensual things of life, and a source of the purest and highest intellectual pleasure is opened up. No man can engage in the study of the works of God in any department without being benefited thereby; and a devout mind will be led to exclaim, at every new step he takes in this way, with the Psalmist—"O Lord how manifold are Thy works, in wisdom hast Thou made them all, the earth is full of Thy riches."

Mr. Vivian was loudly applauded at the close of his lecture, after which a resolution, thanking the Mayor for granting the use of the Town Hall to the Society, was unanimously adopted.

At the usual monthly meeting of the Society, held March the 1st, a paper was read by G. C. Thompson, Esq., entitled "Notes and Suggestions on the Objects of the Society."

MR. THOMPSON'S PAPER.

Mr. President and Gentlemen,

Our Society has just been passing through a period of rapid growth, and, like all young creatures, a great part of its energies has been devoted to the care and development of its own organization. But now, if not yet full grown, it has at all events fairly established itself, and we shall see it applying itself more and more to the fulfilment of its proper functions. But now comes a difficulty which I and doubtless many others feel. We fear we shall be but unprofitable members ; for instance, if we try to collect specimens for the museum, we feel ourselves baffled at once by the multitude of objects, and our want of knowledge to discriminate among them ; but still, we hope to get much good from the Society, and we would gladly repay the benefit by and bye, if we are able. And it is on behalf of those who feel in this way, that I wish to throw out a few suggestions to-night.

The interest and value of our meetings might, I think, be greatly increased by their assuming a conversational character, as soon as the business is transacted, and the papers (when we are fortunate enough to get them) are read. Many members would doubtless be able to communicate interesting facts which had come under their notice, and these things being discussed and commented upon would be, so to speak, interpreted ; and even if trivial things were occasionally brought forward, no great harm would be done, while, on the other hand, some might be worth noting in our "transactions ;" for instance, a record of the dates of the first blossoming of the various wild flowers would be most interesting for future reference, as showing the character of the seasons.

Then again, among our members a great many of the scientific serials are, no doubt, taken in, some seeing one, and some another. We should be very much obliged to those gentlemen if they would from time to time tell us what progress is being made in the various branches of science with which our Society has to do, and what new theories are rising in the scientific world—for the theory is the key of the whole matter : a mere isolated fact is barren and meaningless, but let it be understood with what theory it is linked, and it becomes full of interest.

I have alluded to our ignorance as a bar to our usefulness as collectors. Would it be too much to hope that some of our members, who are qualified to do so, may give us a few elementary papers on the various subjects of geology, botany, entomology, and so on ? What we want, I think, is a clearer idea of the principles of classification, and the characteristics of the various groups; and then, with an occasional hint at the various seasons of the year, as to what we should specially look for at those times, we should work, at all events, with clearer ideas of what we are seeking. I would beg any one writing such papers for our benefit not to be afraid of making them too elementary.

In conclusion, my object in writing this short paper will be amply attained, if it provokes a few expressions of opinion on the subjects I have touched upon.

A very interesting lecture was delivered April the 5th, at the Town Hall, by the Rev. J. T. Campbell Gullan, of Swansea, on "The Ant, its habits and its teachings."

LECTURE ON THE ANT.

The chair was occupied by William Adams, Esq., F.G.S., President of the Society; and the audience, which was numerous and highly respectable, consisted of naturalists and their friends, and a good sprinkling of the general public.

The Rev. Lecturer, who was warmly received, commenced with a sketch of the different species of these singular creatures, and of their universal distribution, the Arctic Regions probably excepted, over the surface of the globe. He then glanced briefly at their anatomical structure, and pointed out that the chief peculiarity in their formation consisted in the slender connection between the thorax and abdomen, that gave the appearance of having been cut in two; hence the origin of the word 'insect,' derived from the Latin. The food of the ant was next considered, and a playful and amusing description given of their excessive fondness for sweets, a fact that was sometimes painfully impressed on any materfamilias who happened to have her jam pots in too close proximity to one of their nests. The aphides—those curious green insects, which often constitute blight and furnish the secretion called honey-dew—were also mentioned as affording a large amount of saccharine food to the ant tribe. The method in which this is obtained was graphically described, and the process is so similar to milking, that the lecturer did not hesitate to call the aphis the ant's cow. The propriety of this name was rendered more striking by the fact that a family of creatures in Brazil, which bears the same relation to the ant there as the aphides do in this country, actually possess horns. Moreover, the ants are very jealous of their rights of property in these cows, and when any danger is threatened they carry them off into the dark chambers of their abodes for security. It has been supposed that the ordinary English ants stored up food in their nests for the winter use, but this does not appear to be the case. The error arose from the larvæ, carried in their mouths when an ant nest is disturbed, having been mistaken for corn or seeds of some kind. Our ants are dormant in the winter, and have no need of exercising their providence in this way. Some species, however, do undoubtedly provide for themselves in this manner, and the agricultural ant—as it is called—not only stores up grass seeds for future use, but actually grows them too, and this is accomplished by clearing, digging, and sowing a piece of ground some feet square near their nest, and a plentiful crop is usually obtained. Some such species as this must have been referred to by Solomon in his well-known advice to the sluggard.

The lecturer proceeded to notice that ant communities are composed of three kinds of individuals—males, females, and neuters. The males have wings throughout their brief existence, the females only for a short time, and the neuters have none. In the summer time the two former appear in large numbers, after quitting their nests where they were developed, and spend a short honeymoon in the air. When flying in this way they present a most brilliant appearance, and have been compared to the aurora borealis. This brilliant life is soon ended, and the gentlemen make their bow at the termination of the mazy dance, and finally depart. Their fair partners then tear off their own wings and devote themselves entirely to household duties, but the actual labours of the society finally devolve on the neuters. They form the nest, carry off the eggs, and feed the larvæ with the utmost care.

Space will not permit us to follow the Rev. Lecturer through his agreeable account of the courage, perseverance, and sympathetic kindliness of these remarkable insects. Their migrations, wars, and singular military discipline, marching order, and powers of attack and defence, must also be passed by. We cannot, however, forbear mentioning that the red ants—a proud, lazy, but warlike tribe—are fond of doing battle with their black (nigger) brethren, and carrying off their young into slavery in true human fashion. The captives thus taken do everything for their military and noble masters, even to the extent of feeding them. An experiment was once tried to ascertain what this lordly race would do if left to shift for themselves. They were shut up in a glass case without the "blacks," but well provided with food; but were absolutely too lazy to help themselves, and all would soon have died. One little "nigger" was then let in, and it was marvellous to see how quickly his active body and energetic mind "set things to rights." He attended to the larvæ, fed his useless *superiors*, and rescued them all from an ignoble death.

The dwellings of the ants were then described. These are of three kinds—1st, those built above ground, in trees, on roofs, etc.; 2nd, nests underground; 3rd, those erected upon the ground. These exhibit great diversity of structure, and usually consist of numerous passages and chambers. The larvæ contained in them are removed about from one room to another, according to the temperature, &c. If cold, they are kept in the deepest recesses; if warm, near, or even upon, the surface. We cannot enter into the details of these interesting structures, but will briefly remark upon the dwellings of the white ants as the most astonishing, although these are not now considered to be ants at all, but are removed into another zoological class.

The most usual form of tenement built by these destructive creatures is more or less conical; in general aspect it somewhat resembles a spire surrounded by many smaller pinacles. When a lot of these are placed near together, a wanderer in the woods where they abound might imagine that he had suddenly come upon a native village. On a close examination he would be surprised to find no entrance to the huts, or trace of human habitation. After a while, by observation or information, he would ascertain their true nature. They are made 12 feet or more high, and the material is clay, masticated by the insects, which, when dry, becomes exceedingly hard. These dwellings are very strong, and are sometimes used as a look-out by hunters. They are very difficult to break into. The interior is elaborately divided into chambers and galleries. The royal apartments are placed in the basement, and the anterooms are thronged with soldiers to guard the august precincts. The queen lays the enormous number of 80,000 eggs in 24 hours. These insects destroy everything that comes in their way, and will often reduce wooden structures to a mere shell, and the mischief may not be apparent until the whole inside is ruined. We have been informed by a civil engineer of Cardiff, who held a Government appointment in the Gambia, that the ravages of this creature constituted quite an engineering difficulty, and had to be specially considered whenever timber was employed. The woods best suited to resist their incursions were teak, a variety of palm, and rose wood. If human residences were built in the same proportions to the size of the inhabitants they would be many times higher than the pyramids of Egypt. The lecturer concluded with an account of ant-eaters, and ant-lions, and pointed out the very important lessons to be derived from the many good qualities of the ant. At the close of the lecture a vote of thanks was unanimously passed to the Rev. Mr. Gullan for his admirable lecture, which was most attentively listened to throughout.

The monthly meeting of the members of the Cardiff Naturalists' Society was held in the Grand Jury-room, Town-hall, on May 3rd. The President, Mr. W. Adams, F.G.S., took the chair shortly after eight o'clock, but the attendance of members was not large—owing, probably, to the unfavourable weather. Several new members were balloted for and accepted—increasing the number to 175—and several others were proposed.

A highly interesting series of specimens of the local carnivora was exhibited at this meeting by Mr. John Williams, of Duke-street. It comprised the fox (canis vulpes), the marten (martes foina), polecat (mustela putorius), stoat or ermine (m. erminea), and weasel (m. vulgaris). The marten is now almost extinct in England, its size and rapacious habits rendering it an object of eager pursuit by every keeper and game preserver. The specimen exhibited was taken in a trap at Courtyralla, about three weeks since. It is a female, and measures, from the nose to the tip of the tail, 26 inches, the height being 10 inches. It was in very poor condition when killed, and this occasioned some surprise, as, in a district well stocked with game, so active a "vermin" would be expected to find abundant prey. On a close examination, however, it was noticed that one of its eyes was covered with a film, a species of cataract; this, no doubt, had rendered it to some extent helpless, and hunger then led to its visiting the trap. Instances of the capture of the marten have of late years been so rare that Col. Rous (for whom it has been stuffed by Mr. Williams) may be congratulated on having acquired a specimen, as well as for having got rid of a most daring poacher. The polecat—or fitchet, as it is generally called in Glamorganshire—is also a rare animal, though often confounded with its lesser congeners, the stoat and weasel. Amongst other curiosities also exhibited was a very beautiful nest of the long-tailed tit (parus caudatus), cunningly adorned and covered over with grey sparkling lichens from the oak and apple; and a blue egg of the redstart (phœnicura ruticilla), found in the nest of a tomtit (parus major), which contained three eggs laid by the proper owner. Both these birds build in holes in trees or walls, so possibly the redstart in this instance may have mistaken the door; this, at any rate, is the only excuse to be made for so sad an impropriety. It seems that Nature herself is not free from little mistakes occasionally.

The President stated that he was not aware, until late on Saturday evening, that no arrangement had been made for delivering a lecture or address. He had that morning noted down some ideas in regard to their Society, and if the members would excuse the crude and hurried manner in which he had put them together, he would proceed to state them to the meeting. Mr. Adams remarked as follows:—

THE WORK AND PROGRESS OF THE SOCIETY.

The time of year is now come when the out-door work of our Society may be expected to commence. This, together with the great addition to our members since the close of the last year, and the inquiry from several of them as to what they are expected to do to be useful, leads me to propose (with your permission) to give an account of the formation and progress of the Society, the district we propose examining and collecting the natural history of for the Cardiff Museum, and what we contemplate doing for the present year. As we had but a sufficient number of last year's Report printed for the members then enrolled, for the information of the new members, and more especially those residing away from Cardiff, I shall be obliged to take up more of your time than I otherwise should. The Report states that "The Cardiff Naturalists' Society was established in September, 1867, by a number of gentlemen interested in and desirous of extending the study of natural history, and it was decided that one of its primary objects should be the formation of a local museum." It goes on to state that the specimens collected by the Society shall be deposited in the museum connected with the Free Library, and become the property of the Corporation of Cardiff. Our Society commenced at its first meeting with twenty-four members; by the year's end, September, 1868, the number was increased to seventy-six; and at the present time we have on the roll no less a number than one hundred and seventy-five. The district we proposed to work in embraced an area of about 530 square miles, bounded as follows:—On the south by the Severn and Bristol Channel, from the mouth of the river Rumney to the mouth of the Ogmore. On the west by following up the Ogmore to near Tondu, where it is joined by the Llynfi; thence up the Llynfi to Blaen Llynfi —cross over the hill by Hoel Fawr to Cymmer, in the Afon Valley, where it is joined by the Corrwg; thence up the Corrwg fawr, by the village of Glyn Corrwg and Blaen Corrwg Farm, to its source; cross over the hill near to Carn-fach—the highest ground, I think, in the county, 1971 ft. above sea level—and into the valley at the western end of Hirwain Common, to a junction with the boundary between the counties of Glamorgan and Brecon. For our north boundary follow this line past Hirwain, north of Cyfarthfa and Dowlais, until we come to the river Rumney near the Rhyd y-Milwr, north of the Abergavenny and Merthyr turnpike road and Rumney bridge and gate. Then for our eastern boundary follow down the river Rumney to its junction with the Severn. Such was the district we allowed ourselves to explore and investigate—one rich in its agriculture, mineral wealth, and historical remains.

The President then proceeded to give a somewhat lengthy review of the proceedings of the Society since its establishment, and also noticed contributions which had been made to the museum and library. He then proceeded to refer to the

WORK FOR THE ENSUING SEASON.

For one of our field meetings, one of our members, the Rev. Mr. Fordyce, has obtained a promise from Wm. Carruthers, Esq., F.G.S., &c., of the Botanical Department of the British Museum, to come down and give us a paper, and for another day we may expect Professor T. Rupert Jones. For further papers each member must look around and see where some kind friend can be found to help us. I had strongly relied on one of our members (Mr. Drane) giving us a paper on botany or entomology, for which he is so thoroughly competent; but, alas! to-day I was doomed to disappointment by his refusal, and for no other reason, I believe, than extreme modesty. But the motto of the Woolhope Club must be ours too—"Hope on—hope ever,"— as I cannot conceive the nearly 200 members who have enrolled themselves will allow the Society to be broken up. Let each member follow the advice given by Dr. Stanley, Dean of Westminster, a few months ago, in a sermon to the Post-office Volunteers, and each be as the "working of a wheel in the middle of a wheel," and we shall yet prosper; but committee and members must be more active than hitherto, and now the winter is passed, awake from our lethargy.

THE NEED OF A MUSEUM.

I feel very much that our chief want is a Museum, in which to place the objects we collect, and where the members and public can see what is doing. A mere description is of no earthly use. We must learn with our eyes, as well as our ears, and failing this, I fear our labour will be in vain. Even the one evening's exhibition, open to the public in November last, clearly showed the interest they take in such things; and let any person during the day and evening just look at the interest evinced by all passers by at the various shop windows where pictures of any kind are open to view. Just screen those pictures from sight, and describe, with all the eloquence possible to people, the beautiful painting, the exquisite engraving, the delicate sculpture, covered by the screen, and can you for a moment think they could realize or care for your description? And so with the objects we collect for our Museum, they are brought here by members, month by month presented, thanks returned to the donor, packed away, both out of sight and out of mind. If we had a museum open to the public, who can tell how many of the 600 or 800 Militia men assembled here, would be struck with something new to them, their thoughts awakened, and then return home wiser and better men? I know some will think quite the contrary, but it is because they do not know the "working men" sufficiently well. I can give an instance of the benefit derived by a visit to a museum in this very county. Some years ago, four working colliers from the Rhondda Valley went to Swansea for a holiday, and visited the Museum. They stared at the different things exhibited, and upon coming to some coal fossils one exclaimed, "What do they put these stones here for? We throw many prettier into the gob every day." Of these four men, one thought, "What can all this mean?—'Presented by Mr. So-and-So to the Swansea Museum;'" and this label appeared so often, that he thought there must be some use and meaning attached to it. So he again walked over the building, and returned home determined to know more about these things. He continued at his work as a collier, bought some books to get an insight into geology, and that man gradually rose to become the manager of one of the large steam collieries sending its coals to Cardiff. That man's mind was awakened: he has not only read scientific works, but has visited the large collieries and mine works of other districts, and is possessed of a large amount of general local information. There is not a spot in valley or hill in his neighbourhood but he can give you the relative height of, and he has interested his wife to assist him in his observations. For instance, whenever he goes out from home on business, or a stroll, he sets his two aneroid barometers—taking one with him, leaving the other with his wife, to record the readings every hour, or at such time as may be arranged. Depend upon it he is not alone in the ranks of the working men. I could name others in our district; but I will proceed with an illustration from another district, a working collier in Northumberland, who occasionally visits Newcastle-on-Tyne, where he, too, became alive to the wonders of a museum; and to show you what even a working collier can do in his leisure hours, I have brought some microscope slides, with objects prepared and mounted by himself, of organic remains of the fauna of that district. He has also commenced a microscopical examination of fossil plants, which he procures in exchange from a friend in Lancashire; and to compare the fossil plants with those growing at the present day, he is busy mounting sections of trees and plants. There is also another collier living near him who is much interested in such pursuits, and who, not being able to purchase a microscope, set to work and made one entirely himself, even to the grinding of the lenses. Such are the working men of many districts, and such will be found in Cardiff, and within our field, if we but give them an opportunity of seeking knowledge and *seeing* for themselves. Let us therefore, by all possible means, obtain a museum, and open to all.

THE "WASTE" OF GLAMORGANSHIRE.

A short time since, one of our local papers (the *Cardiff Times*) had a long and interesting article on "The future of Cardiff," and after treating largely on the superior quality of our steam coals, our railways, and docks, and our port as admirably placed for an import trade, they challenge the Naturalists' Society to bestir themselves, and to state whether the fire clays of Glamorganshire can be put in competition with those of Staffordshire. To this a short and ready answer can be given, "yes." And it is a reproach to this county that pottery, fire bricks, gas retorts, chimney pots, and other clay products are procured from long distances, with costly carriage, when a superabundance of fire clay of the best possible kind can be had close at home, and when we are almost within sight of Cornwall and Devon, where the china clays are raised. It is well known that at one time china of a fine description was made at Nantgarw, within seven or eight miles of this town; and if capital or workmen are brought into the district, the same can be done again—there is abundance of good fire clay for making the "saggers," which is one of the great requirements in a china or pottery trade. Taking another instance in which the members of the club can be of use, and save waste; we throw away in South Wales thousands of tons of what people in the north utilize and make money of. Just look over Mr. Hunt's mineral statistics, year by year, and you see from Durham, Northumberland, Yorkshire, and Lancashire, over 10,000 tons a year of coal brasses saved and used, realising over £5,000 a year; and in South Wales you do not see a ton returned. During the first lesson in yesterday morning's service I could not help thinking of it, when the minister came to the verse "A land whose stones are iron, and out of whose hills thou mayest dig brass." We do indeed dig out brass, and bury it for ever just as speedily.

THE SOCIETY'S RAIN GUAGES.

Next as to our rain guages at work, last year we had four, now in different parts we have ten at work, pretty well scattered over our field, but we yet require in the Bridgend district two, and the same number in the Rhymney Valley. And to make our "working field" more complete, I would suggest that we extend it eastwards, and take in that part of Monmouthshire lying within the coal field, and make the boundary Blaenavon, Pontypool, Caerleon, and Newport, to the mouth of the river Usk. By doing this we shall get a more complete collection for the museum.

SUGGESTIONS TO THE MEMBERS.

To our mining members, I would draw attention to their collecting any rare minerals, specimens of building materials, fossils (fauna and flora), carefully recording the date, seam, and locality found in; there are plenty to be found if people will but look for them. Members living in the neighbourhood of Llantrissant will be interested in knowing that a short time ago John Edward Lee, Esq., F.G.S., of Caerleon Priory, found some fragments of bone in a heap of rubbish obtained from sinking a trial pit for coal, in a field a little west of New Park, on the right hand side of the road from the South Wales Railway Station to Llantrissant. On showing them to Professor Owen, he states they are the remains of an air-breathing vertebrate, known in the coal shales of Carluke, but he had not before seen any such fossils from English or Welsh formations of the same antiquity. The reptile is described and figured by Professor Owen, in vol. 2 (1865) of the "Geological Magazine," page 7, and he has named it Anthrakerpeton Crassosteum.* He says they were discovered in the much-disturbed coal beds at Llantrissant, which are referable to the lower part of the "middle," if not the upper part of the "lower coal measures." It is probable, indeed almost certain, the same bed is continuous throughout the coalfield, and I am inclined to think it will be found a little below the No. 3 Rhondda seam of coal. This will be an interesting puzzle

* The plates have been re-drawn, and the paper is re-printed from the "Geological Magazine," by the kind permission of Henry Woodward, Esq., F.G.S., &c., &c. (see page 108).

for our geological members to unravel. We have this year to record lady members in our Society, and we hope to obtain their assistance in any branch of natural history. For their encouragement, I would say we have some very good lady workers in the kingdom as geologists, botanists, entomologists, &c. There is work enough for all to do, and room enough, too ; and few societies are better placed than ours, if every member will but add his mite to the general stock ; and, in the words of one known to some of our members—a hard worker in his profession, and in furthering scientific pursuits, more especially his favourite one, geology, but cut off in early life and in his prime :— "Man's enterprise is an instrument in the hand of the Creator, for furthering knowledge of His works, and displaying to us, in rock cutting and tunnelling, the operation of His hands—whispered truths of hidden and secret Nature—whether we will hear, or whether we will forbear."

The President illustrated his remarks by frequent reference to a large geological Ordnance Map, showing the chief portion of the South Wales coal field, which was exhibited in the room. At the close a vote of thanks, proposed by Mr. T. G. South, and seconded by Mr. Rhys Jones, was accorded to him for his address.—Thanks were also expressed by the President to Mr. E. J. Williams, of Gelligear, and Mr. John Williams, Duke-street, for their contributions to the Society, and the proceedings shortly afterwards concluded.

ADDENDA.

I would again draw the attention of members, more especially those immediately connected with the two great public works now in progress within our "field," to the necessity of examining, and carefully recording by sections and specimens, all matters met with during their construction. The works will readily be recognized as, first, the new Bute Docks, the chief engineer of which, together with several of his staff, we have already members of our Society.

The "alluvial deposits of rivers" is becoming a matter of much interest. An able paper on this subject was read a few weeks ago by the Rev. J. D. Latouche, F.G.S., at a meeting of the Woolhope Club, and during a discussion which followed in relation thereto, it was said, Sir Charles Lyell expressed an opinion as to the great advantages resulting to science from the observations of members of naturalists' clubs, and hoped they would proceed with their inquiries, and carefully record the results.

The second work is the tunnel now being made by the Rhymney Railway Company, under the Cefn On hill, near Caerphilly, and which exhibits a complete section of the lower coal measures, from the base of the Pennant Rocks to the Farewell Rock, or Millstone grit, through the whole of the beds of the carboniferous, or mountain limestone, and into the higher beds of the Old Red Sandstone. Upon this work, too, several of our members are engaged ; and shall we appeal in vain to Scotia's worthy sons to carefully search those rocks of the Old Red Sandstone for organic remains ?—rocks so justly celebrated to all time by the labours and writings of one who worked upon them in his younger days, earning his bread by the sweat of his brow, both as a quarryman and a stone-mason, and one who so raised himself as to be esteemed by all the great scientific men of the world, and of whom no less a man than the late talented Dr. Buckland said, after reading some of his writings on the Old Red Sandstone, "He had never been so much astonished in his life by the powers of any man as he had been by the geological descriptions of Mr. (Hugh) Miller which had been shown to him. That powerful man described these objects with a felicity which made him ashamed of the comparative meagreness and poverty of his own description in the Bridgewater Treatise, which had cost him hours and days of labour. He (Dr. B.) would give his left hand to possess such powers of description as this man."

The *Stagonelepis* and the *Telerpeton Elginelse* of Moray, the *Pterichthys*, *Holoptychius*, *Megalichthys*, &c., of Dura Den, are found in rocks of the same geological age as those through which the railway tunnel is now being made under the heights of Cefn On ; and such an opportunity within our field will not in all probability occur again during the lifetime of any of the present members of our Society, for examining such a thickness of these rocks as this new railway tunnel offers to our view.

The first field meeting of the year was held at the Cefn On Tunnel and Caerphilly, on Tuesday, June 22nd. The members assembled at 10 a.m. at the Town Hall, to the number of about 80, with a fair sprinkling of ladies. Mr. Adams, the president of the club, led the way in a fly, and like a prudent general went to mark out the line of march, and to arrange the disposition of his forces in the assault that was to be made upon the secrets of Nature. The rank and file followed in three brakes, each drawn by a pair of horses, and the masculine lines were relieved by the brilliant tints of the dresses of the ladies, who might be considered as the vivandières, or daughters of the regiment. The whole company halted on the top of Thorn Hill, and proceeded in loose order, and by an irregular path, through picturesque and broken ground to Cefn On—which means the Ash Ridge —the first point of interest in the programme of the day. This is a part of a high range of hills, about 850 feet above the level of the sea, and marks the spot where the tunnel of the new Rhymney line passes through to Caerphilly. From this high position the view is magnificent and of varied character. To the south there is a green cultivated slope, well relieved with clumps of trees, with Cardiff and her docks and the Bristol Channel in the distance. On the north side the spectator could see the grand and rugged outline of Caerphilly Castle, embosomed in the midst of sombre-looking hills, which harmonize well with its gloomy and massive aspect. In the distance could be seen the lovely village and church of Bedwas, resting near the bottom of a range of sunny hills, cultivated to the very top. After a little time spent in the enjoyment of the scenery, Mr. Adams read the following paper on

THE CHARACTERISTICS OF THE CEFN-ON TUNNEL.

Ladies and Gentlemen of the Cardiff Naturalists' Society,

Your Committee have fixed, for your first Field Meeting of the year, on a rallying point, which I think you will agree with me in admitting to be one of much interest to all.

Where is the person who loves not to look with much pleasure upon the varied landscape which we behold from this spot, now elevated some 850 or 900 feet above the level of the sea? yet one which, in a day long gone by, lay buried under the waves of the ever restless sea. Between us and that sea there now lies a long and fertile plain: on its sea-border are noble docks, on the bosom of whose waters float ships bearing the flags of many nations; on its river banks is seen a large thriving town, teeming with a busy population, earning their bread by the sweat of their brow; and there is seen, too, in the midst of this activity, rearing their heads heavenward, the old Cathedral spire, the noble tower, the less aspiring and quiet country parish church; and the many churches of various denominations, in all of which "He who is Lord over all" has promised, "where two or three are gathered together in My name, there am I in the midst of them."

Let us now turn our eyes northward, and immediately at our feet lie the castle ruins of Caerphilly, a fortress which was built some six centuries ago, the history of which is to be given us by one of our members further on in the day. On the plain, too, below us is situated the Van, an old residence of considerable interest, a description of which has been courteously promised by Mr. Rowlands, of Bedwas, who is known to many of our members for his antiquarian lore.

Passing through the valleys are seen the rivers of Rumney and Taff, with their tributary streams; the railways of the Taff Vale Company, the Old Rhymney (now called the Newport, Merthyr, and Brecon), and the New Rhymney, the completion of the main line of which is now in course of progress, 500 feet beneath us. In various places over the Caerphilly plain you perceive smoke from the colliery engines raising that mineral fuel to daylight which is the backbone of England's greatness. Further away in the distance again is seen the smoke ascending to the skies from the large iron works of the district ; and still further yet, and bounding our northern limit of view, is seen, at a distance of 25 miles, the noble mountain pile of the Vans of Breconshire, known, too, as the Brecon Beacons, the summit of the highest of which is 2,910 feet above the level of the sea, and some 2,000 feet above the level of the place we are assembled upon.

Ten miles to the north-east we discern a hill where, just twelve months ago, several of our members spent a long and pleasant day with the members of the Woolhope Naturalists' Field Club. They hold their second meeting for this year on Friday next, in the neighbourhood of Pontrilas, the Hereford side of Abergavenny.

So far as geology is concerned, their work will be exclusively in the rocks of the Old Red formation. They will be much gratified if they hear our meeting to-day passed off successfully, and we shall ever find them ready and willing to extend to us a helping hand. Their indefatigable member and our good friend Dr. Bull, of Hereford, has very considerately sent me a couple of photographs of a fish of the Old Red, found in a quarry on the Skyrrid Mountain, near Abergavenny, by E. Y. Steele, Esq.

Let us once more look around this varied landscape, comprising hill, and dale, and plain ; its iron ways traversed by the steam horse ; its collieries, iron mines, and works ; its brick, paper, and tin plate manu factories ; its busy towns and hamlets. Pause for a moment,—then listen to what was published just one century ago in the "Universal Magazine," November, 1765, in an article entitled "A Geographical Description of Glamorganshire." It was this :—" Glamorganshire has no manufactures." Has there not in that comparatively short time a great change taken place ? and may not a much greater change be expected ere another century has passed away ? I will now come to a short description of the new Rhymney Railway, with its tunnel works —works of considerable magnitude, as you may perceive on looking at the extensive cutting, embankments, engines, and shafts on the north and south sides of this hill. The information was kindly given me by the railway company and the contractor's engineers. The company's line of railway, as is known to most members, now forms a junction with the Taff Vale Railway at the Walnut-tree Bridge, and thence to Cardiff. They have running powers over the line of the latter ; but as it is pleasanter to have a home of one's own than to be in lodgings, they lately obtained an Act of Parliament to construct the works now in progress from their main line near the existing Caerphilly station, through this hill, and to their own line at Crockherbtown-bridge, Cardiff, and thence to the Bute Docks.

Commencing at the north end of these works there is a long embankment, with a small cutting and embankment of about 1½ miles in length, where the commencement of the great cutting to the north end of the tunnel takes place. The depth of the cutting at the entrance to the tunnel will be about 78½ feet, and this will have been entirely in the coal measures formation, beginning a little below the Pennant Rocks, and will have intersected the following seams of coal, with intervening beds of sandstone rock, argillaceous and other shales: the outcrops of the Little Rock coal, Big Rock coal, Boddwr coal, Yard Vein coal, Red or Spotted Vein coal, Big Vein coal, and Black Vein coal. (This cutting is crossed by a fault, running from N.W. to S.E., but its throw or dislocation cannot yet be measured.) After which the tunnel will intersect the Forked Vein coal, Brass Vein coal, Hard Vein coal, Sun Vein coal, and a thin seam generally known on the south outcrop as the Crowsfoot coal.

Underneath the Sun Vein lie the shales and rock known as the Farewell Rock or Millstone grit, which is of considerably less thickness than on the north outcrop of the coal field; while on the north, in the neighbourhood of Merthyr Tydfil, the thickness is 630 feet, here on the south rise it is but 300 feet. Next, the carboniferous or mountain limestone is met with, the thickness of which at Merthy Tydfil is 520 feet, while here it is 840 feet. The subdivision of the limestone series passed through is—the top bed: black limestone, black shale, white limestone, black shale having a slaty cleavage, Rhiwbina limestone (under this in places there occurs a bed of encrinital iron ore), dark shales (indurated and much disturbed).

Next follows the "Old Red Sandstone" series—for a distance along the line of tunnel to its south entrance of about 750 yards. Soon after entering the Old Red series below the limestone, a very hard silicious conglomerate bed, eight feet thick, was passed through, and there were also cut through beds of yellowish coloured sandstone, grey and red beds of sandstone, alternating with beds of clay and marl. At the south entrance to the tunnel the depth of the cutting will be about 72 feet.

The whole length of the tunnel will be one mile, of which there is one-eighth of a mile, or 220 yards, yet to cut through. The tunnel works were commenced in September, 1866.

From the surface there have been five shafts sunk communicating with the tunnel, for the purpose of expediting the works, and on which pumping and winding engines are erected. The respective depths are from surface to level of rails in tunnel:—No. 1, or north shaft, about 143 feet; No. 2 shaft, about 315 feet; No. 3 shaft, about 350 feet; No. 4 shaft, about 180 feet; No. 5, or south shaft, about 94 feet. On this latter a new engine has been recently erected for pumping, which is equal to delivering to the surface through an 18-inch double column of pipes about 1,600 gallons of water per minute.

The early part of this year being so excessively wet, very little progress was made with the works.

The height of the tunnel, south entrance, above sea level, is about 311 feet, and of north entrance 354; the entire length being one mile. The distance from south entrance to No. 5 shaft is 150 yards; from No. 5 to No. 4, 301 yards; from No. 4 to No. 3, 308 yards; from No. 3 to No. 2, 429 yards; from No. 2 to No. 1, 384 yards; from No. 1 to north entrance, 188 yards; total 1760 yards.

The distance from Crockherbtown-bridge to south entrance of tunnel is about five miles; length of tunnel, one mile; north cutting, half a mile; from this to junction with main line, one mile and a half; total distance, eight miles.

The cutting and works from south entrance of tunnel in the direction of Cardiff are well worthy of notice.

The cutting at the tunnel entrance, as before observed, is about 72 feet, and continues very heavy for nearly seven-eighths of a mile, where the line crosses the Nantmawr brook or stream. The ground consists of clay, old red conglomerate pebble beds, beds of grey and red sandstone rock, with alternating beds of grey and green marl. In the cutting following this is met clay, red and different coloured marls, and a bed of tough blue boulder clay, containing numerous water-worn sandstone pebbles, and reaching from the surface to within a few feet of the level of the rails.

This cutting is highly interesting, as showing an anticlinal line running in an east and west direction. A little south of this cutting is the Llanishen station, and immediately after the Llanishen parish road crosses over the railway. Then commences shortly an embankment of considerable extent. Its greatest height above the surface of the ground is 62 feet, and the earth put into it amounts to 668,000 cubic yards. At the end of the embankment a valley is crossed by a viaduct of three stone arches, 60 feet above the surface of the ground; afterwards, the works to Crockherbtown-bridge, about 2½ miles, are comparatively light.

The new station at Crockherbtown-bridge, Cardiff, is in course of construction, and the whole of the works are expected to be completed and the line opened for traffic about this time twelvemonths.

The angle of dip of the strata was taken in several places—on the north side of the hill it was found 40, 41, and 42, and in one instance 44 degrees, on the south side, 36, 37½, and 38½ degrees north dip.

In the deep cutting south of the tunnel it is very varied, varying from 25½ to 42 degrees, which is accounted for from its proximity to the anticlinal line.

I would desire again to draw the attention of our young geologists to a careful examination and study of the cutting south of the tunnel, in which the anticlinal, and also a synclinal line is shown. For example—supposing that only the works shown in the tunnel had been exposed to view, and it was desired to know the probable thickness of the Old Red formation in this neighbourhood, how would you set about it? You would have seen its junction with the carboniferous limestone in the tunnel, and would take an average angle of dip there. Next, you would probably get over to Penylan quarry, where the Upper Silurian underlies the Old Red. There again you would take the average dip of the strata, and having ascertained by the road cuttings, and any foundation cuttings, nearly where the junction beds occur, you would ascertain the distance and difference of level between this point and the tunnel junction beds, and from the data so obtained calculate the thickness of the Old Red. This of course would be the natural course to pursue, and unless there was somewhere in the district an exposed section showing an anticlinal line, and where its direction could be observed, no other conclusion could be come to. My object in directing your attention to it is that you should, in going over any district wherever a rock section can be seen—whether in quarry, tunnel, road-cutting, or any other source—note it in your book or on your map, marking the direction and angle of dip; and from a collection of such facts you will sometimes be prevented from drawing hasty conclusions. This same anticlinal line has lain long exposed to view from both turnpike road and Taff Vale Railway, and at a distance of only about three miles west of the new cutting. The place I allude to is just south of Castell Coch, on the east side of the turnpike road leading from Cardiff to Merthyr Tydfil.

ECONOMIC USES.

We will again return to the new railway works, and inquire whether any beneficial results may be expected by their construction, irrespective of the works as connected with a railway; and I will venture to answer in the affirmative, commencing with the cutting south of the tunnel, and its development of Old Red Sandstone as affording a valuable stone for building purposes. The want of building stone in Cardiff has been long felt, and a general inquiry from builders is, "Can you find a good stone quarry near here? we can't get any stone; they use all that can be had for the new docks;" and this want will become still greater when Cardiff takes its proper place as a port of import, and when ships will be carriers of more productive cargoes than building stone and sand brought in as ballast. When it is considered that good building stone can be procured on each side of a public railway five miles from Cardiff, it must be admitted it will be a great boon to the builders of the town, the landowners, and the railway company, irrespective of the improvement in taste which stone of this colour will produce, and which may be further and more tastefully improved by relieving with the durable grey Pennant rocks, obtainable on the north of the tunnel. The following rocks are those of the carboniferous or mountain limestone, which, if worked for building purposes or lime making, will probably be raised on the northern side of the hill. It was anticipated iron ore would be found in passing through the limestone beds, but it has not been met with, and judging from the neighbouring deposit at Pentyrch, it could not be expected to be conformable with the stratified beds of the limestone.

A peculiar deposit of iron ore is found in Cwm Noddfi, just west of the tunnel, composed almost entirely of encrinital stems imbedded in iron ore; it appears to be quite local, and although the bed is lithologically alike, yet it is very different in its chemical composition. I have not heard of a similar deposit in England, although in Germany it is of common occurrence, but there more uniform in its composition.

Again, two miles eastwards, at Maen Llwyd, a deposit of iron ore was found, but this was quite different, being of the usual red Hematite character. This, like the other, was at or near the base of the mountain limestone.

Assays of several samples were made, yielding from 40 to 50 per cent. of iron, but the ore dipping rapidly north, and the surface of the ground rising also rapidly in the same direction, with a large quantity of water, the mine was abandoned, not being commercially workable.

Lead ore has not been met with in the tunnel, although at various periods it has been worked both to the east and west of it, but I think it could only have been found in the fault or fissure lines running through the district in nearly a north and south direction, and even then not in sufficient quantity to pay for working.

About eighteen months ago I noticed the in-filling of a fault in the western workings of the Fan colliery to be highly charged with lead ore, but its breadth was too limited to be available. Lead ore some time ago appears to have been sufficiently abundant near here to cause a furnace to be erected for smelting, and the farm on which it was erected, and on which its ruins may still be seen, is called "Farm Furnace Blwm," or the Lead Furnace Farm. And in the *Archæologia*, vi., 18, is recorded, "Several Roman Coins discovered in an old lead mine in Cefn-pwll-du, near Ruperra, Glamorganshire." This is some two miles and a half to the east of the tunnel.

The minerals crossed in the tunnel are the lower series of coals usually found in the south crop, and require no special notice.

PALÆONTOLOGY OF THE TUNNEL WORKS.

Commencing again at the south of the tunnel, I have not myself, neither have I heard of any other person meeting with any fossil remains.

My examination of the rocks brought to surface has been of the most cursory kind; in fact, I have not at all examined them, merely walking over them, although could I spare the time I fully believe my labour would be rewarded.

For some time the Old Red of Scotland was thought to be the special home of the "fish of the period," and although not "netted" they were "chiselled" out, and said to belong to Scotia alone; but as the Ichthyolites of these old rocks became known to the world through the researches and writings of Hugh Miller, then did men of other districts set themselves to work with a will, which was soon rewarded by the discovery of similar fossils in different parts of the country, some indeed being disentombed from hills almost, if not quite, within our sight—the one Cephalaspis, which is illustrated by the photographs.

This formation is divided into Upper Devonian, Middle and Lower, and tile stones attaining a thickness in Herefordshire and South Wales, according to Murchison, sometimes between 8,000 and 10,000 feet.

The fish of this formation are most peculiar and characteristic, and were referred by Agassiz to two of his great orders—the Placoids and Ganoids; to the latter the Cephalaspis belongs. One of this species, the Asterolepis, attained the length of between 20 and 30 feet. The Old Red is also well known for its crustacea, testacea, and plants, which are said to be specially distinct from the plants of the coal measures.

The carboniferous limestone does not appear to have yielded many organic remains, probably because not sought for.

On the rubbish heap from the No. 3 pit, on its western side, you will find a thin band of limestone, three or four inches thick, composed of bellerophon; and in the open quarry on the north side of the hill I some time ago met with a small fish scale. I also met with stones containing encrinital stems. I have little doubt but a careful search would yield some fish remains, because finding even the single scale proves that fish lived when these rocks were being deposited under the waters of the sea. We can only expect occasionally to meet with an entire fossil fish, indeed this rarely occurs; but by collecting fragmentary remains, the comparative anatomist will tell us to what fish they belong.

MILLSTONE GRIT AND ITS SHALES.

On the north outcrop of the coal field, and immediately opposite to us, there is a bed of shale, containing numerous shells, both of marine and fresh-water origin, which you will find described and figured in Part 3 of the "Iron Ores of Great Britain."

LOWER COAL MEASURES FOSSILS.

On the spoil heap from the No. 1 shaft, on the eastern slope, I found some fish scales, fragments of bone, etc., which I believe to have come from the shale lying on the *Sun* vein of coal; its equivalent on the north crop being the bottom vein, or Pin Garrw coal.

In one of the ironstone beds I also found a *productus scabricula*, which are very frequently met with in the meadow vein ironstones at Blaendare, Pontypool, on the south outcrop. I have also met with this fossil in several places in the same bed on the north outcrop.

I have now finished my description of the tunnel works, and unless I have exhausted your patience, I would direct your attention to a general description of the district within our view, beginning with the older rocks.

At and in the very neighbourhood of Penylan we have a very slight exposure of the Upper Silurian rocks, which we only see again in the high ground to the east of Pontypool, between that town and the town of Usk. That Silurian ridge lies 12 miles north-east from where we now are.

The next formation ascending is the Old Red Sandstone, or Devonian, a small area of which can be found to the west of the Taff valley lying within the limits of our Society's field. East of the Taff we find it comprising all the area between the mountain limestone, down to the alluvial plain, or the marshes, extending down the valley of the Ebbw from Risca to Newport, thence skirting the eastern boundary of the coal-fields by Cwmbran to Pontypool, on towards Abergavenny in the valley of the Usk, then taking a turn towards the west, passing into the valley of the Clydach, a most picturesque ravine, up which passes the Merthyr, Tredegar, and Abergavenny Railway, the ruling gradient of which is 1 in 50—some points as steep as 1 in 35. Crossing the Clydach, it continues well exposed under the mountain limestone, opposite to and south of Crickhowell, and on a little to the north of our north-western boundary.

A little of the west of north, and 25 miles from where we are assembled, you see the Brecon beacons, 2,910 feet above the level of the sea, and 2,437 feet above the bridge over the Usk at Brecon.

From Brecon the grandeur of the beacons can be best realized, the whole mass being composed of Old Red Sandstone, which Sir Roderick Murchison calculates to be here at least 9,000 feet thick.

Next in order is the carboniferous limestone, on which we now stand, lying immediately on the Old Red. Its boundary will be as already described, until we get opposite to Crickhowell, where an instructive lesson in Geology is taught us by an outlier of this formation, lying to the north of the town, called Pen-cerrig-calch (2,250 feet above the level of the sea). The limestone here is about 50 feet thick, capped by 200 feet of millstone grit; this outlier is separated from the main body of the formation by the valley of the Usk, and the distance intervening four miles. And how has this valley been formed? will very naturally be asked. The reply is by denudation.

We pass on over the millstone grit into the coal measures, which is at last the most interesting to us of all. The breadth of the coal field immediately opposite to us in the valley of the Taff is about 14 miles, and its extreme length from Pontypool on the east outcrop to St.

Bride's Bay, Pembrokeshire, in the west, is 90 miles; and looking at the workings up to the present time being almost entirely along the outcrop, it is quite apparent that its exhaustion will be at a very distant day, although there were shipped from the port of Cardiff alone during the year 1867, 2,859,922 tons; and during the year 1868, 3,000,912 tons.

Rather than tire you with a description of the various seams found in this part of the coal field, I will show you the section of Merthyr Tydfil, as published by the Ordnance Department, and which is sufficiently correct to give a general idea of the district, and on the geological map of the coal field, I will point out to you the direction of the "faults" (to use a technical term), and we will briefly notice whether, although a source of trouble to the miner at times, they are not oftener a wise provision of the Almighty, to supply man with that most valued treasure, coal, black coal, and as we say in our district "smokeless coal" too.

The "miners" of our party will, perhaps, excuse my relating to those who are not, that original idea of the late George Stephenson, when on a visit with several other of the leading scientific men of the day, and ladies too, at Sir Robert Peel's mansion at Tamworth.

Standing on the terrace near the hall, they observed in the distance a railway train flashing along, throwing behind it a long line of white steam. "Now, Buckland," says Mr. Stephenson, "I have a poser for you. Can you tell me what is the power that is driving that train?" "Well," said the other, "I suppose it is one of your big engines." "But what drives the engine?" "Oh, very likely a cannie Newcastle driver." "What do you say to the light of the sun?" "How can that be?" asked the doctor. "It is nothing else," said the engineer; "it is light bottled up in the earth for tens of thousands of years, light absorbed by plants and vegetables, being necessary for the condensation of carbon during the process of their growth, if it be not carbon in another form; and now, after being buried in the earth for long ages in fields of coal, that latent light is again brought forth and liberated, made to work as in that locomotive, for great human purposes." We shall probably have this subject again brought before us in a few weeks by Mr. Carruthers, in a lecture on "What is coal?"

You all know Mr. Stephenson was the great engineer of his day, and many of you probably remember the anecdote of a meeting of railway men in London. Their talk had been on railway matters alone, when one of the party said—"Come, Stephenson, we have had nothing but railways; cannot we have a change, and try if we can talk a little about something else?" "Well," said Mr. Stephenson, "I'll give you a range of subjects. What shall it be about?" "Say birds' nests," rejoined the other, who specially prided himself on his special knowledge of this subject. "Then birds' nests be it." A long and animated discussion ensued, and the company were surprised to discover the extraordinary knowledge which Mr. Stephenson possessed on the subject, and one of them remarked that if George Stephenson had not been the greatest engineer of his day, he might have been one of the greatest naturalists. I have introduced this to show that a man, however high his attainments in his profession may be, may yet find leisure to study the book of Nature.

To return to the "Faults." You must know the ground we now stand upon was at one time comparatively flat, and not tilted on end, as we now see it. These limestone rocks were once covered by the coal measures many hundreds of feet in thickness, but the terrible earthquakes and volcanic forces, causing "the earth to shake and tremble," rending it as it were into ribands, caused these faults and dislocations, making the dry land to be seas, also the then seas to be dry land. This, too, was one of the Almighty's merciful acts, enabling man to work these coals, by openings such as you see in these tunnel works, and for a long time to come by pits of shallow depths.

This lecture gave great satisfaction, and after its delivery the Society proceeded, under the guidance of Mr. John Rowlands, of Bedwas, to the Van, an outpost connected with Caerphilly Castle, and at one time the residence of the Lewis family in this county. At this place a dovecot on a large scale excited much interest. It consisted of a massive round tower partially closed at the top, and pierced inside with pigeon holes, for the nests ranged in rows from the bottom to near the summit. This building was capable of containing at least 1,000 nests, but its gentle tenants have long since departed, and no soft cooing of the dove now breaks the deep solitude. This interesting spot was described by Mr. John Rowlands in the following paper:—

THE VAN, CAERPHILLY.

The word Van means the top or surface. There is a mountain in Caermarthenshire called the Van Fach, as well as others in the neighbourhood of Brecon. Before the Norman invasion, the whole of this country, the lordship of Senghenydd, belonged to Iforab Cadifor or Ifor Bach; when Fitzhamon conquered Glamorgan, he gave the lordship of Senghenydd to Einon ab Collwyn, as well as the lordship of Miscin. The Lewises lived at the Court, Merthyr. They resided at the Court and Pontyrhen. Lewis ap Richard Gwyn of Merthyr, a member of this family, bought the Court and Pontyrhen, a part of which was sold in the 18th century to strangers. Those parts which were not sold are now in the possession of Baroness Windsor and Mr. Wyndham Lewis. All the land from Cibur to Morlais was recovered by one of the family called Hywel Velin. The first of the family who settled at the Van was Edward Lewis, who filled the office of high sheriff for Glamorgan in the years 1548, 1555, and 1559. He was deputy custos for the county, Henry, Earl of Pembroke, being custos. It is probable that Edward Lewis bought the Van of the Earl. His son Edward the 3rd, was the founder of the Llanishen family, from whom Mr. Wyndham Lewis descends. He was succeeded by his son Edward Lewis, sheriff of Glamorgan, 1569, deputy custos of the county. He built the Lewis's house, St. Mary Street, Cardiff; that house stood where the West of England Bank now stands and the new Town Hall. He died seized in Glamorgan of Le Vanne in Bedwas, with gardens, outhouses, etc., and he held in fee the manor of Senghenydd. Edward Lewis was his son. His will was proved in London, February 3rd, 1594. He left to his widow Catherine a dwelling-house, and another house in St. Mary Street, Cardiff. To his son John Lewis he gave the lands purchased of Henry Earl of Pembroke. Sir Edward Lewis of the Van, and St. Fagan's Castle, Penmark, and Llantrythyd, Knight; born 1560, knighted at Whitehall 1603, high sheriff of Glamorgan, 1601 and 1603. In the year 1616 he purchased St. Fagan's and Pencoed, of Sir William Herbert. He died 1628, and was buried in Bedwas church, where he directed in his will that his body should be buried. He left 40*s.* to Llandaff church, to Bedwas poor 3*l.* 6*s.* 8*d.*, and the same to St. Fagan's annually. William Lewis of the Van, who was a second son, came to the possession of it on the death of an elder brother. He and his wife adhered strongly to the cause of the Parliament in the Civil War. Edward Lewis, of the Van and Bristol, was born 30th July, 1650. It appears that he died without issue, as he left the Van to his uncle Richard Lewis. Mary Lewis, his sister, married William Jephson; secondly she married Sir John Aubrey, of Llantrythyd, who was M.P. for Brackley; thirdly she married Sir Charles Kemeys, of Cefn Mably; fourthly, William Aubrey, of Brecon. Richard Lewis, of Caerleon, and afterwards of Eddington Priory and Van, was M.P. for Westbury, 1660. He devised Energlyn, in 1696, to Roger Powell. He was succeeded by his son Thomas, of Van and St. Fagan's. He was a Jacobite. He married Elizabeth Tremoxer, of St. Martin's-in-the-Fields, and left one child, Elizabeth Lewis of Van, their sole heiress, who was married at the age of 21 to Other Windsor, third Earl of Plymouth. Other Lewis Windsor, fourth Earl of Plymouth, was Lord Lieutenant of Glamorgan. This nobleman was the grandfather of Harriet Clive, Baroness Windsor.

After this the party made their way to the Castle Inn, at Caerphilly, for the important purpose of refreshing the inner man. This was very necessary, after having been some hours on the mountain top. The dinner provided was ample and good, and reflected credit on the caterers. The repast was the more highly relished, in consequence of a fear of "short commons" which had taken possession of the members, who were more than twice as numerous as dinner had been provided for. Among the company present we noticed Mr. Adams, the Revs. Archdeacon Blosse and Canon Morgan, Mr. Luard, Lieut.-Colonel Hill, Drs. Edwards and Taylor, Captains Bedford and John, Messrs. Franklin, G. Evans, Waldron, Bassett, Brown, John Morgan, Lindon, Hier Evans, Badge, Adams, junior, Revs. J. R. Jenkins, Green, and Waite, Messrs. Jones, Downing, Davie, Tomlinson, and Price, Mr. T. G. South, the Secretary of the Society, and a great many other gentlemen whose names we did not know. After dinner, the Society examined a very beautiful collection, comprising some 70 distinct species, of the mosses and lichens of this neighbourhood, which had been collected by the Rev. Professor Gagliardi during his residence here. A few notes by the Professor (who was himself unable to attend), in explanation of them, were read by Mr. Adams, and then a paper entitled "Jottings on Scorpions," was read for him by Mr. Rhys Jones. Some specimens of Egyptian and other scorpions were shown in illustration.

PROFESSOR GAGLIARDI'S PAPERS.

Lichens and Mosses! says Ruskin. Meek creatures! The first mercy of the earth, veiling with hushed softness its dintless rocks; creatures full of pity, covering with strange and tender honour the scarred disgrace of ruin, laying quiet finger on the trembling stones to teach them rest. No words that I know of will say what these mosses are. None are delicate enough, none perfect enough, none rich enough. How is one to tell of the rounded bosses of furred and beaming green, the starred divisions of rubied bloom, fine filmed, as if the rock spirits could spin porphyry as we do glass; the traceries of intricate silver and fringes of amber, lustrous, arborescent, burnished through every fibre into fitful brightness and glossy traverses of silken change, yet all subdued and pensive, and framed for simplest, sweetest offices of grace. They will not be gathered like the flowers, for chaplet or love token; but of these the wild bird will make its nest, and the wearied child his pillow.

And as the earth's first mercy, so they are its last gift to us. When all other service is vain from plant and tree, the soft mosses and grey lichen take up their watch by the head stone. The woods, the blossoms, the gift-bearing grasses, have done their part for a time, but these do service for ever. Trees for the builder's yard, flowers for the bride's chamber, corn for the granary, moss for the grave.

Yet as in one sense the humblest, in another they are the most honoured of the earth children; unfading, as motionless, the worm frets them not, and the autumn wastes not. Strong in lowliness, they neither blanch in heat nor pine in frost. To them, slow-fingered, constant-hearted, is entrusted the weaving of the dark eternal tapestries of the hills; to them, slow-pencilled, iris-dyed, the tender framing of their endless imagery. Sharing the stillness of the unimpassioned rock, they also share its endurance; and while the winds of departing spring scatter the white hawthorn blossoms like drifted snow, and summer dims on the parched meadow the drooping of its cowslip gold;—far above, among the mountains, the silver lichen spots rest, star-like, on the stone; and the gathering orange stains upon the edge of yonder western peak reflect the sunsets of a thousand years."

PROFESSOR GAGLIARDI'S JOTTINGS.

Arachnida is the name which entomologists give to every kind of spiders. In Westwood's arrangement they form Class II. of the annulose or articulated animals. It comprises not only the spiders, commonly known as such, which bear their proper entomological name of *araneidæ*, but the scorpions also, which are scientifically marked out by the names of *pedipalps* or *scorpionidæ*. The *acari* (mites), which include the well-known dog and sheep ticks; the *tardigrada* (sloths or water-bears), which, with the help of a microscope, one can easily see wallowing in a droplet of water, like swine in a mire; the *pycnogonidæ* (crab or sea-spiders); the *phalangidæ* (long-legged shepherd-spiders); the *pseudo-scorpionidæ* (book-scorpions); and the *solphryidæ* (blind, sun-avoiding insects):—all these wonderful creatures belong to the arachnida; but none of them shall have, at least for the present, aught to do with our jottings. A few preliminary hinds on the araneidæ, or spiders in general, and, if the time permits, some short observation, at the end, about the scorpion-fly or *panopa*, which, properly speaking, belong, not to the arachnida, but to the neuropterous insects, will more than sufficiently fill up our paper. Beginning then with the *araneidæ*, or commonly so-called spiders, I say—

Spiders are usually described as differing from insects, in having no *antennæ*, or feelers. The fact is they have no mandibles, the organs so called being but transformed, or—as the technical expression goes—*metamorphosed antennæ*, which are changed into prehensile—as in the case of scorpions—or masticatory parts.

Most of the members of the spider tribe seem to be got up, as it were, in octavo. They have always eight legs; owing to their fragility they are often broken, but soon mended again, by a simple process of natural renovation. Eight also are often their eyes—such is mostly the case with British spiders—which are properly called *stemmata.* These are so fitly and variously arranged that entomologists make use of them to characterise the genera. They are exceedingly useful, no doubt, to the lively spinning-jenny or crompton-mule, for looking freely in any wanted direction. Eight likewise are the spiracles, or *stigmata,* they wear on both sides of their abdomen. These are capital air-vessels wherewith the animal can easily breathe to their heart's content.

Spiders' young do not undergo any change or metamorphosis, as other properly called insects do, but freely escape from egg-like envelopes in the shape of their parents.

Such are the most conspicuous features of spiders in general, about which the most extravagant reports have been afloat, among which are some very curious stories related by Byron, Pellico, Michelet, and other famous writers. You would certainly be astonished should I tell you of the spiders of the Antilles, where they are to be bought in the market, and how much they are valued by the housekeepers for their natural cleaning instinct; or of the Siberian, which promptly destroy those myriad of troublesome midges that cloud the air during the brief Siberian summer. That, I think, has been the reason why, in the Scandinavian mythology, the world's creation was attributed to a giant spider.

But time forbids us to tarry longer amid spiders' webs, seeing we have so many, and all very interesting things to say about

> " That cold animal,
> Which, with its tail doth smite amain the nations,"

as the great American poet has lately defined the scorpion, after Dante.

Look, in the mean time, at this Cardiffian collection. This smallest of the lot was caught somewhere near the docks, where it must have been imported, most likely from some foreign country, whilst the poor harmless creature—such is certainly even the scorpion, within this fortunate island, without *baneful* poison—was skulking amid the crannies of some old frowzy box.

All these other scorpions are exotic, Egyptian probably, and therefore with a very dangerous poison, if we are to believe what Kirby and Spence have written in their much-esteemed "Introduction on Entomology," for they said that "the only means of saving the lives of our soldiers who were stung by them in Egypt was amputation."

Scorpions, whose name, the best entomologists assure us, is from an Arabic root (of a grab) which means to wound, smite or strike—are a genus of pedipalpous, pulmonary arachnida, which three names simply mean in English—spiders with feet like feelers and lungs. They have no distinct head and chest, both the which form the so-called *cephalothorax* of the common spiders. They have not even a properly distinct stomach (abdomen). All these three important members are so blended as it were together in the scorpion body, that they form one single piece, which looks somewhat like the ancient armour of a mediæval warrior in harness. This foremost broad joint (let our brother and sister naturalists have a look at it), which is called the *cephalothoracic* segment, is intended for the head-breast. The next six—or they may be seven—joints, not so broad as the first, still tolerably large, belong to the stomach, and are properly called the *abdominal* segments. There are also the last six segments, which get suddenly narrower and thinner, and are very improperly called the scorpion's tail.

Mark well this last joint. Here is the sting ! See how it terminates in a sharp crocked spur-like point. 'Tis with it that this terrible African brute pierces its prey, and sometimes also its foe to death. Horrible ! horrible ! Pray, ladies, don't fear ; there is no barbed dart concealed in this sheath to smite you with, such as bees, wasps, and similar hymenopterous insects have, even when apparently dead. This ampullaceous joint, indeed, is interiorly connected with two small yellowish glands, which get inflated like bladders, and secrete a milk-white fluid. This suddenly gushes forth, when discharged or blown out by these two scarcely perceptible orifices, by the hungry or irritated animal.

The eight spreaded legs you see well enough. These two foremost extended limbs, with a two-fingered pincer, or, as éntomologists call them, didactyle claws, very much like those of our common lobsters, and, like them, quite harmless, though they might unpleasantly pinch a naughty boy or girl who should ever take a fancy to tease the fearful animal. These two limbs, I say, are the very feelers or palpi, which, looking much like feet, gave the scorpions their proper denomination of *pedipalps*. It is with them that the greedy animal seizes hold of the insects, beetles, cockroaches, crickets, etc., which it feeds upon, after having stunned them with a stroke of its tail.

I shall not entertain you now with the description of such delicate organs as are the *trophi*, delineated by Prof. Huxley in his clever article "On the structure of the Mouth and Pharynx of the Scorpion" (Micr. Journal, viii., 280) ; but what I cannot forego, by any means, are the combs of the scorpion.

The combs are a peculiarly distinctive organ that fringes the lower part of the scorpion's breast, like the embroidered girdle of Venus in Heine's position. The number of its scaly teeth, or, as they are called, *lamellæ*, is various. They have been looked upon by some entomologists particularly to distinguish the different species. Their final use is still problematic. Nobody has yet fairly stated what is their special purpose. The most probable was given by a French author, Marcel de Serres, who thinks that the combs are providentially given to the scorpion on purpose to facilitate the progressive movements of of its body, which otherwise would be but a wormlike creeping. Latreille, however, seems rather to demur to this notion, and would fain have somebody bold enough to try the rather dangerous experiment which he proposes, of binding the scorpion's combs tightly close to its breast, and see whether after that it can move on freely as usual, or merely creep along. Moreover, he surmises that the complexity and consistency of this wonderful organ, the various number of its teeth, and their different positions, might perhaps indicate some other functions, which are not easy to be determined without such trials as very few, whether professional or amateur, entomologists would be probably willing to undertake. Perhaps, says, in conclusion, our French *savant,* they might be simple hygrometrical instruments, by which the lonely animal receives unfailing telegrams about the state of the atmosphere, and thus spares it to get out of its lair when the inclemency of the air forbids it.

The President also called attention to the volume of Transactions of the Woolhope Club, 1868, which he had received that morning from Dr. Bull, of Hereford. It consisted of a most handsomely got up book, containing numerous well-executed photographs, a series of photographs of "the remarkable trees of Herefordshire," numerous coloured and plain lithographs, and 300 pages of closely printed typography.

The Society then visited the noble ruins of Caerphilly Castle, and Mr. Luard addressed a few observations to the members upon the chief points of interest in the grand old pile, and then read copious extracts from Mr. G. T. Clarke's excellent book on Caerphilly and other castles. This brought the business of the day to a close, but the assembly continued to stroll for some time afterwards around the ruins, and examined the stones and mortar that enter into the composition of the still firm and strong masonry, and drew comparisons that were very unfavourable to our modern structures, with a few honourable exceptions. Speech-making is prohibited by a salutary rule of the Club, but the Rev. Canon Morgan begged to be permitted to break through it on the present occasion, and in a short and pithy address proposed the health of "Our excellent President, Mr. Adams." The weather was very fine throughout the day, but sometimes the sky became overcast and seemed to threaten thunder and rain. Happily these gloomy signs, which, by the bye, threw an additional sombre hue over the castle, disappeared, and the company returned home through Nantgarw soon after 8 o'clock, thoroughly pleased with their day of rational enjoyment. We sincerely hope that the Cardiff Naturalists' Society may grow and prosper, and be the means of doing much good to the town and neighbourhood of Cardiff.

At the Monthly Meeting of the Society, held on July 6th, Mr. Vivian, of Mwyndy, sent a paper (read by the President) on "Ancient Copper;" also a paper on "Birds' Nests" by the same gentleman.

NOTE ON ANCIENT COPPER.

A piece of an old copper implement, or weapon, was lately found here; from its curved and bladed form, it seems to have been part of a bill-hook or large knife. On applying the microscope to it, to observe its structure, I find it is composed of very impure metal, having about one-third of its bulk of the oxide of copper. According to the present mode of liberating the oxide from the metallic copper before it is ladled out into the moulds, a green pole is plunged into the bath of metal, causing violent ebullition, when the oxide, from its lighter gravity, rises to the surface, and is then skimmed off at the furnace front. In this piece of ancient copper, however, the oxide is retained in the mass, from which it may be inferred that the process of poling copper was not applied in the days when this was made.

BIRDS' NESTS.

A pair of tomtits, having built their nest in a climbing rose, are now busy rearing their young only a foot above the front door of our house; the male showed his fidelity and kindness to the female by feeding her assiduously during the period of incubation. As a proof of attachment to locality and confidence in man which birds will sometimes evince, I may mention, that a colony of house sparrows, having for years located in the rocks in our open workings here, continue to maintain the position, although the miners are making advances upon them, and a nest is now to be seen not more than 15 feet above the spot where a succession of rounds of holes are blasted every day; still the pair of birds keep determined possession of their domains. But for courage and tenacity of purpose in a bird I have not met with, or heard of, any instance which surpasses the following:—One of our ore-laden trucks was sent to the Swansea Vale Junction on the South Wales Railway, and was returned in a few days; directly as it came back, one of our men passed by the end of the truck, and hearing a peculiar hissing sound near him, looked into the hole in the end of the buffer, and found there a blue tomtit, sitting on her eggs and hissing a protest against disturbance. I am unable to say whether she commenced her domestic affairs before the truck was sent off full, but I think there can be scarcely a doubt that she travelled from that place here without a railway ticket, and stood well the shock of some heavy concussions.

The second Field Meeting of the Society was held at Southerndown on Tuesday, July 20th. The members went to Bridgend by train, and then in carriages to Ewenny Abbey, the first point of interest in the programme of the day. This ancient structure was erected by Maurice de Londres, fourth in descent from William de Londres, to whose lot the Lordship fell on the Conquest of Glamorgan by Fitzhamon. It is now partly in ruins, but the church, with its handsome square tower, supported by strong buttresses, is still in good preservation, and used for public worship. The style of architecture is Norman, and very massive, and, with the exception of a portion of an arch in Llandaff Cathedral, is supposed to be the oldest in the county. The age of it must be upwards of 700 years, and there is an interesting monument of its founder in the chancel. The order was Benedictine. In the building Mr. P. Price read an account of the Abbey out of Mr. Rowlands's book. The mansion is the residence of the Turberville family, who are coeval with the Conqueror, and have lived at this place uninterruptedly to the present day. The Society were much pleased with what they saw, and, after a promenade round the grounds, went on to Southerndown.

Having arrived at this place, the members strolled about the rocks and sands, and examined objects of geological and botanical interest. They were then summoned to a table rock, and with maps spread out before him, Mr. Adams explained the principal features in the strata around him. He then introduced T. Rupert Jones, Esq., F.G.S., Professor of Geology at the Royal Military College, Sandhurst, who delivered a lecture on the Primeval Rivers of Britain.

PROFESSOR JONES'S LECTURE.

THE geological action and results of Rain and Rivers may be easily recognized by even casual observers. The muddy waters of a clay country after showers, and the numerous little deltas of rain-washed grit and mud on the slopes of roads and fields where sandy soil abounds, attest the action of the rain in removing earthy material from a higher to a lower level, under ordinary circumstances. The powerful action of torrents suddenly charged with melted snow or with tropical rains, or locally flooded by a bursting water-spout, is well known, and can be likened only to the devastating agency of a broken reservoir, such as those of Huddersfield and Sheffield. In all cases mud, sand, and shingle, together with drifted timber, herbage, leaves, and water-plants, bones and carcases, insects, shells of land

and water molluscs, and other organic remnants, are slowly or suddenly moved down-stream,—laid down here, stirred up and pushed forward there,—buried deeply at one place, ceaselessly drifted to and fro at another; and such changes go on until the river-plain, having been made level by marsh-deposits, and excavated repeatedly along the wandering lines of the river's changing course, extends seaward; and the delta pushes out even into the sea, which takes more and more of the mingled detritus for its share, laying it down in the deeps and the shallows with a seemingly capricious irregularity, which is really recognizable order, dependent on the gravity of particles and the force and direction of tides and currents.

By its alluvium, or deposits of gravel, sand, and mud, often blackened with peat or charged with shells and bones, the river keeps an imperfect record of its work, as a carrying agent, in removing the ruins of the higher ground, whether reduced by the chipping frost and the grinding glacier, by the soaking mists and sapping springs, by the washing rain and raging torrent, or by all of these, assisted by the slow and sure decomposing power of carbonic acid. As a red river runs from red ground, so does a muddy river come from clay ground, and a hard-water river from limestones. The shingle of slate or quartz-rock, of granite or mica-schist, of sandstone or limestone, bears direct evidence of its local origin; and the sand from old sandstones, from the quartz of granite newly rotted, or from the frost-bitten quartz-rock, still shows traces of its birthplace. Whether in lakes or seas, such detritus tells of its former belongings, and is subject to unchangeable laws of deposition and arrangement. Clay may have been fine mud derived directly from the decomposition and degradation of felspathic rocks, or from the wear and tear of clay-slates, shales, and other argillaceous rocks; but in any case the river carries it in suspension until the current is checked in the still water of a lake, or of a broad reach or bend of the river, or in the sluggish delta-streams where they commingle with the sea. And even here the sweeping tides may drive on the clay-stained waters for many a league, until, transferred to the quiet of a land-locked bay, they drop their sediment, or, borne out to depths where nothing else can reach but drift-wood and floating shells from shore, it slowly sinks among the creatures of the deep.

Where clay has settled near a river's mouth, it is often associated with the decaying marsh-plants, drifted trees, and the water-logged leaves of successive autumns. Where rain-floods and freshets of snow-water have periodically deluged the river's course, the sediment will include the carcases and bones of drowned land animals, and the mud-choked water-creatures that lived at and near its mouth.

What rivers do now they have always done, since the land began to be drained of atmospheric waters along the cracks and crevices of the strata, and the old creeks and arms of the retiring seas. Whether the ground was left by the sea as flats and table-lands, planed horizontally by "marine denudation," or still rugged with the inequalities of crumpled strata crushed upwards by the contracting crust, the air, rain, snow, and frost have had to reduce the elevated and to fill up the hollow surface. And amidst the many changes that this terraqueous globe has suffered (changes due mainly perhaps to the reaction of internal heat on a cooling and contracting crust, with its shifting loads of water-borne sediments), such varied deposits as those of ever-changing river-systems, rising in the high lands, lifted up in each successive period, and depositing their loads of mud as stratified sediments in the corresponding water-areas, were always being made and often swept away again, but sometimes buried under other strata and kept as part of the stratified series, as we see it now.

The characteristic signs of fluviatile and lacustrine strata have been indicated above, and the kinds of shells, such as *Paludina*, *Limnæus*, *Planorbis*, *Cyrena*, *Cyclas*, *Unio*, *Anodon*, etc., are well known. So also *Cypris* and *Estheria* among the low crustacea have left their carapace-valves in fresh or brackish waters and their silts. Fishes are not good witnesses; for many genera and even species of fish inhabit both rivers and sea, and may be imbedded in the mud of either. Accumulations of vegetable matter (especially land plants) are more likely to occur in lakes and rivers than in the sea; and the skeletons of land animals get dissipated as separate bones in most instances before they reach the sea. In Shells, Corals, and Encrinites we have the best criteria for judging of the origin of strata. There are fossil beds of shells, such as *Paludina*, that are never known to live in the sea; and there are others, as *Ostrea*, that flourish only in salt water, though some individuals may have a struggling existence in brackish estuaries. Others, as *Venus* and *Turritella*, are sea-shells. Of Entomostraca, *Cythere*, *Bairdia*, *Leperditia*, and others, are habitually marine. Of Corals there are none that live in rivers or lakes; and all fresh waters, too, are destitute of Echinoderms, whether Starfishes, Encrinites, or other forms, as well as of Foraminifera, the microzoa so abundant in the fossil state. Take limestones (a various group, comprising chalk, oolite, common limestone, and marble), with the exception of a few that have originated from the chemical arrangement of carbonate of lime, as travertine, all have been made up of organic remains, namely, the calcareous shell or crust, or other support, of some of the creatures above mentioned — mostly Shells, Corals, Encrinites, and Foraminifera; and only occasional bands of limestone made of fresh-water shells (*Paludina*, *Cyrena*, etc.) are found. They tell, however, plainly of their local origin, and are associated with equally powerful and distinct witnesses of the extent and influence of rivers and lakes, deltas and lagoons, at many, if not all, periods of the earth's history.

The chief examples of such evidences as are retained among the known strata, in different parts of the world, will now be noticed in a brief review of the several great groups of geological formations.

The oldest known strata are the Laurentian, formerly involved in the little understood mass of old schists, slates, and gneiss lying below the Cambrian rocks, but of late years disentangled by Logan and others, and recognized as crumpled beds of masked and altered sandstones, shales, and limestone, such as constitute any of the later formations. They contain also some thin bands of graphite ; and if this be altered coal, that was accumulated (like the later coal) in salt-marshes and lagoons, the existence of land and its concomitant conditions is indicated thereby. In other respects the Laurentian strata appear to be of truly marine origin, with shingle and sand-banks of the coasts, and calcareous formations of the deep water.

The Cambrian rocks have not yet presented evidence of the existence of rivers or lakes. Land, however, there was ; for sand-banks under tidal influence were rippled and sun-cracked, drilled and furrowed by shore-worms and small crustaceans, and pitted by rain-drops. They imbedded here and there the sea-weeds, and, if some decide truly, land plants also (*Eophyton*). The Silurian strata are also wholly of marine origin as far as is known ; but in the uppermost formation (the Passage-beds or Ledbury Shales) land plants were brought into the shallows or estuaries, possibly by streams, and remain for us to examine as twigs, branches, and spore-cases of Lycopodiaceous plants (*Lycopodites* and *Pachytheca sphærica*). These Passage-beds lead us into the Old Red Sandstones of Herefordshire and Scotland ; and for these Mr. Godwin-Austen has strongly argued a freshwater origin. That freshwater conditions did predominate when a part at least of the Old Red of Caithness was formed, the multitudes of *Estheria membranacea* attest ; and *Anodon Jukesii* in the Upper Old Red of Ireland speaks of similar conditions. Wide regions were certainly occupied then as forest-land and by jungle-growth, with Conifers and Cryptogams, whence originated the plant-beds of New Brunswick and the coal of Gaspé. Coniferous trees, too, were not wanting in the Scottish area ; and in either case were probably washed down by rivers to the salt-marshes, with the sand, mud, and vegetable débris that form the associated sandstones and shaly layers.

On a still larger scale the succeeding period witnessed the action of rain and rivers. These nourished a rich vegetation and swept it away, to be buried beneath like material again and again, jungle on jungle, time after time, as the lagoon became a marsh, the marsh a forest, the forest a ruin of trees, silted up with river-mud, and buried beneath sea-sand, but succeeded again by marsh, and soil, and trees. The streams played their part in this old land. It was rich with trees and ferns, and the great congeners of our small club-mosses and horsetails, and furnished with land-snails, myriapods, arachnids, and insects in abundance ; reptiles too, great and various, were there, and possibly birds and mammals. The streams cutting through the older beds of peat and coal brought down the tribute of the higher ground, flooded the forests, and gradually filled the sunken areas. Basins also, barred off from the sea by shingle banks, were thus made into brackish lagoons, full of marsh-plants, and alive with reptile, fish, crustacean, and mollusc, that made the foul waters and black mud their home.

In the "Rothliegende" of the Permian Series we again find *Estheria* and Dreissena-like Molluscs that indicate brackish habitats. The Permian breccia of Worcestershire has been referred to a glacier for its origin; and so also some of the conglomerates of the Old Red series, and even of the Cambrian, have been thought to have originated in such an ice-river of the ancient lands.

In the New Red Sandstone series of Germany the shaly coal called "Lettenkohle" is of freshwater origin; and the same *Estheria minuta* that abounds therein occur also in the "Keuper" or Upper New Red of Worcestershire, with fragmentary plant remains. In the succeeding Rhætic strata the influence of occasional rivers and lakes is seen in the drifted land plants and insects, and the interpolated Estherian beds of Gloucestershire, Somersetshire, and elsewhere. The Lias of the Banat (Austria) has abundance of terrestrial plants, forming a coal; but here in the West the fossil trees and leaves of the Lias are but waif and stray, and were washed to sea with the bones of the great *Scelidosaurus*; and the sudden river floods must have killed by the million successive generations of fishes, Ammonites, and Belemnites, and buried them in thick new mud, together with the unhurt carcases of the associated Ichthyosaur and Plesiosaur. These last have their skin and bowels intact; the molluscs were imbedded with the animal in the shell, and the cuttles retain even their inkbags unemptied, for death was quicker than their fear. Melting snow produces such sudden floods in temperate climes, and the monsoons on the eastern coast of India supply such abundance of fresh water, as to kill the sea fish in myriads.

During the time that the Oolitic formations were being laid down, some rivers ran into the sea from the west (the direction that all the older rivers also had in this region probably, as the old land lay where the North Atlantic and parts of North America are now), and we find traces of their influence in the Brora coal and the Moorland coal of Yorkshire, and further south in the plant-bearing sandy shales of Collyweston, and in somewhat similar laminated oolite at Stonesfield. In the last-named beds, which supply a roofing-stone, bones of land animals have long been known to occur, especially the lower jaw-bones, such as fall off from floating carcases in rivers, as Dr. Buckland pointed out to be the case with dead dogs washed down towards the mouth of the Thames. The *Megalosaurus* then lived upon the land, as we know by his bones having been washed into the sea.

When we examine the Purbeck strata, lying on the Portland Oolite, we find thick beds of limestone formed of shells that lived in lake and estuary; and in one particular bed, mis-named a "dirt-bed," but really an old lake deposit, hundreds of bones have been found by Messrs. Beckles and Brodie, that belonged to land mammals and reptiles of small size and various kinds, herbivores, carnivores, and insectivorous. The river-system that gave rise to the Purbeck beds came from the west, as did the older rivers from the old land; and it continued in a modified form, and made the delta-beds, mud-banks, sand-shoals, and lagoon deposits, sometimes full of vegetable matter, that are known as the Wealden formation. The Megalosaur lived on, with the Iguanodon, Hylæosaur, and other monster reptiles of the times; and they not only left their drowned carcases as evidences of their existence, but their foot-tracks remain on the marshy banks now converted into sand and clay; and these are often full of *Paludina*, *Cyclas*, *Unio*, and other such-like shells, with Ferns and Cycads, and other spoils of land and river. Similar deltas and lagoons existed in Europe and America, with the allied or analogous inhabitants of the different regions. The sea again asserted its dominion over these areas, and deposited the various Cretaceous strata, until, by the silting up of the hollows, and by local elevations, land was again formed, with its marshes, lakes, and rivers. Of these, the lignites and wonderfully mammaliferous strata of Nebraska and the adjacent regions bear full witness; and the South of France is said to have similar passage-beds between the Cretaceous and the Tertiary systems. Since then, that is, during the Tertiary period and until now, continental areas, the nuclei of the present continents, have existed, with varying outlines and elevations, and with glaciers and river-systems, which have left numerous freshwater formations. The Woolwich beds are the oldest of these. The London Clay, lying on the last mentioned, was the mud of a great gulf, receiving, perhaps, the same river, with others, draining a land rich with a sub-tropical flora of Conifers, Palms, Spice-trees. &c., and stocked with Crocodiles, Serpents, Birds, and Mammals, A modification of the same drainage system afterwards washed the Palæothere and many other land animals into the seas and lakes of the subsequent period, as we see in the Barton Cliffs, in the Isle of Wight, and in the Paris district; for the Nummulitic sea came and went, and oscillations of the land changed the levels, and fresh water alternated with salt on many coasts. The Middle Tertiary times had a still more chequered scene of sea and land; for bays, straits, archipelagos, rivers, lakes, and glaciers abounded. The Dinothere, Mastodon, and other land animals, great and small, and a characteristic flora, have been preserved here and there in lake deposits of that time, often in beds of great extent and thickness.

In later Tertiary times the world had much the same continental contours as at present; but with vacillations, letting in the Glacial and Pluvial periods, when ice and water exerted their utmost power in modelling the northern hemisphere at least, and produced the great banks of gravel, and coatings of boulders and clay, that mask so much of its rocky surface. To the existing deltas, marshes, turbaries, lakes, glaciers, and river-systems, with their often subterranean streams, we need only refer as examples of the natural machinery by which fresh water acts in modifying the surface now, and has acted in times past, as shown by this brief sketch of the primæval rivers of Britain.

The long roll of the advancing tide now drowned the tones of the Professor's voice, and threatened to drown the bodies of him and his audience, and the lecture was brought to a conclusion amid the loud plaudits of the assembled company.

The next step in the day's proceedings was a very important one, viz., *dinner*, which was served up under the shade of a wood in the grounds of Dunraven Castle, and was highly relished by ladies and gentlemen now well nigh exhausted by the heat of the sun, and the severe scientific training they had undergone.

After dinner—which was enlivened by the pleasant strains of a harp—the guests strolled through the conservatory and grounds of Dunraven Castle. When they were all re-assembled on the top of the hill by the flag-staff, the President said that the next point in the programme was a paper by Mr. Franklen G. Evans, M.R.C.S., F.M.S., etc., on some Silicious Stones found in the Coal Measures, and on a White Substance found on the Cardiff Moors during a recent excavation. Mr. Evans had, upon short notice, kindly promised the paper which he would now ask him to read.

Mr. Evans, who was warmly received, said: Mr. President, Ladies and Gentlemen,—After the very able lecture we had the pleasure of hearing this morning from Professor Jones, I cannot but feel some hesitation as to the propriety of my laying before you any feeble efforts of my own. I can only plead, by way of extenuation and apology, that I was beguiled by the persuasive voice of my friend Mr. Adams to promise the paper, and having made the promise it would be unnatural in a naturalist not to perform it. Having said this much, I can only throw myself upon your clemency and forbearance, and request that you will not draw any odious comparisons.

At a recent meeting of the Cardiff Naturalists' Society, Mr. Adams exhibited some stones which were found embedded, partly in the roof and partly in the coal, in No. 3 vein in the Rhondda Valley, and Mr. Davie brought a piece of white substance which had been dug out of the excavation for the new outfall sewer. These objects are of sufficient interest to merit further notice, and as no one else better acquainted with the subject has written a paper, I would beg leave to submit a few observations in reference to them.

The stones shown by the President were rounded and black in appearance, and composed of a hard, silicious material. Their outward form seemed to be the result of the action of water, and it was stated that similar stones had been met with in the north of England in the substance of the coal, and that some of them contained a fossil plant. Mr. Adams propounded the query, "How did these things get into the coal?" To this question it would be very desirable to find an answer, and I think the only way of arriving at it is to consider some of the circumstances connected with the formation of coal.

Coal consists of the vegetable growth of a former and remote age, modified by mechanical and chemical forces, and deposited in beds of various thicknesses in certain special localities and formations. Its vegetable origin is unquestionable, and proved by the presence of leaves, ferns, reeds, cones, nuts, and trunks of trees in its substance. The microscopical characters of sections of coal also closely resemble similar sections of woody fibre. The conditions of vegetable growth in the Carboniferous period were much more rank and luxuriant than at the present day; the mean temperature was high; the atmosphere loaded with carbonic acid gas, and the surface of the earth was wet—a vast swamp perhaps, or even a shallow sea. Such warmth, moisture, and abundance of carbonic acid conduce to a rapid and gigantic growth, far in excess of anything we have ever witnessed. At intervals this vegetable material was submerged, and covered over with a deposit of sand or clay. In this way a bed was formed, and heat and water reduced the mass to a soft consistence resembling pulp, so as to give the requisite mobility to the ultimate molecules to enable chemical action to be called into play. This would have been an essential condition, because solid bodies cannot be made to combine chemically without the agency of heat, or a solvent, to cause the movement and close approximation of the minute particles of matter. The high temperature then existing has been attributed to the internal heat of the earth, which is a very possible explanation, considering the comparative nearness of the coal measures to the molten interior of the globe, and the thinness of the external crust, which even now bears a smaller proportion to the entire planet than the shell does to the egg. I must state, however, that some geologists say that this heat would not have been operative later than the Silurian period, and others consider an internal fire by no means proved. Again, it may have been due to a different distribution of land and water, and the chemical action excited would also contribute a portion of heat. The last is perhaps the most important in reference to the actual conversion of vegetable matter into coal; and when we consider the great heat often induced by fermentation in a hayrick, it appears sufficient by itself to account for the change. The ultimate elements of the tissues of plants are carbon, hydrogen, oxygen, and nitrogen. The last named, as well as the salts constituting the ash, need not be considered. The results of the forces mentioned upon the other three bodies would be the evaporation of the water. A portion of the oxygen would combine with the carbon, and form carbonic acid, and the hydrogen with another portion of carbon, to form light carburetted hydrogen, or fire-damp. By these changes the carbon would be a little diminished absolutely, but increased relatively to the other constituents; the hydrogen unaffected in quantity, but altered in combination; and the water that forms so large a per-centage of vegetable tissues would be expelled from the cells of the plants, and its place occupied by the carburetted hydrogen or fire-damp—there to remain until it should be liberated, after the lapse of countless ages, by the mandril of the collier, and perchance to deal out death and destruction in the form of a colliery explosion.

This brief account of the chemistry of coal must be taken as merely a slight sketch of its broadest features, for it entirely passes over the infinite variety of ways in which the elements of coal may be made to combine to produce new and curious results. The seam, formed as we have seen and inclosed in deposit, is made compact by the pressure of the superincumbent sand, or clay, which forms fresh strata. The differences in the quality of the mineral depend upon the variations of the formative materials, the amount of pressure and other circumstances. One great peculiarity that strikes one in considering this matter is, that whereas the luxuriant vegetation must have been more or less distributed over an enormous area, the coal-beds are confined to particular spots; and the very frequent changes of level, to bury the Carboniferous trees and plants, must have produced so much disturbance as to interfere with the steadiness of the growth. This suggests the probability that the immense masses which formed the coal-measures were not all grown on the spot, but that the vegetation of vast regions was transplanted by water currents of some kind to make up the required quantity. This view accounts for the localisation of coal, and satisfies the condition of producing a sufficient amount of vegetable matter without perpetual depression and upheavings of the surface. From the great difference in the thickness of the veins, which ranges from an inch or less to upwards of a hundred feet, it is probable that both methods may have been in operation. If this theory is correct, it also answers our worthy President's question; for if the organic materials of coal were often carried from a distance by the agency of water, the stones could very well have been carried with them, and their water-worn appearance lends additional probability to that conclusion. The fossil plants found in some of the specimens no doubt formed the nucleus for the aggregation of the silicious matter, and show a very early connection between the stony mass and the coal-forming vegetation. Having been brought to the spot, the probable pulpy condition of the incipient seam at once explains their sinking to a greater or less extent into the soft bed, and sometimes remaining partly in the roof, according to the degree of tenacity the vein had attained. Chemists tell us that the ashes of coal are partly determined by the nature of the inclosing strata, in consequence of the insinuation of minute particles; and if this be so, we cannot wonder at the penetration of any heavy substance. In the present day the nearest approach we have to the position of the commencing coal beds are the great bogs, and any one who may have had the ill-luck to sink into one of them, and the good-luck to get out again, either by his own activity or the aid of a friendly hand, will have a lively recollection of the risk he ran of being permanently embedded, and perhaps of exciting the scientific astonishment of some enterprising naturalist in after-ages. Lignite is another form of imperfect coal, in which the process might have been interrupted by some disturbance that exposed it to the air; but in this case I think it is more probable that the conditions necessary for its complete development have never been fully obtained.

In thinking over this subject I have been struck with the analogy that exists in some degree between the conversion of wood into coal, and the change of the latter into coke, as effected in a coke oven, or in a retort for the manufacture of gas. We have seen that the metamorphosis of vegetable matters into coal was attended by a loss of a great portion of its water and some of its oxygen. I believe this took place after the vein had been formed, and the atmosphere almost entirely excluded. The temperature would have been just enough to accomplish the chemical changes, and to blacken, but not absolutely to char, the mass. In the gas retort there is a cherry-red heat, and a complete expulsion of the volatile constituents. Coal therefore occupies a position more or less intermediate between wood and coke. Its evaporating power is in direct proportion to the per-centage of carbon; in other words, to the closeness of its approximation to the condition of coke. This is why anthracite, or stone coal, is the strongest fuel. Its value for illuminating purposes, on the contrary, depends upon the amount of the volatile ingredients. Hence the highly bituminous varieties are the best for the manufacture of gas. The key to the correct appreciation of the changes in wood and coal just mentioned consists in the remembrance that combustion, which we are too apt to regard simply as fire, is a phenomenon that accompanies chemical action, and varies in degree according to the intensity of that action. We have examples of the different degrees in the slow combustion of a piece of phosphorus in the atmosphere, and the night-signal of the glow-worm (*Lampyris noctiluca*) to attract the attention of her volatile spouse; in the maintenance of the temperature of animal bodies by a little more active burning of the component tissues, and the white incandescent fluid in the fiery blast-furnace. When heat is applied to wood and coal in closed vessels, a process called destructive distillation ensues, by which the chemical elements are released from existing combinations, and re-unite to form an endless variety of new compounds.

The second part of my subject is the piece of white substance brought by Mr. Davie. This material was dug out of the lower part of a thin bed of peat, about five or six feet from the surface, found in excavating for the new outfall sewer near Tyndall-street. In appearance it resembled solid tallow or suet, and was highly combustible. Upon submitting it to a microscopic examination, under a power of about 210 diameters, I found it to be composed apparently of vegetable cells full of fatty matter, and an occasional shred of woody fibre. The general form of the cells was spherical, except where altered by lateral pressure. There was a depression on the surface of most of them, which seemed to be the result of the evaporation of the more fluid portion of the fat, and a consequent shrinking of the cell wall. Under a power of about 750 diameters, more than one surface depression was seen, and some of the fibres of the cell could be made out. In comparison with this substance I examined butter, which showed oil and water globules and crystals of chloride of sodium, or common salt. Also lard, which exhibited crystals of stearic and margaric acids, but no cellular structures, which would doubtless have been destroyed by the boiling it had undergone in purifying. I then tried suet, which was very similar to the matter in question, but the cells were smaller and less distinct. Finally, I heated the white substance over a spirit lamp, and then examined it, and found all the cells burst, and the field of the microscope covered with the white fibres that had composed their walls. In the lard experiment there were very similar fibres, which probably had belonged to cells that had contained the animal fat before boiling. The conclusion I came to was, that the white material from the excavation was of vegetable origin, and analogous to animal stearine. Next to starch oily secretions are the most common in trees and plants, and perhaps their antagonism to water saved the fat cells from the destruction that overtook the parent stems in their conversion into peat.*

From the foregoing observations, it is evident that the two subjects of my paper, though apparently so different, find a connecting link in their association with coal seams and peat beds. What a marvellous illustration of Divine Providence do these great sources of fuel furnish for our contemplation ! It is a stupendous thought, that myriads of years before the foot of man trod the soil of this earth, such wonderful stores of materials so necessary for his welfare should have been by slow degrees deposited. It has been well said that if an intelligent being could have visited this globe at that time, the whole process would have appeared to him an extraordinary waste of creative power. But I think we may now say that if the same being could also revisit us and see the enormous work performed by machinery driven by the power which was so long latent in these fuels, he would then

* Some skeletons were also found in the same neighbourhood, which suggest as a possible explanation that the white substance was adipocere. This, however, was not the case, for the fatty matter was quite distinct and separated from them by a wide interval.

understand the meaning of what before seemed a mystery. Some months ago an architect was examining an old mansion in Scotland, and found that the exterior indicated more space than was known of within ; so he concluded that there must be a concealed room there. It was sought for and discovered, and a hole broken through the wall. A very curious scene then presented itself. The apartment, which had no window or visible entrance, contained a bed, table, chairs, and other furniture, and candles that had never been lighted ; the whole deeply covered with dust. The room had evidently been prepared for some distinguished person in troublous times, and it was supposed that the Pretender or his son was the intended guest, but it was not his fate to occupy it. This affecting little incident that starts up out of the dust of so many years has a human sentiment attached to it which excites our sympathy. We cannot help feeling some interest in the preparations made for a guest who did not appear, and whose bones have long since bleached in their mother earth. Have we then no interest in preparations on a magnificent scale for sojourners who though long coming did at length appear? or is the scale of them so vast that we are unable to realize the whole matter, but are content to regard it as the mere order of Nature? This cannot be so, for we must accept it as the work of the Omnipotent Jehovah, who feeds the raven and clothes the lily, and is not unmindful of the requirements of the creatures made in His own image. In return, we are only asked to acknowledge from whose hand our blessings are received, and to recognize the fact that every good gift and every perfect gift is from above, and cometh down from the Father of Lights.

When the paper was concluded, there was a general burst of applause, and Mr. Adams immediately proposed a vote of thanks to Professor Jones and Mr. Franklen Evans, for their interesting lectures, which was seconded by Dr. Taylor and carried unanimously, with a request that the papers might be published in the Transactions of the Society. This was readily assented to, but the Professor said that in his case there was a difficulty, as he had no paper, to which the President jocularly remarked that it would perhaps be found on the beach washed up by the waves.

Mr. Vivian then suggested that they should not forget their Sovereign, and proposed the singing of "God Save the Queen," which was then done right heartily and loyally. Three ringing cheers for the President were given, with a well-known ditty by way of musical honours.

This brought the business of the day to a close. Amongst the company were Mr. Adams, President; Professor Jones, F.G.S., and Mr. Franklen G. Evans, M.R.C.S., F.M.S., etc., the lecture and paper givers of the day; Mrs. Franklen Evans; Dr. Taylor, Vice-President, and Mrs. Taylor; Mr. William Vachell, Mr. Edwin Vachell; Revs. V. Saulez, J. H. Protheroe, and John Jenkins; Drs. Yellowlees and Badge; Messrs. John Morgan, Rhys Jones, Lindon, Sankey, Peter Price, Drane, Vivian, Oliver, Gooch, Holst, Davie, Beck; Mrs. Lindon, Misses Adams; Mr. T. G. South, Hon. Sec., etc. There were about 80 present. About 6.30 the party began their way back to Bridgend, and returned to Cardiff by mail train. The commissariat department, provided by Mrs. Williams, of the Queen's Hotel, was very abundant; but the conveyances were not numerous enough for the work, although the resources of the town were taxed to the utmost. The weather was lovely, and a most delightful day was spent, and the meeting was proclaimed a most decided success. The thanks of the Society are due to the Dowager Countess of Dunraven and Major Turberville for their kindness in throwing open their grounds.

At the monthly meeting of the Society, held August 10th, Mr. Adams, the President, read a letter from Mr. Vivian, of Mwyndy, inclosing a few "Notes on Silkworms," which were designed "to show that silk is but the hardened, toughened, and manufactured juice of the plant which the caterpillar feeds on." Mr. Vivian's paper is as follows:—

It is well known that silk is produced by the worm from a gum fluid in its body, wound off or drawn through its jaws, just as a manufacturer draws a metallic wire. But let us see where the gum comes from at first. A silkworm, like an architect or artisan, can only use such materials as he finds. He cannot create; and when, as naturalists, we speak of an animal or insect "secreting" a substance, we mean that it prepares and stores up a certain thing for use. Now, a silkworm makes its silk out of gum which it secretes in its body; and, from observations I have made, I find the gum is procured from the green leaves which it devours, whether they be leaves of the mulberry tree or the lettuce plant.

If we break a leaf of lettuce, we may observe a whitish fluid exuding from the pores, and especially from the most fibrous parts of the leaf; and if a drop of this fluid is allowed to stand exposed to the action of the air, it quickly hardens and assumes a darker colour. Apply a microscope to it, and scratch it with a pin, and it will be seen to draw out into threads of a silky colour and texture. During the last few days of this stage of its existence, the worm eats voraciously, and is particularly fond of the fibrous part of the leaf. It now grows rapidly, and the time when it will begin spinning may be calculated on almost to a day by holding it up to the light, for when ready to begin, the rich amber colour of the gum appears plainly through the membranes of the body. The thread is glutinous when drawn, but it quickly toughens into silk in contact with the air.

The next point I wish to observe is, "The object of spinning its cocoon." It is well known that the object is self-preservation during the time of the change of condition which therein takes place from the worm to the aurelia state ; but I am not aware that the special purpose of the cocoon has been pointed out. From observation, I gather that this period—about a fortnight—is a sort of period of incubation ; and, although it can bear, or rather the egg may preserve its germ of vitality in great cold, in this state it is absolutely necessary that an equal temperature be kept about the chrysalis, that it should not be too hot nor too cold. Now, nature has provided the best material, and the knowledge, which we call instinct, to enable it to make for itself a structure admirably adapted to the purpose desired. Silk is one of our best non-conductors of heat, as it is also of electricity. This quality arises, not only from the close gummy substance of each thread having no pores for the escape or conduction of heat, but also from the make and glassy cast of the threads. Each thread of silk, as you know, reflects light, and that which reflects light generally reflects heat rays also. The same characteristics apply in a less degree to hair, wool, cotton, and other textile substances. Then we have the make of the cocoon. When we see a silkworm at work, restlessly swaying from side to side, laying thread upon thread, we do not see the design at first. The complicated looking mass, however, is not a tangle, but an orderly arrangement ; and, when fitted with an inner case or membrane of the same gummy substance, is more powerful to resist the passage of heat, and thus to protect the inhabitant from unequal changes of temperature, than if it had been encased in a foot thickness of solid iron.

After reading the paper, the President asked the gentlemen present to give their opinions upon Mr. Vivian's notes. To this general invitation there was no response, so Mr. Adams then requested Mr. Franklen G. Evans to address the meeting on the subject.

Mr. Evans said that Mr. Vivian's observations were highly interesting, as pointing out the close resemblance between silk and the gummy matter out of which it was formed ; but he could not help thinking that the writer had rather overstated the case in saying "that silk is but the hardened, toughened, and manufactured juice of the plants fed upon." If that was so, it would be possible to make silk without the intervention of the silkworm. There are few things more interesting than the change which raw material undergoes when converted into some secretion, or fabric, by an animal body. Sometimes the resulting substance, as in the case before us, is similar in appearance to the crude matter, but more highly organized. In other instances, it is quite altered in property, as exemplified by the poison generated by the venomous serpent. Mr. Evans mentioned hair, feathers, wool, etc., in illustration of his argument; and detailed many curious, and some amusing, physiological facts in reference to them. He further stated that the gummy secretion was stored up in the caterpillar in proper receptacles, and it unquestionably underwent a change before its final conversion into silk. If the drawn-out threads of gummy material, spoken of by Mr. Vivian, were submitted to a breaking strain in comparison with the fibre of silk, the difference in their tensile strength would be at once apparent; and if a moderate degree of heat were applied, the superior tenacity and comparative indestructibility of the silken fibres would be fully established. Mr. Gooch here interposed a suggestion that silk did not exhibit a fibrous structure under the microscope. To this Mr. Evans replied that a fibrous structure was an aggregation of fibres, and that a single fibre was a mere unit in the general mass, and could not usually exhibit a quality which belonged to numbers of them together. Nevertheless, in the case of silk each thread is really composed of two fibres, spun simultaneously from the two reservoirs of secretion. They lie parallel to each other, and the quality of the article depends on the accuracy of the parallelism, which is also one of the points which distinguish it microscopically from cotton, wool, and other materials. Mr. Evans further dwelt upon the truth of Mr. Vivian's remarks on the "object of spinning its cocoon." The main intention is evidently to take care of number one, by building a sort of nest to keep the chrysalis safe and warm during the next phase of its existence. This is done by merely following a blind instinct, but the utility of the process to man is just as great as if the wants of Creation's masterpiece had been uppermost in the caterpillar's mind. This double purpose of the cocoon furnishes strong evidence of design in arranging the order of nature in relation to the necessities of mankind.

Mr. Adams regretted the absence of some silkworms and cocoons, which were intended to illustrate the paper, but unfortunately they had not arrived.

The date and locality of the next field meeting were discussed, and provisionally agreed upon.

A few new specimens were exhibited, but every addition to the materials for a public museum gives as much pain as pleasure to the Society, in consequence of the town being absolutely destitute of a building, or room even, to display the treasures entrusted to the Society. This sad state of things was the subject of some conversation amongst those present, but no one could suggest anything more substantial than hope by way of a remedy.

The third Field Meeting of the Society came off on Tuesday, August 31st. The members assembled at the Town Hall soon after nine o'clock, to the number of about fifty, with a fair proportion of ladies. Breaks were provided to convey the company to their destination, and in half an hour everything was ready for the start, which was effected in good order. The route lay along the London Road to St. Melan's, where a halt was made to examine the fine old parish church, which has recently been restored. The points of interest in the structure were explained by the Vicar, the Rev. J. W. Evans. One great peculiarity in the edifice is the position of the tower, which stands at the side of the main building, and over the little chapel connected with it. So much is this the case that the chapel has been supposed to be the original church, and the principal building an addition to it. The roof is an alcove, and its timbers are very old, but in a good state of preservation. The chancel rafters are new, and in general harmony with those of the nave, but a little more ornamental. The windows are Early English, Decorated, and Perpendicular in style, according to their date. Between the pew belonging to George Williams, Esq., of Lanrumney Hall, and the chancel, there is a large squint, as it was formerly called, a name which has given place in the present day to the more pedantic one of hagioscope. The church still has the doorway and staircase that used to lead up to the rood-loft, in which were displayed the cross and image of the Virgin. In the chapel before mentioned remains exist of ancient paneling, with tooth carving; and these were rendered more complete by Mr. Freeman, when he resided in the neighbourhood, by the addition of new panels of the same pattern. Some of the arches take a peculiar curve at their junction with the pillars on which they rest; but it is not known whether this form has any significance, or was merely a fancy on the part of the designer. They also project beyond their support, and the overhanging portion has been fastened by clamps to prevent it from falling. The porch is evidently of more recent date than the main building, as it encroaches on the masonry of one of the windows. The church is placed in a commanding position on a considerable eminence.

From St. Melan's the party went on to Bassaleg, over the old Roman road, and took a hasty view of the remains of a Roman encampment near that place. Here Mr. John Rowlands read the following paper:—

Bassaleg, the ancient Maesaleg, or Maes Syllwg. Syllwg means a view or prospect. This is one of the most interesting spots in South Wales, from its many historical associations. The church of Maesaleg is an old building of the Norman period. The walls are adorned with monuments of several of the Tredegar family. On the south side of the chancel there is one in memory of the Hon. Charles Rodney Morgan, the late M.P. for Brecon, and eldest son of Lord Tredegar; and two monuments in memory of two members of Chancellor Williams's family who died in the prime of life. The chancel window, which is of stained glass, was put up by the late Miss Lyson in memory of her father, who was vicar of this parish. In the north wall, near the west entrance, there is a tablet with a list of benefactions given by members of the Tredegar family to the poor and the parish schools, etc. The font, which is an elegant one, was presented by the Hon. Godfrey Morgan, M.P. Close to the church stands the Rectory, the residence of the Rev. Chancellor Williams. The Chancellor is highly esteemed in the parish, and has been considered an authority on all Welsh matters. The parish schoolroom stands a short distance from the Rectory. One of the most interesting objects is the site of Gwern y Cleppa, formerly the residence of Ivor Hael, the "generous," an ancestor of the family of Tredegar. This family came originally from Kilsant, in Caermarthenshire, in the time of Jestin ab Gwrgant, the Prince of Glamorgan. They are descended from Beily Mawr, King of Britain, in a direct line. Llewellyn ab Ivor, Lord of St. Clere, county Caermarthen, married Angharad, daughter and heiress of Morgan Meredith, knight, of Tredegar. The eldest son of Llewellyn ab Ivor was Morgan ab Llewellyn, of Tredegar; and the second son was Ivor Hael, the generous lord of Maesaleg; he lived at Gwern y Cleppa. Gwern y Cleppa stood on a hill which commanded a fine view of the surrounding country. The hospitable mansion at Gwern y Cleppa has been in ruins for centuries; the paths where the muse used to tread are now the haunts of the moping owl.

Y llwybrau gynt lle bu'r gan
Yw lleoedd y ddallhuan.

In the time of Ivor Hael, an Eisteddfod, or a congress of bards, was held at Gwern y Cleppa, under the patronage of the lord of Maesaleg. He and his wife Nest were noted for their hospitality; his gates and his halls were always open. This generous spirit is a peculiar trait in the character of the Tredegar family. With all due deference to Mr. Bright and other Radical illusionists, we cannot help paying a tribute of respect to our old families ; our country would be a kind of wilderness without them. To them we are indebted for our charitable institutions, aye, for our liberty in this country. Centuries ago every family had its bard and harper. The family bard of Gwern y Cleppa was David ab Gwilym, who is styled the father of Welsh poetry. He lived in the early part of the fourteenth century. We give the following extracts from one of his poems to the generous Lord of Maesaleg :

TO IVOR, THE LIBERAL.

Thou Ivor, darling of the muse,
Who through the world thy fame pursues,
Proclaims thy worth in every clime,
Whilst rapture fills her lay sublime,
And feels her thrilling soul expand,
Whilst fostered by thy bounteous hand;
Thy ample gate, thy ample hall,
Are ever opening wide to all.
And, warm'd in Heaven, thy ampler mind
Dilates in love to all mankind;
The poor from thee with joy return,
They bless thy name, they cease to mourn;
And bid the God who knew their grief
Reward thy hand that gave relief.

As lately sitting at thy board
Where every guest thy worth ador'd,
With grateful warmth I tun'd my lays,
And felt high transport in thy praise;
Whilst nobles, dukes, and barons bold.
Sprung from those heroes fam'd of old,
United, anxious to proclaim,
The peerless glories of thy name—
Name far renown'd for worth complete,
The greatest of the truly great.

* * * * *

To sing thy deeds, I often rove
Through stately Wenallt's verdant grove,
When May displays her florant hues,
Invites to joy the tuneful muse.
I feast on thee the shades among,
On luxuries of ancient song.
Thy princely stock was ever grac'd
With martial sons and daughters chaste;
The noblest virtues all combine
To gild the glory of thy line.

David ab Gwilym was the son of Gwilym Gam, of Bro Ginin, near Aberystwith, and his mother was Ardydfyl. He was prematurely born under a hedge, near Llandaff, where his mother died the next day ; and he was christened on her coffin. The following lines are said to have been composed by Gwilym Gam over her grave :

In memory of Ardydfyl, whom I yet
Shall join, fair gentle form, on Olivet,
God's holy hill! an angel to my eyes,
In choir of saints above the starry skies.
Depriv'd of her, oh! what waste of tears,
To my lorn soul this dreary world appears;
Plac'd on its brink, to my long home I shed
My gush of anguish for Ardydfyl dead.

After paying his last farewell, he took his infant son to Gwern y Cleppa, to his relative Ivor Hael, where he lived until the death of his father, when he returned to Bro Ginin. David did not remain long there. He returned to Gwern y Cleppa, where he became an agent to Ivor Hael, and superintended the education of his daughter Angharad, who died young. He remained here until the death of Ivor Hael and his wife, Nest, who died of a glandular plague, at the palace of the Bishop of Llandaff. Both died at the same time; and John Pascall, Bishop of Llandaff, died of the same plague in the year 1360, in the thirty-fourth year of King Edward the Third. After this event, David travelled through the Principality, returning now and then to Glamorgan, where he was elected to the Bardic chair of Glamorgan. After his father's death, he returned to Bro Ginin, to his patrimony. In his old age he retired to the Abbey of Talyllychan, near Llandilo-Vawr, where he breathed his last, about the fortieth year of Edward the Third's reign. He had several contests with the bards of his time, and he always came off victorious. Rhys Meigan, one of his rivals, was so deeply affected by one of David's satires against him that he dropped down dead.

The Rev. Evan Evans (Jellan Brydydd Hir), a great genius, who was born in the year 1730, at Cynhawdref, in the parish of Lledrod, Cardiganshire, was at one time a curate of Bassaleg. He received his classical education at Ystradmeurig, under the celebrated Mr. Edward Richards, the founder of that famous school. His talents were chiefly classical. In his youth, he made himself eminent as a Latin and Greek scholar, and studied Hebrew under the Rev. Mr. Barker, at the Caermarthen Grammar School, then in the heyday of its glory. After receiving orders, he officiated as curate at Newick, in Kent, and other places. Having received a college education, he became the associate of many of the most talented men of the day, and his society was courted by every gentleman of erudition and taste in the Principality. Owing to disappointments, he gave himself up to despair, and was at last reduced to penury. Dr. Warren, the Bishop of St. David's, had too much discrimination and generosity to suffer a man of such brilliant talents and erudition to fall into poverty, and he allowed him an annual income, and Paul Panton, Esq., of Plâsgwyn, some time afterwards granted him an annuity for life, and, in return, Mr. Evans left him his valuable collection of MSS., which amounted to above a hundred volumes of various sizes. A great many of them are now in the possession of the Rev. Daniel Silvan Evans, B.D., the talented rector of Llan-ym-Mawddy, who is about publishing them. Evans died in August, 1789, in the 58th year of his age, and was buried at Lledrod churchyard ; and I am sorry to say that his grave is unknown ; there is nothing to indicate his resting-place. He was the author of the "Dissertatione Bardis," and other works, which were published in his lifetime. He was a great admirer of David ab Gwilym and Ivor Hael, and it is said that he walked all the way from Cardiganshire to see the ruins of Ivor Hael's palace at Gwern y Cleppa ; on which occasion he composed some touching stanzas, of which the following is a translation. It is impossible to do them justice in a translation.

TO IVOR HAEL'S PALACE.

Amidst its alders Ivor's palace lies,
In piles of ruins to my wandering eyes,
The bramble there and the prickly thistle reign,
And cursed thorns assert their wide domain.

No longer bards inspir'd thy table grace,
Nor hospitable deeds adorn the place;
No more the generous owner gives his gold
To modest merit as to bards of old.

In plaintive verse his Ivor Gwilym moans,
His patron lost, the pensive poet groans;
What greater grief that Ivor's lofty hall
Should now with screeching owls rehearse its fall.

Attend, ye great, and hear the solemn sound,
How short your greatness this proclaims around;
Strange that such pride should fill the human breast,
Yon ruinous walls the vanity attest.

"Sic transit gloria mundi."

It appears that a priory of black monks had a cell at Maesaleg, which was attached to Glastonbury, which was given by Robert de Haya and Gundreda, his wife, between 1101 and 1120; but this cell fell into disuse long before the Reformation. In the vale below Gwern y Cleppa, on the banks of the Ebbw, stands Tredegar, the stately mansion of Lord Tredegar, with its extensive park well stocked with deer,

"Where they bound with gladness free,
And the heath is bent by the singing bee."

Tredegar is one of the old mansions of the "olden time," where old customs are still kept up. As I have stated already, this family is one of the oldest in Wales. They can trace their descent to Beili Mawr, or "the Great," King of Britain ; and the Morgans of Tredegar, Machen, and Lantarnam have played a conspicuous part in the annals of Gwent and Morganwg.

The next point of interest in the programme was the examination of the church of St. Woolos, at Newport. This edifice has a fine Norman interior, with additions of a later period. The Norman arch of entrance to the nave is particularly fine, and the pillars supporting it are supposed to have had a Roman origin. There is also a handsome square tower, built of Old Red Sandstone, relieved with Bath stone. The great defect in the structure is the organ gallery, which is heavy, unsightly, and obstructive, and quite in the wrong place. The party were conducted through the church by the Rev. A. Blundell.

The Society then proceeded to Caerleon, where they were met by John Edward Lee, Esq., F.G.S., of The Priory, who very kindly acted as conductor throughout the day, and described the antiquarian remains which are so abundant in this picturesque and interesting locality. Under his guidance, the Museum was visited, and its rich and varied contents of monuments, urns, pottery, coins, flint and metal implements, tessellated pavements, coffins, etc., were pointed out and explained by him with great clearness and never-failing urbanity. The site of a Roman villa was next visited, but very little remains to greet the eye, and the company could only fill up the picture in imagination from the vivid description given of it by Mr. Lee, as it existed within his memory. A large, well-wooded mound, in close proximity to the villa site, was next examined, and excited much attention as an object of antiquity, and a place of very agreeable resort.

It being now three o'clock, the company sat down to dinner in the open air, at a spot known as "King Arthur's Round Table," and among the company present were—Mr. Adams, F.G.S., the President of the Society; Mrs. and Miss Adams; Rev. Canon Morgan; Mr. Franklen G. Evans, M.R.C.S., F.M S.; Mrs. Evans; Miss Chester Thomas, of Neath; Mr. Jefferies, Pentyrch; Mr. John Morgan; Mrs. and Miss Morgan; Capt. Bedford, R.N.; Rev. A. Blundell, Newport; Rev. J. W. Evans, St. Melan's; Rev. Mr. Hunter, London; Mr. Harrison and the Misses Harrison; Mr. Milward; Dr. Badge; Messrs. Tomlinson, Peter Price, Wightman, and Evans, of Pengam; and Mr. R. Rhys Jones, Hon. Secretary, who arranged all the details of the excursion very satisfactorily.

After dinner, a paper was read by the Rev. Canon Morgan, on "Geology and Scripture," which was well received and loudly applauded, and acknowledged by a unanimous vote of thanks.

THE REV. CANON W. LEIGH MORGAN'S PAPER ON GEOLOGY AND SCRIPTURE.

At the request of your Secretary, I appear before you to make a few remarks upon a subject that is to me most interesting, viz.,—the consistency of Geological Discoveries with Divine Revelation. And in making my remarks I do not pretend to say anything that may be new, even to the least informed amongst us. As a clergyman, fond of science had I time to pursue it, I have chosen "Geology and Scripture," as a matter most in agreement with my own studies, and as affecting the deepest desires of my heart.

In reading my Bible, and thinking over its contents, I am very careful to distinguish between God's word and man's interpretation of that word, and to give to each its own separate importance. I know how individuals have gone astray, and how the Church, both of the Jew and of the Christian, has gone wrong, when "taught for doctrine the commandments of men."

In consequence of the varieties and diversities of men's teaching, increased by the investigations and discoveries of Astronomy and Geology, no portion of the Bible is more difficult to be understood than the first chapter of the book of Genesis, in which Moses gives a detailed account of the creation of the earth, and of its present fauna and flora.

In 1804—now 65 years ago—a clergyman of the Established Church of Scotland, whilst lecturing at St. Andrew's upon the various properties of the earths of the chemist, alluded to the science, then in its infancy, that specially deals with the rocks and soils which these earths compose, and said,—"There is a prejudice against the speculations of the Geologist which I am anxious to remove. It has been said that they nurture infidel propensities. It has been alleged that Geology, by referring the origin of the globe to a higher antiquity than is assigned to it by the writings of Moses, undermines our faith in the inspiration of the Bible, and in all the animating prospects of the immortality which it unfolds. This is a false alarm. The writings of Moses do not fix the antiquity of the Globe."

I need hardly say this clergyman was the great and good Dr. Chalmers,—and this bold proposition, made more than sixty years ago, by a lecturer then comparatively obscure, respecting Geology, at that time scarcely acknowledged as a science, has been fully recognized by the most learned and brightest ornaments of our own Church, as well as by the most scientific of our Nonconformist brethren.

The recognition of this proposition has at once removed a mountain of difficulty, and we must fairly acknowledge that it is quite in agreement with the Mosaic narrative. "It teaches, and teaches truly," says that accurate observer, Hugh Miller, "that between the first act of creation, which evoked out of the previous nothing the matter of the heavens and earth, and the first act of the first day's work recorded in

Genesis, periods of vast duration may have intervened; but, further, it insists that the days themselves were but natural days of twenty-four hours each; and that, ere they began, the earth, though mayhap in the previous period a fair residence of life, had become void and formless, and the sun, moon, and stars, though mayhap they had before given light, had been, at least in relation to our planet, temporarily extinguished. In short, while it teaches that the successive creations of the Geologists may all have found ample room in the period preceding that creation to which man belongs, it teaches also that the record in Genesis bears reference to but the existing creation, and that there lay between it and the preceding ones a chaotic period of death and darkness."

Such is the teaching of Chalmers, and it is still, with some exceptions, adopted by geologists of the present day. I do not say this teaching takes away all the difficulties of the explanation of the Mosaic chapter of man's creation, but that it removes a great difficulty. The remaining difficulties are as to whether the six days of creation are natural days of twenty-four hours or lengthened periods of years. There is a difficulty also as to the arrangement of light on the fourth day. I beg to make one or two remarks here.

I.—Before we can arrive at any correct conclusion as to the agreement between the facts of Science and the statements of Scripture, there must be a full and accurate knowledge of the one, and a fair and faithful interpretation of the other. Science must be rightly understood, and Scripture correctly interpreted. For the want of this, how often have the Scriptures and Science appeared to contradict each other? Let me remind you of a remarkable instance. Some 300 years ago a solemn conclave of Cardinals condemned Galileo for holding opinions respecting the motions of the sun and the earth, and pronounced them to be "philosophically false, and formally heretical, because expressly contrary to Holy Scripture." We now know that these people were wrong in their science, and wrong in their interpretation of the Bible also. But they relied upon such Biblical statements as these—"Sun, stand thou still upon Gibeon, and thou moon in the valley of Ajalon; and the sun stood still, and hasted not to go down about a a whole day." I need hardly say that Joshua and the people knew no better, and could not understand more correct scientific speaking. The result to them was the same—a lengthening of the day of victory; whether the earth revolved around the sun, or whether the sun revolved around the earth. The other expressions are these: "The sun is as a bridegroom coming out of his chamber, and rejoiceth as a strong man to run a race."—Psalm xix. 5. "The sun knoweth his going down."—Psalm civ. 19. "The sun ariseth and the sun goeth down."—Eccl. i. 5. Again, "the world is established that it cannot be moved."—Psalm ciii. 1. "Thou hast established the earth, and it abideth."—Psalm cxix. 90.

These expressions are clearly according to appearances; and we ourselves to this day, in our speaking and writing, make use of them. They contain no religious error. We understand them better and more correctly than our forefathers did, yet we have still to wait for more truthful discoveries upon many scientific points, and especially in the researches of Geology. We now know that Peter's language in the last chapter of his second epistle is not contrary to the language of the Psalmist and of Joshua.

II.—The present dispensation is the dispensation of man, giving an account of man's creation, of man's history, and of man's redemption. What other and previous dispensations there may have been, we do not know, and it is idle, and sometimes worse than idle, to speculate. The Bible is certainly suggestive of one previous dispensation,—viz., the dispensation of angels. And of these we read that some of them kept not their first estate. Man was not, therefore, the first created intelligence that sinned and rebelled against his Maker. The tempter of man is mentioned as early upon the stage of man's history; and he is still connected with that history, and will be so to the end of this dispensation. In interpretating Scripture, therefore, we must never lose sight of the fact that it is man's history; and Moses, in giving an account of his creation, gives only so much of it as relates to the heavens and the earth as is necessarily associated with that history. If we then agree with Dr. Chalmers's view of the first chapter of Genesis, would it not be right to say that the work of the six days consisted in forming the present system of things, and that in the first verse we have an account of the creation of the ancient earth and heavens, which existed long before the six days' work of creation commenced?

It formed no part of the object which the sacred historian had in view to enlighten us upon the occurrences of the interval which we have supposed took place between the first creation of the earth and the placing of man upon it. Moses, therefore, describes only so much of the work of creation as was associated with man. Previous events, as they did not immediately affect his history of man and of man's dwelling-place, are left, as all the facts of natural science are left, unnoticed in Scripture, and to be discovered by other means.

If we are right in these observations, then I certainly do not see any disagreement between the Bible and Geology—between the works of God and the word of God. If we believe that Moses describes not fossils, but only existing species, all our difficulties disappear.

We are bound to look upon facts, and by the soundest reasoning of inductive philosophy to accept them, and to argue upon them. And as it is one of the maxims of true philosophy never to shrink from a doctrine which has evidence on its side, so is it another of its maxims, equally essential to it, never to encourage any doctrine when this evidence is wanting.

I will only add one further remark. We are not driven to our interpretation of the first chapter of Genesis by the discoveries of Geology only, for the fathers of the early Church have given a similar interpretation before the existence of Geology. And such names as these are given to us: Augustine, Theodoret, Justin Martyr, Gregory Nazianzen, Basil and Origen. I will conclude with a writer nearer our own day —160 years ago. Bishop Patrick, in his admirable commentary, says: "How long all things continued in mere confusion after the chaos was created, before light was extracted from it, we are not told. It might have been, for anything that is here revealed, a great while. And all that time the mighty Spirit was making such motions in it as prepared, disposed, and ripened every part of it, for such productions as were to appear successively in such spaces of time as are hereafterwards mentioned by Moses, who informs us that after things were digested and made ready to be wrought into form, God produced every day, for six days together, some creature or other, till all was finished, of which light was the very first."

As to the existence of death in the world previous to the fall of Adam, I see nothing in Scripture to contradict it. The sin of man has brought about the death of man, but there is no Scriptural authority for more than this.

As to the deluge in the days of Noah, it may be pleasing to some of you to know that Dean Conybeare told me that the most rational and satisfactory account of it was that given by Dr. Pye Smith, who makes it local, co-existent with man's residence at the time, and so answering the purpose of God in punishing man for his iniquity.

Let me conclude with a quotation from Professor Miller's address at the British Association, at Exeter, on the 23rd of August last, to 2,000 working men:—"The material works of God are laid open to our investigation to an extent which is really unlimited; and one of the noblest occupations in which man can be engaged is in thus tracing the footprints of his Creator, and in discovering the laws which He has imposed upon matter, and by which suns and systems are controlled. But, if there be a spiritual as well as a material universe, we must not the less have our material upon which to work before we can attempt its investigation. It is for the purpose of supplying this material, and of instructing us in this most important of all knowledge, that the Bible professes to have been given; since it is a knowledge which we might for ever seek in vain, in meditating on the works of creation, however successful in unveiling its secrets by scientific investigation. While, then, we explore, in admiration and delight, what are called the wonders of Nature, or, as they truly are, the works of Him who is the Author of Nature, let us not forget to study with equal diligence that volume which alone professes to reveal to us the spiritual, the unseen, and the eternal—a study which, to be effectual, must be approached in the spirit of prayer for that guidance which is promised to every one who asks in the belief that, so asking, he shall receive."

Mr. Lee, accompanied by Miss Lee, then invited the Society to the Priory, to examine his splendid collection of fossils and other objects of high interest and great antiquity. Claret-cup, tea and coffee, etc., were provided for the many guests, and everything which thoughtfulness and kind feeling could suggest was promptly supplied to promote the comfort of all present. The unaffected hospitality of Mr. Lee and his family contributed not a little to the success and enjoyment of the day, and was warmly acknowledged by the Society. At 7 o'clock, p.m., the party commenced the return journey to Cardiff, and arrived safely and in good time.

The monthly meeting of the Society was held at the Town Hall on Tuesday evening, October 6th. There was an unusually large attendance of members and a fair sprinkling of ladies present; William Adams, Esq., F.G.S., President, in the chair. After the routine business and balloting for new members, the subjoined paper on "Intelligence and Instinct," prepared by Dr. Taylor, was read by Franklen G. Evans, Esq., at the request of the President, in consequence of Dr. Taylor's absence. The paper was listened to with attention, and elicited the encomiums of all present. After which some interesting and instructive experiments were made by Mr. Edmund Brown, M.R.C.S., of Mountain Ash, on the "Inductorium and Electric Light." The members were highly pleased with the results, and unanimously passed a vote of thanks to Mr. Brown.

DR. TAYLOR'S PAPER ON INTELLIGENCE AND INSTINCT.

THE actions guided by instinct and intelligence, respectively, may be usually distinguished by the two following tests: 1. Although, in most cases, experience is required to give the will command over the muscles concerned in its operations, no experience or education is required in order that the different actions which result from an instinctive impulse may follow one another with unerring precision. 2. Instinctive actions are performed by the different individuals of the same species, nearly, if not exactly, in the same manner; presenting no such variation of the means applied to the objects in view, and admitting of no such improvements in the progress of life, or in the succession of ages, as we observe in the habits of individual men, or in the manners and customs of nations, which are all for the most part adapted through the attainment of particular ends, by voluntary efforts guided and directed by reason.

Where we find individual animals "learning wisdom by experience," and acquiring the power of performing actions which do not correspond with their natural instincts, we cannot do otherwise than regard them as possessed of a certain degree of intelligence by which they are rendered susceptible of education.

Besides the material substance of which the body is constructed, there is also an immaterial principle, which, though it eludes detection, is none the less real, and to which we are constantly obliged to recur in considering the phenomena of life. That immaterial principle originates with the body, and is developed with it, while yet it is totally apart from it. The study of this inscrutable principle belongs to one of the highest branches of philosophy, and I shall here merely allude to some of its phenomena which elucidate the development and rank of animals.

The amount of reasoning power possessed by some of the lower order of animals may be considered as very much on a par with that exhibited by an intelligent child about the time when it is learning to speak. One of its first exercises is in the connection or association of ideas, which is the source of the faculty of memory, and this becomes the foundation of that power of profiting by experience, which is manifested in the actions of animals that are distinguished for intelligence. The organs of sense are the instruments for receiving sensations, but they are not the faculty itself, without which they would be useless. We all know that the eye and the ear may be open to sights and sounds about us, but if the mind happens to be pre-occupied we perceive them not. We may even be searching for something which actually lies within the reach or compass of our vision : the light enters the eye as usual, and the image is formed on the retina ; but, to use a common expression, we look without seeing, unless the mind that perceives is directed to the object.

In addition to the faculty of perceiving sensations, the higher animals have also the faculty of recalling past impressions, or the power of memory. Many animals retain a recollection of pleasure or pain which they have experienced, and seek to avoid the objects which may have produced these sensations, and in so doing they give proof of judgment. This fact proves that animals have the faculty of comparing the sensations and of deriving conclusions from them ; in other words, that they carry on a process of reasoning.

These different faculties taken together constitute intelligence. It has been stated that the relative amount of intelligence in different animals bears a petty constant proportion to the size and development of the cerebral hemispheres. That size alone, however, does not produce the difference, is evident from a number of facts. As we advance from the lower to the higher vertebrata, we observe an obvious advance in the complexity of the structure of the brain. In proportion to the increase in number and depth of the convolutions by which its surface is extended, do we find an increase in the thickness of the layer of grey or vesicular matter, which seems to be the real centre of all the operations of the organ.

In man this superior principle, which is an emanation of the Divine nature, manifests itself in all its splendour. God "breathed into him the breath of life, and man became a living soul." It is man's prerogative, and his alone, to regulate his conduct by the deductions of reason ; he has the faculty of exercising his judgment not only upon the objects which surround him, and of apprehending the many relations which exist between himself and the external world, but he may also apply his reason to immaterial things, observe the operations of his own intellect, and by the analysis of his own faculties may arrive at the consciousness of his own nature. Other animals cannot aspire to conceptions of this kind ; they perceive only such subjects or objects as immediately strike their senses, and are capable of continuous efforts of the reasoning faculty in regard to them. But their conduct is frequently regulated by another principle of inferior order, called Instinct, still derived from the immaterial principle.

Under the guidance of instinct, animals are enabled to perform certain operations in one undeviating manner, without instruction. When man chooses wood and stone as the materials for his dwelling, in preference to straw and leaves, it is because he has learned by experience, or because his associates have informed him, that these materials are more suitable for the purpose. But the bee requires no instruction in building her comb. She selects at once the fittest materials, and employs them with the greatest economy ; and the young bee exhibits in this respect as much discernment as those who have had the benefit of long experience. She performs her task without previous study, and, to all appearances, without the consciousness of its utility, being in some sense impelled to it by a blind impulse.

If, however, we judge of the instinctive acts of animals, when compared with the acts of intelligence, by the relative perfection of their products, we may be led into gross errors, as a single example will show. No one will deny that the honeycomb is constructed with more art and care than the huts of many tribes of men ; and yet who would presume to conclude from this that the bee is superior in intelligence to the inhabitant of the desert or of the primeval forest ? It is evident, on the contrary, that in this particular case we are not to judge of the artisan by his work. As a work of man, a structure as perfect in all respects as a honeycomb would indicate very complicated mental operations, and probably many preliminary experiments.

The instinctive action of animals relates either to the procuring of food or to the rearing of their young ; in other words, they have for their end the preservation of the individual and of the species. It is by instinct that the leopard conceals himself and awaits the approach of his prey. It is equally by instinct that the spider spreads his web to entangle the flies which approach it.

Some animals go beyond these immediate precautions ; their instinct leads them to make provision for the future. Thus, the squirrel lays in his store of nuts and acorns during the autumn, and deposits them in cavities of trees, which he readily finds again in winter. The bee, more than any other animal, labours in view of the future, and she has become the emblem of order and domestic economy.

Instinct exhibits itself in a no less striking manner in the anxiety which animals manifest for the welfare of their anticipated progeny. All birds build nests for the shelter and nurture of their young, and in some cases these nests are made exceedingly comfortable. Others show very great ingenuity in concealing their nests from the eyes of their enemies, or in placing them beyond their reach.

It is among insects that the instinctive solicitude for the welfare of their progeny is everywhere exhibited in the most striking manner. The bees and wasps not only prepare cells for each of their eggs, but take care, before closing the cells, to deposit in each of them something appropriate for the nourishment of the future young. It is by the dictate of instinct, also, that vast numbers of animals of the same species associate at certain periods of the year for migration from one region to another; as the swallows and passenger pigeons, which are sometimes met with in countless flocks.

Other animals live naturally in large societies, and labour in common. This is the case with the ants and the bees. Among the latter, even the kind of labour for each member of the community is determined beforehand by instinct. Some of them collect only honey and wax; others are charged with the care and education of the young; whilst others are the natural chiefs of the colony.

There are certain animals so guided by instinct as to live like pirates on the fruits of others' labour. The lestris, or jager, will not take the trouble to catch fish for itself, but pursues the gulls until, worn out by the pursuit, they eject their prey from their crop. Some ants make war upon others less powerful, take their young away to their nests, and oblige them to labour in slavery.

There is a striking relation between the volume of the brain, compared with the size of the body, and the degree of intelligence which an animal may attain. The brain of man is the most voluminous of all, and among other animals there is every gradation in this respect. In general, an animal is the more intelligent in proportion as its brain bears a greater resemblance to that of man.

The relation between instinct and the nervous system does not present so intimate a correspondence as exists between the intellect and the brain. Animals which have a most striking development of instinct, as the ants and bees, belong to a division of the animal kingdom where the nervous system is much less developed than that of the vertebrata, since they have only ganglion, without a proper brain. There is a certain antagonism between instinct and intelligence, so that instinct loses its force and peculiar character whenever intelligence becomes developed. Instinct plays but a secondary part in man; he is not, however, entirely devoid of it. Some of his actions are prompted by instinct, as, for instance, the attempts of the infant to nurse. The fact, again, that these instinctive actions mostly belong to infancy, when intelligence is but slightly developed, goes to confirm the last proposition. We perceive the presence of intelligence, also, in the difference of character which we encounter among the various individuals of the same species; thus, every one knows that there are stupid dogs and clever dogs, ill-tempered dogs and good-tempered dogs, as there are stupid men and clever men, ill-tempered men and good-tempered men. But no one could distinguish between a stupid bee or a clever bee, or between a good-tempered wasp and an ill-tempered wasp, simply because all the actions of these animals are prompted by an unvarying instinct.

The opportunities of public meetings for discussion, for instruction, and for amusement, are an advantage which can only be appreciated by being first enjoyed and proved. There are a thousand little defects and infirmities of our common nature which an enlarged intercourse with each other on such occasions has an irresistible tendency to eradicate and overcome. It is a great privilege, after the business of the day is over, which occupies most of us beyond what we feel to be healthful for mind or body, to be able to repair the "waste of tissue," to feel, as it were, a renewal of life for a few hours of calm and rational enjoyment, so that, in the words of the Psalmist, "Night unto night giveth knowledge."

I beg, therefore, in conclusion, to ask the members of our Society to regard the objects and hours of our field meetings—few, comparatively, and far between as they must be—as moments of important and responsible purpose. There should not be an object of science or of archæological interest unexplored in this county, which abounds with both; not a plant, or a pebble, or a rock, nor a place of interest unnoted and unclassified. We have railroad maps, and ordnance maps, and geological maps; but there is a map still wanting which shall rescue every spot from the obliterating hand of Time and the equally injurious oversight of forgetfulness, unappreciation, or ignorance. This is one of our tasks, and has more than once been urged upon the members of our Society by our very able and worthy President, Mr. Adams. I earnestly invite every one who hears me, and I ardently look myself to its accomplishment, and that, under God's blessing, this young and vigorous Society may be of great public and private benefit to this town and neighbourhood.

BAROMETRICAL OBSERVATIONS MADE

1868.	AT TYNANT, PENTYRCH, By Mr. F. G. Evans, F.M.S.						AT TREDEGARVILLE, CARDIFF, By Mr. William Adams, F.G.S.				
	Monthly Mean.	Highest Reading at 9 a.m.		Lowest Reading at 9 a.m.		Mean Temperature.	Monthly Mean.	Highest Reading at 9 a.m.		Lowest Reading at 9 a.m.	
	Inches.	Date.	Inches.	Date.	Inches.	Degrees.	Inches.	Date.	Inches.	Date.	Inches.
January	29·94	29th	30·35	22nd	29·03	38·7	29·870	29th	30·268	19th	28·994
February	30·19	10th	30·62	1st	29·37	44·2	30·121	10th	30·562	1st	29·318
March	30·06	29th	30·65	11th	29·25	45·5	29·976	29th	30·562	11th	29·194
April	30·01	1st & 2nd	30·48	20th	28·93	48·8	29·939	15th	30·450	20th	28·948
May	30·06	14th	30·36	23rd	29·55	56·7	29·985	14th	30·298	23rd	29 400
June	30·25	29th	30·47	22nd	29·74	60·6	30·191	24th	30·500	22nd	29·628
July	30·19	24th	30·50	29th	29·81	66·6	30·115	22nd	30·500	29th	29·650
August	29·98	1st	30·40	22nd	29·32	62·3	29·915	1st	30·366	22nd	29·224
September	29·55	9th	30·45	30th	29·13	59·2	29·817	10th	30·276	29th	29·138
October	30·04	28th	30·46	24th	29·46	48·4	29·948	28th	30·440	17th	29·572
November	30·08	13th	30·71	22nd	29·02	42·4	29·969	13th	30·590	22nd	29·022
December	29·54	9th	30·25	24th	28·72	46·2	30·719	9th	30·150	27th	28·910
Yearly Mean	29·99	Nov. 13	30·71	Dec. 24	28·72	51·6	30·047	Nov. 13	30·590	Dec. 27	28·910

BAROMETRICAL OBSERVATIONS MADE

1869.	AT TYNANT, PENTYRCH, By Mr. F. G. Evans, F.M.S.						AT TREDEGARVILLE, CARDIFF. By Mr. William Adams, F.G.S.				
	Monthly Mean.	Highest Reading at 9 a.m.		Lowest Reading at 9 a.m.		Mean Temperature.	Monthly Mean.	Highest Reading at 9 a.m.		Lowest Reading at 9 a.m.	
	Inches.	Date.	Inches.	Date.	Inches.	Degrees.	Inches.	Date.	Inches.	Date.	Inches.
January	30·02	9th	30·56	29th	28·98	43·0	29·473	1st	30·497	29th	28·878
February	29·70	15th	30·44	1st	28·84	45·7	29·886	15th	30·331	1st	28·752
March	29·39	23rd	30·35	17th	29·24	40·5	30·111	22nd	30 301	17th	29·122
April	30·06	13th&29th	30·38	16th	29·23	51·0	29·915	26th	30·210	16th	29.137
May	29·86	13th	30·31	7th	29·11	50·7	29·745	13th	30·200	7th	29·076
June	30·18	28th	30·40	13th&14th	29·64	57·5	30·026	9th	30 353	14th	29·440
July	29·23	10th	30·50	26th	29 89	63·1	30·021	10th	30·402	26th	29·747
August	30·22	17th, 18th, and 31st	30·47	9th	29·80	61·3	30·082	20th	30·347	9th	29·568
September	29·87	1st	30·52	13th	29·34	57·7	29·717	1st	30·370	13th	29·221
October	30·14	22nd	30·56	16th	29·47	51·5	30·151	22nd	30·395	16th	29·291
November	30·04	18th	30·54	22nd	29·31	44·7	29·920	18th	30·487	23rd	29·264
December	29·85	6th	30·60	13th	29·18	37·5	29·771	6th	30·433	13th	29·221
Yearly Mean	29·88	Dec. 6	30·60	Feb. 1	28·84	50·36	29·901	Jan. 1	30·497	Feb. 1	28·752

RAINFALL RECORDED IN CARDIFF AND NEIGHBOURHOOD,

1868-9.

POSITION OF RAIN GUAGES.

	LATITUDE.	LONGITUDE.
Cardiff Town Hall	51° 28′ 50″	3° 10′ 35″
Mr. F. G. Evans, F.M.S., Tynant, Pentyrch	51° 31′ 55″	3° 15′ 20″

HEIGHT OF RECEIVER OF RAIN GAUGES.

	Mr. T. Waring, Cardiff Town Hall.	Mr. T. G. South, Ely Water Works.	Mr. T. G. South, Lisvane Water Works.	Mr. F. G. Evans, Tynant, Pentyrch.
	Ft. In.	Ft. In.	Ft. In.	Ft. In.
Above Surface of Ground	About 1 1	About 4 0	About 2 0	About 1 0
Above Sea Level	„ 20 0	„ 45 0	„ 142 0	„ 100 0

1868.	Mr. Waring, Cardiff, Town Hall.				Mr. T. G. South, Ely.				Mr. T. G. South, Lisvane.				Mr. F. G. Evans, Tynant.			
	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.			Depth.	Date.	
January	5·69	1·21	10th	18	5·43	1·43	11th	15	5·05	1·28	11th	19	6·61	1·15	10th	24
February ...	2·17	·76	2nd	13	2·50	·95	29th	14	2·04	·65	3rd	17	2·96	·75	2nd	18
March	2·64	·5	12th	15	2·65	·48	13th	16	2·42	·53	8th	16	4·12	·78	7th	21
April	2·48	·7	20th	12	2·20	·73	21st	8	2·43	·68	21st	12	2·80	·78	20th	15
May	1·79	·49	27th	9	2·07	·39	23rd	11	1·61	·31	10th & 20th	9	2·51	·79	11th	11
June	0·47	·38	21st	2	0·39	·33	22nd	2	0·30	·26	22nd	4	0·58	·38	21st	6
July...... ...	0 38	·23	28th	5	0·34	·31	29th	3	0·22	·06	27th	3	0·37	·21	28th	7
August... ...	5·96	1·40	18th	12	5·70	1·50	22nd	13	5·40	1·02	22nd	19	5·60	1·02	21st	21
September ...	4·41	·89	18th	18	4·77	1·00	18th	11	4·45	·75	27th	11	5·40	·92	25th	13
October ...	4·36	·83	16th	16	4·62	·74	17th	14	3·59	·74	7th	10	4·76	·76	6th	19
November ...	1·47	·60	21st	8	2·14	·90	22nd	7	1·99	1·15	22nd	8	3·55	1·48	21st	13
December ...	7·95	1·13	26th	29	8·78	1·03	27th	29	8·56	·73	27th	29	9·42	1·26	26th	30
Totals ...	39·77	1·40	Aug.18	158	41·59	1·50	Aug.22	143	38·06	1·28	Jan. 11	157	48·68	1·26	Dec. 26	198

POSITION OF RAIN GAUGES.

	LATITUDE.	LONGITUDE.
Mr. W. Adams, Tredegarville............	N. 51° 29′ 10″	W. 3° 9′ 55″
Rev. J. Rees Jenkins, Cwmbrân...............	N. 51° 39′ 38″	W. 3° 1′ 35″

HEIGHT OF RECEIVER OF RAIN GAUGES.

	Mr. W. Adams, Tredegarville.		Rev. J. Rees Jenkins, Cwmbrân.		Mr. W. T. Lewis, Mardy, Aberdare.		Mr. W. T. Lewis, Treherbert.		Mr. Phineas James, Ebbw Vale.		Mr. Robt. Jordan, Sirhowy.		Mr. T. J. Dyke, Merthyr Tydvil.		Mr. F. J. Mitchell, Llanfrechfa Grange.		Mr. D. M. McCullough, M.D., Abergavenny.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Above Surface of Ground..	1	0	1	0	1	0	1	0	1	0	0	9	2	0	1	0	1	3
Above Sea Level	40	0	350	0	430	0	634	0	918	0	1055	0	550	0	360	0	220	0

1869.	Mr. Waring, Cardiff Town Hall.				Mr T. G. South, Ely.				Mr T. G. South, Lisvane.				Mr. F. G. Evans, Tynant.			
	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.			Depth.	Date.	
January ...	5·29	·91	4th	18	5 61	1·03	5th	16	5·30	·86	5th	19	6·86	1·12	4th	20
February ...	4·80	·93	12th	21	4·01	·89	12th	21	4·75	·82	12th	25	5·95	·90	12th	22
March	1·70	·46	19th	11	1·58	·53	19th	10	1·72	·57	20th	10	2·03	·55	19th	16
April	1·82	·36	20th	11	1·66	·65	20th	8	1·63	·32	16th	9	2·30	·42	15th & 20th	11
May	4·92	·86	3rd	18	4·80	1·19	4th	18	3·72	1·00	26th	13	5·18	·82	3rd	21
June	·84	·32	14th	8	·99	·38	15th	7	·62	·16	15th	9	1·04	·41	14th	9
July	·89	·36	25th	7	1·06	·43	26th	4	·64	·45	26th	6	1·49	·39	25th	10
August... ...	1·38	·43	12th	8	1·06	·55	3rd	6	1·86	·60	3rd	8	2·05	·76	12th	11
September ...	6·82	1 24	18th	23	6·07	·70	18th	23	6·01	1·00	19th	20	8·25	1·57	18th	24
October ...	3·16	·70	17th	16	4·16	·80	18th	15	3·70	·95	18th	13	3·73	·96	17th	18
November ...	3·68	1·30	28th	18	3·73	1·46	28th	18	3·09	1·13	28th	14	5·97	1·78	27th	19
December ...	3·55	1·40	16th	14	5·66	1·33	17th	16	5·15	1·26	17th	15	6·74	1·46	16th	17
Tota's ...	38·85	1·40	Dec.16	173	40·39	1·46	Nov.28	162	38·19	1·26	Dec.17	161	51·59	1·78	Nov.27	198

1869.	Mr. W. Adams, Tredegarville.				Mr. W. T. Lewis, Mardy, Aberdare.				Mr. W. T. Lewis, Treherbert, Rhondda.				Rev. J. Rees Jenkins, Cwmbrân.			
	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.			Depth.	Date.	
January ...	4·888	·860	4th	19	13·950	2·456	4th	22	...	...	...	...	8·780	1·470	4th	20
February ...	4·520	·830	12th	22	10·670	2·605	7th	17	...	...	...	...	6·295	1·100	7th	21
March	1·445	·495	19th	11	2·510	·805	16th	15	...	...	...	...	2·260	·720	16th	11
April	1·720	·350	20th	10	2·890	·917	15th	11	...	...	...	...	1·875	·460	15th	9
May	4·775	·840	3rd	18	4·247	·748	3rd	18	...	...	...	...	6·200	1·020	25th	18
June	·850	·360	14th	7	1·461	·753	14th	7	1·090	·638	14th	6	·730	·410	14th	7
July	·725	·090	30th	8	1·853	·610	29th	9	3·113	·788	29th	10	1·290	·490	25th	7
August... ...	1·066	·380	3rd	9	1·734	·650	2nd	10	2·765	·939	2nd	10	1·420	·840	2nd	6
September ...	6·095	1·230	18th	22	10·092	1·694	18th	24	14·308	1·945	18th	24	7·880	1·470	18th	20
October ...	2·915	·890	17th	15	3·799	1·026	1st	14	4·762	·965	1st	15	2·360	·64	17th	12
November ...	3·410	1·160	27th	20	5·387	1·293	27th	23	10·222	1·940	27th	21	2·800	1·06	27th	12
December ...	5·760	1·340	16th	18	11·755	2·070	18th	20	14·115	2·270	16th	19	8·250	1·63	16th	17
Totals ...	38·240	1·340	Dec. 16	179	70·348	2·605	Feb. 7	190					50·140	1·470	Jan. 4 and Sep. 18	160

1869.	Mr. Phineas James, Ebbw Vale.				Mr. Robert Jordan, Sirhowy.				Mr. T. J. Dyke, Merthyr Tydvil.			
	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.	
January	12·710	1·68	28th	21	12·871	1·510	28th	23	10·80	2·56	31st	16
February... ...	7·260	1·33	8th	23	8.521	1·625	8th	25	8·95	2·00	8th	19
March	2·664	·78	16th	15	2·773	·810	16th	12	2·89	·95	17th	8
April	2·220	·68	15th	10	2·310	·535	20th	11	1·86	·58	21st	11
May...	5·760	1·19	25th	19	5·955	·860	25th	20	4·19	·60	4th	17
June	1·260	·76	14th	9	1·246	·613	14th	7	1·13	·57	15th	5
July...	1·675	·39	25th	11	1·745	·440	25th	9	1·48	·74	30th	7
August	1·610	·59	2nd	7	1·700	·495	3rd and 16th	7	2·01	·58	3rd	9
September ...	11·005	1·33	30th	25	9·508	1·578	18th	25	9·32	1·51	19th	22
October	3·730	·79	1st	14	3·768	·815	17th	14	4·27	1·10	2nd	15
November ...	5·021	·54	30th	21	5·481	·790	13th	20	4·97	1·00	27th	19
December ...	7·574	1·45	13th	17	8·416	1·480	16th	18	8·60	1·78	17th	15
Totals ...	62·489	1·68	Jan. 28	192	64·294	1·625	Feb. 8	191	60·57	2·56	Jan. 31	163

1869.	Mr. F. J. Mitchell, Llanfrechfa Grange.				Mr. D. M. McCullough, M.D., Abergavenny.			
	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total Fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.	
January	7·85	1·53	4th	19	8·72	1·32	31st	19
February	9·47	1·01	7th	19	3·89	·75	11th	21
March	1·94	·59	19th	13	2·18	·80	16th	14
April	1·50	·44	15th	6	1·31	·75	20th	9
May	5·70	·92	25th	19	5·23	1·00	25th	20
June	·84	·42	14th	6	·75	·35	14th	9
July	1·33	·43	25th	10	·43	·13	25th	7
August	1·64	·70	2nd	6	·70	·35	2nd	7
September	7·38	1·30	18th	17	5·80	1·25	30th	20
October	1·71	·70	16th	6	2·25	·59	17th	13
November	2·57	1·06	27th	9	1·90	·72	27th	16
December	8·52	1·84	18th	18	5·35	1·05	16th	20
Totals	46·49	1·84	Dec. 18th	148	38·51	1·32	Jan. 31st	175

MONTHLY METEOROLOGICAL REPORT,

1869.

By Mr. FRANKLEN G. EVANS, F.M.S., etc.

January.—The weather of this month was very similar to that which prevailed in December, but not quite so uniform. The first day was dry and frosty until the evening, when it changed to wet, which continued, with but little intermission, until the 16th. This was succeeded by an interval of a full week without rain, which was comparatively fine, but the sky was generally obscured by a dull, leaden cloud-canopy, accompanied with raw south-east winds, heavily charged with moisture, which was sometimes visible as mist and fog. The remainder of the month was again wet, and, in addition to heavy rain, there were occasional showers of hail, with thunder and lightning. High winds were extremely prevalent, and the temperature, with the exception of a few days, exhibited nearly the same excess as in the previous month. The warmth and moisture induced the pastures to continue to grow, and beguiled the birds into premature nest-building, and the too early commencement of family cares. Primroses and violets bloomed throughout the month, the wild strawberries were in blossom, and bushes coming into leaf. Plastered walls illustrated the peculiar character of the season, being covered to an unusual extent with green mould, which would disappear under dry cold air or a hot sun. Mosses never looked more soft and verdant, and the scarlet cup-moss, which was sometimes seen in the hedgerows, was a most brilliant object. This growth, although called a moss, has more the appearance of a fungus. It is pale outside, but the interior looks as if lined with the finest scarlet velvet. The shape is like that of a wine-glass with a stem, but without the foot, and forms just such a goblet as fairies might be supposed to drink out of. The damp, mild winter does not appear to have been injurious thus far, excepting when floods have occurred, but one cannot help trembling at the prospect of the east winds in the coming spring.

The barometer was generally unsteady, and sometimes fluctuated very rapidly. The maximum height, 30·56, was attained on the 9th, and the minimum, 28·98, on the 29th, showing a total range of 1·58. It was at or above 30 inches on twenty days.

The temperature was singularly high, and the excess was manifested on every day but five. The mean warmth of the entire month was 43 degrees, which is full six degrees above the average heat of January for the last fifty years. Frost was noted on five occasions.

Violent gales often occurred, particularly at the end of the month, and did much damage.

The rainfall was considerable, and amounted to 6·86 inches. This is equal to 693 tons, or upwards of 2,854 hogsheads to an acre. It was distributed over twenty days. There was a great deal of sickness, but it did not proportionately affect the rate of mortality. A green winter need not necessarily make a fat churchyard ; but, on the contrary, I am persuaded that in the case of thousands of the aged and very young, Death has been robbed of his prey by the exceptional and genial temperature which has prevailed.

February was singularly like the two previous months. There was a similar predominance of constant barometric disturbance, high temperature combined with a soft, damp atmosphere, frequent and violent westerly gales, and heavy rainfall. Vegetation has proceeded uninterruptedly throughout the winter, and fields are greener now than they often are in May. Meteorologists are accustomed to note the earliest appearance of flowers as indicative of the forwardness or lateness of the season, but in the present year these signs do not especially mark the beginning of spring and the revival of the dormant energies of nature from the icy torpor of an ordinary winter. Primroses, violets, wild strawberries, and other rural favourites, in banks and hedgerows, have been utterly unconscious of the time of the year, and quite oblivious of the frosts and snows so confidently promised in the prophetic records of a Moore or a Murphy. Notwithstanding the excess of moisture, I believe that, excepting some wet lands, no damage has been done, but that the "green yule," by economizing dry food, has more than compensated for an other accompanying disadvantage. The lambing season has commenced favourably, and will probably be not less productive than usual. The winter has been quite as extraordinary in its way as last summer, and cannot be regarded as otherwise than propitious to agricultural prospects.

The barometer, though not low on the whole, was very unsteady, and oscillated through limits exceeding an inch and a half. The maximum height, 30·44, was attained on the 15th, and the minimum, 28·84, on the 1st; showing a total range of 1·60 inch. It stood above 30 inches on twenty days.

The temperature was remarkably mild, particularly at night, and of moderate range. The mean warmth of the whole month was 45·7 degrees, which is 7 degrees above the average heat of February in the last fifty years. It exceeded the temperature of the corresponding period of last year—itself a mild month—by one degree and a half.

The force of the wind was often very great, and productive of disastrous results on land and sea.

The rainfall was considerable, and amounted to 5·95 inches. This is equal to 600 tons, or upwards of 2,480 hogsheads to an acre. It was distributed over twenty-two days, and was in excess of the average of the month. The moist, mild, and relaxing atmosphere was incompatible with a high degree of tone and general vigour, but it does not appear to have conduced to any excess of serious sickness, or to an increase in the rate of mortality.

March.—The monotonous continuance of mild, open weather, with heavy rainfall, which was so persistent throughout December, January, and February, at length gave place early in this month to a state of atmosphere more in accordance with the traditional characteristics of the season. The heroic month of March, that derives its name from the classic evil genius of war, repudiated peace and calm, and claimed the right to do battle, if not with cannon and ball, with violent tempests scarcely less destructive to life and property on sea and in exposed situations. Nevertheless, the month was a fine one for the general interests of the country, and counteracted the too softening influences of the winter. The diminished temperature furnished a very desirable check to the premature exuberance of vegetation. The drying winds also dissipated the excess of moisture in the ground, and enabled farmers to make good progress with spring sowing and other agricultural operations of the time of year. Notwithstanding the opportune check referred to, gooseberry bushes were in blossom before the middle of the month, having been previously in too forward a condition. Still, the country at large is less precociously advanced now then it was a few weeks ago. The dry weather and absence of any quantity of snow have been favourable for the young lambs, which skip and caper in full enjoyment of abundant circumstances. The country is still very green, and quite forward enough to make a good fresh start under the influence of warmth and April showers.

The barometer was rather low and very unsteady, and oscillated through limits exceeding an inch. Some of the fluctuations were very rapid. From the 1st to the 2nd, there was a fall of more than half an inch, and a still more abrupt rise between the 2nd and 3rd of nearly an inch. There was a sudden descent again from the 8th to 9th, and the 16th to 17th, and a recovery of nearly three-quarters of an inch on the 18th. The maximum height, 30·35, was attained on the 23rd, and the minimum, 29·24, on the 17th ; giving a total range of 1·11 inch. The instrument stood below 30 inches on nineteen days.

The temperature of March was lower than usual on most days in the month. The mean warmth of the whole month was 40·5 degrees, which is about 1·5 degree below that of the past three years, and 1·1 degree below the mean heat of the month during the last fifty years. There was frost on fifteen nights.

Polar currents far outnumbered the equatorial, and impressed their piercing quality on the weather. The force of the wind was almost continuously high, and strong gales frequently prevailed, which did much damage.

The rainfall was considerably under the average of the past three years. It amounted to only 2·03 inches, and was distributed over sixteen days. This is equal to 205 tons, or upwards of 840 hogsheads to an acre. Some snow-showers occurred, and the miniature snow-balls which have been observed for several years about the 8th of March were this year not noticed until the 27th.

A great deal of sickness prevailed, but the mortality was confined to feeble infants, or infirm or aged persons. The health and comfort of the community were affected by the very rapid transition from a mild winter to a biting, searching spring.

April.—The meteorological characteristics of this month were a generally high and moderately steady barometer ; a warm, but changeable and wide-ranged temperature ; winds shifty in direction, and often of considerable force ; an atmosphere of average dryness, a light rainfall, and rather above the mean amount of ozone. The season so far has been a favourable one, and there is no appearance at present of a contrary tendency. Vegetation, which was so forward throughout the winter, but checked by a cold March, advanced again rapidly early in April. Hedges and small bushes and shrubs have been in such a state of chronic verdure that it is difficult to say at what precise date they came into leaf. In the case of trees of a larger growth, and with more regard for the proprieties of spring, it is possible to fix the time more accurately, and to name the day on which they came into leaf and blossom. The buds of the sycamore were expanded on the 11th, and the horse chestnut on the 12th ; the beech on the 18th, oak the 20th, elm 21st, and ash on the 25th. Plum, cherry, and pear trees were in blossom on the 5th, the garlic plant on the 12th, the sycamore on the 13th, apple on the 16th, lilac on the 19th, wistaria on the 22nd, laburnum and hawthorn on the 25th, and horse chestnut on the 28th. These are all early dates, and illustrate the quality of the season. The oak this year is peculiarly forward, rather in advance of the elm. The first swallow appeared on the 19th, and the cuckoo's note was not heard until the 23rd. These are later in proportion than our own foliage, and probably indicate a less advanced season in other countries The meadows are very green and luxuriant, and promise an early and abundant hay crop.

The barometer stood above 30 inches on twenty-three days. The maximum height, 30·38, was attained on the 13th and 29th, and the minimum, 29·23, on the 16th; showing a range of 1·15 inch. It was subject to a few rapid fluctuations.

The temperature of April was higher than usual, but marked by very abrupt transitions and a wide range. The mean heat of the whole month was 51 degrees, which is several degrees above the average. The temperature of the warmest day, 75 degrees, is not often experienced in April. There was very little frost.

The rainfall of April was rather light, but pretty well distributed over eleven days. It amounted to 2·30 inches, which is equal to 232 tons, or upwards of 950 hogsheads to an acre.

The cold, dry east winds were very trying to delicate chests, and by no means conducive to the tranquillity of nervous systems, even in the hearty and strong. People always feel these winds the more after mild and relaxing weather.

May.—The weather of this month was very unlike that which we are accustomed to anticipate in the brilliant season of advanced spring, and will not add to the reputation of the month of May. The barometer was low and unsteady; the temperature cold and ungenial; winds were shifty, rough, and biting; the rainfall was heavy, and the production of ozone abundant. The hay crops have grown rapidly under the influence of the copious moisture, and are likely to prove heavy, early, and good. Wheat and other cereals are not so flourishing, particularly on damp soils. In some places they are looking yellow, in consequence of the deficiency of sunshine and the excess of wet. The forwardness which characterized the early portion of the year has been nearly lost from the opposite qualities of the past few weeks. Brighter weather will probably soon remove our apprehensions on the score of harvest, but it is not now likely to be an early one. All our trees this year came into leaf in April, and most shrubs put out their blossoms. Oak apples were general on May 1st, and they have been much more numerous than usual. Formerly, when the 29th of the month was a marked day in the calendar, the inhabitants of Cardiff used to commemorate the occasion, and put on a festive appearance, by suspending large branches of oak over their doorways; and they usually preferred those specimens that were well laden with oak apples. This custom, like many other ancient usages, has now, I believe, almost if not quite disappeared. The oak apple is similar to the gall nut in its origin, mode of growth, and object. It is produced by a fly called the *Cynips terminalis*, and is a diseased excrescence which serves as a nest to shelter and feed the larva until it arrives at maturity. The foxglove was in blossom on the 31st. There are very few cockchafers this year.

The barometer was low and fluctuating throughout the month, and oscillated to the extent of nearly an inch and a quarter. The maximum height, 30·31, occurred on the 13th, and the minimum, 29·11, on the 7th; giving a range of 1·20 inch. It stood above 30 inches on twelve days.

The temperature of May was below the average, and indeed was colder than April. The mean heat of the whole month was 50·7 degrees. This is full four degrees lower than my own recorded average, and several degrees below the mean of fifty years as determined by Mr. Glaisher. The chief deficiency of warmth occurred in the day-time, and was partly due to the large amount of cloud and consequent absence of sunshine. The nights were relatively less cold, and there was little or no frost, which was most fortunate for vegetation. The wind was often rough and cold, and sometimes amounted to a gale.

The rainfall was copious, and amounted to the considerable total of 5·18 inches. This is equal to 523 tons, or upwards of 2,150 hogsheads to an acre. Rain fell on twenty-one days.

On the night of the 13th a brilliant display of Aurora Borealis was visible towards the north. Thunder was heard on two occasions.

Deaths were numerous, and some of them were the direct result of the cold east wind; and in others, such as old people and chronic invalids, the fatal termination was timed by the same cause. In this instance the usual winter harvest of mortality was postponed, and only partially reaped in the month of May.

June was a very singular month, and will contribute its quota towards the sum total of eccentric and abnormal peculiarities which have marked the present year. The salient points were a high and steady barometer; a low temperature, with occasional bursts of great heat; an extreme prevalence of polar winds, a dry air, light rainfall, and deficiency of ozone. I have often had occasion to remark how honestly Dame Nature pays her way, and how inevitably a suspension of the customary amount of any meteorological element is compensated by a remittance of the required quantity at a subsequent period, and often with compound interest. December, January, and February, were memorable for their wet and warm character, caused by the predominance of equatorial winds laden with the hot vapours of the Gulf Stream. This led to corresponding arrears on the opposite side of the page, and the accumulation of a debt due to the polar aspect of the account. This debt was partly *liquidated*—if I may be allowed so moist an expression for so harsh a month—in March, and punctual repayments continued to be made throughout May and June. In the winter season mentioned, the earth was covered with a green carpet, and the wild flowers blossomed freely on the mountain side. In the summer, on the contrary, the snow was seen in drifts three feet deep in Westmoreland and Scotland, and hundreds of clipped sheep are reported to have died in one night in different places. The rains of

May were favourable to the growth of the hay crops, which were harvested to a great extent last month in good condition, and will prove very heavy and excellent. The wheats, which were yellow and sickly from the damp and cold, have now greatly improved. They came into ear about the 15th, and bloomed on the 25th, and may yet turn out an average yield. There has been an unusual amount of blight on rose-trees this year. An immense number of buds were completely destroyed and cut off, causing a great diminution in the amount of bloom, and the leaves look shrivelled, puckered, and burnt up. This damage is the handiwork of the aphides, or plant-lice, and the foliage is rendered sticky by the sweet secretion called honey-dew, which they produce. They leave this behind, we must suppose, as some compensation for their depredations, but the value of the material is doubtful, and scarcely an equivalent for the loss of the flowers.

The barometer was more than ordinarily high and steady, and stood above 30 inches on every day but three. The maximum height, 30·40, was attained on the 28th, and the minimum, 29·64, on the 13th and 14th, giving a range of 0·76.

The temperature of June was decidedly low and ungenial. The mean heat of the whole month was 57·5 degrees, which is several degrees below the average. These readings show a low mean temperature, and a high range, which are both unfavourable to animal and vegetable life. The losses of sheep, caused by the unseasonable cold, clearly demonstrate the utility of observing these matters, for if the gentleman at Ipswich who lost 210 in one night, and others who lost smaller numbers on different occasions, had kept a good self-registering thermometer, it would have been impossible for them to have risked the lives of their flocks by clipping them in such weather. The wind approached the south *only once*, a very uncommon circumstance in June, and the dominant directions—*hinc illæ lacrymæ!* for the sheep—were arctic currents from the north and east. The force of the wind was sometimes strong and fresh.

The rainfall was light, and distributed over 9 days. It amounted to 1·04 inch, which is equal to 105 tons, or upwards of 430 hogsheads to an acre.

Mortality was confined to the aged, and those suffering from chronic incurable diseases. The type of disease was more that of winter than summer, and there was an absence of the complaints that result from great and continued heat. I may mention as a curious illustration of the abrupt changes of temperature which have marked the season, that there was a case of frost-bite, and one of sunstroke at the same time in one of the London hospitals.

July was brilliantly fine and genial, and a very agreeable contrast to June. Atmospheric pressure was high and uniform; the temperature warm, but not excessively so; winds were generally light and pleasant; there was a light rainfall and moderate development of ozone. Agricultural interests have progressed favourably under improved meteorological influences. The hay harvest was mainly gathered in June, and the remnant picked up in July. The yield was heavier than for several years past. In consequence of the large quantity, combined with a deficiency of heat during harvest, a great many ricks have been damaged by over-heating. The wheats have benefited wonderfully by the dry warmth of the past month, and on light soils seem likely to be a better crop than last year. Barley and oats also will probably prove well. Turnips and lattermath require more moisture. Oats have been cut in many places during the last ten days, and a few fields of wheat are down. Wheats, on heavy lands, are much lighter than last season, and these crops in general are not expected to be more than an average. Nevertheless, taking all kinds of agricultural produce together, the food prospects of this year are better than those of last, and only require for their realization the absence of an extreme prevalence of drought.

The barometer was remarkably high and steady throughout the month, and its widest limits of oscillation did not much exceed half an inch. The maximum height, 30·50, was attained on the 10th, and the minimum, 29·89, on the 26, giving a range of 0·61. It stood at or above 30 inches on every day but one.

The temperature was moderately high, and amounted to a good average. The mean heat of the whole month was 63·1 degrees. This is more than one degree in excess of the average of the last fifty years as determined by Mr. Glaisher; but if the Greenwich correction is applied to it, the result would be rather below the mean temperature of July. In extremes and averages July, 1868, was a much warmer month than the corresponding period of 1869.

The rainfall was light, and distributed over ten days. The total quantity measured 1·49 inch. This is equal to 150 tons, or upwards of 620 hogsheads to an acre. The rainfall of June and July together amounted to 2·53 inches, as against 0·95 in the corresponding months last year. From this comparison it appears that this season rain was much more than double that of the previous one, and it accounts for the drought having been so much less intense than that of last year.

The public health on the whole was favourable, and the season may be considered healthy.

August.—The weather of this month was of a chequered and varied character, and presented some strong points of contrast. The first fortnight was rather wet and windy, and decidedly cold. With one small exception, every other day was fine and dry, and from the 20th to the 27th inclusive, very great heat prevailed. The rainfall in the earlier part of the month was extremely beneficial to most crops, which were languid and drooping from the partial predominance of drought in July. Roots, pastures, lattermaths, oats, barley, and garden produce were especially benefited by the welcome moisture. Just as the cereals were ready for the sickle, the weather cleared up and remained fine long enough to gather in the harvest in splendid condition. My impression is that all crops in Glamorganshire are very superior to those of last year. This also, I think, holds good for the country generally, with the single exception of wheat, which is said to be light in some places, particularly in damp soils. Potatoes, peas, and beans appear to be a better yield than last season. The only deficiency at the present time is in grass, which is certainly rather scanty, and requires more rain. The scarcity of this article, coupled with the absence of much old stock, renders the present price of hay higher than the abundance of the recent harvest would otherwise seem to justify. Considering the cold wet weather of May and the ungenial quality of June, cereals have proved much better than might have been expected. Altogether, we may fairly congratulate ourselves on the excellence of our food prospects for the coming winter.

The barometer was rather fluctuating during the earlier part of the month, but very high and steady for the latter half. The greatest limit of oscillation did not much exceed half an inch. The maximum height, 30·47, occurred on the 17th, 18th, and 31st, and the minimum, 29·80, on the 9th, showing a total range of 0·67. The instrument stood above 30 inches on 25 days.

The temperature was variable, and not very high upon the whole. On most days it was below the average, but the great heat of the last ten days or so brought it up to something like the usual mean. The average heat of the whole month was 61·3 degrees, which is nearly one degree below the average of the two previous years, and one-tenth of a degree above Mr. Glaisher's mean of fifty years. The maximum heat of August was exactly the same as that of the corresponding period of last year. The day temperatures were rather higher in the same comparison, and the depression occurred in the greater coldness of the nights. In the beginning of the month, and again at the extreme end, the force of the wind was considerable on several occasions.

The rainfall of August was moderate, and fell entirely in the first half of the month. It amounted to 2·05 inches, which is equal to 207 tons, or upwards of 850 hogsheads to an acre. Rain fell on 11 days.

The cold and damp weather in the early part of the month was strongly conducive to bronchitis and colds. Diarrhœa was prevalent all through the month, but more particularly so during the hottest part of it. No decided case of sunstroke occurred, and mortality was low.

September was singularly wet and boisterous, and in these respects contrasted strongly with the previous three months. The barometer was low and in a state of perpetual oscillation; the temperature moderate; the prevalence of nimbus, or rain-cloud, almost constant; rainfall was excessive, and ozone most abundant. The drought in the months of June, July, and August was considerable, and the recent and still-continuing downpour is no more than sufficient to compensate for past deficiencies, and to restore equilibrium. It is, moreover, remarkably well-timed in reference to the in-gathering of the crops. Last year the harvest was very early, and was completed before the heavy rains of August came to refresh the ground burnt up by the intense heat. This season the cereals were later, but the dryness, though less severe, was more extended. This was a most fortunate coincidence, for the prolongation of dry weather exactly balanced the greater lateness of the crops; and the rains, which might have been excessive in August, were kept back until September, when the great bulk of wheat, barley, and oats had been secured. The principal scarcity for some time past has been in the grass crops, and even now the lattermath and pastures are not over-luxuriant, notwithstanding the copious moisture. This is, no doubt, accounted for by the exhaustion consequent on the extraordinary bulk of the hay crops, and is the reverse of the case of last summer, when the unexpended vitality of grasses resulted in a rapid and exuberant growth of vegetation under the influence of favourable weather. Potatoes are plentiful and good, and entirely free from disease. Ladybirds (*coccinella septempunctata*) have been very numerous this year, and about a month ago they appeared in such numbers on the south-east coast as to excite astonishment and various conjectures as to how and whence they had been conveyed there. Their presence in such unusual swarms is probably to be explained by an equal superabundance of aphides, upon which they feed. Not that—on the principle that where the carcass is, the eagles will be gathered together—the ladybirds were attracted by the aphides from a distance, but that the abundance of their natural food was the cause of so many arriving at maturity. In fact, they found themselves "in clover," and throve accordingly. This furnishes an illustration of the just balance of life in nature, and a proof of Providential design in the order of creation. This is equally the case whether the ladybirds were sent by a special fiat or evolved by the working of a general law. The benefit to vegetation and the harmonious wisdom of the arrangement eloquently proclaim the Divine authorship.

The barometer was very fluctuating and usually low. The maximum height, 30·52, occurred on the 1st, and the minimum, 29·34, on the 13th; showing a total range of 1·18 inch. It stood below 30 inches on twenty-one days.

The temperature was moderate and not marked by any great extremes. The mean heat of the whole month amounted to 57·7 degrees, which is not far from the usual average.

The force of the wind was unusually great almost throughout the month. From the 11th to the 19th inclusive, it blew a tremendous and nearly continuous gale, which caused a great deal of damage on sea and land. The effect upon the foliage of trees and hedges was peculiar. The side next to the storm presented a withered and shrivelled appearance, and contrasted singularly with the comparative verdure of the opposite side. To many persons this suggested the idea of blight, and it looked sufficiently like it; but it was really only the result of the fierce fury of the blast acting upon leaves which had been rendered rather sapless by the previous drought. Many elm trees that usually retain their foliage until November were in this way entirely stripped ten days before Michaelmas.

The rainfall was very heavy and constant. It amounted to the large total of 8·28 inches, which is equal to 836 tons, or upwards of 3,450 hogsheads to an acre. In my diary this has only been exceeded twice —September, 1866, and December, 1868. Rain fell on twenty-four days.

The diseases were diarrhœa, in accordance with the usual epidemic constitution of the atmosphere at this season of the year, but in a slighter degree. Bronchitis, pneumonia, severe colds, and rheumatic affections were very prevalent. The production of these complaints was much favoured, if not caused, by the wet weather. The fever class was nearly absent.

October.—The weather of this month was fine on the whole, and generally favourable for the time of year. The principal meteorological features were a high but variable barometer; a mild and at one time unusually warm temperature; the prevalence of north-westerly winds; a low degree of humidity, a light rainfall, and deficient development of ozone. The season was propitious for ploughing and sowing, and a good seed bed has been secured by many farmers. In my report for September I referred to the peculiar stripping of the foliage of trees consequent upon the violent gales following previous drought. Many of the smaller ones thus denuded, such as lilac, larch, etc., put forth young leaves during the exceptionally hot days in the early part of October, and I have heard of a laburnum coming into bloom for a second time. The storms predicted to occur about the 5th, 6th, and 7th of the month, in consequence of the moon's proximity to the earth, and her position in conjunction with the sun or the equator, did not put in an appearance. In fact, they allowed judgment to go by default, and in any meteorological court no doubt costs would have been given against Mr. Saxby. It is a curious circumstance, that the only period of disturbance foretold by this gentleman for last September was from the 20th to the 22nd; but such is the perversity of the elements, that the time mentioned proved calm and fine. It was, in truth, the only break in the wet boisterous weather that ruled throughout the month after the 4th. This clearly shows that no one who consults his comfort and reputation should become a weather-prophet, excepting for a few days beforehand. There are no means at present known for ascertaining such changes in the distant future, and the best prediction is but a chance guess, or the mere balancing of probabilities. In the case under consideration, a great deal of needless alarm was excited, which required to be calmed by the soothing assurances of the Astronomer Royal. The simple fact of the matter is, that the Admiralty authorities can calculate the tides almost within an inch for any part of the kingdom ; but these figures are reckoned for calm weather, and storms produce an increasing or diminishing effect, according as to whether the wind is blowing with or against the tide. The popular mind associated the idea of a tidal wave with the so-called tidal waves n volcanic districts. The latter are erroneously named, and have nothing to do with tidal phenomena, but are the result of the fissures and upheavings of the ocean's bed, which occasionally accompany violent earthquakes.

The barometer was generally high, and often unsteady, though not uniformly so. From the 4th to the 14th inclusive, it was very free from variation, but on all other days the fluctuations were considerable. The maximum height, 30·56, was attained on the 22nd, and the minimum, 29·47, on the 16th, giving a total range of 1·09. It stood above 30 inches on twenty-two days.

The temperature was warm for the season, but marked by some trying changes, which occasionally amounted to 20° on consecutive nights. The mean heat of the whole month reached 51·5 degrees. This is somewhat in excess, on an average of 50 years. Frost occurred on four nights.

The rainfall was light, and distributed over 18 days. It amounted to 3·73 inches, which is equal to 376 tons, or upwards of 1,540 hogsheads to an acre. On the morning of the 28th snow fell to the depth of an inch.

At 11·30 p.m. on the 28th a bright flash of white light crossed my path, and on looking in the direction from which it proceeded, I was just in time to see a large meteor explode and disappear. It was observed in the east, about 25 degrees above the horizon. There was no audible report.

The public health in this neighbourhood is not unsatisfactory.

November is generally associated in our minds with everything that is dark, dull, and dreary, and it commonly furnishes a suitable background for the display of squibs, Roman candles, and blue balls, with which young folks are, or at all events were, accustomed to commemorate the sinister attempt of Guy Faux—wrapped in a mantle of London fog—to blow up the Houses of Parliament. The past month was not much better or worse than its predecessors, but was characterized by rather less fog and more rain than usual. The barometer was singularly unsteady, and on one occasion fell an inch in 24 hours—from 9 a.m. on the 21st to the same hour on the 22nd. This was not followed by very much wind, as generally happens, and not immediately by rain. On the contrary, there were fully three days of calm, fine, frosty weather. These were succeeded by very heavy rains. There was a remarkable fall of the mercury, and the absence of corresponding atmospheric disturbance was singular, but not inexplicable. The explanation is to be found in the fact that the low barometric tension extended over the whole of Western Europe; consequently we were all in the same boat, and there were no inequalities of pressure to be balanced by a storm of wind. Gales arise when considerable differences in the height of the barometer occur at two or more places within a reasonable distance of each other, and the direction of the current of air is from high to low pressure. This, however, does not usually take place in a straight line, but in a circular manner, producing what is called a cyclone. In the centre of low pressure there is a tendency to a partial vacuum, and the atmosphere moves round it after the fashion of a whirlpool until equilibrium is restored. When the area of diminished tension is represented by a continent, the same state of things prevails, but the disturbance occurs in the far-off circumference of the circle, and is not much felt by the inhabitants within. The temperature of the month was mild, and wild strawberries and blue and sweet-scented white violets bloomed in the hedgerows. The high tides which Mr. Saxby promised in October were below even the Admiralty calculation, but they indemnified themselves for their moderation by appearing in November in considerable force, to the astonishment and inconvenience of the residents in the low-lying districts on the Thames, who had received no warning of such a visitation.

The barometer was characterized by extreme unsteadiness. Its oscillations were constant throughout the month, although the average readings were not particularly deficient. The maximum height, 30·54, was attained on the 18th, and the minimum, 29·31, on the afternoon of the 22nd, giving a range of 1·23 inch. The instrument stood above 30 inches on eighteen days.

The temperature was in excess of the daily mean on 16 days. The average heat of the month was 44·7 degrees, which is over one degree above the Greenwich mean of 50 years. There was frost on eleven nights. There was a remarkable prevalence of north-westerly winds. The force of the wind several times amounted to a strong gale.

The rainfall of November was heavy, and amounted to 5·97 inches. This is equal to 602 tons, or upwards of 2,490 hogsheads to an acre. Rain fell on nineteen days. Commencing winter soon tells a tale of lowered vitality in a greater tendency to complaints of an inflammatory and rheumatic character, and it often brings an increase of diseases of the zymotic class. There is, however, nothing to complain of in the health of the community in this neighbourhood.

December.—The weather of December was of a mixed character, alternating between sharp frost and heavy rain. The principal meteorological features were a fluctuating barometer, low temperature, high wind, copious downfall, and rather deficient development of ozone. The first nine days were generally dry and frosty, with easterly winds ; the next eleven were very wet, with currents from the west. From the 21st to the 29th inclusive, Boreas was again in the ascendant, and brought severe but suitable Christmas weather. The month then closed with more moisture and some wind. In the north there was heavy snow, which occasioned the loss of at least one life ; but in our more genial climate the snowy garb of winter was light and thin, and only served to maintain the appearance required by tradition, and to give zest to the enjoyments of the season. The aspect of the country is satisfactory, and wheat and other crops look strong and promising. Blue violets and wild strawberries were still in bloom in sheltered spots, and the hedge-banks wore a soft and velvety-green appearance, from the abundance of ferns and rich mosses, which are so conspicuous at this time of year from the absence of other foliage. Amongst the latter the cup-mosses and peziza, or scarlet cup-moss, were very prominent and pretty. The past month was rigorous in comparison with the exceptional warmth of the previous December ; but the cold was not injurious to vegetation.

The barometer was very unsteady, and oscillated through limits of nearly an inch and a half. The maximum height, 30·60 was attained on the 6th, and the minimum, 29·18, on the evening of the 13th, showing an entire range of 1·42. Many of the changes were sharp and rapid, having been half an inch or more between one day and another. The instrument stood at or above 30 inches on fourteen days.

The temperature of December was decidedly cold, and below the standard of the month. The mean heat of the whole month was 37·5 degrees, which is nearly nine degrees below that of the corresponding month of last year, and 2·3 degrees less than the mean temperature of the last 50 years, as determined by Mr. Glaisher. There was frost on fifteen occasions, which was sometimes severe.

The wind represented a stand-up fight between the east and west, with poor humanity, alternately shivering and drenched, lying helpless in the middle of the "ring." The force of the wind was often considerable, and strong gales prevailed in the beginning, middle, and end of the month, which were very destructive in their effects.

The rainfall was decidedly heavy, but unequally distributed ; the bulk of it having fallen continuously from the 9th to the 20th. It amounted to 6·74 inches, which is equal to 680 tons, or upwards of 2,800 hogsheads to an acre. Rain fell more or less on seventeen days. Thunder and lightning occurred on the morning of the 16th, and snow and hail occasionally.

Weakly people, and those who are much exposed to atmospheric changes, are always liable to suffer from severe weather, and this season of the year usually brings with it a large increase of general illness. The past month was no exception to the rule, and brought with it rather more sickness than ordinarily occurs. This neighbourhood, however, is not peculiarly affected, but only shares in unwholesome conditions which are influencing in an equal or greater degree the rest of the community.

METEOROLOGICAL REPORT

FOR THE YEAR 1869.

BY

MR. FRANKLEN G. EVANS, F.M.S.

Mr. Evans, who was warmly greeted on rising, said : Mr. Chairman and Gentlemen,—I have much pleasure in laying before you my Meteorological Report for the past year, and in doing so think it may be desirable to refer briefly to the locality and kind of instruments employed. My house is situated at a point where two valleys intersect each other, one of which runs north and south, the other east and west, and I live at the north-west corner of the intersection. The house has an aspect nearly south, and stands 100 feet above the level of the sea at half-tide. Behind it the Little Garth rises abruptly to the height of 350 feet—making 450 above the sea—and is thickly wooded from summit to base. The instruments are by Negretti & Zambra, and Casella, except the barometer, which has been verified by the former firm. The maximum and minimum self-registering thermometers have a certificate of accuracy from Mr. Glaisher, of the Greenwich Observatory. They are mounted on a modified Glaisher stand, about four feet from the ground. The position thus imperfectly sketched is warm and sheltered, and has a sensible influence upon the meteorological data. This fact should be borne in mind in comparing them with others taken in a more exposed and less wooded situation. The following is a condensed summary of my reports for the past twelve months.

WIND-DIRECTION, BAROMETER, RAINFALL, ETC. OZONE AND TEMPERATURES.

1869.	More or less Westerly, Days.	More or less Easterly, Days.	Combined with Southerly, Days.	Combined with Northerly, Days.	0·01 in. or more of Rain fell, Days.	Barometer below 30 inches, Days.	Mean degree of humidity, Days.	Rainfall, total inches.	Maximum fall in 24 hours.	Mean degree of ozone.	Maximum temperature.	Minimum temperature.	Total range.	Greatest daily range.	Least daily range.	Mean daily range.	Mean of Maximum temperatures.	Mean of Minimum temperatures.	Mean temperature of the month.	Difference from average of 50 years.
January ...	18	13	21	7	20	11	92	6·86	1·12	5·484	54	25	29	19	3	9·9	47·9	38·1	43·0	+ 6·1
February ...	25	3	13	15	22	8	87	5·95	0·90	5·821	60	29	31	21	2	11·3	51·4	40·1	45·7	+ 7·0
March	7	21	8	20	16	19	74	2·03	0·55	3·774	57	28	29	24	6	13·7	47·4	33·6	40·5	— 1·1
April	15	15	11	15	11	7	75	2·30	0·42	5·700	75	32	43	30	5	17·8	59·9	42·1	51·0	+ 4·8
May	9	18	15	14	21	19	77	5·18	0·82	6·500	65	35	30	30	4	16·1	58·8	42·7	50·7	— 2·2
June	14	14	1	23	9	3	65	1·04	0·41	3·667	83	39	44	29	13	22·3	68·7	46·4	57·5	— 1·6
July	19	10	13	13	10	1	71	1·49	0·39	5·000	88	42	46	33	4	22·8	74·5	51·7	63·1	+ 1·3
August... ...	17	13	6	22	11	6	68	2·05	0·76	3 387	88	39	49	32	11	22·2	72·4	50·2	61·3	+ 0·1
September ...	25	5	16	13	24	21	79	8·28	1·57	7·000	74	38	36	33	5	16·4	65·9	49·5	57·7	+ 1·1
October ...	15	13	7	22	18	9	79	3·73	0·96	3·548	74	27	47	27	6	15·8	59·4	43·6	51·5	+ 1·3
November ...	27	2	1	29	19	12	88	5·97	1·78	3·333	60	25	35	27	4	14·3	51·8	37·6	44·7	+ 1·6
December ...	14	17	8	21	17	17	84	6·74	1·46	4·200	55	20	35	23	5	11·3	43·2	31·9	37·5	— 2·3
Totals, Means, etc.	205	144	120	214	198	133	78	51·62	11·14	4·784	88	20	68	33	2	16·2	58·4	42·3	50·3	+ 1·3

In this table I have divided the wind into two principal directions—westerly and easterly, which are shown in the first two columns. The third and fourth indicate the number of days on which southerly and northerly currents were combined with the two main quarters. The usual proportion of easterly winds is rather more than one day in three, but in the past year this ratio was exceeded in the proportion of 144 to 205. Southerly currents were deficient, and northerly ones prevailed in considerable excess. The predominance of these cold quarters impressed their character unpleasantly on some portions of the year. The fifth column gives the number of days on which rain fell, and the total corresponds exactly with that of the previous year, and both were below the usual amount. The number of wet days generally coincides very nearly with that of westerly winds.

The maximum height of the barometer was 30·60 on December 6th, and the minimum 28·84 on February 1st, showing an entire range for the year of 1·76 inch. It stood below 30 inches on 133 days.

The mean degree of humidity was 78, complete saturation being represented by 100.

The rainfall of 1869 was a good average, and amounted to 51·62 inches, which is equal to 5,213 tons, or upwards of 21,500 hogsheads to an acre. The sum of the maximum falls in 24 hours reached 11·14 inches, which is rather more than one-fifth of the grand total. It is a singular coincidence that this proportion has been steadily maintained for some years. The driest months were March, April, June, July, and August. The last three constituted a period of drought that was more prolonged but less intense than that of the summer of 1868.

The rainfall at Tynant is always upwards of ten inches in excess of Cardiff and its immediate neighbourhood. This was still the case in 1869, and in comparison with the mean of the records taken by Mr. Adams at Tredegarville, Mr. Waring at the Town Hall, and Mr. South at Ely and Lisvane, the excess amounted to 12·73 inches. This is partly due to increased elevation above the sea, and partly to the attraction of the Little Garth. The rainfall at Mardy, Aberdare, taken by Mr. W. T. Lewis, at 430 feet above sea-level, was 70·34 inches; that at Treherbert, registered by Mr. W. T. Lewis, at 634 feet above half-tide level, was 50·375 inches for six months; so we may conclude that the total for the year would much exceed all other stations. So far we have a direct increase in proportion to elevation, but there is one exception to it in the Cwmbrân record, kept by the Rev. J. R. Jenkins, at 350 feet above the sea, which is 50·140 inches, or a little less than my own fall at Pentyrch. Some account of the character of the country in which the guage is placed would be interesting in reference to this point.

The development of ozone was rather above the average. The maximum occurred in September, and the minimum in November. The greatest manifestations coincided with strong south-westerly winds, and the least with those of the opposite quarter. This accords with my usual experience. October and November are apt to have a lower degree than probably belongs to them, in consequence of the ozone being used up in oxidizing the products of decaying vegetation.

The maximum temperature of the year was 88 degrees on July 17th and August 27th, and the minimum, 20 degrees, on December 28th; showing a total range of 68 degrees. This is the exact limit of variation of the previous year. The mean temperature was 50·3 degrees, which is 1·3 degree below that of 1868, and the same amount above the average heat of fifty years, as determined by Mr. Glaisher. January and February were remarkably warm, and their excess more than counter-balanced the opposite quality of some of the spring and summer months. In the last column of the table, I have indicated the difference—plus or minus, as the case may be—from the Greenwich average. In doing so, I stumble upon a difficulty which I may point out, but have no authority to remove. To the simple arithmetical mean of the maximum and minimum thermometers, Mr. Glaisher applies a correction, ranging from 0·0 degree in December to 1·9 degree in July, which is used subtractively to get at the average temperature. Mr. Buchan, Secretary to the Scottish Meteorological Society, on the other hand, says that the Leith correction is much less than that of Greenwich, and that the necessity for applying a correction at all depends on local circumstances. From comparisons of observations taken hourly in different parts of the globe, he finds that the correction is sometimes to be added to, and sometimes deducted from, the simple mean, and that the difference in any case is inconsiderable. He recommends the adoption of the mere mean of the extremes, which is the result of observation, and is not vitiated by misleading hypotheses. This is the plan I myself follow; and, having given the plain figures, it is easy to qualify them by any correction that may be desired.

The sickness and mortality of the past year were not excessive. The east winds of spring and early summer were very trying, and productive of rheumatism and chest complaints, and not favourable to a placid state of nervous system. It is quite possible to run more risk with less discomfort.

There was an unusual absence of thunder-storms in this neighbourhood.

The winter of 1868-9 was so singular that it may not be uninteresting to take a brief retrospective glance at its principal feature—the remarkable excess of warmth and moisture in December, January, and February. An imaginative friend has suggested to me as an explanation that Great Britain must have slipped from her moorings and drifted towards the Equator. This is a very graceful and poetical idea, but too suggestive of instability in Britannia's rule of the waves to be acceptable, to say nothing of the physical obstacles to its reception. The general characteristics of our climate are to a large extent due to what is called, with too much limitation, the Gulf Stream. This may be taken to signify a large body of warm water that passes from the Equator to the Gulf of Mexico, and ultimately washes the shores of Great Britain and Ireland. This extraordinary oceanic current raises the temperature of these islands from 20 to 40 degrees, according to locality, above that which would be due to latitude alone, and keeps ports open which would otherwise be ice-bound for some months in the year. Its influence to this extent is always felt, but when strong south-westerly winds prevail, the current is borne up more forcibly with the accompanying air laden with warmth and moisture. This humidity condenses and falls as rain, and in doing so parts with its latent heat and still further augments the temperature. These conditions together constitute a mild green winter. The north-east wind is the exact contrary of all this—cold and dry. It derives its quality from its polar origin, and the vast continental tract passed over on its way to this country. The effect of this is to oppose and retard the Gulf Stream, and to drive away the warm moist air. Hence the comparatively hard winter, though this is far less rigorous than we are entitled to from our geographical position.

These two winds are constantly opposing each other, and the alternations of their conflict make up the chequered variations of an English winter. Atmospheric and marine currents have been partially mapped out with more or less definite results in certain regions, but the infinite play of the elements in this corner of the world is too fickle and various to admit of the laws of their action being very accurately laid down. During the south-westerly gales mentioned, many specimens of the *physalia*, or Portuguese man-of-war, were picked up on our coasts. The appearance of these visitors from more southern seas helps to prove the reality of the warm current, as wind alone could never have dislodged them from their ocean home, and conveyed them to a distant land.

The present winter so far is of a much more ordinary character.

In conclusion, gentlemen, I may be permitted to say that although this is my first report to the Society, I trust that it may by no means be the last. Hitherto I have made observations as a lonely sparrow on the house-top, but my future *notes* will be as a member of a community with every variety of *note* and plumage. I shall no longer gather meterological honey as a solitary specimen of the order Hymenoptera, but as a busy unit in this great industrious hive of working-bees. I sincerely wish you all a happy year, and a pleasant, useful, and prosperous career to the Cardiff Naturalists' Society.

At the conclusion of the paper Mr. Evans was loudly cheered, and a vote of thanks to him was carried by acclamation.

DESCRIPTION OF SOME REMAINS OF AN AIR-BREATHING VERTEBRATE (*ANTHRAKERPETON CRASSOSTEUM*, OW.) FROM THE COAL-SHALE OF GLAMORGANSHIRE. By Prof. Owen, F.R.S., etc.*

Since the discovery of remains of air-breathing Vertebrates in the Coal-shales of Carluke,† several other evidences of a like grade of organization have been obtained from Scotch Carboniferous deposits; but I had not until the present year seen any such fossils from English or Welsh formations of the same antiquity. The specimens figured in Plate I., however, give evidence of the fact. They were discovered by John Edward Lee, Esq , F.G.S., in the much-disturbed coal-beds at Llantrissent, Glamorganshire, which are referable to the lower part of the 'Middle,' if not to the upper part of the 'Lower,' Coal-measures.

The specimens include an impression of part of the integument, with a few of the scutules, Plate I. fig. 1; portions of long, slender, curved bones, like ribs, fig. 2; part of the roof of the cranium, associated with a long, nearly straight, slender bone, and part of a similar bone, slightly bent, figs. 3 and 4; portions of two straight slender bones, fig. 5; portion of a symmetrical bone, probably from the naso-palatine chamber of the skull, fig. 6; portions of ribs, fig. 7; parts near the articular ends of bones, figs. 8 and 9. There is also what seems to be the base of a tooth, anchylosed to a rough rising of bone, according to the 'acrodont' type, broken away from the alveolar border of a jaw, *cut*, fig. 1, *a*, *b*.

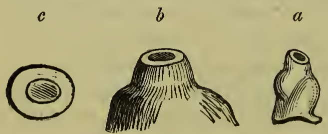
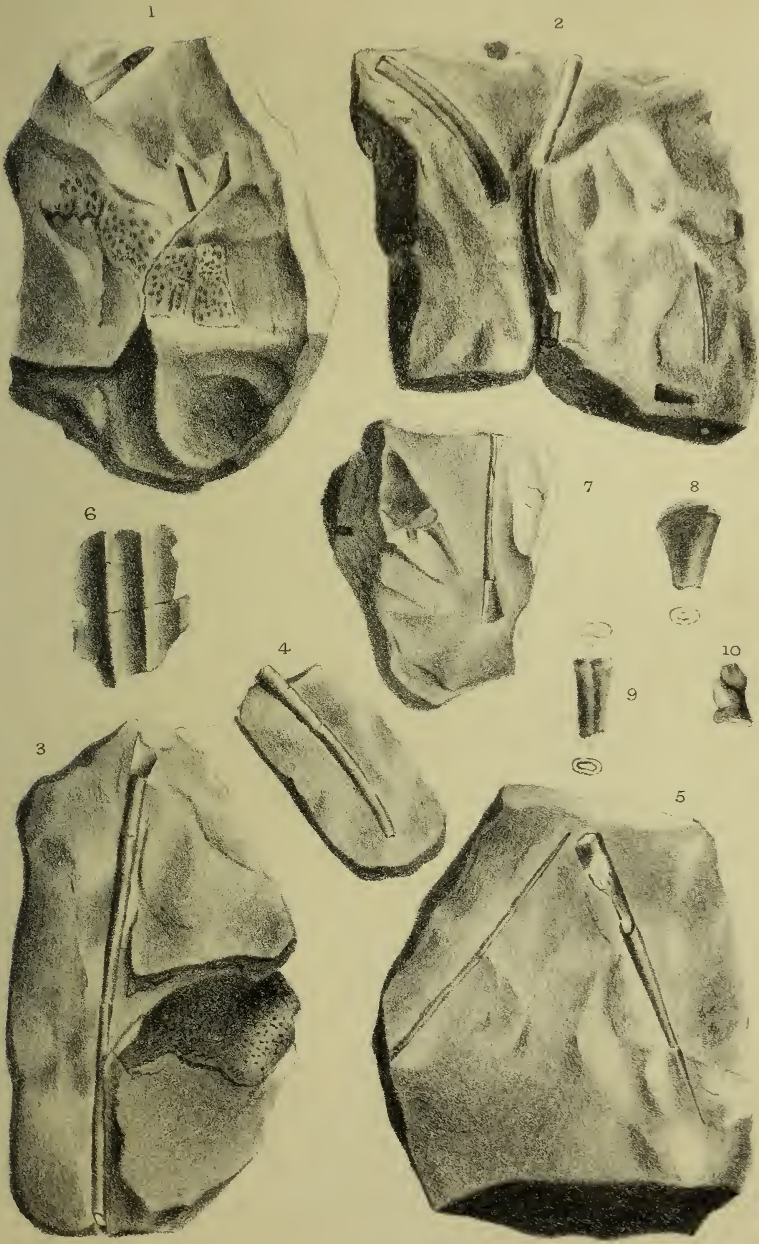


Fig. 1. *a*. Base of tooth, anchylosed to alveolar process; *b*, *c*, magnified.

The base of the tooth, fig. 1, *c*, has a full, oval, almost circular, transverse section, exposing a pulp-cavity, the diameter of which is half that of the fractured part of the tooth, surrounded by dense dentine, with a glossy fracture, without any distinct outer enamel or layer of other substance; there is no trace of linear impressions on its exterior, although the part preserved corresponds to the beginning of the base of the tooth, where the inflections of the cement, which give

* Extracted from the Geol. Mag., Vol. ii. No. 1, pp. 6–8.

† *Parabatrachus Colei*, Owen; Quart. Journ. Geol. Soc., 1853, vol. xi. p. 67, Pl. 2, fig. 1.



Murdoch Morison del. et lith.

W. West imp.

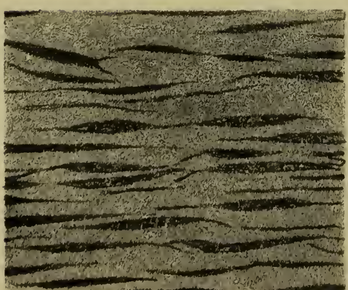
Anthrakerpeton crassosteum, Owen.

from the Coal-shale of South-Wales.

1.

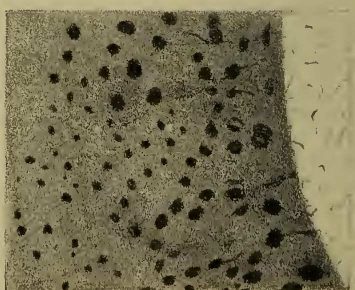
$\frac{50}{1}$

2.



$\frac{222}{1}$

3.



Murdoch Morison del et lith.

W. West imp

Structure of Reptilian Bone.

from the Coal-shale of South Wales.

rise to the converging lines or labyrinthic windings, are seen in the teeth of some Labyrinthodonts, in which the upper two-thirds or half of the crown of the tooth may be entire.

The portion of cranial bone is impressed with small circular pits which, toward one side of the bone, elongate and run into wavy grooves anastomozing and causing the reticulo-striate and divergent impressions characteristic of Ganocephalous and Labyrinthodont cranial bones; *cut*, fig. 2. The expanded end of a long bone, Pl. I. fig. 8, has not terminated in a smooth, well-ossified surface supporting articular artilage for a synovial joint, but has terminated, like some limb-bones in existing Perennibranchiate Batrachians, in unossified fibro-cartilage, showing in its present state the matrix in a finely granular state, surrounded by a thin film of bone: this rapidly thickens as the articular surface contracts into the shaft, where, at the point of fracture, a small sub-central unossified tract is exposed.

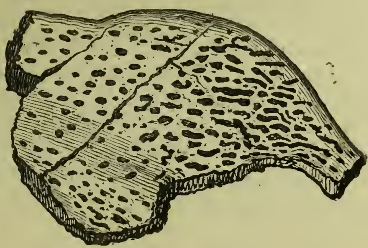


Fig. 2. Part of cranial bone (Pl. I. fig. 3); magnified.

The portion of bone, fig. 9. indicates a similar incompletely ossified condition of the articular expansion; where, however, the thin outer crust of bone is continued from the periphery across the short diameter, leaving or marking out two unossified spaces filled by matrix, and which I infer, from Batrachian analogies, to have originally contained unossified cartilage. The side of the bone is longitudinally impressed, indicating the coalescence or connation of a pair of bones, and the fracture of the shaft, as in that of the connate tibia and fibula of the frog, shows the confluence of the two unossified tracts into one, simulating a medullary cavity. The fractured ends of the other long and slender bones are remarkable for the contracted area of the corresponding cavity, and for the density and thickness of the surrounding bony wall.

Such a section is figured, magnified 50 diameters, in Pl. II. fig. 1; and microscopical evidence of the Batrachian character of the bone is given in fig. 2, longitudinal section, and fig. 3, transverse section, of the 'bone-cells,' magnified 222 diameters.

In both size and shape these bone-cells closely correspond with those of *Baphetes planiceps*, from the Pictou Coal, Nova Scotia.

The present portions of the skeleton of the air-breather from the Welsh Coal indicate a species intermediate in size between *Baphetes planiceps* and *Dendrerpeton Acadianum*. The ribs were longer than they are known to be in any Labyrinthodont, and they were better developed in that extinct group than they are in Ganocephalans or in modern Batrachians.

The structure of these long and slender bones, as of the thicker limb-bones, shows that the cavity was not truly medullary, but had been occupied by unossified chondrine, as in perennibranchiate Batrachia, and in the bones of many fishes that are hollow after maceration, and show in the fossil state cavities, like medullary spaces, occupied by matrix.

I conclude from such evidence as has hitherto been submitted to me, and for which I heartily thank Mr. Lee, that the *Anthrakerpeton* from the Welsh Coal belonged to that low, probably primitive, air-breathing type, which, with developmental conditions of the bones, like those in some fishes, and very common in Devonian fishes, showed forms of the skeleton more resembling those in Saurian reptiles than are attained by any of the more specialized Batrachian air-breathers of the present day.

I propose, in reference to the characteristic density and thickness of the walls of almost all the long bones hitherto obtained of this air-breather, to name it *Anthrakerpeton crassosteum.*

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. Portion of Coal-shale with impression of the integument and a few scutules.
2. Portion of Coal-shale with portions of two ribs.
3. Portion of Coal-shale with part of the cranium and of a long and slender bone.
4. Smaller portion of a similar bone on the opposite side of the shale.
5. Portion of shale with parts of two slender, straight, and pointed bones.
6. Portion of a symmetrical, grooved, flat bone; *qu.* from naso-palatine cavity?
7. Portion of shale with slender posterior ribs.
8. Articular end of humerus? or femur?
9. Articular end of connate leg-bones?

PLATE II.

Fig. 1. Transverse section of a long-bone; magnified 50 diameters.
2. Section of part of the bone in the direction of the long axis of the bone-cells; magnified 222 diameters.
3. Section of part of the bone near the central cavity, taken transversely to the long axis of the bone-cells.

These sections were prepared, and the drawings of them made on stone, by John Edward Lee, Esq., F.G.S., the discoverer of this extinct Coal Reptile.

Appendix.—Now that so many remains of reptiles have been found in the Coal-shales of the British Islands, besides those known when *Anthrakerpeton crassosteum* was first described, it has been thought advisable to append a list of the known species. —EDITOR.

1. Parabatrachus Colei, *Owen.* 1856. Quart. Journ. Geol. Soc., vol. ix. p. 66. Scotland.
2. Loxomma Allmani, *Huxley.* 1862. Q. J. G. S., vol. xviii p. 292. Scotland.
3. Pholidogaster pisciformis, *Huxley.* 1862. Q. J. G. S., vol. xviii. p. 294. Scotland.
4. Anthracosaurus Russelli, *Huxley.* 1863. Q. J. G. S., vol. xix. p. 56. Scotland.
5. Anthrakerpeton crassosteum, *Owen.* 1865. Geol. Mag., vol. ii. p. 6. . South Wales.
6. Keraterpeton Galvani, *Huxley* and *Wright.* 1867. Trans. Roy. Irish Acad., vol. xxiv. p. 354. Ireland.
7. Urocondylus Wandesfordii, *H.* and *W.* 1867. Tr. R. I. Ac. vol. xxiv., p. 359. Ireland
8. Lepterpeton Dobbsii, *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 362. Ireland.
9. Ophiderpeton Brownrigii, *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 364. Ireland.
10. Dolichosoma Emersoni, *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 366. Ireland.
11. Ichthyerpeton Bradleyæ, *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 367. Ireland.
12. Erpetocephalus rugosus, *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 368. Ireland.
13. Discospondylus, sp., *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 369. Ireland.
14. Brachyscelis, sp., *H.* and *W.* 1867. Tr. R. I. Ac., vol. xxiv. p. 369. Ireland.
15. Petroplax cornuta, *Hancock* and *Atthey.* 1868. Ann. Nat. Hist., Ser. 4, vol. i. p. 266. North England.
16. Ophiderpeton nanum, *Hancock* and *Atthey.* 1868. Ann. Nat. Hist., Ser. 4, vol. i. p. 276. North England.

ON SOME BIVALVED ENTOMOSTRACA FROM THE COAL-MEASURES OF SOUTH WALES.* By T. Rupert Jones, F.G.S., Professor of Geology and Mineralogy at the Royal Military College, Sandhurst. (Plate III.)

In the spring of 1869 Mr. William Adams, F.G.S., of Cardiff, sent to me for examination several pieces of Coal-shale, bearing some minute organisms which had been recognized as Entomostraca by Mr. Charles Moore, F.G.S. The shale, in some of its layers, which are more or less bituminous, is full of *Anthracomya Phillipsii*, Williamson, sp.; and amongst these shells are a few others, differing very slightly in shape, but characterized by their minutely reticulate surface, therein resembling *Estheria*. There are also a few specimens of *Estheria tenella*, and numerous small Cytheroid forms, which cannot belong to either *Cythere* or the allied genera, as far as the carapaces show. In some pieces of the bituminous shale another Entomostracan Bivalve, namely, *Leaia*, occurs in abundance on some slabs, but without associates. This genus is now for the first time found so far south in Britain; the hitherto known specimens have come from different parts of North America (Pennsylvania, Illinois, and Nova Scotia), from Scotland, Lancashire, and Germany. A layer of what at first sight appear to be small Seeds or Spore-cases coats one face of a slab rich with *Anthracomya* and *Estheria*, but these little bodies are possibly small Daphnia-like Entomostraca, as suggested by Mr. Carruthers, F.G.S. A single larger Spore-case (?) occurs on another piece, and a Lepidodendroid leaf on another. In some of these shales there occur black shining circular spots, with irregularly concentric wrinkles, that at first sight look like compressed fruits; but Mr. Carruthers has explained (Brit. Assoc. Meeting, 1869) their nature and origin, as spots where gases, disengaged from decomposing organic matter, formed bubbles, imprisoned in the mud; and, whilst gradually diminishing, their successive walls were again and again squeezed and slickensided by the double action of pressure and expansion. The less bituminous shale contains fragments of *Neuropteris* and *Cyclopteris* (?). Fish (?) bones also occur on some of the slabs.

* Extracted from the Geol. Mag., Vol. vii., No. 5, pp. 214-220.

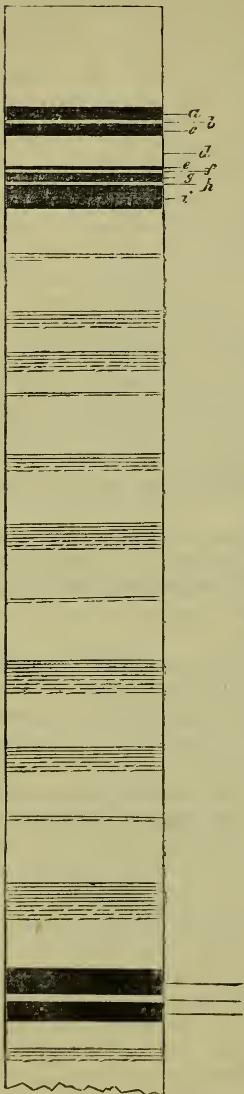
These shales, associated with "Black Band Ironstone" of the South-Welsh Coal-field, are regarded by Mr. Adams as the equivalent of the bed referred to as "Rider [Coal], 1 foot," in the Section of strata of the "Pennant" series, at page 172 of the Mem. Geol. Survey, Iron-ores, Part iii., 1861. Mr. Adams informs me that "about one and a half mile south-west of Bedwelly Church, and one and a quarter mile north-east of Gelligaer Church (on Sheet 36 of the Ordnance Survey Map), in Glamorganshire, on the west side of the River Rumney, a coal-level was opened on the crop of the Mynyddysllwyn Coal, on Cilfach-bargoed-fawr Farm. After driving westward in the coal, they struck a down-throw west fault (from 25 to 30 yards); and in place of the coal, or rather on the same level, came in the Black Band beds, and in these the fossil shells are found. (See Section.) The Black Band is apparently of limited area. This new bed of fossil shells is about 800 ft. higher in the South-Welsh Coal-measures than any hitherto met with. At Llancariach Colliery, the property of George Worthington, Esq., 1¼ miles nearly due west from Gelligaer Church, this Black Band again occurs, with the same fossil shells, some acres in extent, but of less thickness than at the works above mentioned; and here also it is between two faults."

A shale full of *Anthracomyæ* of the same species as that above noticed has also been found by Mr. Adams at Aberbeeg, in the Ebbw Valley, overlying a coal called the Troed-rhiw-Clawdd Coal, which lies at the bottom of the Pennant rocks, about 226 yards below the Mynyddysllwyn Coal.

§ 1. *Anthracomya.*—The Molluscan shells referred to above are very numerous, flattened and compressed, in layers. The chief form is similar to Prof. Williamson's *Unio Phillipsii*, from the Upper Coal-measures at Ardwick, near Manchester, described by him in the "Phil. Mag.," 1836, p. 241. It is the same also as Prof. Phillips's *Unio linguiformis*, "Sil. Syst.," p. 88, and Mr. Binney's *Modiola* (?), "Manchester Lit. Phil. Soc. Trans.," vol. xii. p. 221. Prof. Williamson has lately favoured me with a sketch of this shell, and with a piece of the Ardwick shale. The same form occurs plentifully in the Coal-shales of other places, and has been labelled *Anthracomya* (*Unio*) *Phillipsii* in the Museum of the Geological Survey. In 1861 Mr. Salter instituted the genus *Anthracomya* for such shells as these, of which there are several forms that "have oscillated between *Avicula* and *Modiola*, and even *Unio*" ("Iron-ores," etc., p. 230). Prof. King's *Anthracosia* had already taken in the Unio-like forms, and Mr. Salter afterwards proposed *Anthracoptera* * for the reception of the obliquely angular forms, somewhat like *Myalina* and *Dreissena*.

* Quart. Journ. Geol. Soc., 1863, vol. xix., p. 80.

SECTION OF STRATA AT CILFACH-BARGOED COLLIERY.



Shale.

a.	Blackband	1'.0"
b.	Shale	0'.2½
c.	Blackband	1'.0
d.	Shales (Fossil Shells and *Leaia*)	2'.0"
e.	Blackband	0'.3"
f.	Shale	0'.3"
g.	Blackband	0'.8"
h.	Shale	0'.3"
i.	Blackband (Fossil Shells)	2'.0"

Shale and Rock, 80'.0"

Coal, 2'.8"
Shale, 1'. } Mynyddysllwyn.
Coal, 2'.6"

Shale.

(Scale, 20 feet to the inch.)

Fig. 3, Pl. III., represents the *Anthracomya*, so abundant in the shales under notice; specimens like Fig. 18 are rare. The shell is concentrically wrinkled, somewhat irregularly, and the ridges are modified by pressure. The surface is marked with fine lines parallel to the ridges. Fig. 3, in plate 2 of the "Iron-ores, etc.," Part iii., may be a small *Anthracomya Phillipsii*, but it is rather too narrow.

§ 2. *Estheria Adamsii.*—Together with the above we find several very similar shells, concentrically ridged, but marked all over with microscopic pittings, like the pattern of a thimble-top on a very minute scale—an ornament very unusual in Molluscs, but common in *Estheria* (*E. Dunkeri* and *E. Hislopi*, Baird, for instance). The punctation differs from that of the little Mollusc, *Lepton squamosum*, in being far smaller and very much more closely set. The best preserved specimen of this Estheria-like shell is more like *Anthracomya Adamsii* (Salter, "Iron-ores, etc.," Part iii., p. 230, pl. 2, fig. 7) in shape than *A. Phillipsii*, being less oblique than the latter, and having a longer hinge-line. The specimens, however, are all too much crushed to be taken as perfect types of form.

In some slabs of shale there are films of whitish minute network, which appear to have resulted from the decomposition of these punctate shells; whilst the common *Anthracomyæ* have become changed, sometimes into white calcareous shells, but are usually brownish, sometimes minutely granular, but not reticulate.

The outline of the reticulate valves, when perfect, or nearly so (Fig. 1), closely approaches that of *Estheria striata*, var. *Beinertiana* (Monog. Foss. Esth., p. 25, pl. 1, fig. 13). The superficial ornament, however, constitutes a specific difference. In other cases the valve is narrower, and has a shorter hinge-line (Fig. 2); but it is difficult to determine if this be an original shape, or if it be due to squeezing.

I propose to register this large *Estheria* (more than an inch in length), obliquely ovate in outline, with a long straight hinge, and with numerous concentric irregular ridges, and a general ornament of very minute hexagonal punctation, as *E. Adamsii*. In ornament it resembles *E. punctatella*, Jones, as well as the recent forms mentioned above, but differs from them materially in shape.

In the piece of Anthracomyan shale from Ardwick, given me by Prof. W. C. Williamson (see above, p. 113), I also recognize, under the microscope, a morsel of a similar reticulate valve. This *Estheria* will therefore be found elsewhere.

In a piece of the shale from Mr. Adams's collection, I observe two specimens of *Estheria tenella* (Monog. Foss. Esth., p. 31, pl. 1, fig. 26, 27, &c.).

§ 3. *Cytheroid Entomostraca.*—There are at least three Cytheroid forms in the shales under notice; although often crushed, or occurring as mere casts, yet in some instances the valves are well preserved. They differ from known *Cytheræ*, *Cyprides*, &c., not only in the patterns of the "muscle-spot," but in having the inner face of that spot excavated at its margin, and in having the inner surface of the valves reticulated with vascular impressions, especially near the centre. In such points these old Cytheroids have Leperditian and Beyrichian characters; but their valves resemble those of *Cythere* and other *Ostracōda*. The very common Carboniferous species, *Cythere* (?) *fabulina*, Jones and Kirkby, MS. (Trans. Glasgow Geol. Soc., vol. ii., p. 217, 1867), is an allied form, and probably belongs to the same generic group, which I designate *Carbonia*.

1. *Carbonia Evelinæ*, nov. (Pl. III., Fig. 4).—Subovate; dorsal line divided in unequal thirds by the front and back slopes and the straight hinge-line between. Anterior end blunter than the posterior. Ventral border well curved. Surface wrinkled by numerous small, smooth, rounded ridges, longitudinal, interrupted, sinuous, tapering away amongst themselves, and converging towards the ends of the valves. In the centre of each valve a small circular area or "muscle-spot" is visible, consisting of three or four minute subtranslucent spots crowded together within a darkish circle. The wrinkling of the general surface is continued faintly over these muscle-spots. This species is rare.

2. *Carbonia Agnes*, nov. (Pl. III., Figs. 6 and 7). — Ovate-oblong; dorsal edge gently arched, ventral line straight or slightly incurved; anterior third of the valve rather smaller than the posterior. The surface is quite smooth in some specimens, and shows a small central muscle-spot, consisting of a narrow darkish circle, inclosing a light (translucent) area, in which a dark, irregular, four-bodied spot is set, with a few black specks along one of its edges.

The casts have a faintly reticulated surface, due to the structure of the shell; and on the casts the place of the "muscle-spot" is indicated by a small round area with a raised ledge, higher on one side than the other. There is also a slight transverse hollow behind and below the central spot on the cast.

a. Var. *subrugulosa* (Fig. 10).—Here the shell has its smoothness partially interfered with by faint longitudinal striæ.

β. Var. *rugulosa* (Figs. 8 and 9).—The shell is strongly striated by longitudinal interrupted wrinkles, converging towards the ends of the valves.

The casts also show some faint signs of the wrinkles, together with reticulation around the raised circle of their "muscle-spots." On the outside shell the "muscle-spot" appears only as a small obscure patch of darkish tint.

§ 4. *Carbonia* (?), sp. (Pl. III., Fig. 5).—There are at least two specimens of a large Cytheroid species, not well preserved, casts only remaining, which deserve notice. The larger one, which is best preserved, is here figured; but it is hazardous to fix its generic relationship. The cast is faintly reticulate.

§ 5. *Leaia Leidyi*, Jones, Monograph of the Fossil *Estheriæ*, 1862, Appendix, p. 115, &c. (Pl. III., Figs. 11-14). Messrs. Meek and Worthen have shown that in some specimens of *Leaia* (*L. tricarinata*, M. and W., Report Geol. Survey Illinois, 1869, p. 540, &c.) there is evidently a third (dorsal) carina on each valve, bounding a dorsal depression (their "lanceolate false area"), along the bottom of which is the hinge-line. In compressed specimens this is not distinguishable, and whether or no it is present in all (as it well may be) they leave an open question (p. 543). We may add that, thanks to our artist, Mr. George West, we can now point out that *Leaia* had the usual Crustacean ornament of reticulation, so common in Entomostraca, especially in *Estheria*. As this character may have been present in other *Leaiæ*, but destroyed by pressure and change, we cannot use it as a specific character in this case; and as to outline and proportions, the many individuals on the shales found by Mr. W. Adams, in South Wales, comprise all the forms yet figured by Lea, Dawson ("Acadian Geol.," 1868, p. 256), Meek and Worthen, and myself, and may be due to differences in age or sex, or conditions of preservation. Perhaps we may say the same of Geinitz's *L. Bæntschiana*, from the Lower Permian beds near Neunkirchen, "N. Jahrb.," 1864, p. 657. It is, of course, probable that different "species" did exist, and are represented among the several forms found in distant countries; but we still wait for further and decided evidences of specific characterization.

§ 6. *Daphnioid* (?) *Entomostraca.*—On one of the slabs of bituminous shale from South Wales is a layer of small black bodies, acute-ovate and wrinkled, that were at first thought to be spore-cases, but Mr. Carruthers cannot discern any plant character in them, and suggests that they may be small thin Entomostracan valves, analogous to those of the modern *Daphnia* and their allies. They show indications of being bivalved, and have one end more pointed than the other. They are also boldly marked with longitudinal and inosculating wrinkles (probably lines of breakage from compression), which distantly imitate the wrinkles on a collapsed seed-vessel, or even the ornament on some seeds; but the eminent botanist just mentioned cannot find in them sufficient evidence for a place among vegetable organisms. Mr. Carruthers has reminded me that the woodcuts (figs. 10 and 11) at pages 39 and 40 of Emmons's "American Geology," Part vi., 1859, closely resemble these crushed organisms, and are there referred to Entomostraca.

Appendix.—1. We are enabled, thanks to Principal Dawson, to offer a good drawing (Pl. III., Fig. 15) of a specimen of the

Nova-Scotian *Estheria*, roughly figured in a woodcut at p. 256 of "Acadian Geology," 1868. Not being well preserved, this specimen shows no reticulate or other ornament besides the concentric ridges. These are bold and distant, as in *E. Portlocki*, *E. Mangaliensis*, etc.; but as the form before us differs in outline from the broad-ridged species, we may regard it as distinct, and catalogue it as *E. Dawsoni.* It occurs in the Lower Carboniferous rocks at Horton.

2. Another species of *Estheria* has lately come into my hands, through the kindness of Mr. C. Peach. Several specimens have been found in argillaceous concretions in the Carboniferous Shales of the Camstone quarry, at Salisbury Craigs, Edinburgh, by Mr. B. N. Peach. It is a subquadrate form, boldly ridged. Its sculpture is not preserved, and, indeed, only mere films of the shell itself. The form, however, is sufficiently distinct to authorize us to regard it as a new species—*E. Peachii.*

EXPLANATION OF PLATE III.

Fig. 1. *Estheria Adamsii*, sp. nov. *a*, Left valve shown; natural size. *b* and *c*, Ornament (*c*, near the margin); magnified 40 diameters.

2. *Estheria Adamsii* (?). Right valve shown; 2 diam.

3. *Anthracomya Phillipsii*, Williamson, sp. Nat. size.

4. *Carbonia Evelinæ*, sp. nov. *a*, Left valve shown; magn. 25 diam. *b*, Muscle-spot; 70 diam. *c*, Dorsal view of the two valves; 25 diam.

5. *Carbonia ?* sp. A cast; 25 diam.

6 & 7. *Carbonia Agnes*, sp. nov. 6*a*, Left valve shown; 25 diam. 6*b*, Reticulation on the cast, and 6*c*, the muscle-spot; 70 diam. Fig. 7. Dorsal edge of the left valve, and outline of the other; 25 diam.

8 & 9. *Carbonia Agnes*, var. *rugulosa*, nov. 8. Left valve shown; 25 diam., 9. Muscle-spot and reticulation of the cast; 70 diam.

10. *Carbonia Agnes*, var. *subrugulosa*, nov. Left valve shown; 25 diam.

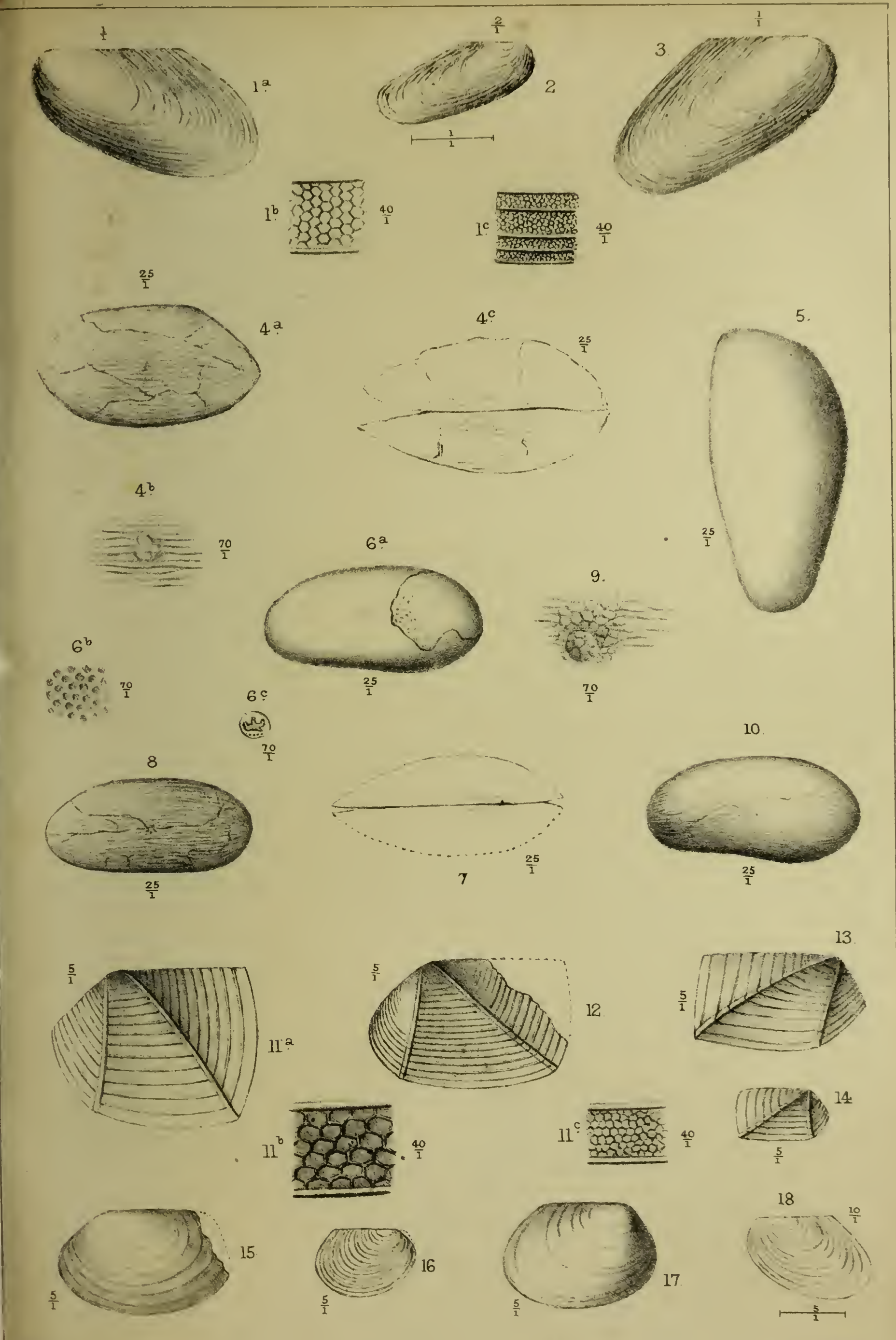
11–14. *Leaia Leidyi*, Jones. Various forms: differences due to age, sex, or variety, probably the first. Fig. 11*a*, Left valve, old; 5 diam. 11*b* and *c*, Ornament (*c*, near the margin); 40 diam. Fig. 12, Left valve, adult (typical form); 5 diam. Figs. 13 and 14, Young right valves; 5 diam.

15. *Estheria Dawsoni*, sp. nov. Left valve (cast); 5 diam.

16. *Estheria tenella*, Jones. Right valve; 5 diam.

17. *Estheria Peachii*, sp. nov. Right valve; 5 diam.

18. *Anthracomya* (young of *A. Phillipsii ?* See fig. 3.). Magn. 10 diam.



G West delt W. West imp

Carboniferous Entomostraca, &c.

REFERENCE TO RAIN GUAGE MAP.

No. of Guage on Map.	Authorities.	Stations.	Rain Guage. Diameter.	Height above ground	Height above Mean Tide-level. Ordnance Station.
			Mls.	Ft. In.	Feet.
1	Dr. McCullough	Abergavenny...	5	1 3	220
2	F. J. Mitchell, Esq. ...	Llanfrechfa Grange, Newport	5	1 0	360
3	Rev. J. R. Jenkins ...	Cwmbrân Parsonage, Newport	5	1 0	350
4	J. Laybourne, Esq. ...	Isca Foundry, Newport ...	5	1 0	20
5	P. James, Esq.	Ebbw Vale Iron Works ...	5	1 0	918
6	R. Jordan, Esq.	Sirhowy Iron Works, ...	5	1 0	1055
7	T. J. Dyke, Esq.	Merthyr Tydvil	6	2 0	550
8	Messrs. Morris & Roberts	Plymouth Iron Works, Merthyr Tydvil	8	0 8	579
9	Franklen G. Evans, Esq..	Tynant, Radyr, Cardiff ...	5	1 0	100
10	T. G. South, Esq	Ely Water Works, Cardiff ...	5	2 0	45
11	Do.	Lisvane Water Works, Cardiff	5	2 0	142
12	William Adams	Tredegarville, Cardiff	5	1 0	40
13	T. Waring, Esq.	Town Hall, Cardiff	5	1 0	20
14	G. W. Nicholl, Esq. ...	The Ham, Cowbridge	8	1 3	50
15	T. Forster Brown, Esq..	Glyncorrwg, Briton Ferry ...	5	1 0	730
16	W. T. Lewis, Esq. ...	Treherbert, Pontypridd ...	5	1 0	634
17	Do.	Mardy, Aberdare	5	1 0	431
18	Evans Jones, Esq. ...	Ty Maur, Aberdare	5	1 0	450

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Expenses of Soirée... ...	3	11	9
Lectures—fees, etc. ...	15	18	10
Field-day receipts	41	0	4
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CARDIFF NATURALISTS' SOCIETY.

Rules.

1.—That this Society be called the "Cardiff Naturalists' Society," to consist of Subscribing and Honorary Members.

2.—That Ladies be eligible as Members.

3.—That its objects be the practical study of Natural History, Geology, the Physical Sciences, and other objects of interest; and the formation of a Museum in connection with the Free Library.

4.—That the Society be managed by a Committee, consisting of a President, Vice-Presidents, Curator, and Honorary Secretary, and Twelve other Members of the Society; and that in Committee Meetings, Three form a *quorum*.

5.—That the Annual Meeting be held in the month of January, at which the Committee and Officers be elected for the following year by Ballot.

6.—That the General Meetings be held on the Third Tuesday in every month, at Eight o'clock p.m. Committee Meetings at the same hour on the First Tuesday of every month; and that a discretionary power be vested in the Committee to alter the times of all meetings when necessary.

7.—That all Candidates for Membership shall be proposed and seconded by existing Members, either verbally or in writing, at any meeting of the Society, and shall be eligible to be Balloted for at the next meeting, provided there be Five Members present. One black ball in Three to exclude.

8.—That the Annual Subscription be Seven Shillings and Sixpence (payable in advance to the Secretary on the First of January), entitling each Member to a copy of the transactions. Members may commute the Annual Subscription into one payment of Three and a Half Guineas.

9.—That Specimens collected by the Society shall be deposited in the Cardiff Museum, and shall become the Property of the Corporation of Cardiff.

10.—One Month's Notice of withdrawal from Membership is required, such notice to be given in writing to the Hon. Sec.

11.—One Month's Notice to be given of any proposed alteration in the Rules.

Resolved,—"That strangers be invited to attend the Meetings of the Society, and to exhibit any Curiosities or Collections which may be in their possession."

REPORT.

The Committee have much pleasure in presenting their Annual Report of the proceedings of the Society for the Year ending the 31st December, 1870.

The number of Members on the 31st December was 289, showing an increase over the preceding year of 45.

At a Meeting of the Society held at the Town Hall on the 8th February, 1870, after the election of the Officers and Committee for the Year, Mr. Franklen G. Evans read a Paper on the Meteorology of 1869; and it was resolved that Cards be printed and sent to each Member, giving the dates of the Meetings fixed for the Year; but it has since been decided that the Monthly General Meetings be called together by Post Cards.

On the 5th April the President read a slight Memoir of the late Rev. Professor Michael Sars, late of Christiana, and the sum of 52s. was collected for the Widow and Orphans. A Paper was read by Mr. Vivian on "Water, in its various conditions of solid, fluid, and vapour." Professor Gagliardi then gave a description of Hydroida, Diatomaceæ, &c., and illustrated it by living examples found in the neighbourhood.

On the 3rd of May a Paper, prepared by Mr. P. Price, was read, "On the best means of promoting the study of Natural History in Cardiff." Mr. South exhibited cases of Butterflies collected in the West of England. About this time the Society entered into communication with Mr. Buckmaster, of Kensington Museum, and with Mr. Leipner, of Bristol, with the view of engaging a Lecturer to deliver a Course on Botany, Geology, and Zoology; but the matter was for the time postponed.

On the 7th June the President exhibited a selection of Fossils from Mr. Edward Wood, F.G.S., of Richmond, Yorkshire, which he had presented to the Society; and a vote of thanks to Mr. Wood was carried unanimously. Mr. Milward read a Paper on "Zoophytes," prepared and microscopically illustrated by Professor Gagliardi, of which Captain Bedford kindly lent several specimens.

On the 5th July the first and only Field Meeting of the Year was held at Llantrisant, where the very fine Entomological Collection belonging to Evan John, Esq., was inspected. On the road to Llantrisant a visit was paid to the Mwyndy Iron Ore Mines, and Mr. Vivian, the Manager, very kindly explained the process of working. From Llantrisant the Members proceeded to Hensol Castle, where Mr. Franklen G. Evans read a Paper on "The Carboniferous Limestone;" and Mr. Drane read a Paper on "Field Botany." Notwithstanding that the weather was most unfavourable, a very pleasant day was spent.

At the Meeting held on the 2nd August, Mr. South tendered his resignation of the office of Hon. Secretary, and it was resolved unanimously that the best thanks of the Meeting be given him for undertaking the duties of that office, and that he be requested to continue them to the end of the season.

After this date the proceedings of the Society may be considered to have come to an end, in consequence of the increasing demands made on the time of several of the most active members by the Exhibition of Fine Arts. But although the Society, as such, did no work during the time the Exhibition was open, it has, there is no doubt, been benefited to a great extent. The fossils, minerals, and specimens of Natural History that were shown to the inhabitants of Cardiff and the surrounding districts, *must* have excited their admiration, and will result in a greater interest being felt in our proceedings. Indeed we have already experienced beneficial results. The Committee of the Free Library have thrown the top floor of their building into one large room in order to be able to exhibit the numerous valuable objects now in their possession.

The following Lectures have been delivered during the year :—

Aug. 20th.—By W. Carruthers, Esq., F.L.S. and F.G.S., "On the Forests of the Coal Period."

Aug. 26th.—By W. Pengelly, Esq., F.R.S. and F.G.S., "On Fossil Organic Remains."

Sept. 1st.—By Rev. H. Geary, M.A., "On Palestine Explorations."

Sept. 17th.—By Rev. John P. Hastings, M.A., "On China and the Chin ese.

Nov. 22nd.—By Mr. J. Morgan, "On the Relations between the Fine Arts, Natural Science, and Industrial Productions."

Cardiff Naturalist's Society.

Dr. TREASURER'S ACCOUNT. Cr.

1870.	£	s.	d.	1870.	£	s.	d
To Balance, 31st Dec., 1869 ...	12	15	3	June 14.—By Nash, Use of Chairs	2	9	6
July 5.—Field day	10	17	0	July 19.—Lewis & Co., Printing	21	11	0
December 12.—Subscriptions Received	21	15	0	Gas, &c., Town Hall	1	14	0
				August 20.—Car, Transactions	0	5	0
				Expenses, Field Day	7	15	11
				Sundries, including Postage, Stationery, Cab Hire, &c.	3	9	0
				By Balance...	8	2	10
	£45	7	3		£45	7	3
To Balance Down	£8	2	10				

Dr. BALANCE SHEET. Cr.

	£	s.	d.		£	s.	d.
To S. Austin, for Printing Transactions	42	6	0	By Subscriptions, 1869, unpaid	22	5	0
„ Lewis and Williams, Stationery	5	3	4	„ Subscriptions, 1870, unpaid	49	10	0
„ D. Duncan, Advertisements	1	16	0	„ 400 Copies of Transactions, at 1s.	20	0	0
„ Andrews, Omnibus Hire Estimate...	5	0	0	„ South	8	2	10
„ Sundries, Estimated ...	2	0	0				
„ Balance down	43	12	6				
	£91	15	0		£91	15	0

TRANSACTIONS, 1870.

MONTHLY METEOROLOGICAL REPORTS, 1870.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

JANUARY.

The weather of the past month naturally divides itself into two nearly equal parts, separated by an abrupt line of demarcation, which represent antagonistic meteorological elements and well illustrate the opposite poles of British climatology. The month commenced with a low and changing barometer indicating much atmospheric disturbance. The temperature was considerably milder than that due to the season, and exceeded the average to the extent of from one to ten degrees on every day, with a single exception, up to the 18th date. During the same period winds were generally westerly, and the air was heavily charged with moisture that was deposited in copious rainfall. On and after the 18th winds were easterly, the barometer went up suddenly to a high point, and sharp frost set in. For nearly a fortnight the weather was extremely fine, and the accompanying frost of an enjoyable character. The cold was not at any time of great intensity, and the usual calm state of the atmosphere still further mitigated the icy grasp of the polar current. We seldom get a frost of such genial quality, or one, the degree being equal, so little likely to be injurious to the agricultural interests of the country. The absence of snow also was favourable to farming operations that require a hardened soil, and the wheat crops received a timely and salutary check to undue luxuriance of growth. Some garden seeds have already been sown, and the general prospects of vegetation are very satisfactory.

The barometer showed great variation, having been depressed and fluctuating during the first half of the month, and very high and comparatively steady for the remainder. The maximum height, 30·62, was attained on the 18th, and the minimum, 28·94, on the 8th, giving an entire range of 1·68. The instrument stood above 30 inches on 16 days.

The temperature of January exhibited a similar alternation of excess and deficiency in the two halves of the month. The highest reading of the day thermometer was 53° on the 16th, and the lowest night record 21° on the 28th, showing a total range of 32 degrees. The greatest daily range amounted to 19° on the 13th and 30th, and the least variation to 2° on the 20th. The mean daily range was 10·8°. The mean of the maximum temperatures was 44·2°, and of the minimum 33·4°. The mean heat of the whole month was 38·8°, which is 4·2° below that of the corresponding period of last year, and 1·9° above the average warmth of January for 50 years. The temperature was in excess on 18 days, and deficient on 13 occasions ; but the former over-balanced the latter, and resulted in a gain of nearly two degrees on the entire month.

The winds again were arrayed in two opposite camps of equal numerical strength—15 westerly and 15 from the east, and neither could claim the victory. The combined current showed a preponderance in favour of the north in the proportion of 17 to 11. The force several times amounted to a strong gale, and on one occasion, the 8th, it culminated in a storm of great violence, which happily did not last more than about seventeen hours. This tempest coincided with the lowest reading of the barometer.

The quantity of moisture in the air was considerable, and twice reached the maximum amount. The mean degree of humidity was 89, complete saturation being represented by 100.

The rainfall of January was distributed over 17 days, and fell almost entirely in the first half of the month. The total was below the average, and measured exactly 4·00 inches. This is equal to 404 tons, or upwards of 1,660 hogsheads to an acre. The dryness of the end proved an efficient counterpoise to the wetness of the commencement of the month, and reduced the entire rainfall to less than the usual mean.

The development of ozone was decidedly deficient, and less than the average of January. It was present in the air on 19 days, but did not once reach the maximum of the scale. Antozone was occasionally noted. The mean degree of ozone was 3·645.

The principal diseases in January were bronchitis, pneumonia, colds and sore throats, various forms of rheumatism, typhoid fever, whooping cough, some diarrhœa, hepatic disorders, and cutaneous eruptions. The mixture of cold and damp at this season of the year always conduces to the production of inflammatory complaints and rheumatism, while the fever class, which popular opinion attributes to hot weather, are really fostered by depressed vitality, huddling together in cottages, and filthy surroundings, The London mortality was less than the average, which shows that the frost was not severe enough to make its mark on the register of deaths—a record that so speedily unmasks the poverty and scarcity of fuel in the Metropolis, as soon as a severe fall in temperature takes place. There was a time when the summer sun was the fell destroyer, but sanitary science has made a great alteration in this respect. Unfortunately, it is not equally capable of grappling with misery and want, which make the winter's cold such a formidable enemy. Greater prosperity, more prudence, and wiser charity, will be necessary to deprive ice and snow of their terrors for the poor.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

FEBRUARY.

The weather of the past month was of a varied character, and marked by abrupt and severe changes. The principal meteorological features were a rather low barometer, generally cold temperature, strong and bitter east winds, moderate humidity, a light rainfall, and not very full development of ozone. The period was distinguished by dangerous extremes and trying contrasts. The month opened with a very warm and moist atmosphere, and heavy rains. After the first week a strong Polar wind set in, accompanied with hard frost. This lasted about a fortnight, and was very injurious to most constitutions. The month ended less severely, with alternations of rain and frost. The evergreen shrubs in gardens were much damaged in appearance by the easterly blăst. Their leaves are blackened and shrivelled, as if burnt with fire, and the whole aspect of the bushes is so drooping and woe-begone as to suggest a resemblance to the mutes in the "unmitigated sorrow" department of a London establishment for "performing" funerals. There is every reason to hope that the sorrow is only leaf-deep, and has not touched the heart, or, perhaps, I ought to say root, and the trees will again come out green and bright under the influence of the spring sun. The crocuses that rashly bloomed in the beginning of the month were completely spoiled. A few primroses have lately peeped out in sheltered nooks, notwithstanding the severe weather. Thrushes began to sing on the 25th, and make the woods alive with melody. The lambing season has commenced, but it is too soon to judge of its results. It is satisfactory to have our cold weather in the winter, which gives a better prospect of an early and genial spring.

The barometer was, speaking generally, low with westerly and high with easterly winds. The maximum height, 30·45, was attained on the 12th, and the minimum, 29·41, on the 8th, giving an entire range of 1·04. The instrument stood abave 30 inches on 12 days. A sudden fall occurred between the 1st and 2nd, and an abrupt rise took place between the 9th and 10th, which ushered in the period of north-east winds. Another descent followed the 20th, and continued to the end of the month. The ascent of the barometer and the change of wind to north-east, with the accompanying hard frost which most of us feelingly remember, were sufficiently sudden and remarkable to demand a passing notice, and an attempt to furnish an explanation. For the proximate or immediate cause of the phenomena we shall not have far to seek. It must be borne in mind that the wind always blows from the place of high to that of low barometer, although not commonly in a straight line. At the time in question there was an area of low pressure over France, Spain, and the South of England. In Central and Northern Russia, on the other hand, the barometer was remarkably high and the weather intensely cold. It was therefore inevitable that the polar current should rush down in all its bitter force to fill up the partial vacuum, and it did not cease until that had been accomplished. The cold and heavy Russian air, as it always does, speedily sent up English barometers as it sped on its way to Southern lands.

The temperature of February was very variable, but cold on the whole. The highest reading of the day thermometer was 56° on the 28th, and the lowest night record 21° on the 13th, showing a total range of 35 degrees. The greatest daily range amounted to 22° on the 25th, and the least variation to 2° on the 9th. The mean daily range was 11·0 degrees. The mean of the maximum temperatures was 42·8°, and of the minimum 31·8°. The mean heat of the whole month was 37·3°, which is 8·4° below that of the corresponding period of last year, and 1·4° less than the average temperature of 50 years. The deficiency on many days was as much as ten or eleven degrees, but this was counterbalanced to some extent by excess on the warmer days. The minus readings occurred on 15 days and the plus on 13 occasions, with the above result on the whole month.

The general direction of the wind was more or less westerly on 10 days, and easterly on 17 occasions. With these principal quarters southerly and northerly currents were combined in the proportion of 10 to 15. These figures show a considerable predominance of cold winds. The force was often considerable, and several times amounted to a gale, which was much aggravated in quality when the direction was easterly.

The amount of moisture in the air fluctuated a good deal, from 90 and upwards in the beginning, to 50 in the middle of the month. The mean degree of humidity, which was moderate, reached 81, complete saturation being represented by 100.

The rainfall of February was light, and measured 3·09 inches. This is equal to 312 tons, or upwards of 1,280 hogsheads to an acre. One half of it fell in one day, but it was distributed altogether over 17 days.

Ozone was rather deficient on the average. It was present in the atmosphere on 23 days. The antagonistic principle, antozone, was observed very frequently. The mean degree of ozone was 4·643. The prevalence of east winds was unfavourable to its full manifestation.

The principal diseases in February were bronchitis, pneumonia, quinsy, abscesses, and other inflammatory disorders, whooping cough, typhoid fever, some diarrhœa, erysipelas, and rheumatism in various forms. The public health was influenced unfavourably by the piercing winds and sudden alternations of temperature. Many deaths occurred, but these were more timed than caused by the inclement weather. Feeble frames ripe for dissolution, like autumn fruits shaken from the trees, often have their end determined by the violence of the elements.

The usual monthly meeting, on April 5th, of this excellent Society was very fairly attended, and the proceedings excited much interest. Amongst the company present we noticed Mr. Wm. Adams, F.G.S., President, in the chair, Mrs. and Miss Adams, Dr. Taylor and Mr. Franklen G. Evans, Vice-presidents, Captain Bedford, Professor Gagliardi, Messrs. John Morgan, William Vivian (Mwyndy), Buist, Milward, Drane, Tomlinson, and Downing. After balloting for new members and other routine business had been gone through, Mr. Wm. Vivian (Mwyndy) was called upon by the President to read his paper on

Water, in its Various Conditions of Solid, Fluid, and Vapour.

The natural history of Water is a very extensive subject, too extensive for a single paper ; we can therefore only attempt to explain some of its phenomena at present. It is said to be constituted of two gases—hydrogen and oxygen—in the relative proportions by weight of one and eight, or by volume two and one. These two gases, so disproportionate in weight and bulk, combine however with immense powers of adherence, and constitute a body whose capacity for taking in and giving out heat is very great indeed ; and it is upon this property that the great changes of condition to which it is subject depend. We are, perhaps, accustomed to think and speak of the fluid as being the normal condition of water, probably because we most often meet with it in that form ; but considering its readiness to change from the fluid to the solid on the one hand, or to a state of vapour on the other ; that a little less of heat will bind the rolling majestic billow into an iceberg, or a little more will raise it into vapour to float in air over the world, it may well be doubted which is its normal state after all.

What changes of combination and circumstances, as well as condition, it is also subject to ! "As cold water to a thirsty soul" is the old proverb, the thirsty soul quaffs the grateful draught, seldom, if ever, reflecting that possibly a portion of that identical water may have been before drawn up the trunk of the first elephant created from the bankside of some primeval river ; that it afterwards gurgled down the throat of an antedeluvian monster floundering in the morasses of that period; that a drop of it helped to swell the breakers which thundered in on the shores of ancient seas; another portion floated as part of an iceberg from the land of the Esquimaux to equatorial latitudes long before Columbus navigated the Atlantic—now nauseous to the taste as sea-water ; then, rising as vapour to aerial regions, driven, the sport of winds, distilling as dew, or falling in fertilising showers on vegetation, creeping through crevices, percolating through rocks, parting and reuniting, and bursting at last through its new outlet in the bubbling spring. All this however, and much more is possible. The water we just now drank may have come from the Black Sea, the White Sea, and every other sea, and have combined its particles for the first time as it passed down the thirsty throat.

As a fluid it holds a vast amount of heat. This force is in all matter repellant, and its effect on water is so to suspend the particles that they are then free to move about each other ; and this elasticity or freedom of action is what we understand by the fluid state. In this state it is, to a certain extent, compressible, but only in proportion to a certain reduction of its temperature. No power can compress it until the heat escapes.

There is a simple and pleasing experiment showing the expanding effects of heat on water: Place a clear glass bottle of water near the fire, and in a few minutes a number of small bubbles will be seen to have formed, most of them adhering to the sides of the bottle. It has been supposed that these bubbles are caused by the liberation and expansion by heat of certain portions of air previously existing in combination with the water, or they may be heat vacuums, that is, spherical cells made by the heat itself, repelling the water particles to such a distance from the centre where the cohering force of the water is able to balance and effectually resist the action of the heat. These cells have a very high reflective power, almost equal to that of quicksilver, showing that on the surface of these cells, the water particles are so closely packed, that even light, itself the subtlest of things, is unable to penetrate their cordon lines.

We need not dwell on the utility and vastness of the might Ocean which surrounds us, and, indeed, borders almost every land; how its restless, rolling tides and currents pass from shore to shore, preventing stagnation, and modifying the climates of the world, but let us look at the river. The flowing river is ever an object of great beauty and interest. It is the eye of the picture, and any landscape, otherwise beautiful, is tame without it. Look at its rise—high up in the background of yonder mountains, if you search, you may find a few drops oozing out of a small fissure in the rock, the rock is covered with lichen, moss, and fern, which seem to laugh in the enjoyment of the dripping favours; a little further down the drops aggregate into a tiny stream, which creeps away from its birth-place, stealing through the mosses, tumbling over the bosses, till it meets another sister streamlet, they gurgle and unite, and roam downward, meeting another and another at the mouth of every ravine and glen, till a respectable river in volume and force is constituted, and then, mighty in energy and speed, it dashes headlong over the precipice in the foaming cascade to the valley below; quickly composing itself, it now moves sluggishly onward, meandering through meadows, as if in doubt which way to take, not forgetting however to reflect the beauties of the scenery through which it winds its way—turning the old mill wheel by a rivulet diverted from its main body; on and on it glides, till its volume is lost in the swell and roar of the great deep. But let us go back to the waterfall for a moment. What is it makes its water white? The water is transparent above and below the fall, but here it is almost dazzling white. The whiteness is the effect of the fall breaking the volume into myriads of drops, and each drop being round, becomes a brilliant reflector of light, causing the whole mass to look white. Clear still water admits of the passage of light to a considerable depth, but when this water is diverted into drops, the particles are then packed by the cohering force into the globular or spherical form, so as to forbid the passage of light through them, hence the whiteness, which is but a brilliant reflection of light. That the whiteness of a cataract is the result of a minute subdivision of the water is shown by the prismatic or rainbow effects seen in the spray—a portion of these drops ejected from the main body decomposes the light into its primary colours beautifully.

Please note the difference between the reflection and refraction of light by water, as seen in the case before us. In water reflection, the atoms are so packed that when the light, subtle as it is, strikes the surface, a large portion of it is unable to penetrate, and is sent back, showing the brilliant surface from which it rebounds, but in refraction, that portion of the light which is able to enter the water is by the globular arrangements of the atoms composing the drop, divided in its passage through into the primary rays which constitute the rainbow colours, each ray being projected from the others at an angle peculiar to itself. Hence the rainbow and all prismatic effects of light upon water, but these can only exist in a strong light—sunlight pre-eminently —or, if a lunar rainbow is seen, which is rare, it can only be a faint one, and that under a clear moon in showery weather.

The ocean which surrounds us, and which borders many lands, is not only the highway of nations for commerce, but is the great equaliser of climates everywhere. Its rolling tides and sweeping currents pass from shore to shore, reducing the ardour of equatorial heats and modifying the rigour of polar cold. It is also the great source of moisture to the land. The sun's rays strike, and the warm winds ruffle, the surface of the water, and a portion becomes volatile, ascending into the atmosphere to constitute clouds. The daily quantity thus taken up is incalculable, though vast. That water should be volatile at all may seem strange when we remember that, bulk for bulk, it is from 800 to 1,000 times heavier than air. Atom for atom water could not be buoyant in air, but it is because of the peculiar mechanical conditions of vapour that it rises. Water in a state of vapour is not diffused in separate atoms, but is disposed in the form of minute vesicles or balloons. These vesicles are formed under the combined forces of heat and cohesion, acting in some respects on each other as in the formation of heat cells in the bottle, in the experiment already referred to, the heat force within driving the atoms outwards, and the cohering force of the atoms resisting, so that at that point of the radius, where the atoms are balanced between the two forces, the vesicle forms, displacing its bulk of air, and, rising by its inferior gravity to the stratum where it maintains its buoyancy, countless myriads of them aggregrate into clouds and float away.

The general form of clouds is quite in accord with the vesicular unit, for though science has divided them into several classes, the vesicle is the type and unit of every cloud. To prove that this is the form of water volatilised, place a cup of hot water in the slanting rays of the rising sun, stand at a short distance and observe, and the practised eye will easily detect the round, mealy forms of the steam as it ascends. Steam as generated in a boiler is invisible because the great heat present, overcoming the cohering force, drives the atoms apart from each other. Observation of the water-gauge glass, and the point of exit from the safety-valve, prove this invisibility; but at a point of one to two feet above the place of exit, a portion of the heat having radiated off, the natural cohering force flashes the invisible atoms into vesicular position, and instantly white steam is formed. White, if the vesicles simply reflect light, but tinted red—if the sun happens to be rising or setting—because each vesicle then reflects to the beholder a perfect image of the sun in all its painted glory.

These effects may be seen on the locomotive engine standing at the station any day, and gives us some little insight to the constitution of the clouds, with their glorious colours and forms.

To explain the causes of the beauty of a summer's sunset, we must then think of countless myriads of these minute vesicles aggregated into clouds, each one of which is a perfect reflector of the sun's image, as well as of the modified tints of the surrounding clouds. Now, at sunset, the sun's rays dart obliquely through long lines of these irregularly disposed vesicles, steaming up from the ocean and land, and depicting themselves upon the under surfaces of the cloud masses, modified and varied by the density of the vesicles—the reflections of neighbouring masses of cloud—and the position of the beholder relative thereto. Cloud scenery has ever fired the poetic soul. The Psalmist, in rapture and awe, exclaimed of the Divine Being metaphorically—"Who maketh the clouds His chariot." Sublime poetry, that saw in the dark rolling masses of the thunder cloud the war chariot of the Deity, and in the forked lightning His javelin bolted forth. Beautiful conception, which saw the emblazonry of ancient royalty and state eclipsed by the panel-painting on the cloud.

Let it be observed, that however gorgeous the colours of the clouds, these colours are not prismatic effects, which are only obtained by the decomposition of light. There can be no rainbow in the cloud, simply because there are no drops of water there. It must be a solid drop of water to decompose light, and directly the vesicles collapse they form drops and fall, and no longer constitute the cloud.

It will not be proper at this time to dwell on the causes of rain, by cold currents of air impinging on the clouds—the abstraction of heat by electrical disturbances, and other causes; but we may observe how beautiful is the arrangement, this balancing of the forces by which vast bodies of water are raised, collected, and carried great distances—some of it probably thousands of miles—in its passage screening the grateful earth from the ardours of equatorial heat, and mantling it from the rigours of winter, to fall again at the proper time and place, not in devastating torrents, but in showers to fertilise the earth.

As a little heat added to fluid water sends it up into the air, so a little heat taken out of it changes it to ice or solid form. The phenomena attending this change are interesting also, and bring about also stupendous results. Whatever may be the form of the ultimate atom of water, it is certain that in changing from the fluid to solid, the structure is built up of angular lines.

This change of disposition of the atoms is exceedingly curious. It would seem that when sufficient heat is present to produce the fluid condition, the atoms being then free to move, arrange themselves at certain definite distances around each other, and, in the absence of pressure, will assume the globular form; that is, under the native cohering force they pack themselves as close to each other as the repellant force of the heat present will allow; but directly the balance of these forces is destroyed by the abstraction of heat, these atoms build themselves up into angular and symmetrical lines, and this result is crystallization. This change of relative position in the atoms produces tremendous effects in nature. That which bursts our strongest water pipes in winter is a great disrupting force everywhere around us; under it walls crack and totter, rocks splinter and crumble to dust, and even the surface of the earth is upheaved. The latter is produced in this way: The rains percolate into and saturate the pores and fissures of the soil, rocks, and other exposed substances, then comes the change which we call frost, and the contained water expands in the containing substance with rending force. The direct cause of this increase of bulk is, that the atoms of water in entering into this new arrangement leave spaces or vacuum between their lines, by which the remaining fluid is drawn up to the point where the crystallising force is active. In this process of crystallisation there is an incalculable drawing power at work. Observe it on a sharp hoar frost. There has not been any rain for some time, and the ground is apparently dry, but a white frost comes, and the "sounding way is ice congealed;" the sun shines out warmly, a thaw ensues, and in two hours the roads are wet, almost splashing with mud. From whence comes the water? It comes up from the soil, drawn by the force of crystallisation the moisture rushes upwards from the deep soil and makes the ice which afterwards thaws into fluid water. The water in a wheel rut is another instance of this ascending effect of water in freezing, by which the whole of the water, if the body is not too large, will ascend in one night and form a crust at the top of the original water level. Illustrations of the same law of crystallisation may be seen in other substances. Make a saturated solution of any salt, half fill a wine glass of it, and put it aside for a few days or weeks, and as the moisture evaporates the salt in becoming solid will, in most instances, raise itself above the first level and even creep over the glass.

Snow is a beautiful form of water, and affords a fine illustration of the expansive power and symmetry of action of the crystallising force. Its dazzling whiteness is caused by the brilliant reflections of light from the countless myriads of facets which it presents to us. Hail is a raindrop congealed to ice while it falls through the atmosphere, but snow commences to crystallise on the collapse of a single vesicle of vapour, and around this nucleus the contents of other vesicles are gathered by the force into angular lines as they come into contact in the descent. Most of us may have seen the symmetrical forms of snow crystals as they appear in books on Natural History. They were known and figured more than a hundred years ago, but the snow crystals themselves are not so well known; few comparatively have seen them in their beauty, although they fall almost every winter. Snow-flakes are an agglomeration of partly thawed crystals, but it is the single crystals which are so beautiful, and which, though of the same general type, are of almost endless variety. They may be best seen in the calm, cold and cloudy weather of February, when, from the appearance of the sky, a fall of snow is expected, but when the barometer is too high for a fall of much consequence, then a few minute feathery forms descend, as the apparent precursors of legions soon to follow. They should be caught upon a piece of black silk or wool-cloth, and examined with the aid of a good magnifying lens. Their exquisite symmetry and vast variety make them an exceedingly interesting study. If we could have watched the gradual development of their lines of beauty, we should probably have first seen a central speck, falling through the cloud vesicles before described, and as it came into contact with each vesicle new points would be seen darting out in lengthening lines, and in six equi-distant radii, and these again crossed by sectional and oblique supports, all conforming to make each crystal an unique and complete design, there being not one ill-balanced imperfect form among the countless myriads which descend.

Hoar-frost, or frozen dew, is another beautiful arrangement of water in the solid form. As dew, it is a round drop, pellucid and sparkling, decomposing light, and this power to decompose light is obtained by the convex arrangement of the water atoms before alluded to; so that light, subtile as it is, in its passage through, is dissected and split up into its primary rays.

The dewdrop distils in the early part of the night from vapours, but towards morning, if the sky be clear, the heat radiates upwards from the lower strata of the atmosphere, and the dewdrop gradually solidifies. It is now changed from a globular drop to an angled prism, modified and grouped according to circumstances, and the upper end of the prism is sometimes studded with pinacles like a tower, and the prisms are grouped and clustered as if with architectural taste and design. Note one of the effects of solidification. As a dewdrop it will decompose light, but as a hoar prism it can only reflect light from its angles, and hence the whiteness seen. That it first forms as dew is proved by the form of the solid prism, for had it congealed while the vapours were condensing we should have snow crystals and not hoar frost.

A pleasing study is the conversion of these hoar prisms back again to water under the microscope. It may be done by gathering a leaf that is besprinkled over with the hoar, place it under the instrument, focus clearly, and the hoar will be seen to be distributed in groups of exquisite beauty, of six-angled prisms, many of them having hollow cups, and the whole piled up in grandeur indescribable. Then breathe once or twice upon the leaf, and look again and you will see chaos, as icebergs melting, towering masses falling topsy turvy, detached pieces floating along to fill the hollows, and all the angles changing into globular forms, till every prism becomes a drop.

Ice flowers are, perhaps, not generally known, but they are interesting and beautiful, and may be found as the first formation of ice on very still water.

Another way of seeing them is by condensing the sun's rays to a strong focus in a piece of solid ice. After a few minutes' steady action of the lens, if withdrawn, these little ice flowers may be seen ; and it would seem that they owe their existence to the heat centralised by the lens melting the ice at this point, and thus creating a small vacuum, around which, as the heat is withdrawn, recrystallization takes place in symmetrical lines.

The foregoing is a humble attempt to explain some of the familiar phenomena that are seen in the several conditions of water in our everyday life, the writer being desirous to diffuse a knowledge of the causes so far as they may be understood. It is not pretended that the ideas given are all new to the world, but it is believed that some of them are, as they have not been met with in books, but are the results of personal studies for years.

Complex and mysterious as the laws of Nature confessedly are, they, nevertheless, display a beautiful harmony and simplicity when we are able to trace them ; and the study of Nature in any department can never fail to delight the inquiring mind, and should always excite in us feelings of reverence, adoration, and love to the all-bounteous Author who worketh all in all.

Upon the conclusion of the paper, which was most attentively listened to and afforded much pleasure, Mr. Adams requested Mr. Franklen G. Evans to make some remarks upon the subject of the address.

Mr. Evans, in complying with the President's wishes, said : I am quite sure, Ladies and Gentlemen, that we are all very much obliged to Mr. Vivian for being present here this evening, and for the excellent paper which he has just read to us. For myself I may say that with a few exceptions I entirely concur in the views advanced in his paper. The subject, as Mr. Vivian told us, is a most extensive one, and could not be exhausted within reasonable limits. In my remarks I must be still more brief, and only touch upon some of the points submitted to the members. All bodies in nature have their condition determined by the action of two opposite forces—the attraction of cohesion, and the repulsive agency of caloric. When cohesion predominates we have a solid more or less dense ; if caloric prevails, a vapour or gas results ; but when cohesion and caloric exactly balance each other the ultimate particles of matter are in perfect equilibrium, and move freely upon each other. This constitutes the fluid condition, and is the reason why matter in that form presses equally in every direction. Water is a good illustration of these different states, for when cold is applied and heat extracted, the attraction of cohesion, no longer balanced, binds it into a solid form, and ice is produced. Similarly, when heat is given to it, the repulsive force of this agent expands it into vapour of any degree of tenuity, which we are familiar with in the powerful form of steam. It was formerly supposed that all bodies contracted under the influence of cold. This is still true in a general sense, and I only know three exceptions to it, one of which is of great importance. Zinc, after being heated, under some circumstances does not contract to its former dimensions, in consequence of a re-arrangement of crystalline particles. Clay *contracts* by the application of heat, but this is only an apparent departure from the rule, for the contraction is due to the loss of moisture. The one grand exception is water, which expands in its passage to the state of ice. This fluid reaches its maximum density at a temperature of about 40 degrees. A little consideration will show what a remarkable provision this is in the economy of nature. The coldest water being specifically lighter, necessarily rises to the surface. It there freezes into a thin sheet, and from the non-conducting property of ice the water below is partly protected from the cold. In this way the frost extends slowly by the gradual formation of fresh layers of ice under the first. From these circumstances it follows that it requires a very intense frost to produce a foot of ice, which is only reached in our hardest winters. Meanwhile the fish and other inhabitants of rivers and lakes are living in comfort at the bottom, in comparative warmth, and the principal risk they run is from a deficiency of air, if holes are not broken in the ice. If it were not for this exceptional property of water, the coldest portion would constantly fall to the bottom, and the whole mass would very soon be solid. This actually occurs sometimes in shallow brooks, which, although difficult to freeze at first in consequence of the movement of the stream, solidify all at once when the whole of the water is reduced to 32 degrees. I need scarcely say what effect this state of things would have upon the numerous tenants of fresh water. The frogs, perhaps, from the readiness with which they submit to be frozen and thawed again, might regard it with indifference; but fishes are not frogs, and they would inevitably die out in the first severe winter, and leave a gap in the dinner-table very difficult to fill. In another aspect, this expansion of ice causes some injury to masonry which is too often built up in the summer to crumble down in the following winter; but, by way of compensation, the very same force pulverises the soil and facilitates the labours of the agriculturist. In conclusion, I have much pleasure in proposing a vote of thanks to Mr. Vivian for his paper, with a request that it may be published in the Transactions. (Hear, hear.)

Mr. Adams cordially seconded Mr. Evans's proposition, and dwelt upon the pleasure and advantage of taking some interest in natural history. He further observed: Some people call us the butterfly society, and I am not ashamed to acknowledge an interest even in butterflies. Mr. Evans has just told us that fishes are not frogs, and it is something to know that the butterflies do not follow the swallows in their annual migration, and many persons might study their habits with profit and improvement. From an amusing sketch that appeared some time ago, *Mr. Punch* seems to think that a course of natural history would not hurt railway officials and others. A lady was travelling with a multitude of pets, and the porter was puzzled about the charges, and consulted his superior. On his return he said, "If you please, mum, station-master says cats is dogs, and rabbits is dogs, and so is parrots, but this 'ere tortis is a insec', and there aint no charge for it." (Laughter.)

Mr. Vivian having returned thanks,

The President then called for Professor Gagliardi, and eulogized that gentleman's readiness to entertain them on all occasions. He had been spoken of as a "foreigner," but the term had no place in that room, where men of all countries were regarded as brother-naturalists, and judged only by the standard of personal worth. This sentiment was warmly endorsed by the meeting, and suitably acknowledged by the Professor.

Professor Gagliardi then gave a microscopic demonstration of the organisms from ditches and ponds in the neighbourhood, and facetious members expressed a hope that the animals were muzzled. There were many fine specimens of Diatomaceæ, Infusoria, Fungi, &c., in the examination of which the remainder of a very agreeable evening was spent.

> " O Nature ! a' thy shows an' forms
> To feeling, pensive hearts hae charms !"—*Burns.*

The first object which attracted the general attention of the ladies and gentlemen present, and they were in pretty good number, was a small cluster of eggs of the common water-snail, taken off a little sprig of white crowfoot *(Ranunculus aquatilis).* Under a very low power it looked like a nicely-arranged nest of pigeon's eggs. But there was another thing in the same live-box far more important and worthy the careful attention of the zoologist as well as that of the biologist. This was a fine specimen of *Chontogaster Linnei,* which, not long since, was one single water-worm, but had now divided itself in three, thus making three distinct animals. The two wretched wights, newly formed by the self-division of their parent, were still looking amazed and stupefied, showing their imperfect and incomplete cephalization.

The next striking object for the many were entomostraca (microscopical crustaceans), among which came first the Ostracoda (oyster-like) *Candona reptans* and *Cypris Vidua ;* then the Cladocera (branch-horned), *Daphnia Pulex* (the common water-flea), and the beautifully-transparent *Sida Crystalina ;* at last the Copepoda (oar-footed) *Canthocampus Minutus,* a blushing little Cyclopide, upon whose bristling tail an expert observer remarked that there were sticking several *Vagincolæ,* and a fair specimen of *Podophrya Fixa,* the acinetic form of *Vorticella Microstoma,* which was there, too, in its natural and perfect form.

The said expert and other thoughtful naturalists were then examining a four-spored Alga *(Tetraspora lubrica)* from a ditch along the railway to Caerphilly, making several remarks upon the nature of this beautifully green-shining protophyte, whether palmellaceous or ulvaceous, and its allies the *Monostroma,* the *Merismopœdia,* and the *Gonium Pectorale.* This last tablet-monad was there also to be seen. Whilst most of the members of the society preferred to look at the far-better developed higher Algæ, admiring above all the Chœtophoraceæ, among which were to be seen, besides the very common, yet always charming *C. elegans,* that extremely delicate bead-leaved *(fornlous)* Draparnaldia (Stigeoclonium tenne Kütz), which might be styled "The Lady of the Confervœ," and that pretty epiphytic green spot which, looking under the microscope, like a bristling porcupine, was called not improperly by Dr. Thwaites *Ochlochate Hystrix.* Many were still admiring the beautiful Sporangia (Spermatosphœres Jtzigsohn) of two siphonaceous Algæ *Vaucheria*

Ungeri and *V. racemosa*, when Professsr Gagliardi, who had prepared, with the kind assistance of Mr. Milward, some liveboxes and slides beforehand, called particular attention to the *Diatoms*, that "microphytic vegetation," as Dr. Carpenter likes to call them, which is the main store of food to that living protoplasm which nearly covers the bottom of the deep.

Beginning with the always attractive *Meridion Circulare* (this preparation was marred by the smoky place where it had been gathered, which was a ditch near the railway deposits in Cathays), and showing the typical form of *Diatoma Vulgare*, with its relative *Fragillariæ*, the stringed golden rings of *Melosira Varia* and *M. Dickiei*, in both of which were to be seen some swollen specimens, showing the very interesting sporangial frustules, both whole and burst. He called special attention to vial No. 4, which gathering was from a yellow-brown scum floating on the surface of a brackish pool near the Bute Chain and Anchor Test Works, along the Glamorgan Canal. Here were to be seen in plenty the pretty little jewels of *Surirella Minuta*, with some rare specimens of *S. Gemma* (a true gem, indeed), and *Tryblionella Gracilis.*

It was from the same gathering that an extremely minute protoplasmic bit of lively matter came to be seen : some enthusiastic biologist would have exclaimed *Eureka !* I saw the life ! although he had seen nothing but a bit of *matter* which has, but is *not*, the life. Under the power of 500 diamt. it looked like a brief comma (,), being scarcely half the size of the *Surirella minuta*, that was living with it. Another unusually large specimen of *Amœba* came out of a gathering from a pond in Cathays ; it looked somewhat like a streaming worm. I have no doubt that it was but a stronger variety of the *Amœba princeps*, yet, seeing how steadily it kept to the vermicular form, with very slight changes now and then, I shall rather call it *A. vermicularis.*

Whilst treating of the sarcodic effusions of protoplasm, it is well to remark that on a careful examination of nearly every kind of Diatoms it will often be seen that a sarcodic matter is commonly oozing and fringing, as it were, the commissures of the two valves of which each frustule is composed. This is particularly the case in hot weather, when the Diatoms seem to be gasping for breath.

In a pure and very abundant gathering of *Pleurosigma decorum* from another brackish pool in Grangetown Moors, I could see the sarcodi bubbling, so to say, quite distinctly, out of a teeming, or perhaps unhealthy, specimen, flowing side by side with, though perfectly separated from, the yellow endochrome, which was also extravasated from the same Diatom.

Passing by numerous branched frustules of *Gomphonema* and *Cocconema*, a very rich gathering of *Navicula cuspidata* from between Landough and Canton, and several other minor interesting Diatoms, such as *Amphora*, *Ciclotella*, &c., we come to the stellate, but seldom entire *Asterionella formosa*, and innumerable needle-like frustules of *Homœocladia filiformis*, with a few sporadic *Eunotia*, and several groups of *Scenedesmus obliquus* with its green lunated cells.

A last puzzle, for which nobody could find a satisfactory solution, was in the gathering of vials Nos. 6 and 12, both from a shallow, muddy-looking bog on Splottland moor. No. 6 was filled with the yellow gelatinous substance which deposits the famous bog iron, consisting chiefly of a very minutely twisted conferva, which Ch. Lyell, after Ehrenberg, called *gallionella*, but which is now more commonly named with Griffith *Didymohelix ferruginea*. Within this yellow substance was an innumerable swarm of bluish-green animalcules *(Stentor polymorphus)* such as I never saw before so plentiful, with several specimens of two other kinds of Vorticellineæ—viz., *Urocentrum turbo* and *Cænomorpha medusula*. This latter fresh water medusa, a very funny living parasol really worth seeing. No. 12, except the yellow stuff, which was eliminated on purpose, had the same trumpeters which, wonderful to say, on being corked disappeared, collapsing all at once and leaving nothing behind but a milky bluish-green water, which does still keep its colour after several days, and we shall wait to see if any living creature will ever come out of it by spontaneous or hemigerminal generation. From another vial a good harvest of phytozoa (*Euglenæ*) was expected, all the water looking deep yellow-green; but this water, too, never settled, as it does when living *Englenæ* are collected, a clear proof that here also the animals came to grief—when and how?—that is the question the members of the Cardiff Naturalists' Society wish to have solved by some clever naturalist.

The beautiful Rotifer *Floscularia cornuta* was lately gathered on the Grange Town moor.

In the course of the proceedings, Mr. Adams read an appeal sent by Mr. J. Gwyn Jeffreys, on behalf of a Norwegian clergyman named Michael Sars, who was a most distinguished naturalist, but not sufficiently blessed with this world's goods to make provision for his family. A subscription was at once commenced, and a moderate sum collected in the room. This was a good practical illustration that the Society have hearts to feel as well as brains to think, and that they do not recognize the designation of "foreigner."

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

MARCH.

The weather of the past month was very fine and seasonable for the time of the year, and was not characterized by excess in any direction. Habitual grumblers, and sufferers from twinges of rheumatism, harsh dry skin, or nervous irritation when the wind is in the east, who always think the *present* spring worse than its predecessors, may dissent from this opinion, and think that there must be something in meteorology which makes people oblivious of the disagreeable nature of some of the facts that they take a pleasure in recording. There would be a certain amount of truth in this idea, for the interest felt in watching natural phenomena does unquestionably mask their less pleasant features. In the case of rain, which is generally so much disliked, this holds good, and I feel satisfied that those who are engaged in measuring its quantity not only become aware that we do not get too much in the aggregate for our soil and climate and water-supply requirements, but they also grow less conscious of its dispiriting attributes. Their sensitiveness to undue moisture is lost in the contemplation of the "capital rainfall" just measured, which they come to regard something in the same light as a sportsman does a good bag. Thus the *rain*-gauge must be considered—paradoxical as it may appear—as the best *waterproof* for the observer. To return to my March—from which I digressed to a much wetter subject, as if to lay the dust —I may say that I do not compare it with May, but with months of the same name in other years, and the result of the comparison is to place the one just past in a favourable position. March should be moderately cold and dry, with a preponderance of east winds. It is rather the keystone of the season, and is the first link in the traditional chain that leads to April showers and ends in May flowers. The past month was suitable to agricultural and gardening preparations, and we may hope to see the crops and fruits in due course. Lambs appear to be very numerous, and look healthy and vigorous. Gooseberry bushes came into leaf at the end of the month, but are as yet almost alone in their foliage. The purplish inflorescence of the common and wych elms *(ulmus campestris and mantana)* is fully out, and the catkins of various willows, hazels, and alders—the pussy-cats of children—are a very pretty relief to the otherwise still wintry aspect of the woods and hedge-rows. Evergreen shrubs will be some time recovering their greenness after the severe winds of February. Vegetation is by no means too forward, and blossoms are not so likely to be nipped by late frosts as in more advanced seasons.

The barometer was high, and for the most part steady, and its extreme limit of oscillation was about an inch. The maximum height, 30·54, occurred on the 28th, and the minimum, 29·53, on the 3rd, giving a total range of 1·01. The instrument stood at or above 30 inches on 20 days.

The temperature of March was variable, but very near an average on the whole. The highest reading of the day thermometer was 56° on the 10th and 18th, and the lowest night record 23° on the 14th, showing an entire range of 33 degrees. The greatest daily range amounted to 26° on the 30th and 31st, and the least variation to 4° on the 4th. The mean daily range was 14·5°. The mean of the maximum temperatures was 49·1°, and of the minimum 34·7°. The mean heat of the whole month was 41·9°, which is four-tenths of a degree above the average of the previous three years, and three-tenths higher than the Greenwich mean of 50 years, without correction. The temperature was in excess and deficiency upon about an equal number of days, and fluctuated occasionally as much as eight degrees in both directions. The final result was very nearly equal. There was frost on 15 nights.

The general direction of the wind was more or less westerly on 10 days, and easterly on 21 occasions. This is a bout the usual ratio of the month. Wi these main quarters, southerly and northerly currents were combined in the proportion of 5 to 25, showing a great predominance of polar winds. The force amounted to a moderate gale during the first week, and then slackened to fresh, and the remainder of the month was very calm with sharp frosts.

The quantity of moisture in the air was a fair average, and varied from 98 to 57. The mean degree of humidity was 78, complete saturation being represented by 100.

The rainfall of March was light, and distributed over 10 days. It measured 2·88 inches, which is equal to 290 tons, or upwards of 1,180 hogsheads to an acre. Four inches of snow fell on the 13th, but no minature snowballs were observed during the month.

The development of ozone was deficient, in consequence of unfavourable winds. It was present in the atmosphere on 20 days, and once reached the maximum of the scale. Antozone was frequently noted. The mean degree of ozone was 3·581.

The principal diseases in March were bronchitis, colds, and sore throats, with a tendency to phthisis; rheumatism, typhoid, and scarlet fevers, whooping cough, glandular enlargements, abscesses, and skin eruptions. The general health was not below the usual standard of the month.

METEOROLOGICAL REPORT.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

APRIL.

The weather of the past month was singularly fine, dry, and dusty, and completely belied the mixed character of showers in the midst of sunshine, and smiles mingled with tears, we are accustomed to assign to it. The principal meteorological features were a very high and generally steady barometer; a temperature above the average, and exhibiting an unusually wide range; cold parching wind, of moderate force; a low degree of humidity; light rainfall; and no great development of ozone. The condition of the soil was favourable for late spring sowing, and advantgeous to farmers who were unable to complete their seed beds in March. To crops already in the ground the absence of moisture was very prejudicial; and this, coupled with the cold of winter and early spring, has made the season late, and the prospects of agriculture, at least, doubtful. Pastures are still bare, and hay crops have hardly begun to grow. Even wheat, which is more independent of rain than any other crop, is looking yellow for want of water. Early potatoes have been very much cut up by sharp frosts, and in some places nearly destroyed. Vegetation in general is more backward than usual, but in the case of fruit trees, this may conduce to the preservation of the blossom. Hedges came into leaf in the beginning of the month, larch about the 10th, elder, the 12th, sycamore and horse-chestnut on the 16th, wych elm, the 17th, early oaks and common elms were just coming into leaf on the 30th. Plum, pear, cherry, and sycamore trees blossomed about the 18th, lilac bushes and garlic on the 23rd, and horse-chestnut on the 24th. Swallows appeared on the 15th, and the cuckoo's note was heard on the 19th. Lady-birds, which were seen all through the winter, are now plentiful, and may be expected to play a prominent and beneficial part in the coming summer. These pretty insects, the pets of childhood, are worthy of more notice from children of a larger growth than they generally receive. Their natural food in the larval and mature state is the plant lice, or *aphides*, which, under the name of *aphis rosa*, infest rose-trees, and under that of *aphis humuli*, are sometimes so destructive to hop-gardens. This little insect has been known to influence the public revenue to the extent of hundreds of thousands of pounds, from the variation in the hop duty consequent upon its presence or absence. Politicians are often anxious about the balance of power in Europe, while they entirely lose sight of the no less important balance of power in the insect world. I have an impression that this year the lady bird will be in the ascendant, and will only suggest as a practical hint that the very best way of preserving rose-trees and hop-vines from the "blight" is to colonise them with these little creatures. Ladies would probably value this remedy from its getting rid of an excuse for the inordinate consumption of tobacco, which is sometimes thought necessary to effect the same end. The liking of children for them, too, might be utilized in collecting them, which is easily done with the help of a small box.

The barometer was continuously high, with the exception of a slight break on the 8th, 9th, and 10th, and another dip on the 30th. The maximum height, 30·59, was attained on the 16th, and the minimum, 29.49, on the 9th, showing an entire range of 1·10 inch. The instrument stood above 30 inches on 26 days.

The temperature of April was high, and above the average on every day but six. The excess sometimes reached 11 degrees, but the greatest deficiency noted was less than 4 degrees. The highest reading of the day thermometer reached 74° on the 19th and 20th, and the lowest night record 30° on the 5th, 6th, and 7th, giving a total range of 44 degrees. The greatest daily range amounted to 40° on the 17th, the least variation to 12° on the 26th, and the mean daily range was 24·2°. The mean of the maximum temperatures was 62·0°, and of the minimum 37·7°. The mean heat of the whole month was 49·8°. This is about equal to the average temperature of the last four years, but 3·6° above that of the past 50 years—without correction—as determined by Mr. Glaisher. The range of temperature was wide, having been as much as 40° in one day, and never less than 12°. The warmth was very unequally divided between day and night, the maximum readings having been unusually high, and the minimum correspondingly low. The month, therefore, was characterized by warm days and cold nights with considerable fluctuation. Frost occurred on several occasions.

The general direction of the wind was equally shared between the west and the east, with a preponderance of northerly over southerly combined currents in the proportion of 14 to 11. The force of the wind was sometimes fresh and strong, but never violent.

The atmosphere was more than commonly dry, the mean degree of humidity having been only 70, complete saturation being represented by 100.

The rainfall of April was very light, and was distributed over six days. It amounted to 0·28, which is equal to 28 tons, or upwards of 112 hogsheads to an acre. Slight snow and hail were noted, and thunder once heard.

The mean degree of ozone was 4·067, which is less than the average of the month. Antozone was frequently observed.

A brilliant meteor of pale green colour was seen to fall in the south-east on the 21st shortly before sunset.

The principal diseases in April were bronchitis, pneumonia, quinsy, rheumatism, typhoid and scarlet fevers, and whooping cough. The contrast between the day and night temperature greatly conduced to colds and inflammatory complaints, and often added bronchitis as a complication to whooping cough. Rain and westerly winds are required to soften the atmosphere, and bring in genial summer weather. The long drought is already doing much mischief, and has resulted in fires on mountains and moors from the excessive combustibility of the parched vegetation.

The usual monthly meeting of this Society was held on Tuesday evening, May 3rd, in the Grand Jury Room of the Town Hall. The attendance of members was scanty, and it was thought that the discontinuance of circulars announcing the time of meeting did not work well. The question was referred to the committee for their consideration. The chair was occupied by Mr. W. Adams, F.G.S., President. There were also present, Dr. Taylor and Mr. Franklen G. Evans, M.R.C.S., F.M.S., &c., Vice-Presidents; Messrs. Frederick Adams, Deacon, Bradley, Lamb, Jones, South (Treasurer), &c. Some bones were sent by Professor Gagliardi, which had been dug up in constructing the new outfall sewer. One of these was the metatarsul bone of a small equine, which was found in peat, and was blackened by that material to something the colour of bog oak. The other, taken from a clay bed, was brown in hue, and had belonged to the *Cygnus Ferus*, or wild swan. Mr. South also exhibited a cabinet of fine butterflies and moths taken in Somersetshire. After balloting for five new members and other routine business, the President asked the Treasurer to read the following paper, by Mr. Peter Price, Secretary to the Free Library,

On the Best Means of Promoting the Study of Natural History in Cardiff.

The object of the Cardiff Naturalists' Society is defined by our rules to be the promotion of the study of natural history in our own town and district. It has, however, some time been felt that we have pursued that object in an unsystematic manner, and without sufficient consideration for the elementary state of the scientific knowledge which the majority of our members must of necessity possess. It is true that we rank among our members many gentlemen distinguished for their scientific acquirements, and one especially who enjoys even an European reputation for his profound knowledge of natural history. But there are many of us (perhaps the large majority) who are content to range themselves as students only, and for such it has often been felt that we have not made adequate provision of elementary instruction. My object in this paper is to endeavour to suggest a means of remedying this deficiency, and to make known (what I think is very insufficiently understood) the substantial assistance which the Science and Art Department of the Council of Education are prepared to furnish in aid of the study of these subjects. The Science and Art Department has evidently been organised by gentlemen whose object is the promotion of scientific study nationally, just as it has been our object to promote it locally. With this intention, twenty-three branches of scientific knowledge have been selected for special encouragement. Of these twenty-three departments of knowledge, ten of them are either comprised within the Naturalists' Society's province, or they are closely allied thereto. The subjects I allude to are the following, viz. : 1. Geology. 2. Mineralogy. 3. Animal Physiology. 4. Zoology. 5. Vegetable Physiology. 6. Systematic Botany. 7. Chemistry, Inorganic. 8. Ditto, Organic. 9. Electricity and Magnetism. 10. Acoustics, Optics, and Heat. In order to encourage the study of the subjects, the department offers to supplement the very moderate pecuniary rewards which the public is willing to afford, with substantial grants of the public funds. These payments are made through the agency of local committees to qualified teachers of science. Scholarships and Exhibitions are given to successful students, grants of money are made towards the erection of lecture-rooms and class-rooms, and for the purchase of scientific apparatus. Gentlemen are, of course, aware that the Corporation of Cardiff, with the enterprise and intelligence which has marked the proceedings of that body in respect of education, have set an example to the rest of Wales by establishing these Schools of Science in the town. But they have hitherto been unable to introduce masters qualified to teach those branches of scientific study in which we are interested. This being so, it is well worth considering whether our Society in this emergency should not step forward and assist in supplying the deficiency. By so doing they would not only supply the want in our own Society's arrangements at which I have before hinted, but at the same time would assist in creating among the young people of the town a love for the study of nature. The precise mode in which this object can best be carried out had better perhaps be considered in detail by the committee. What is required is to offer adequate inducement to qualified scientific teachers to establish themselves in Cardiff. This may be done by individual members, or by the society undertaking to subscribe to courses of lectures on any or all of the subjects before mentioned, by establishing evening classes under the patronage and sanction of the society for the young people of the town and neighbourhood. In this latter object the Society would not only be assisted by the department, but the Town Council also would have power to assist under the provisions of the Public Libraries Act. Perhaps by combining these sources of income a sufficient remuneration might be secured to competent teachers. I thus briefly endeavoured to sketch what the Society might and should do, and I beg respectfully to commend it to the earnest consideration of the Society, and I believe its adoption would very much tend to the cultivation of the elegant, useful, and refining study, which our Society was formed to promote.

Upon the conclusion of the paper, a vote of thanks to Mr. Peter Price was proposed by Mr. Adams and seconded by Dr. Taylor, and carried unanimously.

METEOROLOGICAL REPORT.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

MAY.

May was a fine and generally dry month, and exhibited many of the meteorological features which so strongly characterized its immediate predecessor, April. The barometer was again high and for the most part steady; the temperature ruled warmer by day and cooler by night than is usually the case; winds were calm, dry, and often cold; the rainfall was deficient, and very unequally distributed; and ozone, though absolutely abundant, was relatively below the average of this actively oxidizing month. Wheats are very flourishing, and potatoes have not for many years been so strong and vigorous as this season. On the other hand, pastures are still scanty, clover and ryegrass light and backward, though their harvest time has arrived, and meadow hay crops are so poor that there is little hope of an abundant yield, and every probability of a deficient one. The season, however, happens to be late, and there is yet a possibility of the growth materially improving with moist and favourable weather. Oak trees came into leaf on the 3rd, and ash trees about a week later. The elder came into flower on the 22nd or thereabouts. Bluebells have been so thick in many clearings in the woods as to give the appearance of a field of azure hue. Oak-apples are numerous, and more than commonly fine and fruity looking. They are the product of the *cynips terminalis*, that deposits its eggs at the extremity of a branch and causes the well-known excrescence to grow up around them to furnish protection and food for the larvæ until they arrive at maturity. The gall nuts of commerce and the common gall of our own country are produced by insects of the same family. The "dead sea apples," as they are called, have a similar origin, through the instrumentality of the *cynips insana*. The protuberances contain one or many grubs, according to the species of insect. The common gall has usually only one, and the oak-apple many tenants concealed in the interior of the globular mass. An irritating secretion is believed to be deposited in the wound with the egg, to stimulate the plant to throw out this curious growth. The turnip fields of Yorkshire are said to be devastated by swarms of brown beetles ; but whether these are the skip-jacks,—whose larva is the wireworm,—the turnip-hopper, or a new species, does not appear. Farmers are deeply interested in the ravages of insects, and require to enlist birds and other destroyers of noxious ones in their service. Nothing can be more impolitic than the efforts made by sparrow-clubs to exterminate small birds. This is an act of folly which, I believe, is not shared by the agriculturists of Glamorganshire. Man is peculiarly helpless in dealing single-handed with the lower forms of animal and vegetable life, which are so small and numerous as to elude his vigilance and attack. For this reason they often serve as instruments of punishment and humiliation. They invade alike the palace of a Pharoah and the cottage garden of a labourer, and neither the monarch nor the peasant can hope to offer them an effectual resistance save by availing himself of those counterbalancing checks which have been designed for his relief by the wisdom of Providence.

The barometer was high and generally steady. The maximum height, 30·50, occurred on the 25th and 26th, and the minimum, 29·40, on the 12th, giving a range of 1.10 inch. The instrument stood at or above 30 inches on 22 days.

The temperature of May was warm by day and cool by night, and exhibited a very wide range. The highest reading of the day thermometer was 78° on the 21st, and the lowest night record 28° on the 3rd, showing a total range of 50 degrees, which is the widest I have hitherto recorded. The greatest daily range amounted to 35° on the 7th. the least variation to 12° on the 13th and 31st, and the mean daily range to 23 degrees. The mean of the maximum temperatures was 65·3°, and of the minimum 42·3°. The mean heat of the whole month was 53·8 degrees. This is 3-10ths above the average of the previous three years, and 9-10ths higher than the Greenwich mean of the last 50 years without correction. The day temperatures were warmer and those of the night were cooler than usual, hence the large range.

The general direction of the wind was more or less westerly on 17 days and easterly on 13 occasions. With these main quarters southerly and northerly currents were combined in the proportion of 12 to 15. Calm weather predominated, and there was no strong gale.

The quantity of moisture in the air was not large, and seldom approached the maximum. The mean degree of humidity was 75, complete saturation being represented by 100.

The rainfall of May was not heavy, and was very unequally distributed. The total amounted to 3·01 inches, which is equal to 304 tons, or upwards of 1,250 hogsheads to an acre. The bulk of it fell on the 10th and 11th dates. Rain occurred on nine days.

The development of ozone was good, but scarcely equal to the average of May, which is usually very rich in this principle. It was present in the atmosphere on twenty-six days. Antozone was noted several times. The mean degree of ozone was 5·613.

The principal diseases of the past month were similar to those of April; bronchitis, colds and sore throats, whooping-cough, scarlet and typhoid fever, and rheumatism still prevailed; hapatic disorders and abscesses were also prevalent. Inflammatory complaints are always present in spring, and even later, for it takes a long time for the sun of early summer to overcome the *accumulated* cold of a whole winter, and the longest day is often past before the nights become really soft and warm.

The monthly meeting of this Society was held in the Town Hall, on Tuesday evening, June 7th, when the following members attended: Mr. Adams, President, in the chair; Dr. Taylor; Captain E. J. Bedford, R.N.; Mr. J. Morgan; Rev. Professor J. Gagliardi; Mr. J. Milward, Mr. J. Boulanger, Mr. Parry, Mr. R. W. Jones, Mr. G. Bradley, Mr. J. Tomlinson, Mr. William Davis, Mrs. Boulanger, Miss A. M. Adams. Visitors: Mrs. Decandia, Mr. Milward, sen., Mr. T. Riches, &c.

The usual business having been gone through, the President, on behalf of Edward Wood, Esq., F.G.S., &c., Richmond, Yorkshire, presented to the Society a beautiful series of Yorkshire fossils, chiefly from the mountain limestone formation. There were two fine specimens of the Woodocrinus Macrodactylus —De Koninck,—and to more completely explain them to the meeting, Mr. Adams placed on the table *The Geologist* for 1858, containing an abstract of a joint paper read before the British Association at Dublin, August, 1857, by Professor L. Koninck, of Liege, and Edward Wood, Esq., F.G.S., of Richmond, on this newly discovered fossil, and the *Geological Magazine* of 1865, containing a paper by G. E. Roberts, Esq., F.G.S., on "The Woodocrinus Expansus," both papers being illustrated with engravings. After an examination of the fossils, a highly instructive and well-arranged series of British Zoophytes, collected and exhibited by Captain Bedford, was passed round for the members' inspection, when the following interesting paper, prepared by Professor Gagliardi, illustrative of them, was read by Mr. Milward, Professor Gagliardi displaying the specimens under the microscopes during the reading of the paper.

The Zoophytes; or, Living Flowers of the Sea.

"Pictures serve to guide us to the archetypes in Nature, but Nature herself ought always to be examined by the learner before he has done."—*Goldsmith's Preface to Dr. Brookes's Natural History.*

Owing to the extreme kindness of our friend Captain Bedford, who has so generously placed at our service his fine collection of Zoophytes, I have had the much-wished-for opportunity of studying these interesting creatures, if not in their most desirable conditon, namely, living, at least in such a state as proves eligible for micro-anatomical observations ; I mean in these marvellous buildings which, even empty as they are, and bereft of their in-dwelling polypes, bespeak the wonderful instinct and the mighty constructive power of their puny architects.

But after having enjoyed, as I wish you may do for yourselves, the delightful view of these charming creatures, when I came to the task of sketching a few pages of their natural history, and attempted to properly and systematically arrange them, I felt greatly perplexed, seeing how modern science had pitilessly unsettled the long-established landmarks of their classification, so much so, that I was doubtful whether to gratify your wish of having a paper read on this subject, I was to throw myself bodily into the midst of this scientific labyrinth, or candidly to acknowledge that I was not prepared for the task.

Trusting, however, in your benevolence, and that you would treat me as indulgently as heretofore, I have ventured, not without some apprehension, to break through this rich though salebrous region of the zoophytical world, marching daringly ahead, exploring and clearing the way before the younger members of our society, whom I heartily wish to introduce into these scientific walks, rousing their energy, and setting them to work for themselves, steadily to advance on the path I am so hesitatingly treading.

Call us not weeds, we're flowers of the sea,
For lovely and bright and gay-tinted are we ;
Our flush is as deep as the rose of earth's bowers,
Then call us not weeds, we are ocean's gay flowers.

The Zoophytes, as Professor Quekett has truly observed, have attracted, on account of their great diversity and beauty, the especial attention of Naturalists from the earliest ages ; neither have they escaped the penetrating eye of the artist, for we find Hogarth thus writing to his friend Ellis : "As for your pretty little seed-cups or vases, they are a sweet confirmation of the pleasure Nature seems to take in superadding an elegance of form to most of her works, wherever you find them. How poor and bungling are all the imitations of Art ! When I have the pleasure of seeing you next, we will sit down--nay, kneel down, if you will, and admire these things."

But what are, some will ask, these things which so attract the admiration of the artist ? What is, properly speaking, a zoophyte ? Indeed I must confess that after long searching, after all I have read on this subject, poring over some weighty, and scanning several lighter volumes, I am still in the dark concerning the nature of this singular being, for it seems to alike disown the vegetable and animal nature, hovering, as it were, between the two, a kind of bashful stripling, loth to be reckoned with the children of Nature, yet not bold enough to proclaim himself a perfect and full-grown animal. A singular creature, with no decidedly pronounced sensitiveness, a mere thrilling, and charmingly provoking, irritable genus, wantonly playing on the skirts of the vegetable and animal regions.

In fact, this word Zoophyte (1) has been so variously accepted both by British and foreign scienziati, as to include, besides the truly vegetable corallines (2) nearly the whole of the lower animal-resembling forms, starting from the mollusks, and passing through the echinoderms (3), the actino,—and hydro-zoa, down to those debatable forms that mock all systematic classification—I mean the sponges (4), and those problematic masses of moving jelly which constitute the far-famed bathybias (5) of Professor Huxley.

Were I now to say but a little on each side of the numerous sections into which the different kinds of Zoophytes have been severally divided, it would occupy too much of your time. I shall therefore restrict my observations to those specimens we have here for inspection. They are so remarkably similar in their *external* characteristics that they have been always classed together until the recent investigations of Van Beneden, Allman, and others, revealed the close resemblance between the internal characteristics of some of them and those of Ascidian molluscs. These latter have been since then separated from the true radiated or hydroid Zoophytes, and made known under the name of molluscoids or ascidoids. It is only by examining them soon after they have been taken of their native brine, and by removing the investing tunic of their living polypes, that their higher organization can be traced out; and it can be proved that they approach in one respect to the molluscous Brachiopod-Terebratula, whilst in another they are closely allied to the tunicated Botryllidæ, or social grape-like Ascidian, of which this Botrylloides Leachü, parasitically resting on a fragment of the sweet oar-weed (Laminaria Saccharina) is a dry specimen.

The molluscoids thus considered, apart from the hydroids, were, and in many foreign countries are still, named Bryozoa, which means moss or shrub-like animals, which name is very closely related to that of Zoophyte, or plant animal. Here in England, however, the term Polyzoa, or manifold animal, has long since been and is still applied to these molluscoid Zoophytes, whilst that of Ciliobranchiata, given by Dr. Farre, seems to have been forgotten.

The Polyzoa are generally divided into two orders—Hippocrepia and Infundibulata, so called from the disposition of the tentacles of their mouths, which is of a crescentic or horse-shoe shape in the Hippocrepia, and in a ringed or funnel shape in the Infundibulata. (Professor Allman's division into Gymno and Phylactolæmata, according to the naked or guarded gullet of the polype, is a still more difficult one for beginners.)

We have little or nothing to do for the present with the Hippocrepia, which are nearly all fresh-water inhabitants. It may be that on our next excursion we may come across some living specimens of this kind, some wandering Cristatella, Lophophorus, or Plumatella, and then we shall have in *it* a new microscopical treat. All that I can show you now belonging to the said order is this sponge-like Alcionella, with its statoblasts in situ, which I gathered from a pond last year at Newnham (Warwickshire).

The Infundibulata, which are by far the more extensive in number, have been recently divided into the following sub-orders, cyclō, cheilō, and cteno-stomata, so called according to the different disposition of the mouths of their polypes, which is a simple round orifice in the cyclo, covered with a moveable lip in cheilo, and bristling with a pectinated fringe in cteno-stomata.

Those who have never seen an infundibulate polyzoon recently taken from its watery habitation, and never examined it under a low power, whilst a pink stream of life is running through its polypidom, can scarcely form an idea of the said division, so that it would be as well for them, and perhaps better, to adopt Blainville's method of classifying them according to their external envelope, though it be not in all respects the best. Considering then that we have nothing at our disposal but these dry specimens, these mere exuvia, and ossa arida of their parched limbs, I have thought it better to arrange them according to the still traceable form and disposition of their cells, as follows :

1. Celleporinœ—with oblong or ovoid, operculated cells.
2. Tuboliporinœ—with tubular unoperculated cells.
3. Vesiculariœ—with free, bladder-like cells.
4. Alcyonidiadœ—(Halcyonellœ) with immersed cells.

The Celleporinœ have been subdivided into two tribes named from their having, or not, a flexible articulation, 1, Articulate, or jointed. 2, Inarticulate, or unjointed.

Foremost among the jointed celleporinœ stands the family of Salicorn*ar*iadœ, their cells, hardly visible to the naked eye, are scattered on all sides, as you will see on examining some of the cylindrical branches of this Salicornaria farciman*oi*des by a one-inch power. [This vegetable, long-branched coralline, looks very much like it, but a glance at the microscope will show you at once its smooth and even surface, without any cellular marking.)

The second family is that of the Cellul*ar*iadœ, whose cells are arranged on one and the same plane, as you may see in this Canda reptans, and Brettia pellucida (?)

Amongst the inarticulata, or unjointed celleporinœ, the most delicate and most remarkable forms are to be seen in the family of the Eucratiȧdœ, or as they are also called Scrupariadrœ. This snake head coralline (œtea anguina, or anguinaria spatulata) and the bull's horn coralline (eucratea or crisia chelata), both parasitic on this vesicularia, to which we shall return presently. This fairy chain (hippothoa catenulata) spreading upon this fragment of a shell (the only known specimen oi hippothoa expansa, preserved in the museum of Newcastle-upon-Tyne, is on a bit of an old shell like this), and lastly this truly marvellous Bean coralline (beania mirabilis) sticking upon a shred of sea weed, are all members of this family, whose cells are arranged in one single series. (A most interesting specimen of the same family, from New Zealand, was exhibited by the president, Mr. Adams.) Should I attempt to describe one by one, these wonderful jewels of nature, I should certainly fail for want of proper and fitting expressions. Suffice it to notice this crisia chelata, which, Ellis says, looks like a number of shoes fitting close to the ancle, joined by the toe part to the heel of the next. "This beautiful coralline," continues the same author, "is one of the smallest we meet with. It rises from tubuli growing upon fuci, and passes from thence into sickle-shaped branches, consisting of single rows of cells, looking like bulls' horns inverted, each one arising from the top of the next one. The opening of each cell is surrounded by a thin circular rim, and the substance of the cells appears of a fine transparent shell or coral-like substance. Pliny's celebrated apoththegm: "Natura nusquam magis quam in minimis tota est." (Nature is nowhere more perfect than in her smallest works)—was never better applied than in this case.

The next family of the inarticulata is that of the Gemellariadœ, or twin-celled corallines, so called from having their cells arranged in two series, as you will see in this loricated gemellaria, and in this shepherd's-purse coralline (notamia bursaria), about which, as well as about this catenicella plagiostoma —which, by the bye, is not a British, but an Australian polyzoon—I should advise you to consult Dr. Busk's monograph.

Not far from the gemellariadæ is the family of the Bicellariadæ, which seems to agree, in name at least, with the former. This family reminded the famous zoophytologist Norman of the flowers of the calceolaria, to the form of which the ovicells of the bicellaria Alderi bear a close resemblance. The Bugulæ are generally considered to belong to this family. Amongst the several specimens we have here for examination stands foremost the bugula purpuro-tincta (here noted achamarchis plumosa). Its beautiful purplished-red tint enables it at once to be distinguished, without any microscopical examination, from bugula plumosa. Then comes this bugula calathus, which is the only specimen I have left in my private collection, having sent the other I had like this to the said Rev. Alfred Norman, who will return it, I hope, ere long, with some other specimens of his own, for which I have asked him, to complete this collection of yours. As I am not quite certain as to the identity of this bugula calathus, I give you Norman's own diagnosis of it: "Polyzoary consisting of a number of strap-formed dichotomously dividing branches, spreading regularly round on all sides from the base, and forming an elegantly-shaped shallow cup, the straps for the most part of about equal length, drying of a yellowish horn colour. Cells in six or eight rows, oblong above, with two stout blunt spines at each angle. Ovicells globular, large, imperforate, smooth, polished, with a raised thread-line, transverse line near their base. Lateral avicularia large; smaller avicularia here and there on the margins of the inner cells.

Very near to this species comes this fine specimen of bugula flabellata, which becomes an ashy colour in drying, whilst bugula calathus preserves the yellowish, horny hue which it has in life. All the bugulœ, but especially this B. avicularia, are remarkable for those curious appendages that resemble vultures' heads in great perfection, though in these dry specimens, which are thickly studded with them, we look in vain for the seesawing, and snapping, and opening of their jaws, which is to be admired in living specimens for the amazing speed with which it is performed. It is on this account that the well-deserved name of bugula avicularia (bird's head coralline) has been given by Ellis to this otherwise called corkscrew coralline.

This *caberea*, called also cellularia (sartularia (?) here must have been a mistake) Hookeri, and by Fleming, flustra Ellisii, belonging to a special family of Cabercadæ, very remarkable for their whip-like flagella, seem naturally to lead to the following :

Flustradæ, so called by Linnæus from a Saxon word (flustren, to weave) which answers prettily to their common English name of sea-mats. This Murray's (flustra murrayana) ; these narrow and broad-leaved sea-wracks ; (F. truncata and foliacea). This paper-like sea-mat, Carbasea papyracea, leads us gradually to the

Membraniporidæ, remarkable for the innumerable cradles of their microscopical cells, which expand, as Figuier has observed in "The Ocean World," like bee-hives, and whose inhabitants enjoy at once a common and independent existence, each eating for the benefit of itself and the community.

"There reign," continues the same enthusiastic author, "among the members of this group, sentiments of the brotherhood of which we have no idea, a physiological bond to draw them together—a moral bond !" What kind of morality Figuier is here aiming at I shall not stay to inquire.

But look, if you please, at the silvery cells of this, so improperly called, marine leprosy, or bright sea-scurf (lepralia nitida) by Dr. Johnson.

"Whilst unassisted sight no beauty sees,"

looking through your magic instruments you will see how the walls of each cell are fissured with six or seven cross slits in the mesial line. Anterior to this subquadrangular aperture is a globular, pearly, smooth, oviparous, operculum, which is properly what is called an ovicell, that is, the reproductive cell of this admirable compound Zoophyte.

Leaving for the present these richly-sculptured lepraliæ, which alone would exhibit an immense variety of microscopic ornaments, we come to those properly called Celleporideæ. One of the most common, yet remarkable, is this cellepora-pumicosa, so called from its resemblance to that porous, spongy matter, which is belched forth by volcanoes, and bears the name of pumice. This C. cervicoenis comes next to it.

And with this admirably net-worked piece of the so aptly called Retepora cellulosa, which belongs to the stony Escaridæ, we shall close our account of the first order of infundibulate polyzoa, which we have termed Celleporinæ.

Coming now to the second division, which we have called Tubuliporinæ, from their tube-like cells, which you see here, rising into strong, coral-like masses, we may first admire this creeping thing (Tubilipora serpens), whose pale rose-tint and semi-transparency readily call to our mind that analogous polyzoary of the Cape which Dr. Busk, at the express desire of Mrs. Gatty, who had brought it home and added it to the Zoophytology, called by the highly poetic, generic name of Tennysonia. Then this very similar Pustolipora deflexa, and this Diastopora obelia, spreading on this fragmentary shell like a lace-work. Lastly, these pretty little cups which, resembling a patine or cover of a chalice, has been called patinella patima.

These bushy tufts of perfectly white corals, with a dash here and there of light-red intermingled, are the Crisiadæ, a second family of the said Tubuliporinæ. The best known of them, commonly given as a fine microscopical object, is the tufted-ivory coralline, or crisia eburnea. Here is also the toothed-ivory coralline—(crisia denticulata), and some more species which, having no strength nor time to describe, I shall leave entirely to your private study and contemplation, certain that these exquisitely frosted little tubes, whereof each of these polyzoaries is made up, will abundantly repay your attention.

The Vesiculariæ, or bladder-celled Zoophytes, have but little to boast of when compared with the minute parasite which we have seen resting on them. Here is a specimen of vesicularia spinosa, and another of serialaria, or amathia lendigera, both belonging to this third class of polyzoa, often reckoned together with these Alcyonidiadæ, which you see covering these fronds of sea-weeds with their shaggy and fleshy incrustations.

Each of these three polyzoaries has a shaggy aspect very much resembling that of the alcyonian Zoophyte, mermaid's gloves (alcyonium digitatum); hence its diminutive name. When, however, the animals (which are distinctly visible to the unassisted eye) of this stag's-horn Zoophyte, alodactylus, or alcyonidium hispidum, are expanded, they are at once seen to be widely different. "The opacity of its polyzoary, observes Jabez Hogg, "renders it unsuited for the examination of anything more than the tentacular crown."

We shall reserve an account of the authozoa for our next meeting.

At the conclusion of this moiety of the paper (the remainder being ready for next month), a vote of thanks was proposed and unanimously carried to all the parties who had contributed to such an intellectual evening's entertainment.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

JUNE.

The weather of June was singularly dry and parching, and intensified by its cumulative effect on the arid condition of the soil that was caused by the drought of the spring months. The principal meteorological features were a high barometer; generally warm temperature; the prevalence of westerly winds; an almost constant absence of rain; and a moderate development of ozone. The result has been a great deficiency of pasture, and the lightest hay crop known for many years. The latter was scarcely worth cutting, and the only redeeming feature in it was that it was cheaply harvested, and got in in good order. Potatoes are healthy, abundant, and good. Wheats are flourishing, and promise a large yield for the breadth sown, which is less than usual in consequence of the total destruction of the plant by the wireworm in some localities. This cereal came into ear on the 5th, and bloomed about the 12th. It passed through that critical period under most favourable circumstances as to weather. Roots are a failure so far, and cannot under any circumstances be worth much. The prospects of food for live stock are unfavourable, and our hopes must mainly rest upon a luxuriant lattermath, under the growing influence of genial showers.

The barometer was remarkably high and steady throughout the month, and its extreme limit of oscillation was less than three-quarters of an inch. The maximum height, 30·64, occurred on the 6th, and the minimum, 29·91, on the 10th, giving a total range of 0·73. The instrument stood above 30 inches on 27 days.

The temperature of June was warm, and rather above the average. The maximum reading of the day thermometer was 84° on the 21st and 22nd, and the lowest night record 41° on the 6th and 29th, showing a total range of 43 degrees. The greatest daily range amounted to 37° on the 6th, and the least variation to 11° on the 1st. The mean daily range was 21·7°. The mean of the maximum temperatures was 71·6°, and of the minimum 50 degrees. The mean heat of the whole month was 60·8°, which is somewhat higher than that of the past few years, but very near Mr. Glaisher's average, if we apply the Greenwich correction.

The general direction of the wind was more or less westerly on 20 days, and easterly on 9 occasions. The combined current was from southerly and northerly quarters in the proportion of 3 to 27. This shows a large predominance of north-westerly winds. The force was sometimes fresh, but no heavy gale occurred.

The quantity of moisture in the air was small, and did not at any time reach the highest amount. The mean degree of humidity was 69, complete saturation being represented by 100.

The rainfall of June was extremely light, and the bulk of it fell during a thunderstorm on the evening of the 16th. The total was only 0·79. Nevertheless this is equal to 79 tons, or upwards of 320 hogsheads to an acre. Rain fell on 8 days. Thunder was heard on one other occasion.

Ozone was fairly developed, and was present in the air on 22 days, but did not once reach the maximum of the scale. Antozone was only slightly manifested. The mean degree of ozone was 4·800.

The principal diseases in June were measles, scarlet and typhoid fevers, and whooping-cough. Rheumatism and lumbago were also common, and several cases of bronchitis and sore throat occurred. Croup was in one instance induced by the cold wind that prevailed at the end of the month.

The rainfall of the first half of the year was much less than usual, and fell short of the average of the corresponding period of the previous four years to the extent of 9·33 inches. This deficiency, coupled with several hot summers of late years, suggests to many minds the possibility of a permanent change in our climate, and information is sought as to the probability of the idea proving correct. It is of course very difficult to draw positive conclusions from the character of a few seasons which may really be exceptional ones, and much more extended periods of observation are required to determine such a delicate point as a persistent alteration in the meteorology of this country, which would go far towards the abolition of an Englishman's traditional privilege of grumbling at the weather. Ten years ago, during the remarkable cold and wet summer of 1860, the popular feeling ran the other way, and *Punch* facetiously represented himself as shaking hands with the sun after an absence of many weeks. I believe there is some truth in the notion of a gradual change in the climate of Britain, and will briefly indicate its probable direction and extent. I need not refer to our geographical position and other circumstances of a fixed nature, which have remained the same for a long period. We must rather look to internal and local conditions that have arisen from human agency. The most prominent of these is drainage, which must tend to an increase of temperature by drying swamps and removing cold stagnant water, and permitting the percolation of rain warmed by the rays of the sun. Trees again play a very important part in producing rainfall, and in flat inland countries their destruction is a powerful cause of drought. England being fairly mountainous and surrounded by water, I do not think timber falling would produce so much effect, even if our woods had been cut down to an extent below the point of safety, which has certainly not yet happened. As a matter of fact, the mean heat of the country has risen in the last fifty years, and the result is probably due to drainage. There does not seem to be any reason to suppose our rainfall has permanently diminished, but our rivers and streams *have* done so in consequence of the rapid discharge of water through the pipes. From this cause rivers rise very quickly, and having lost their flood water, remain low in dry weather. This is a drawback to the advantages of draining, for which we must some day find a counterpoise. This is simple in principle, but will be expensive in practice. From these considerations it would appear that we have a drier soil, a warmer climate, and unabated rainfall; but a remedy must be found for the too sudden outflow of the swiftly running waters.

The first excursion this season of the members of this Society came off on Tuesday, July 5th. The weather was by no means favourable, and resulted, as was anticipated, in a smaller attendance of members than usual. An ordinary monthly meeting of the society was held in the Town Hall; the President, W. Adams, Esq., in the chair. The routine business of the society was transacted, and two new members, Mr. L. Decandia and Mr. F. Riches, were unanimously elected.

The programme of the day's excursion consisted of a visit to Llantrisant, the Mwyndy mines, and other objects of interest in the locality; and then on to Hensol Castle, to which place they had been very kindly invited by Rowland Fothergill, Esq., where the remainder of the day was to be spent in reading papers, and discussing subjects connected with the objects of the society.

At 11 o'clock two of Mr. Andrews' long breaks, drawn by three horses, and several smaller vehicles, drew up in front of the Town Hall. The members and friends then present determined to carry out the day's programme despite of the rain, which continued to descend very unpleasantly. They were Mr. W. Adams, C.E., the President, Mrs. and Miss Adams; Mr. T. G. South and Mrs. South; Rev. J. R. Jenkins; Mr. and Mrs. E. C. Downing; Mr. Alexander Dalziel and Miss Dalziel; Miss Coombe; Mr. J. T. and Mrs. Taylor; Mr. J. Tomlinson, jun., and Miss Tomlinson; Mr. P. Price and Mrs. Price; Mr. W. B. Blessly; Mr. W. Davies; Mr. T. Nixon; Mr. W. Blake; Mr. C. Coe; Mr. J. W. Frazer; Mr. H. Elliott; Mr. R. Drane; Mr. W. Roberts; Mr. J. Biggs, jun.; Mr. Lindon; Mr. H. Gueret; Mr. M. Duluard, &c. The party were soon *en route* for Llantrisant, and the picturesque scenery on the road sides compensated in some degree for the unpleasant weather.

St. Cawrdaf Monastery.

About a mile and a half from Llantrisant the party were brought to a halt by the President to pay a visit to the ruins of an ancient monastery about a quarter of a mile from the turnpike road. Of the monastery itself but little remains to give any idea of its architectural character, but the wide extent of crumbling walls and blocks of stone here and there embedded in the ground showed that it must at one time have been a place of considerable importance. The President, after explaining several portions of the ruins, stated that it was considered to have been built at the end of the fifth or beginning of the sixth century, and was dedicated to St. Cawrdaf, son of Caradoc, regulus of Brecknock. The structure stands on a moderate eminence, overlooking a fertile and pleasant valley, and commanding a view of the country for miles, a strong evidence in support of the trite remark that the monks knew how to choose their situation. But little reverence seems now to be paid to the ancient and sacred character of the building. As the ruins stand upon a farm, a portion of them are turned into the more modern requirements of the agriculturist, and serve to shelter some of the cows of the occupier of the land.

Mwyndy Iron Ore Mines.

A little further on the party were halted in front of the Mwyndy Iron Ore Works, which extend on both sides of the road. These are amongst the most extensive works of the kind in the county, and were purchased a short time since by the Mwyndy Iron Ore Company, and since their possession by the company they have been greatly extended. It was intended to make an inspection of the mines, Mr. Vivian, the manager, having kindly offered to explain them, and had prepared a paper to be read, which, in consequence of the rain, was deferred to a future meeting of the society. This part of the programme was, however, dispensed with, and after a brief description of them by the President, the party proceeded onwards to Llantrisant, arriving there about two o'clock.

Llantrisant Church.

After partaking of some refreshments, the party proceeded to Llantrisant Church, which, according to some persons, is the most ancient church in the diocese; while others consider it simply the restoration of a more ancient edifice. On this point the President would scarcely offer an opinion. Some parts of the exterior are consistent with the opinion that it was once a very fine church. It has, however, been greatly disfigured by human agency, while its present dilapidated condition but ill accords with the wealthy population surrounding it, regarded as it is as the "mother church" of many others in the neighbourhood. The graveyard itself presents many features analogous to the graveyards of ancient churches in densely populated districts. Tombstones and mural monuments of every age and character occupy every portion of the ground, and it would seem as if the accumulated remains of bodies outside the church compelled the raising of the ground for about two feet, which was followed by a corresponding elevation of the floors of the chancel and nave. The nave is divided from the aisles by a series of Norman arches supported by columns, not formed of large blocks of stone, but of smaller pieces cemented together. These are concealed by coats of plaster coloured over, presenting an unpleasant appearance from the irregularities of successive coatings of plastering and colouring which had been heaped upon them apparently for centuries. The bases of the shafts are concealed from the floor having been raised. Iron tubes are fixed in front of the pews, in which lighted candles are placed for lighting the church during the winter season. A portion of the western end of the edifice is divided off from the remainder by an oaken screen, and beyond this again is the belfry, in which there are six bells, considered by some to be the best in Wales. Some short time since the Rev. Powell Jones, the able and respected vicar of Llantrisant, made an appeal for aid to restore the church, and it is to be hoped that sufficient means will be placed at his disposal to enable him to do it. The church, whether an original or a restored edifice, possesses so many features of interest connected with its antiquity and local associations, that it is scarcely creditable to Churchmen to allow it to remain any longer in its present condition. Mr. Prichard, the diocesan architect, has prepared a plan for its restoration; and under his direction the church will become one of the most attractive and pleasing ecclesiastical structures in the district.

Llantrisant Castle.

Stepping from the churchyard, the party of visitors proceeded to the ruins of Llantrisant Castle, situated only a few yards from the church. The date of the erection of the castle is unknown, but it is enumerated as one for which Gilbert de Clare, the Red Lord of Glamorgan, did homage to Edward the First on his accession to the titles and estates of his family after the death of his father. It is generally believed to have been built hy Einon ap Collwyn, the founder of the church, after the invasion of Fitzhamon. It was near this place that Edward the Second was taken prisoner and conveyed to Hereford. It was no doubt a large castle, but little of it now remains besides a portion of one of the towers, which can be seen for a long distance, and it has been in ruins for more than 300 years.

A few of the members, with the President, Secretary, &c., then visited the house of Mr. Evan John to inspect a very fine entomological collection arranged by that gentleman and collected in the neighbourhood.

About three o'clock the whole party again started for Hensol Castle, and after about an hour's drive through a beautiful wooded country, abounding with some of the finest views in the county, the party entered the extensive domains of

Hensol Castle.

On the arrival of the party they were most graciously received and cordially welcomed by Mr. Rowland Fothergill, the owner of the estate, Miss Fothergill, and Miss Jenner, of Wenvoe Cottage, who was on a visit to the Castle. Previous to the arrival of the party from Llantrisant, Mr. and Mrs. Franklen G. Evans, of Pentyrch, had arrived. That gentleman was to have joined the party at Radyr chain, but the unpleasant state of the weather led him to suppose that the "Naturalists" would not venture on an excursion that day, and at the request of the President a vehicle was despatched to Pentyrch for him and Mrs. Evans, with instructions to proceed to Hensol Castle.

An excellent cold collation was served in the housekeeper's room. Had the day been fine the collation would have been served on the lawn in front of the Castle, and under the circumstances the kind host invited the party to the drawing room, and thence to the dining hall; everything necessary for the comfort and convenience of the guests being placed at their disposal.

After dinner, Mr. Franklen G. Evans said Mr. Fothergill placed his entire house and wine cellar at the disposal of the Society, and wished the collation to take place in the dining room. He (Mr. Evans) took upon himself to assure their kind host that he was certain that the members—travel-stained as they were—would much prefer the use of the hall—(hear, hear)—and that they would be amply provided with the wines, &c., required. He concluded with a request that Mr. Adams should convey to Mr. Fothergill the very high sense the Society entertained of the generous kindness and hospitality of the owner of Hensol Castle. Seconded by Mr. Downing, and universally assented to.

The company then adjourned to the Dining Room, when

Mr. Franklen G. Evans read the following paper on

The Carboniferous Limestone.

The Carboniferous Limestone, as its name implies, lies under the coal measures, and is a very important and interesting formation. The strata in relation with it occur in the following order, beginning from below. First the Upper Silurian, of which we only just get a glimpse in this neighbourhood; then the Devonian or Old Red Sandstone. The junction between these two beds has been demonstrated by Mr. Adams, and independently by Mr. W. H. Nicholl, of the Ham, at Penylan. Next comes the Mountain Limestone, which is another name for the stratum under consideration, covered with the Millstone Grit. These are followed by alternating beds of coal, shales, and pennant sandstones that constitute the carboniferous formation. Then the Permian, very feebly marked in this locality, but more strongly so in the North of England. The ironstone at Mwyndy is believed to represent this stratum here. Next come the Triassic, including the New Red Sandstone; the Rhœtic beds, and finally the Lower Lias. In this short summary you have placed before you all the chief geological strata, the oldest of them being the Upper Silurian, and the Lower Lias the youngest. If anyone will look at the chart and observe the number of beds towering above our *young* lias, he will be at once impressed with the enormous antiquity of our rocks; and if of aristocratic sentiments, and perhaps a Welshman to boot, he may be disposed to plume himself on his old-*crusted* position on the earth's surface; but I trust he will not be inclined to look down on the parvenu chalks and green sands of the East of England. (Laughter.) The Mountain Limestone underlies the whole of the South Wales mineral basin. It is of considerable thickness, but inferior in this respect to the corresponding formation in the Northumberland coal fields. Our basin is pyriform in shape, and stretches from Pontypool to Carmarthenshire, and from Hirwain to near Cardiff. Speaking roughly, the bituminous coals occupy the eastern portion, with a natural outlet at Newport; the steam varieties the centre, principally exported at Cardiff; and the anthracite, or stone coals, the western extremity, which are shipped at Britonferry, Swansea, and Llanelly. The coal field on the north crop dips at a moderate angle of 4 or 5 degrees, but the south crop is tilted up very considerably at a variable angle that may be set down at an average of about 40 degrees.

The scenery of all countries that occurs in such infinite variety, and in many parts is so agreeable to the eye, has its character determined to a large extent by the structure and arrangement of the strata beneath the surface. The great masses of rock of different kinds constitute in fact the framework or skeleton of the landscape, which is clothed with a soft covering of turf, and various sorts of vegetation, to give grace and beauty to the rugged and broken form of the earth's crust, and a more finished outline to the general scene. Sometimes a lofty and rebellious crag refuses to accept the verdant drapery, and stands out in all its primitive bareness and boldness to enhance by contrast the charms of the surrounding view. The limestone formation takes a prominent position in this respect, and impresses its varied character on many parts of these islands. In the form of chalk it furnishes those remarkable, pointed, snow-white rocks we are familar with as the Needles off the Isle of Wight. This shape is given to the soft and easily-worn chalk by the constant washing of the ever-restless sea. On the main land of the south and east of England we see the same material rounded into mounds, and scooped out into hollows by the action of rain, frost, and the atmosphere. These surfaces again are rendered comparatively permanent when protected by a coating of green sward, and produce the breezy downs of Wiltshire, and give the swelling undulating character to the views in Dorsetshire and Hampshire. On the sea coast it forms bold white cliffs and lofty headlands, which are visible from a great distance, give a very picturesque effect, and conferred upon this country the fair name of Albion. As mountain limestone, again, it rises in lofty ranges with abrupt, precipitous, and thickly-wooded sides as seen bounding the Bristol river, which is remarkable for its lovely scenery. In our own more immediate neighbourhood it forms a long elevated ridge that marks the south crop of the South Wales mineral basin. To the north of Llanishen and Lisvane its sides slope gently down to the plain, and are divided into fields cultivated to the very top. At Pentyrch it bounds the Taff valley, forming a kind of second entrance by the narrow limits to which it is contracted. On the east side the Forest Hill presents a bold outline with abrupt sides and well-wooded summit. Looking south over green sloping meadows, Castell Coch—so called I presume from the red colour of the limestone it is built of that makes it look as if it had started out of the solid rock—occupies a fine commanding position, suggestive of a great capacity for resistance in its day. The western aspect of the hill has been extensively quarried, and, in that fact and its general conformation, it reminds one of the St. Vincent rocks near Clifton. On the opposite side of the vale the Little Garth is symmetrical in location, and the two hills together resemble watchful sentinels guarding the narrow entrance. The same ridge is continued to Mwyndy, and on westwards to form the fine coast line of Gower, and thence to Pembrokeshire. A glance at the map will show the propriety of the term basin, of which the carboniferous limestone—with the exceptions of breaks at Swansea and Carmarthen bays—forms a continuous earthenware rim to the dusky mineral contents. The rocks are often covered with lichens, mosses and ivy, that soften the cold outline of the stone, and give a look of life, brightness, and variety to the landscape.

I must now refer to the internal structure of the mountain limestone, which is peculiar and interesting. It is a tolerably hard and compact material, and somewhat crystalline in character. The colour varies from gray or blue on the external surface to red more or less deep in the interior. The latter hue is given to it by the sesquioxide of iron that it contains. The rock is stratified in arrangement, having been orignally formed by sedimentary deposition. This order is very plainly seen in the quarries, where the layers appear piled one above another with great regularity, and they serve to show clearly the angle at which the whole mass is inclined. In some parts the beds are broken and tossed about at divers angles, and just below Castell Coch an anticlinal line is observable that Mr. Adams mentioned in his address at Cefn Onn. These dislocations are the result of the same upheaving force that lifted the entire south crop, and are associated with an extensive fault which runs up the Taff Valley. This is not surprising, as there can be no doubt that the vale was at first rough-hewn and shaped by the same agency, and was only rubbed down and smoothed afterwards by the action of air, water, and mechanical trituration. The limestone rocks are marked by extensive nearly vertical fissures that cross the line stratification. In some cases these have been healed—so to speak—by the infiltration of fresh material, and the cracks thus filled are white in colour, and give a streaky aspect to the face of the stone. In addition to rents, the interior of the mountain limestone is hollowed out into chambers or caverns, which constitute a great peculiarity of the formation. These curious subterranean caves are well illustrated in Mr. Booker's mine pit at Pentyrch. In this place the caverns generally occur in chains that follow the line of the fissures, so that when one is opened it is usually known that others are likely to follow. When tapped in mining operations they are commonly found more or less full of water, which rushes out forcibly in a full stream. After this has drained away the inside often presents a beautiful appearance. The roof and sides are covered with splendid crystals of carbonate of lime. They are of all sizes, from that of a grain of sand to many inches in length and diameter. Some of them are clear like glass, others are opaque, and range in colour from that of a delicate milky white to yellow and various shades of red. The latter hues are given by the sesquioxide of iron which they contain. The general effect is that of a grotto lined with great pyramidal masses of Nature's decorated architecture, and tinged with the choicest pigments from her inexhaustible laboratory. The floor is usually coated deeply with large quantities of iron ore, and sometimes ochre, of very rich and good quality. The ironstone that is obtained from the solid rock is usually associated with silica, and in these parts of the workings small cavities are met with of quite a different character. These are lined with beautiful crystals of quartz, which vary in size from a mere speck to a full inch in diameter. They have a white, transparent, vitreous appearance, and some of them enclose a small nodule of sesquioxide of iron, or a needle-shaped crystal of the same material, which increases their gem-like aspect. If we are permitted to give the reins to the imagination, we can fancy that the place might bave been inhabited by the "good people," and that they decorated their tiny persons with these sparkling diamonds to join in the mazy dance in the ornamented, vaulted chambers. (Applause.)

The Mine Pit in which these phenomena occur does not retain the exhibition of them, for the elegant structures I have mentioned are immediately destroyed by the hammer and boring instrument of the pitmen, to meet the exigencies of the iron trade; and the airy fancies one may be disposed to build upon them are rudely dissipated by the every-day working realities of the mine. These, nevertheless, have a charm of their own, not inferior to the beauties I have referred to, and, with your permission, I will endeavour to give a brief description of them. The Mine Pit, then, was orginally sunk on the top of the Little Garth, and for a long time yielded an immense supply of excellent material. After the lapse of many years the excavation became too deep and unwieldy for safe and convenient working, and a tunnel was driven on the north side of the hill to a point very near the bottom of the existing pit. From this new entrance the works were vigorously pushed on in westerly, easterly, and downward directions. The mine has now attained a considerable size, and a depth of over 400 feet, and amply repays the trouble of inspection. Visitors are conveyed through the tunnel in a covered carriage kept for the purpose, and carry a lamp to enable them to examine the sides of the rock as they go. Having arrived at the end of it, and become accustomed to the subdued light, they begin to perceive surrounding objects. Close by a powerful engine is in motion to pump up water and raise the minerals. Men and boys, horses and trams, are seen flitting about, and a hum of voices and the sound of hammers greet the ear. A car is in readiness to take them down the shaft a depth of 170 feet. In the quick descent there is no time to observe much, but there may be noticed in passing a blacksmith's shop, that looks as if it were suspended in mid-air, where the tools of the workmen are sharpened. Below numerous lights are seen; these are the candles of the miners engaged in blasting the rocks. If a Dante could descend this abyss it might heighten his conceptions of the nether regions. The car touches ground, and the occupants—perhaps with a feeling of relief—once more alight. A momentary glance reveals the large dimensions of the place. The smith's shop is now high over head, and far above it a glimmer of daylight is seen insinuating itself through tortuous passages that communicate with the great outer pit. Around the men are making tubular orifices in the hard rock to receive a charge of powder to rend it in pieces. There is peculiar rhythm in the sound of their hammers, of which they are perhaps unconscious, that would probably suggest to the tuneful ear of another Handel a companion to the "Harmonious Blacksmith." From time to time the report of the explosion reverberates through the windings of the pit, and is heard for a long distance in the open air. A short walk westwards leads to a part where daylight is again visible through another opening in the lofty roof. This aperture is singular and striking. It is irregular in form, and divided unequally by flying columns of natural stonework, which greatly add to the effect. The light is dimmed by the smoke of the powder that hangs in heavy fumes about the roof in its efforts to escape, and a sombre, gloomy, almost Stygian character is imparted to the scene. Various galleries and chambers are examined, and finally the chief outer pit, which bears some resemblance to the crater of an extinct volcano. In frosty weather its walls are adorned with massive icicles.

The caverns in this neighbourhood range in size from that of a walnut to a good sized room, and are almost peculiar to the limestone formations. The largest in the Mine Pit was about 60 feet by 24 feet, and thousands of tons of hæmatite and ochre were obtained from it. A fine cave was recently tapped in the Cefn Onn tunnel, and being full of water, mud, and stones, it somewhat impeded the operations. There is a very remarkable one in the Vale of Neath, near the village of Ystradvellte. This is called Cwm Porth, and is situated on the river Mellte, which joins two other streams near Pontneathvaughan, to form the Nedd, or *anglice*, Neath river. The singular point connected with this cavern is that the river runs through it, and is lost to view for upwards of 300 yards. In this part of its course the stream is, in fact, completely subterranean. The entrance, which looks something like a railway tunnel, is 40 feet wide and 20 feet high, but it rapidly lowers at a distance of about 20 yards, and the river runs on its dark and gloomy way unseen by mortal eye. In the summer, when the water is low, the recesses of the cave may be explored for some little distance, but artificial light is required, as the garish eye of day never penetrates the arcana of this stronghold of nature. Picnics are often held at this spot, and after dinner ladies and gentlemen think it necessary to explore the cavern. The engineering difficulties of the enterprise are sufficient to call forth all the gallantry of the rougher sex ; and in consequence of the perverse tendency of candles to premature and inconvenient extinction, the deficiency of head-room that brings crawling into requisition, and the trepidation ladies naturally manifest when placed in positions of novelty and some risk, of course the support of a strong arm is rendered inevitable. This may be one of the cases in which novelists tell us that the emotions of years are crowded into moments, and we cannot wonder that at such high pressure the assistance of an arm on a temporary emergency sometimes leads to the interchange of hearts for mutual support in the more permanent difficulties and trials of after-life. In this sense, wonderful as the cave is in a geological point of view, it cannot be regarded as a *matchless* phenomenon. (Laughter.)

The caverns of Dudley, near Birmingham, are also of a grand and imposing character. Foreign countries furnish still finer examples, some of which may be mentioned. America, where everything is on a large scale, has, in Kentucky, a series of gigantic caves in the basin of the Green River, a tributary of the Ohio. These subterranean cavities have been traced for 10 miles in one direction without any termination ; and one of the numerous chambers, which are all connected by narrow passages, is ten acres in area, and 150 feet in its greatest height. There are also lateral branches not yet explored. Greece, again, illustrates the same features, and has many rivers engulfed for miles. In the Morea are numerous caverns in compact limestone, of the age of the English chalk. In the higher districts of that region there are land-locked basins enclosed by mountains of fissured and hollowed limestone. The torrents of the rainy season, which lasts about four months, fall into them, but do not produce lakes, because the water is carried off by the rents in the rocks. But in many of them these furnish an insufficient outlet, and a temporary lake is formed. In the summer time the chasms are partially concealed by mud and vegetable growth, and the interior serves the purpose of a den for all sorts of carnivorous animals ; the floor of which is strewn with the bones of themselves and their prey.* Thus the channel of an underground stream becomes the hiding-place for wild beasts. This reminds one of the description given by the Latin poet of the cavern inhabited by the celebrated giant, Cacus, who was slain by Hercules for stealing his cattle :—

> Proque domo longis spelunca recessibus ingens
> Abdita, vix ipsis invenienda feris.

I have ventured to render this into English verse, thus :

> And a huge cave with deep recesses for a home,
> Scarcely to be found by the very wild beasts that roam.

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* Lyell's Principles of Geology.

I have shown that these curious cavities are abundant enough in calcareous rocks, and need only mention now those of Adelsburg, in Austria, described by an American traveller. He appears to have been much struck with the variety of the interior, the windings of the passages, and the contrasts of height in the roof. The stalactites and crystals were beautiful; and distant galleries, illuminated by the torches of the guides, looked like verandahs adorned with gothic tracery. Other parts seemed like long-drawn aisles of a cathedral. Here a butcher's shop, with joints of meat hung up; there a throne, with a magnificent canopy. One outline resembled a bearded statue, another that of a warrior with a helmet and coat of mail. Two stalactites hanging down close together were called "the union of two hearts." Then there was the grotto ball-room, which on stated occasions was brilliantly illuminated, and used as such by the peasantry. A natural gallery formed the orchestra, and wooden chandeliers gave the light. There were fountains, seeming as they fell to be frozen into stone. The "Picture," the "Cannon," the "Confessional," the "Pulpit," the "Sausage-maker's Shop," and the "Prisons." Some stalactites like folds of linen, and so thin as to be transparent. Others like shirt ruffles, hemmed and embroidered, &c., &c. Everywhere there was the dripping of a continual shower, showing the mighty work still in progress, and resulting in stalactites and crystals of undiminished whiteness and splendour.

In these imperfect sketches I have endeavoured to recall to your remembrance some of the principal features connected with the cavities of calcareous rocks, which have been so slowly and elaborately excavated in the secret places of the earth by the silent operations of nature. While we have been considering these matters, the thought must have constantly arisen in our minds that these mighty works could only have resulted from the exercise of Infinite Wisdom and Power as their great first cause; but we must have felt, also, a desire to know as much as possible of the natural laws or secondary causes that were immediately concerned in producing them. Before, however, we try to trace out their origin it will be necessary to consider the chemical peculiarities of carbonate of lime. Limestone is composed of the oxide of a metallic base—calcium, and carbonic acid gas. It is but slightly soluble in hot water, more so in cold, which is an exception to the general rule, as heat usually aids in the solution of soluble substances. This exception is, however, more apparent than real, for the greater dissolving power depends upon the presence of carbonic acid in the cold water that has been driven out of the hot liquid. Under pressure, water takes up more volumes of the gas, and will then melt increased quantities of lime. Therefore the natural solvent of this substance is water impregnated with carbonic acid, and the amount dissolved is in direct proportion to the excess of gas. This principle will explain most of the chemical facts connnected with this subject. Lime is also a solvent for silica in its various forms; a circumstance that is taken advantage of on the ground of reason or experience by the practical agriculturist. This then is the composition of pure carbonate of lime in all the manifold shapes in which we meet with it. Its natural form of crystallization is the rhombohedron—best exemplified in Iceland Spar—and its derivatives. In the Pentyrch caverns it usually occurs in 12-sided crystals, derived from the rhombohedron, which are called dog-tooth spar, from a rough resemblance to the dental adornments of the canine mouth. It is very probable that you prefer the imitation modelled in spar to a closer acquaintance with the original "ivories." (Laughter.) Flattened crystals, from the same fundamental type, designated "nail heads," are also met with. These are the usual forms of the lime crystals. Those of the quartz before mentioned are six-sided prisms, surmounted by a six-sided pyramid, belonging to the same rhombohedral system, but quite different in actual composition. Carbonate of lime, in the form of arragonite, also crystallizes in rhombic prisms, which belong to a distinct type. Thus lime is said to be dimorphous, or two-formed, in consequence of its crystallizing in two separate modes, although quite identical in chemical composition. It is a singular fact that carbonate of lime crystallized from a cold solution does so in the rhombohedral form, and from a hot solution in rhombic prisms, like arragonite. When crystals of the latter are gently heated they are resolved into rhombohedra. This shows that Iceland Spar is the primary form of the material, and that arragonite changes to it on slight provocation. It is also interesting to note the influence of heat on the crystallization, from which we may draw the geological deduction that the calcareous rocks of Arragon were probably solidified under a higher temperature than those of our carboniferous limestone. I believe this was really the case, and hot springs were the source of the increased heat.

We are now in a position to consider the probable manner in which limestone caverns, and all their interesting concomitants, were formed. They appear to have been produced by two agents—volcanic action and chemical affinity; both powerful forces, but neither by itself capable of causing all the phenomena. By subterranean influences the rocks were lifted from their solid beds and inclined at angles of different degrees; and limestone being a hard and brittle material it becomes cracked and fissured into long narrow rents across the strata, and in the direction of the greatest strain. This enabled chemical action to be called into play. These fissures once formed gave free access to rain water, impregnated with carbonic acid, derived from the atmosphere and the organic matter of the soil, which gradually dissolved the lime and hollowed out the cracks into a series of chambers in their course. This action would be increased, or diminished, according as it was modified by other circumstances. The process would be intensified at some depth underground where the superincumbent pressure of the rocks—like the cork of a soda-water bottle, to use a very simple and commonplace comparison—enabled the water to condense within itself a larger proportion of carbonic acid, and increase its solvent power. Again, it would be enfeebled by the presence of silicious rock and clay which occur in considerable quantity in many parts of the carboniferous formation, and are not acted upon by the gas. In this way a fissure might be widened into an enormous chasm, with perpendicular sides, to an immense depth; or the mud and clay may partially fill the crevices and limit the outflow of the water, so as to more or less fill the cracks as in Greece. The latter seems to have been the case in the Pentyrch Mine Pit, for the caverns are generally found wholly or partly full of fluid, and when the pit was first opened on the top of the Little Garth, the work could not be carried on in the winter until pumping was resorted to. The lime in solution was thus permitted to be recrystallized on the roof and sides of the chambers in those beautiful forms which give such a pretty and sparkling effect when they are first opened. Again, the sesquioxide of iron that exists in a small percentage in much of the mountain limestone would be concentrated by the washing way of the rock and deposited at the bottom of the cave, where some of the richest samples of the ore are found. A portion of the iron, too, is associated with clay to form ochre, which is so familiar to you, and is obtained in the same spots. The brilliant jem-like quartz spar that lines the small cavities in the silicious iron-stone rock had probably an analogous origin, and the fact that lime is a solvent for silicia is calculated to throw much light on their mode of production. In some limestone caverns stalactites are formed on the roof from a calcareous solution with excess of carbonic acid. Each drop of water deposits a minute particle of solid matter, until long drooping masses resembling icicles are slowly elaborated. The droppings from the same also produce similar concretions from the floor, which are called stalagmites. Both these geological curiosities are the result of the loss of water by evaporation, and the escape of carbonic acid from the removal of pressure, and that prevents the lime being retained in solution. Petrifying springs, which convert everything they touch, as if by enchantment, into stone, and seem so marvellous until explained, owe their remarkable properties to precisely the same causes.

It will be gathered from what I have stated that the cavities of limestone rock are met with in three different conditions, which in some districts may occur as successive periods in their geological history. They are seen as caverns full of water, like those at Pentyrch; then, when the barriers are destroyed, they form broken subterraneous channels for the passage of an engulphed stream, as at Ystradvellte; and finally, when rivers are diverted from any cause, they become dry caves, wholly given up to the fairy-like sway of the stalactite and stalagmite. The latter, however, sometimes exhibits itself in a bold and massive form, like the far-famed rock of Gibraltar, which is a huge stalagmite that has long resisted every effort to take it by land and sea. Long may the Realm of Britain be adorned by the peaceful pendent stalactite, and defended by the rock of stalagmite; to enable her to succour the oppressed, to proclaim liberty to the captive, and to preach to the heathen the glad tidings of PEACE. (Loud applause.)

Some specimens of limestone and quartz spar, with the crystals embedded in them, several of them sparkling like diamonds, were exhibited by Mr. Evans and explained by him.

Mr. R. DRANE then delivered the following address introductory to the study of Field Botany:

I appear before you to-day as did once an unfortunate governess to Lord Byron,

> Who taught the child to read, and taught so well,
> That she herself, by teaching, learned to spell.

I plead, in justification of my confessed incompetence, the acknowledged fact that a child who knows little is yet often the best of all tutors for a child who knows less. With a few exceptions, therefore, I take it that my position of teacher to you to-day is like that of such children to each other. For the sake of those who know nothing of the subject, but wish to learn, I must ask the patience of those to whom the iteration of familiar facts must be more or less tedious. I wish that these field-days should add so much of information to their pleasures as to justify our name of "Naturalists;" but I will try not to oppress you with "science," and will not use a single "hard word" that I can dispense with; for I am aware that many are deterred from commencing the study of botany because they imagine that it consists chiefly in learning to apply a great many unintelligible words. Nothing is further from the truth, for one's knowledge of botany may be extensive and accurate without a tutor, a book, or dictionary of any kind. While on the other hand one may be able to give every plant its name with facility without knowing anything of botany, just as he may be able to recognize every person he meets in his neighbourhood, and yet know nothing more of any of them than the mere name. Begin the study of botany by knowing something of it. It will be found interesting, nay absorbing, just in proportion as it is understood; the more you know the more you want to know; then arises the necessity for certain words to convey certain meanings, which are not part of ordinary English, but then also with that necessity comes the capacity to understand, and therefore to remember the words employed; so the difficulty dies away, and that which was an offence becomes a delight; for the words employed are so definite as to convey a distinct picture to the mind—so definite, indeed, that not unfrequently you will recognise a plant as a familiar friend, though never seen before, from having read its description.

Now, let us proceed to learn a few first facts, and set them up in our remembrance as so many landmarks in an unexplored country. By pursuing this plan our knowledge of its topography will rapidly accrete round these points, and widen till they merge into each other. Then all the crooked places will be made plain; the wilderness will blossom as the rose; and, I say it with profound seriousness, we may if we will walk again in Paradise in close and affectionate intercourse with God; not merely hearing His footstep in the garden, but His voice among its echoes, and seeing His handiwork about us with a distinctness wholly unconceived before. Then, without suspecting it, we shall have learned a strange great secret—that happiness does not consist in abundance of that which we possess. If these are facts—and I assert that they are—who shall ask us—"Of what use is the knowledge of these things?"

Taking it for granted that but few of those present knew anything of the subject, he proceeded to illustrate, by sections of stems of leaves of many kinds tied together in bunches and labelled, the division of all vegetables into three great primary sections—the genera constituting the sections being so different in appearance, that the ordinary observer would hardly imagine that there was any relationship at all between them, until their affinities were thus pointed out. Then, referring to the first of these three prime sections, he proceeded, by the same method of illustration, to show how it was further divided into families, which were to be easily recognised by certain characters common to all their members ; but in which each family differed from all other similar groups, pointing out these characters, while the members had in their hands the various specimens in which they might be seen. When this had been done and recapitulated, Mr. Drane said : If they remembered only so much of botany as had then been explained, and applied this new knowledge when next they took a walk, if only in a small garden, they would find that a field of interest had become opened before them which would amply repay them for the tediousness inflicted by the first lesson. Passing now from systematic botany he pointed out some curious facts as subjects for speculative investigation ; as, for instance, the strange coincidence of form in the *entire* leaf of the sycamore, the septenate one of the horse-chesnut, and that of the plum and apple ; for however different these may appear they are really all of the same form, modified by the operation of laws governing their development, which have yet to be discovered. This idea was illustrated by pointing out the undeveloped portion of the plum and apple leaves, by reducing the sycamore leaf to the precise figure of the horse-chesnut, and cutting out the last from a piece of paper folded in such a manner as to represent a section of the stem of an exogenous plant. He next propounded the proposition that the ascending axis of plants of this order, lengthened by a spiral development which did not cease, in some instances, until the fullest maturity of the plant was attained, as in the case of the common coltsfoot, a plant so common, so manageable, and exhibiting this curious movement with such perfect distinctness, that every one of his hearers could investigate the matter for himself, but it was difficult to put this intelligibly in words without his illustrations to explain their application. This was all he had to say about botany upon this occasion, but he thought he had suggested enough to show what intensely interesting recreation the study of such a subject afforded ; and while advocating the strictest and most persevering attention to business, he hoped that none of them would become, as many were, so wholly absorbed in the getting of money that that grim epitaph might apply to them, which ran—

Reader, I left this world,
In which I had a world to do,
Sweating and toiling to grow rich,
Just such a fool as you.

Mr. Drane was warmly applauded at the close of his interesting address. He then, on the part of the members of the Society, expressed their thanks to Mr. Fothergill for the hospitable manner in which they had been received, and felt that he was expressing the feelings of every one present when he stated that they were heartily obliged to him.

Mr. Fothergill said it gave him great pleasure to receive them on that occasion. He should also be very happy to receive them on any future occasion, when he assured them they would be most cordially welcomed.

Mr. Adams, the President, communicated the resolution of the members passed in the dining-hall, for which Mr. Fothergill again expressed the pleasure it gave him to receive them.

A cordial vote of thanks having been given to the lecturers of the day, tea was served to the guests, after which they departed, their kind hosts accompanying each to the door.

After a pleasant drive of two hours, the party arrived in Cardiff about half-past nine o'clock. During the whole of the day the President, Mr. Adams, was most indefatigable in his efforts to promote the comfort of the members.

METEOROLOGICAL REPORT.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

JULY.

July exceeded the previous month in high temperature, but the warmth was rendered less parching in this neighbourhood by timely copious showers. These were almost entirely the result of electric disturbances which were spread over a large area, and must have caused many localities to participate in the welcome moisture. Under their genial influence the rusty-brown hue of the meadows has given place to something of their former greenness, and the tender blade of the lattermath has again reared its head to furnish a little sustenance to the four-footed tenants of the field. The fierce rays of the sun ripened the grain crops with most remarkable rapidity, and converted the promise of a late harvest into the performance of an early one. Wheat and oats were reaped in the last ten days of the month, and the yield appears likely to be heavy and good. Roots are improved, but cannot be expected to be very productive. Second crops of clover and rye grass will be useful in some places, but the great bulk of after-grass for autum and early winter has yet to be grown, and will require much moister weather.

The barometer was high and very steady throughout the month, the extreme limit of oscillation having been but little more than half an inch. The maximum height, 30·42, was attained on the 20th; and the minimum, 29·87, on the 11th and 12th, giving a total range of 0·55. The instrument stood at or above 30 inches on 25 days.

The temperature of July was warmer than usual after the first week, which was rather cool. The highest reading of the day thermometer amounted to 90° on the 24th, and is the maximum shade temperature I have recorded. The lowest night record was 44° on the 2nd. These figures show an entire range of 46 degrees. The greatest daily range was 34° on the 8th, and the least variation to 9° on the 5th. The mean daily range was 21·1°. The mean of the maximum temperatures was 75·1°, and of the minimum 54°. The mean heat of the whole month was 64°·5, which is 1°·2 above my average, and is 2·7° more than the Greenwich mean of fifty years without correction. The shade temperature, 90°, is 1° in excess of that of the corresponding period of 1868, but the mean heat is 2·1° less than the average heat of that remarkably hot month.

The general direction of the wind was more or less westerly on 21 days, and easterly on 9 occasions. With these principal quarters, southerly and northerly currents were combined in the proportion of 10 to 18, showing a predominance of north-westerly winds. The force generally amounted to a pleasant breeze, and was not at any time violent.

The quantity of moisture in the air was usually small, and ranged from 98 to 45. The mean degree of humidity was 71, complete saturation being represented by 100.

The rainfall of July measured 3.69 inches. This is equal to 372 tons, or upwards of 1,520 hogsheads to an acre. It was produced mainly, if not entirely, by thunderstorms, and nearly one-third of the amount fell on the last day. The total is the largest registered since that of January, which did not much exceed it. This speaks volumes for the dry character of the present year. Nevertheless drought and rapid evaporation were prominent features in the past month, and their effect was only partially neutralized by the occasional heavy rains, which ran off too quickly to produce the effect the same quantity would have done if more slowly deposited. Rain fell on 11 days.

The development of ozone was a full average for July. It was present in the atmosphere on 25 days, but did not once touch the maximum of the scale. Antozone was sometimes noted. The mean degree of ozone was 4·935.

Thunderstorms were very prevalent,—and destructive in some places. The most violent one in this neighbourhood occurred on the evening of the 31st. The storm commenced at 8 o'clock, and raged with scarcely any intermission until 11. The lightning was very vivid, and the accompanying rain heavy.

The eclipse of the moon on July 12th, was well seen here, and was watched by many with deep interest. It began at 7·46 in the evening, and ended at 1·22 in the morning. The circular outline of the earth was very clearly projected on the moon's disc, which was more than covered by the shadow to the extent of 67 per cent. During the time of the totality, clouds collected, and almost obscured the eclipse. I may mention that the red tint given to the shadow is due to the rays of sunlight being refracted in passing through our atmosphere. The blue rays are absorbed, and the yellow and red ones pass on, and give a faint coppery hue to the planet. If the air is charged with dense vapours and clouds, the rays are altogether stopped, and complete blackness is the result, of which there are many cases on record. The next total eclipse of the moon will occur in November, 1873, but the luminary will not rise for an hour after it has commenced, so that the phenomenon will be inferior in interest to that of the present occasion.

The principal diseases in July were measles, whooping-cough, scarlet and typhoid fevers, diarrhœa, and rheumatism. The first-mentioned has been very prevalent. Diarrhœa is not yet severe or general. Rheumatism has usually resulted from rash exposure when heated. The amount of sickness has been great, but the mortality not large.

On Tuesday evening, August 23rd, the first of a series of lectures in connection with the Exhibition was delivered at the Assembly Room of the Town Hall, by William Carruthers, Esq., F.L.S., F.G.S., &c., of the British Museum. The subject of the lecture was "The Forests of the Coal Period." The chair was taken by the Mayor. The attendance was extremely limited, not more than about 30 persons being present. The Lord Bishop of Llandaff; Mr. W. Adams, the President of the Cardiff Naturalists' Society; Mr. Franklen G. Evans, Pentyrch; Captain Bedford, and Mr. E. Payne were among those present. The Chairman briefly introduced

The Lecturer, who first alluded to the early age in which geology was known, but at that period it was purely conjectural, and was not reduced to a science till the time of William Smith, of Bath, in the early part of the present century. He established a basis on which the science of geology was founded, and became the father of geological science. The science of organic remains connected with geology was a subsequent discovery, and was little known until lately, when it was brought more prominently into notice by a Welshman named Arthur Lloyd. The lecturer then proceeded to show the formation of coal in our coal beds, first as bog oak, peat, brown coal or lignite, jet, and common coal. Anthracite was a still further stage in the development of coal, rendered more valuable as an article of combustion from its having hydrogen and oxygen gas forced from it by compression, leaving behind pure carbon alone. If anthracite coal could be crystallized, it would become diamond. He then proceeded to show that coal was formerly wood, and referred to the earliest stage, or bog oak, where the tissues of wood were traced, becoming in succeeding stages a homogeneous mass of coal. At first geologists supposed that the trees were buried after an universal deluge, and this opinion was held as late as Dean Buckland's time. This idea had been laid aside since the researches of a celebrated French geologist, who paid great attention to this important branch of science. Passing on he proceeded to notice the character of the trees at the coal period, which was very different to those found in the same locality at the present day. This part of his subject was illustrated by diagrams, showing forests as they appeared at the period before they were submerged. Some of these trees were 70 feet high. Arthur Lloyd was one of the first men to describe and figure several of these remarkable trees from portions which he found a few miles to the north of Cardiff. One of these trees bore a cone-shaped fruit, which was found on examination to contain *sacs*, with spores holding seeds in large quantities. These seeds were so fine that they would float in the air, and yet in some places whole seams of coal, covering several square miles of ground, and four feet in thickness, were composed entirely of these minute spores. This showed the immensity of the forests, which yielded such enormous quantities of seed, and which he could only compare to the yellow pollen of the fir trees in Scotland, which were blown by the wind, covering the ground with a thick yellow dust. After alluding to other forms of trees found in the coal formation district, differing from those of the present day, the lecturer proceeded to notice the ferns found in the coal seams, which were exceptions to the general rule of vegetables of this period, and were analogous to those of the present time. He mentioned that there were some very beautiful specimens of fossil ferns, showing the fructification, in the Cardiff Exhibition, which he had visited that day. In the ferns of the present day there was the same appearance in size and form to those of the coal period, but the trees, on the other hand, had retrograded, the *calamites* which were found in coal beds, 50 feet high, had now their living representative in the common *equisetum* or horse-tail, a plant often found in hedges, and seldom exceeding two feet high. The living representative of the *Lepidodendron*, a tree found 70 feet high, was the *Lycopodium*, or club moss, which, although so minute, was the counterpart in all respects of the great tree he had referred to. In his concluding remarks he referred to the wisdom of an All Wise Power who had covered over these primeval forests with beds of clay and limestone, preventing the escape of those gases which were necessary to the formation of coal, and locked it up, as it were, until man had arrived at that state of cultivation when coal would become of the greatest value to him, in consequence of the invention of machinery moved by steam power. In the early ages of the world, before man's existence, the sun shone on a vast forest where no animals existed. The gases which the sun gave out were absorbed by the plants and trees of the forests, and these same gases were given out by the coal in the furnace at the present day, showing that though countless ages might elapse, nothing was wasted in God's providence.

A vote of thanks was moved by the Mayor, and seconded by Mr. Franklen G. Evans, to the talented lecturer, which was warmly applauded.

After the vote had been acknowledged by the lecturer,

The Lord Bishop of Llandaff expressed his regret that counter attractions in the town prevented a larger attendance, as he believed that the concert at the Drill Hall had drawn many people to it who would have otherwise attended the lecture. He paid a high compliment to the lecturer for the lucid, interesting, and instructive lecture he had given, and he had no doubt that what they had heard that evening would induce many who were present to turn their attention to the noble science of geology. As astronomy put the mind in possession of an idea of the sublimity and infinity of space, so geology gave the impression of the immensity of duration. He expressed himself particularly indebted to the lecturer for that part of his subject alluding to the coal-producing elements of the country, which must have been very interesting to those who were present.

A vote of thanks to the Mayor terminated the proceedings.

The second of the series of scientific lectures in connection with the Cardiff Exhibition was delivered at the Town Hall Assembly Room, on Friday evening, August 26th, by Mr. W. Pengelly, F.R.S., F.G.S.; the Lord Bishop of Llandaff in the chair. The attendance was not very large, and among those present were the Mayor; Mr. W. Adams, President of the Naturalists' Society; Messrs. Franklen G. Evans, E. Payne; Captain Bedford, Messrs. C. Pearson, W. B. Shand, &c.

His Lordship briefly introduced the lecturer to the meeting.

Mr. PENGELLY commenced by expressing his regret that he was a stranger to the neighbourhood; had he been acquainted with the locality he would have brought subjects to illustrate his lecture, with which they were more familiar than those he had brought with him. Before proceeding with his subject he wished his audience to understand what was the meaning attached by geologists to the word fossil. Literally, anything dug up was a fossil, and early writers use the word in that sense, but geologists of the present day use it in a much more restricted sense. A fossil is generally understood to be something petrified, but this is not the definition of a fossil as geologists consider it. In order to make it more clearly understood, the lecturer gave the meaning attached to the word fossil by Professor Lyell. Professor Lyell says: "By a fossil is meant any body or traces of the existence of any body, whether animal or vegetable, which has been buried in the earth by natural causes." Professor Jukes says: "By a fossil is understood the body or portion of animal or plant buried in the earth by natural causes, or any impression capable of being recognised, or traces of a body or parts of a body." In early ages many strange speculations were made with regard to the formation of these fossils, and many superstitious ideas were prevalent respecting them. Taking up a shark's tooth, the lecturer said in some countries it was called the tongue of the viper petrified, and in others a claw of the Evil One. He remembered that the first fossil he had from the blue lias at Lyme Regis was an *ammonite*, which he presented to a labourer and asked him what it was. He replied that it was a serpent which was drowned in the Deluge and was buried in the mud. He (the lecturer) asked him where the head was, and the labourer somewhat indignantly asked if he had not read in the Bible that "the seed of the woman shall bruise the serpent's head," thus accounting in his mind for the absence of the head. Taking up a number of small shells, he said these were believed to be the very coins received by those unhappy persons who had sold their souls to the Evil One. The lecturer then referred to many other crude opinions respecting the formation of fossils, nor were these very different to the opinions formed on the same subject by learned men in the early ages. As late as the 16th century it was supposed that they were mere stones with figures formed on them by the influence of the heavenly bodies, and also that they were natural impressions stamped in the soil. Leonardo da Vinci, one of the cleverest of men who lived in the middle of the 15th century, demonstrated that these shells were formed in the hills by the influence of the stars. He (the lecturer) would ask, if this was the case, where were the shells which were being formed by the stars now? Throwing aside these speculative theories of ancient writers, the lecturer proceeded to show that the same state of things existing now existed formerly, and this was the whole secret of modern geology. Geologists of the present day did not believe in convulsions of greater intensity than were known at the present time. There was a prevalent idea that the Deluge had a great deal to do with the formation of these fossils. He however abstained from mixing up science with theology, for he did not think that either one or the other would benefit by the combination in the public lecture room, not from any lack of harmony, but he thought it would be unwise to do so. None who read the account of the Deluge would suppose that it was intended to convey the idea that animals and plants were suddenly entombed by it. When Noah sent forth the dove from the Ark the second time, she returned with an olive leaf in her beak, and he knew from that fact that the waters were abated. This showed that the face of nature had not materially changed; that the olive was growing where it was growing before the Deluge, which had not even been of sufficient strength to force or tear up an olive tree, but had left it standing where it was. But to go further into the subject was not his intention that evening. His object was to show how palæontologists proceed in their work. Theirs was not merely guess work—they really have some principles to guide them. From a small fragment palæontologists were able to show the animal or plant to which it belonged, its form, habits, and the climate of the locality in which it lived. If you (said the lecturer) take a common French bean, the seed, not the pod, it divides itself into two parts, or *cotyledons*, and the plant is therefore called *dicotyledonous*. The tulip has but one *cotyledon*, and is therefore called *monocotyledonous*. Taking up the polished section of a tree, he showed that it consisted of rings or layers. In this the sap went down between the wood and the bark. The bamboo and reed have none of these rings, and the sap goes down the centre. These plants are called *endogenous*, and had one *cotyledon*, and the former *exogenous*, having two *cotyledons*. Endogenous plants had parallel veined leaves, and exogenous had reticulated leaves. If, therefore, he found a skeleton leaf, where the veins are parallel, he knew that it belonged to an endogenous plant; and if he found a seed with two lobes, he knew that it belonged to a tree where the sap went down on the outside, and the leaf reticulated. Thus if he found one part, he knew what the remainder was. If, therefore, they had in their hands a seed vessel or a leaf, they had data sufficient to enable them to come to a conclusion of the most important character respecting the condition of the flora, and the nature and clime of that country. (Applause.) After explaining how palæontologists, from the shape of the mouth of a shell, knew whether its inhabitant was a vegetable or an animal feeder—the broad open-mouthed shell being the indication of a vegetable feeder—he proceeded to notice the characteristics of the teeth of various animals, to show how, from a single tooth, they were able to give the form of the animal, what it fed on, its nature, and peculiarities. He showed two teeth, both of which bore a strong resemblance to each other. Both were conical and incurved, but one had a hollow cavity at the base, and the other had not. The one with the hollow cavity at the base belonged to the Saurian, or animal of the lizard tribe. The other was the tooth of a lion, which bore a strong resemblance to the former, but had not a hollow cavity at its base. Thus, from these two teeth the kind of animal could be distinctly identified. Again, a tooth with three or two fangs belonged to the *Mammal*, or an animal that suckled its young; and the tooth with one fang (which he produced) belonged to a viper. But although there were such distinctions between the teeth of the mammal and the viper, the tooth alone would not be sufficient to identify different varieties of the *Feline* or cat tribe. No comparative anatomists in the world could tell a tiger's from a lion's tooth, only certain parts of the skull would decide that point. The lecturer exhibited the teeth of the African and Indian elephant, showing the form of the enamel on each of these teeth; one being lozenge shape and the other transverse; and by this they were able to classify the mammoth, the arrangement of the enamel on the teeth more closely ressembling the Indian than the African elephant. The Indian elephant differed from the African in the number of its toes, the former being an even number, and the latter odd. If they found a foot with an even number of toes, the back bone must consist of 19 joints, and with an odd number it must consist of a greater number, not less than 23. So that by the number of the toes they could tell the backbone and the form of the animal. From the concavity of the tooth or its convexity they were able to tell whether it came from the upper or the lower jaw. With reference to the *vertebræ*, he explained that the ball and socket joint was peculiar to the mammal tribe, while in the animals that lived in the water, who required greater flexibility than strength, the backbone is composed of concave joints. Leaving these animals he proceeded to notice the extinct animals whose remains were found all over Britain. Many years ago a lady walking near Lyme Regis found the bone of an animal which she knew belonged to a very different animal than existed at the present day. She took that bone to a clergyman who resided in the locality, who was also a geologist of great skill, and he from that bone built up the entire structure of the monster extinct lizard the *Plesiosaurus*. The clergyman was Dean Conybeare, formerly Dean of Llandaff. (Applause.) The lecturer showed that though there were large animals living in former ages they were no larger on the whole than the animals of the present time. Some of the animals living now were larger in their earlier stage, but the whale was an animal larger than any that ever before existed. The next point touched upon by the lecturer was, how did fossils get into rocks? Mr. Pengelly, exhibiting a piece of polished limestone with corals in layers, said, the question was, how did the corals get there? By way of illustration, he mentioned that this piece of limestone had come from the bottom of some piece of water similar to our Bristol Channel. In the channel small shell-fish would die and fall to the bottom ; these would be covered up with silt, brought down by the rivers. Other shell-fish would fall on that, to be also cqvcrcd with silt, and by and by it would become rock ; and when they were brought up to the surface they would be fossils, in the proper sense of the term ; and this was the way all fossils got into the rocks, they may depend upon it. How did animal and vegetable matter become mineral ? Organic substances became mineral by conversion. Petrified substances, though called by some fossils, were not fossils ; they had been merely deposited in water supersaturated with carbonate of lime, which had coated over the substance, which, being thus enclosed, remained internally unaltered. Organic substances, on the other hand, which had become fossils, had their internal and external matter entirely taken away. As decomposition was slowly going on, as particle by particle decomposed, particle by particle of mineral matter took their places, and thus the very same arrangements, internally and externally, were preserved, although there was no doubt that not a single particle of the original structure remained. This was mineralization by replacement or conversion. Coal, on the other hand, was not a mineral substance by conversion, but was vegetable matter chemically acted upon and changed into a mineral substance, and this was mineralization by alteration. Another point was the means of pointing out in detail the difference between marine and fresh waters by their shells. He then alluded to the researches of Gwynne Jeffries, an eminent Welshman, who was able to state with mathematical certainty at what depth shells were deposited in the ocean. To illustrate the fact he had previously stated, that the same state of things existed now as did at the time of the life of these extinct animals, he pointed to a diagram of the fossil foot-prints of an animal found on sand. The sand must have been a portion of a sea shore, with the same or similar characteristics as one of the present day. The footprints on the sand showed that there were tides just as now, as the animal whose footprints were on the sand, had passed and repassed between one tide and another, and in the interim between the passing and repassing a shower of rain had fallen, the raindrops being on one set of footprints and not on the other. The impressions of the raindrops were sloping from the sea to the rocks. From these data geologists could with certainty infer that there were at these times tides, and therefore a moon and atmosphere the same as now, or there could not have been rain, and wind driving the rain in a sloping direction. That there were spring and neap tides was proved by other impressions on sand, showing that there must have been a sun as well as a moon ; and if a sun, there must have been seasons, and the earth's axis must have inclined to the plane of the ecliptic similar to now. All these facts, the lecturer said, clearly proved that the natural laws which existed now existed in very early ages. The same phenomena were then going on when these fossils were buried as at the present time. (Applause.)

The Lord Bishop of LLANDAFF proposed a vote of thanks to Mr. Pengelly, for the highly interesting lecture he had delivered that night. He was evidently a perfect master of the subject which he had endeavoured to instruct them upon, and they could not but express their thanks to him for his able and instructive lecture. He trusted that those who had heard it would, when they returned to their homes, pursue the subject, and they would thus derive increased benefit from the lecture they had listened to that evening.

The MAYOR seconded the vote of thanks, which was carried with applause.

The LECTURER briefly acknowledged the compliment.

The MAYOR proposed a vote of thanks to the Lord Bishop of Llandaff, which was seconded by Mr. Adams and carried unanimously.

His LORDSHIP, in responding, expressed a hope that before long, when the museum was more complete, they would have periodical lectures of a similar character, such as were delivered in London, Birmingham, and other large towns.

METEOROLOGICAL REPORT,

BY MR. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

AUGUST.

The weather of August exhibited most of the general features that marked the previous two months, and contributed to make up a summer of a very extraordinary character. The principal meteorological conditions were high and uniform barometric tension, warm temperature, dry atmosphere, and rather small development of ozone. The whole season was most favourable to the ingathering of all grain crops, which have been harvested in splendid order. This much must be admitted by every one, though there may be differences of opinion as to the amount of yield. The commencement of the year was particularly trying to the wheat plant, and many sowings were destroyed by the united efforts of wire-worm, frost, and drought. The crops which escaped their ravages made fine progress at a later period, and the final result is but little, if at all less than an average. Other cereals are not in so satisfactory a position, although there are exceptions in Ireland, Scotland, and Wales. Turnips have made the most of the showers that fell occasionally, but the growth cannot be heavy. Mangel-wurzels stand drought better, and are more promising. Keep is still short in lattermaths and meadows, and second crops of clover and rye-grass are decidedly light. An unusual number of dead trees are noticeable about the country, and the probable cause is the effect of three successive dry summers, combined with a porous soil incapable of retaining moisture.

The barometer was high and steady throughout the month with some slight exceptions. The maximum height, 30·41, occurred on the 13th, and the minimum, 29·60, on the 28th, giving a total range of 0·81. The lowest point was reached by a sudden dip, which was immediately recovered from, but it increased the range to a much wider limit than properly belonged to all the rest of the month. The instrument stood above 30 inches on 25 days.

The temperature of August was warm and rather above the average. The highest reading of the day thermometer was 84° on the 11th, and the lowest night record 39° on the 30th, showing a total range of 45 degrees. The greatest daily range amounted to 31° on the 11th, 18th, and 30th, the least variation to 14° on the 1st, 2nd, and 7th, and mean daily range to 22·6 degrees. The mean of the maximum temperatures was 73·6°, and of the minimum 51·0. The mean heat of the whole month was 62·3°, which is rather above the average of previous years, and a full degree higher than the Greenwich mean of 50 years without correction.

The general direction of the wind was more or less westerly on 11 days, and easterly on 17 occasions. With these main quarters southerly and northerly currents were combined in the proportion of 10 to 21. These figures show a preponderance of northerly and easterly winds. The air was usually calm, or only stirred by a gentle breeze.

The quantity of moisture in the atmosphere was smaller than usual from the prevalence of dry north easterly winds, and the absence of the hazy vapour that often accompanies summer heat. The registered figures varied from 90 to 47. The mean degree of humidity was 66, complete saturation being represented by 100.

The rainfall of August was not much more than half the average of the month, and raises the deficiency upon the year thus far to 11·84 inches. It was principally caused by electric disturbances, although they did not reach this neighbourhood. It fell in heavy showers, occupying only a short time, and leaving the intervals clear and dry. The total amount measured was 2·59 inches. This is equal to 261 tons, or upwards of 1,060 hogsheads to an acre. Rain fell on seven days. Thunder and lightning were only once observed.

Ozone was not very abundantly manifested, and was below the usual mean. It was present in the air on 20 days, and once reached the maximum of the scale. Antozone was occasionally noted. The mean degree of ozone was 4·290.

The sanitary condition of the neighbourhood was much less satisfactory than that which generally obtains at this season of the year. There was a large amount of sickness and considerable mortality amongst children. The diseases which produced this result were measles, whooping-cough, scarlet and typhoid fevers, and inflammation of the chest. In many instances measles and whooping-cough occurred together in the same person, and not unfrequently inflammation of the lungs was superadded. There was one well-marked case of scarlet fever and measles in the same subject. Diarrhœa was not very prevalent. It is impossible to connect the *origin* of zymotic diseases with any special meteorological state, but the weather has a great influence over the course they run and the ultimate result. Measles and whooping-cough both affect the lungs, and inflammation of these organs is often induced by atmospheric changes.

The extensive prevalence of north-east winds is the connecting link on the present occasion. This justifies the old couplet—

> The cold wind from the north east
> Is good for neither man nor beast,

and shows that, come when they will, winds from this quarter are not conducive to health or vitality.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

SEPTEMBER.

The weather of September was more variable than that of the preceding months, but on the whole was remarkably fine. The barometer generally stood high; the temperature was moderate; winds ranged from calm to violent; the rainfall was light, and ozone deficient. The first 14 days were unsettled, and very valuable and refreshing rains fell. From the 14th to the 30th the most agreeable meteorological conditions prevailed, which constituted a second summer. I have seen this referred to as unprecedented, but that is not quite accurate. The only rarity about it was its occurrence after a first summer of an unusually dry, fine, and prolonged character. A short period of brilliant weather in September is not at all uncommon, and is indicated by many popular expressions. In America this brief respite before the rigours of winter is called the Indian summer, and is more marked than in England. In this country it is known as the second, or Michaelmas summer. The latter has its equivalent in the Welsh language, and there is also another phrase, meaning "The short summer before winter." The summer, as a whole, was certainly almost unprecedented, and it is only in comparison with it that the past month appears chequered. The rains at the beginning were very beneficial, and much improved the condition of root-crops and pastures. Most fruits are abundant, and of good quality. The long drought hastened the fall of the leaves, and many wych elms were stripped in the middle of the month. During the past ten days immense swarms of black-looking insects have appeared, which are suggestive of a plague of flies. These are *Aphides*, but they differ in appearance from those familiar to us in the summer. They are of a dark green colour, have the "paps" smaller and less developed, and with little or no honey dew. These insects will lay the eggs that will produce the generation of next year, and if the progeny bear any numerical proportion to the parents, we are likely to have an evil time of it. We can only hope that ladybirds and their other enemies will multiply in a corresponding ratio.

The barometer was fluctuating for the first ten days, and very high and steady for the remainder of the month. The maximum height, 30·56, was attained on the 16th, and the minimum, 29·40, on the 7th, giving a range of 1·16 inch. The instrument stood above 30 inches on 22 days.

The temperature of September was moderate, and below the average of the last four years. The highest reading of the day thermometer was 71° on the 4th, 5th, 26th, 27th, and 29th, and the lowest night record 40° on the 1st, 4th, and 11th, showing a total range of 31 degrees. The greatest daily range also amounted to 31° on the 4th, and the least variation to 10° on the 30th. The mean daily range was 19·9°. The mean of the maximum temperatures was 66·7°, and of the minimum 46·7°. The mean heat of the whole month was 56·7 degrees. This is about the average temperature of the last 50 years, but if the Greenwich correction was applied to it, there would be a deficiency of more than a degree. There were no frosts by night, and an absence of excessive heat by day.

The general direction of the wind was more or less westerly on 15 days, and easterly on 14 occasions. With these principal quarters, southerly and northerly currents were combined in the proportion of 11 to 13. These figures show a preponderance of easterly and northerly winds, which tempered the heat of the bright sunshine in the Michaelmas Summer. The force of the wind was considerable on the 9th and 10th, and the lowest reading of the barometer, which occurred on the 7th, coincided with the storm that proved fatal to the "Captain" turret ship, although calm here at that time. The gale did not reach this locality until two days later.

The quantity of moisture in the air was not large, and ranged from 94 to 59. The mean degree of humidity was 74, complete saturation being represented by 100.

The rainfall of September was light, and confined to the first half of the month, and distributed over 13 days. It amounted to 3·22 inches, which is equal to 325 tons, or upwards of 1,330 hogsheads to an acre. This shows a deficiency of full four inches on the corresponding period of the previous four years; but as two very wet Septembers are included in it, the averages are somewhat disturbed. The entire debt of rain on the year now amounts to no less that 16 inches—a prodigious total, and certain to be honestly paid in due course. Thunder and lightning were only once observed.

Ozone was below the average of the month. It was present on 19 days, but did not touch the maximum of the scale. Antozone was sometimes noted. The mean degree of ozone was 4·233.

The principal diseases in September were measles, whooping cough, typhoid fever, inflammation of the lungs, rheumatism and lumbago, hepatic disorders, and diarrhœa. The first four have been unusually prevalent, and caused some mortality. The last is much less epidemic than usual, and is not now likely to increase. The general character of the month, in its sanitary aspect, was almost identical with that of August, and needs no additional comment.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

OCTOBER.

The singularly fine weather that characterized the previous months was continued until the 7th of October, when a change came over the spirit of the elements, and abruptly terminated the Michaelmas summer. From that time onwards the turbulent sway of rain and tempest, which had been so long suspended, displaced the gentle reign of sunshine and calm. The barometer lost all equilibrium, and oscillated wildly and without ceasing, through extended limits. The temperature was moderate; winds were often violent; the rainfall was very heavy; the manifestation of ozone scanty; and the northern heavens were sometimes brightly illuminated by dancing streamers of aurora borealis. The return of abundant moisture was very acceptable, and it has done much to revive the parched condition of the country, and to replenish the fast-failing springs. Wells, and other sources of water-supply, have seldom been so nearly exhausted, and in some places absolute scarcity prevailed. In our own neighbourhood machinery turned by water-power was often motionless, but there was no lack for all the ordinary purposes of drinking, cleaning, and dust-laying; and we were very far from realizing the saying, "There was no water for the people to drink."

The barometer was low and very fluctuating after the 7th. The maximum height, 30·63, occurred on the 1st, and the minimum, 28·93, on the evening of the 23rd, giving a total range of 1·70. The instrument stood below 30 inches on 20 days.

The temperature of October was not marked by any extremes, and was very nearly an average. The highest reading of the day thermometer was 68° on the 1st, and the lowest night record 30° on the 11th, showing an entire range of 38 degrees. The greatest daily range amounted to 26° on the 10th and 11th, the least variation to 7° on the 19th, and the mean daily range 15·8°. The mean of the maximum temperatures was 58·8°, and the minimum 43°. The mean of the whole month was 50·9, which is 7-10ths higher than my own average, and the same above the Greenwich mean of 50 years without correction. There was frost on only two nights, and hail was once observed.

The general direction of the wind was more or less westerly on 19 days, and easterly on 12 occasions. With these main quarters, southerly and northerly currents were combined in nearly equal proportions. The figures show a predominance of north-westerly winds. The force of the wind was often considerable, and reached a heavy gale on the 12th and 13th. The storms on the 23rd and 24th, corresponding with the lowest reading of the barometer, were not so violent here, but were extremely severe to the north and south of this place. This accords with past experience, as the point of greatest force does not usually coincide with the area of lowest pressure.

The quantity of moisture in the air was above the average. The mean degree of humidity was 85, complete saturation being represented by 100.

The rainfall of October was very heavy. It amounted to 8·53 inches. This is equal to 861 tons, or upwards of 3,550 hogshead to an acre. It exceeded the average of the month by 3·74 inches. This, deducted from the deficiency on the year mentioned in my last report, which reached a total of 16 inches, will still leave a balance of debt to the extent of no less than 12·26 inches. Most people know the difficulty of paying old pecuniary scores out of current income; and even Nature, notwithstanding her moist expenditure last month, will still find a heavy mortgage on the pluvial resources of the future.

The development of ozone, though not absolutely large, was above the average of the month. It was present in the air on nineteen days, and once reached the maximum of the scale. The antagonistic principle, antozone, was frequently noted. The mean degree of ozone was 4. The cause of the apparent deficiency generally noticeable at this season of the year I have often mentioned. It consists in the fact that the ozone is beneficially expended in oxidizing the products of decaying vegetation, and does not necessarily indicate a scanty generation of this vitally important element.

A beautiful meteor, two or three times as large as the planet Venus, was observed at 6.30 p.m. on the 31st. It appeared in the South, about 30 degrees above the horizon. The moon was shining brightly, and lit up a soft white haze in that part of the sky, which quite obscured the stars, and served to show the brightness of the object. The path was nearly horizontal with a slight dip downwards. The colour was a greenish white, and it finally disappeared, leaving behind a shower of bright red sparks like those of a rocket. The substance had evidently been burnt up in the heat developed by the compression of the atmosphere produced by the meteor's enormous velocity.

The principal diseases in October were measles, whooping cough, typhoid fever, diarrhœa, rheumatic disorders, inflammatory complaints of the chest and throat, and erysipelatous affections. Colds were very prevalent from the change to storm and rain after such prolonged dry and fine weather. The heavy floods in the river Taff cannot fail to be productive of benefit to the health of the dwellers on its banks. The stream is so extensively and universally polluted that it always becomes very offensive when the water is low, therefore the late torrents will have done essential service in washing it sweet and clean, for a time, at any rate.

The most interesting meteorological event of the month was the magnificent display of aurora borealis on several occasions, more particularly that on the evening of the 24th. I had intended entering upon an explanation of the causes of the phenomenon; but having already occupied sufficient space, I will reserve the subject for a separate paper to be read before an early meeting of the Cardiff Naturalists' Society.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

NOVEMBER.

The weather of November was of a mixed and chequered character, with sunshine and rain intermingled in about equal proportions. The month was fine, calm, and cold, with some fogs and frosts, up to the 12th. From that date up to the 26th, it was very wet, and there were sharp frosts at night. The last few days were fine. The combination of heavy rains and frosts was very unfavourable to the health and comfort of live stock, and a probable cause of mortality. In other respects agricultural prospects for the winter are not promising. The extensive prevalence of foot and mouth disease, and the unusual scarcity of hay and other provender, will make this season a particularly trying one to the country generally. The autumn leaves, prematurely withered by the long drought, fell very early this year, and the trees immediately put on the aspect of winter. The absence of summer foliage brings out in stronger relief the beauties of the hedge-banks. The rich green covering of moss and trailing ivy, interspersed with the brilliant fronds of the polypody, hart's tongue, the blechnum boreale, and other ferns and plants still flourishing, give them a verdant appearance. This, again, forms a lively contrast to the reddish-brown hue of the beech-leaves and dead fronds of the common brake fern; and the whole makes up a remarkably pretty picture for a November day.

The barometer was very high during the first nine days and the last four, and low in the interval between them. It oscillated through limits exceeding an inch and a quarter. The maximum height, 30·59, occurred on the 3rd, and the minimum, 29·20, on the 22nd, giving a range of 1·39. The instrument stood below 30 inches on 17 days.

The temperature of November was rather low, and less than the average of the month. The highest reading of the day thermometer was 55° on the 1st, 7th, 23rd, 24th, and 25th, and the lowest night record, 27°, on the 12th, 17th, and 20th; showing a moderate total range of 28 degrees. The greatest daily range was 23°, on the 3rd, the least variation only 3°, on the 29th and 30th, and the mean daily range 14·4°. The mean of the maximum temperatures amounted to 49·2°, and of the minimum to 34·8°. The mean heat of the whole month was 42 degrees, which is one degree less than my own average, and 1·1° below the Greenwich mean of 50 years without correction. There was frost on 13 occasions.

The general direction of the wind was exactly divided between the east and the west, and the combined current equally balanced between the north and the south, which coincides with the even proportions of wet and dry weather. The force of the wind was sometimes considerable.

The quantity of moisture in the air was above the average, and once reached the point of saturation. The mean degree of humidity was 88, complete saturation being represented by 100.

The rainfall of November was 5·02 inches, which is equal to 507 tons, or upwards of 2,090 hogsheads, to an acre. It exceeded the mean fall of the month by 0·73, and this subtracted from the heavy debt left over from last months's account, still leaves as the balance of rain due on the year, the large total of 11·53 inches. It is to be feared that most people who realize what an amount of moisture these figures represent, would pardon Dame Nature if she dealt a little in repudiation, a suspense account, or any other device that companies or individuals sometimes resort to when in a state of financial embarrassment. Rain fell on 16 days; hail on three occasions, and snow once, more than an inch in depth.

Lightning was observed on the evening of the 14th. A thunderstorm occurred at 5.30 p.m. on the 22nd, with hail and heavy gusts of wind at intervals. The thunder, lightning, hail, and rain continued more or less throughout the night. They were associated with a west wind and some elevation of temperature, which is a common characteristic of thunderstorms.

Ozone was almost entirely absent for two-thirds of the month, from the prevalence of northerly and easterly winds, and frequent calms. The latter third was less deficient. The mean degree of ozone was 2, which is below the average of a month in which it is generally scanty from the abundance of decaying vegetation.

The diseases of November were similar to those recorded in October. The same zymotic complaints prevailed, but to a slighter extent, but the inflammatory classes were increased. In both months some cases of croup occurred; twice in connection with measles.

The following Lecture was delivered by Mr. John Morgan, on 22nd November, 1870.

The Relations Existing between the Fine Arts, Natural Science, and Industrial Productions.

Mr. Chairman, Ladies, and Gentlemen,—The relations existing between the Fine Arts, Natural Science, and Industrial Productions, are full of intellectual interest. These things are outward expressions of the inner workings of the mind, and are as nearly related together as Poetry is to Prose.

The world without man is the counterpart of the world within him. As the structure of the eye is adapted to the laws of light, and the structure of the ear to the laws of sound, so is the constitution of nature adapted to the constitution of the human mind. Exercise is necessary for the development both of mind and muscle. Man was made for work, and work is everywhere waiting for man. Things within prompt him, and things without invite him to work.

> "All things to our flesh are kind
> In their descent and being;—
> To our minds,
> In their ascent and cause."

Therefore without work man could not live, and, with it he promotes alike the healthy action both of body and mind. The appetite for food is similar to the appetite for knowledge. But however rich might be the feast set before us, and however the tables might groan with dishes, there may be barons of beef and hogsheads of burgundy and the choicest delicacies of all climes and seasons; yet that part of this banquet only is ours which we can partake of, digest, and convert into nutriment for our physical frame. Just so is it with food for the mind. However numerous may be the dishes provided for us, that portion of all the libraries in the world, of all the books in those libraries, and of all the objects of Nature and Art only is ours which we can mentally assimilate and convert into intellectual blood and bone and tissue. Now there are at present upwards of one thousand forms of physical disease in the books of English Physicians, and indigestion is alike a fruitful source of unhealthiness both to body and mind. Each individual has his own mental idiosyncracy, and he sees and hears for himself that which may or may not quadrate with the nature of things. Hence Horne Tooke's explanation of truth is beautifully expressive that "it is what every man troweth."

Truth, indeed, must be to the individual an agreement with the appearances of things to him. But no two mental physiognomies are the same, and no two powers of expression are alike. One man's thought flows into words, like water bubbling up with sparkling freshness from an exhaustless spring; whilst other men have to apply great force to pump it up from the deep well beneath. There may be abundance of water there, but the machinery will not work smoothly, and the water flows at uncertain intervals, with sudden jerks and with great difficulty. There may be other wells where not only the machinery may be defective, but where the water also may be both shallow and dirty. Still most men mentally believe their own opinions to be right, and those who differ from them to be wrong, notwithstanding the fact that all men in later life differ from themselves and their own opinion in youth. Hence generally orthodoxy means my "doxy," whilst heterodoxy is everybody else's "doxy." But at best, both in the reception and in the expression of truth, none of us can know, "but in part" and see—but "as through a glass darkly"—whilst absolute Truth is only known to "Him unto whom all hearts are open, all desires known, and from whom no secrets are hid" either in Man or in Nature. Now, to mistake a part for the whole has been the most common form of human error in all ages, and will be so till the end of time. Hence we should be charitably disposed towards those who differ from us, when they are honestly searching for truth. Seeing but obscurely, and knowing but in part ourselves, we should feel that it is often by the attrition of the different parts of truth with one another, like the percussion of flint and steel, that further luminous sparks may be elicited.

Therefore it is that the study of the higher sanitary science, which includes the health of the mind as well as the health of the body, is necessary in order to bring the habits of Man into harmony with the laws and constitution of Nature; to give him that dominion over material things which is his birthright; to enable him to multiply his powers in replenishing the earth and in subduing it, in order that he may use its manifold productions not merely for the supply of his animal wants, but that he may behold some of the impressions of the true, the good, and the beautiful, which are scattered abroad in the wonderful worlds around him, within him, and above him.

So numerous and so extensive are man's relations to these inner and outward worlds, that we scarcely know where to begin the tracing of them; but there is one little "unruly member" possessed alike by ladies and gentlemen—out of sight, yet constantly near us—which is full of material, mental, and moral uses, as well as of poetical and philosophical symbolism; and which may perhaps, if we examine it, afford us some clue to unravel the relations existing between the Fine Arts, Natural Science, and Industrial productions.

The human tongue with its surroundings is not only the organ of speech and the organ of taste, but it is also the index to the physical health of the body and to the moral health of the mind. The very air which passes over its surface into the blood refinery below, and is essential to the physical health and life of the individual, is arrested by the tongue, and turned into mental vehicles for the conveyance of thoughts and feelings to other minds through the gateway of the ear, and this articulated air can be easily converted into signs by the human hand, and find admission to other minds, beyond the reach of the tongue, through the portal of the eye. These two doors, the eye and the ear, be it observed, open more directly into the mind than the other three senses, which are more immediately bodily entrances.

Hence if one mind wants access to another it knocks at one of these doors. In order to show how much this has been the case in all ages of the world, we may mention the fact which is well-known, that the key which unlocked the meaning of the hieroglyphic writing on the tombs and monuments of Egypt was lost for upwards of two thousand years. When the first Napoleon, at the end of the last century, was digging the foundation for a fort at the Rossetta branch of the Nile, he found the celebrated stone, now in the British Museum, which contained an inscription in three languages, according to the custom of Eastern Nations, from the earliest times. One of these languages was the hieroglyphic or sacred writing of the Egyptian Priests, and as the inscription could be easily read in the other two languages, it was believed by the French Savans then on the Napoleon Staff that the key would immediately be found for unlocking the ancient mysteries of Egyptian hieroglyphics. However it took the most learned linguists of Europe upwards of twenty-five years to find this key, and the entire difficulty and delay turned upon the solution of this one question: Whether these characters were signs of articulated sounds addressed to the ear or pictures of natural objects addressed to the eye? It was ultimately found to be a combination of both kinds of character: and here let it be observed is also found a combination of the natural germs both of poetry and painting. But there is here something more than poetry and painting. It is generally supposed that Plato acquired his knowledge of symbolic philosophy from Egypt, as the Egyptian priests taught religion by means of symbols and figures, which seemed to them a more grave and respectable way of treating Divine subjects as well as of retaining greater veneration for the priests themselves by veiling the truth from the eyes of the public.

To this day there are no alphabetical characters in Chinese writing. It is chiefly a system of symbols, representing ideas rather than sounds; and it not unfrequently happens, that two Chinamen from different districts, meeting to transact business in a fair, do not understand a word of each other's colloquial language; yet they do their business and understand each other with perfect ease, by means of writing with a piece of chalk on the nearest wall. The use of Arabic numerals, amongst European nations, is of a similar kind. The figures 1, 2, 3, 4, 5, 6, 7, 8, 9, when written, are understood by all European nations, whilst the words by which those figures are designated may be unintelligible.

The Bayeaux Tapestry, representing the invasion of England by William I., is a kind of pictorial writing, somewhat similar to that employed by the ancient Mexicans. Savage tribes also convey information by cutting rude figures on trees, which are understood by all the individuals of the tribe. These facts show us that both material and mental figures of speech are common languages.

Poetry has been described to be music mixed with reason, but the definition is scarcely a good one, because we all know there may be poetry without rhyme, and rhyme without poetry. Still perhaps we cannot altogether agree with Prior, who says—

> "For rhyme with reason may dispense,
> And sound has right to govern sense."

Now language is as difficult to define metaphysically as poetry is. In fact, the witty Greeks said long ago of metaphysical philosophy itself—the science of sciences—that it was merely "the profitable process of milking the animal that gives no milk into a pail that has no bottom." We will therefore endeavour to avoid metaphysical disquisitions.

Still the philsophy of mind preceded the knowledge of Nature. Aristotle, 2,000 years since, assigned to it the investigation of the principles and causes of things in general; and ranks it not only as superior, but also as prior in the order of Nature to the whole of the arts and sciences. But what is first in Nature is not first in Man. Nature begins with causes which produce effects. Man begins with effects, and by them ascends to causes. Thus all human study and investigation proceed of necessity the contrary way to the order of

Nature. Man proceeds from the sensible to the intelligible; from body—the effect—to mind, the first and final cause.

But when Man applies his knowledge for his own purposes, as embodied in the arts, machinery, and manufactures, he does so in the order of Nature—that is, by reasoning from cause to effect; and these two methods, the inductive and deductive, embrace all human knowledge.

Therefore the consideration of ideas and words, as instruments of knowledge, seems necessary for those who would take a comprehensive view of science. Words are the mysterious links between mind and matter, as well as between mind and mind. If we define matter to be the unconscious thing, and mind to be the conscious thing, then the triad—mind, word, matter—will represent the total of human knowledge.

This is one aspect in which the tongue itself may be regarded as the type of the Fine Arts, of Natural Science, and of Industrial Productions. It has both its corporeal and its mental uses. Not only is it, as we have already seen, the organ of speech and the organ of taste, but that very expression, good taste, may either mean the discrimination of the flavours and combinations of sweet, sour, and bitter in the viands and wines on our tables, or it may mean the appreciation of the good, the true, and the beautiful in Nature and the Fine Arts. But the term good taste is not confined to the appreciation of the merits of poetry, music, painting, sculpture, or architecture; it descends to the minutest details of our daily surroundings—to matters of dress and furniture, to the jugs on our tables and the paper on our walls, to our speech, our manners, and our conduct—in all the relations of life.

A modern writer, of great refinement, asserts that "A taste enriched by observation and learning—sensitive even to the trembling of the balance by which the scale is suspended—is probably one of the most desirable endowments of the human mind."

But it is not so much with the relations of the "unruly member" itself with which we wish to deal at present as with its utterances. How awful is the responsibility involved in these utterances—whether they are the witnesses of truth or of lies—is shown by the highest of all authority, describing "as fire that world of iniquity, the human tongue, which at times defileth the whole body, and setteth on fire the course of nature, and is itself set on fire of hell."

There are mysterious relations belonging to language which no philosopher can fathom. When we find such men as Dr. Whewell and Stuart Mill differing in opinion as to its nature, it behoves us to step circumspectly, and not be too positive in our assertions. Still, there are certain fundamental principles running through the construction of all languages—common features, as it were, of the human mind—impressed on all tongues, and expressed in all speech, which have been recognized and grouped under scientific arrangement by Max Müller and others. Archbishop Trench said, "There is fossil poetry, fossil ethics, and fossil history, embodied, not merely in speech, but in the construction of individual words."

Every Welshman knows there is poetry, as well as painting and philosophy, embodied in Welsh words. Hence the late Archdeacon Williams, of Cardigan collected the fossil words he found in the *débris* of the old Welsh tongue, and, joining together the thought which he believed to be associated with those words, he attempted to build up a body of philosophy, which he inferred must be known to the minds of the men who used such language. In this respect he followed precisely the plan which Cuvier, Owen, and other comparative anatomists have adopted in building up the outward form of extinct geological animals from the possession of a few pieces of fossil bone.

In all languages individual words have both a literal and a figurative meaning, and thus they form a mirror, like Eves at the fountain, reflecting alike the image of man and the likeness of nature.

Language, then, is the natural reflection both of mind and things, and in the utterances of all tongues in the civilized world, there are traces, showing that the imagination, as well as reason and conscience, are impressed upon the features of speech. "Out of the abundance of the heart the mouth speaketh," and in that very process active minds are always philosophizing, poetizing, or moralizing.

It has been truly said that "the imagination enters into and plays around every word that we utter and almost every thought that we think. The poet calls shadows into the crystal of memory, as the charmer of old time peopled his glass with the faces of the absent. The phantasy of the Greeks, the vision of the Latins, and the imagination of ourselves, signify the same work of the mind, the causing to appear. Imagination then is the union of likenesses and their exhibition in a new form."

Now this is the studio, or mental workshop of the poet and musician, the sculptor and painter. The manipulation of the work of art is only the outward expression of the language of the beautiful addressed to the ear, or the eye, as the case may be. Before we proceed further it may be necessary to put a curb upon the imagination, because an unbridled imagination is almost as dangerous as an unbridled tongue. If the imagination be the leader in the intellectual coach, it must not be allowed to rear and kick and bolt and scamper about as it pleases, but must be trained to work steadily with the wheelers, reason and conscience, whilst the reins are held well in hand by the will who sits on "the box."

The imagination itself therefore is subjected to training, that great law of habit which is second nature. Its healthy development is dependent upon its right use in the same manner as the development of the muscles in a blacksmith's arm is dependent upon its exercise. One great authority informs us that what is called the power of the imagination is not an original endowment of the mind, but the result of acquired habits aided by favourable circumstances, and which in its different gradations fills up all the interval between the first efforts of untutored genius and the sublime creations of Raphael or of Milton. No doubt that a preponderance of the imagination underlies genius both in Poetry and the Fine Arts, but still what Reynolds observed of Painting applies equally to the other Arts. "That as the painter by bringing together in one piece those beauties which are dispersed amongst a variety of individuals, produces a picture more beautiful than can be found in Nature, so that artist who can unite in himself the excellencies of various painters, will approach nearer to perfection than any of his masters."

The motive powers which propel the Fine Arts therefore are a creative imagination and a cultivated taste. The forces are correlative. Without taste imagination would run riot amidst the scenes of its own creation; and without imagination, taste would be tame, spiritless, and deficient in those new combinations of the beautiful, which are its greatest charms.

This subject in its entirety is one of great importance. The re-combining of the true and the good, which seek expression in the beautiful, not only refers to the works of men's hands, but if the principle be sound and it be carried out to its legitimate result, includes Man himself in his relations to God and Nature. The Creation, when looked at aright, is a mirror reflecting the thoughts of the Creator. Man by looking into that mirror has the Divine thought refracted through the medium of his own mind, and transmitted in his own words and deeds. In other words, all natural Science, and all pure Art, are simply the interpretation into human language of Divine thought as expressed in Nature. All true religion is only the translation of Divine feelings into human emotions. Therefore true Religion, Philosophy, Natural Science, Fine Arts and Industrial Productions are all alike resolvable into the harmonious action between the Divine and human will.

Perhaps it will be said that science deals only with secondary causes. It may be so; but "to stop short at second causes is to stop short of knowledge, because it is a fact in science that a universal mind is the cause of all inferior phenomena, and is therefore to be taken into our views of science as much as the general law of gravitation, which includes many phenomena, and is itself included by this law." But clearly, if the cultivation of the beautiful be the union of the true and the good, then if the chief good be excluded or ignored, it follows that there cannot be the highest development of the beautiful.

Illustrating the present position of natural science and industrial productions, Dr. Lion Playfair recently stated at Birmingham—"The amazing changes which have taken place since 1838 are due to our better conceptions of forces, and their mutual relations and conversions. Formerly light, heat, electricity, magnetism, and chemical affinities were thought to be separate and independent existences, not even related to one another. (Here I would remark parenthetically that the celebrated work of our countryman, well known in this place—Mr. Grove—'On the Correlation of Physical Forces,' was one of the pioneers in the discovery of this great fact.) Now we know that physical forces are all convertible and interchangeable. This knowledge has already given great stimulus to their application, and will do so more in the future. Further, we know that the primary source of nearly all the force on this earth is the sun above us. Steam-engines are worked by solar force stowed up in coal—the residue of extinct plants that grew by the agency of sunbeams—trapping them and stowing them up for our use. The gas in the streets is this old trapped sun-light, of some millions of years since, let loose to illumine our darkness. Our water-wheels are turned by the sun, which licks up water by his heat—transports it to the clouds, and lets it loose as rain upon the mountains, whence by its descent it turns the mills and grinds the corn. And recollect, all this is effected by a mere pencil of light reaching the earth, only about the two-millionth part of the solar energy rayed from the sun."

"I have referred to the nature of force, because I wish you to understand, that in all you do by new inventions or by the application of old ones, you cannot turn natural forces, or the properties of bodies derived from their action, a single hair's breadth out of their course. You can neither create forces nor endow anything with properties. All you can do is to convert and combine them into utilities. If you can do this with knowledge you are saved the dismal failure of ignorance; but if you try to use powers for your own purpose, without understanding them, the inevitable operation of law is shown in the punishment of your presumption. Nature is wonderfully bountiful to the wise, but she has no bowels of compassion for the ignorant. Break one of her laws wilfully and ignorantly, and the punishment is swift and sure."

Now, these luminous observations of Dr. Lyon Payfair, on the present state of natural science and industrial manufacture, show us that there is a two-fold object impressed on Nature's laws, which are clearly designed both to benefit man and to educate him also ; and we further see that there is the same system of probation and discipline, involving rewards and punishments, in the material as in the moral universe, in order simply to bring the human will into harmonious action with the Divine will.

We see, moreover, that the infinitesimal quantity, the two-millionth part only of the light of our sun reaches this earth, whilst probably there are two million other fixed stars in the universe emitting as much light as our sun. This small ray of light, then, which visits us, not as it is seen by our physical eye, but as it is seen by the eye of our minds, is the fountain of force on the surface of this globe. Does not this fact suggest to us a higher source of human power? That which constitutes the motive force of all human progress, involving in that term not merely the relations of matter and force, but the relations of intellectual and moral beings themselves, in all the details, which we designate Religion, Philosophy, Ethics, Natural Science, Fine Arts, Manufactures, Agriculture, all that go to make up the sum total of true civilization, to beings who at best "see but as through a glass, darkly," is simply more light, the correlation of those forces, which are involved in the affinity and interchangeability of material, mental and spiritual light.

Well might one of the most profound of modern philosophers suggest "That instead of the temple of science having been reared, it were more proper to say the temple of Nature had been evolved. The archetype of Science is the universe, and it is in the disclosure of its successive parts that Science advances from step to step, not properly raising any new architecture of its own, but rather unveiling by degrees an architecture as old as creation." The labourers on Philosophy (or Natural Science) create nothing, but only bring out into exhibition that which was before created. And there is a resulting harmony in their labours, however widely apart they may have been working, not because they have adjusted one part to another, but because the adjustment has been already made to their hands. There comes forth, it is true, of their labours a most magnificent harmony, yet not a harmony which they have made, but a pre-existing harmony, which they have only made visible; so that, when tempted to idolize Philosophy, let us transfer the homage to Him, who both formed the philosopher's mind and furnished his philosophy with all its materials.

To stop short at second causes, therefore, is not only to stop short of knowledge, but to do that in Modern Science which the Pagans of old did with the Fine Arts, to worship the pottery of nature and to ignore the Potter, thereby frustrating the great design of the material, mental and moral creation, which is to have the Creator enthroned in the mind of man, as the object of its homage and veneration, and the source of its existence, its sustenance, and its happiness.

We have already said that the world without man is in beautiful adaptation to the world within him. The use of the term beautiful in this very place illustrates that construction of language which we have been attempting to describe. There may be beauty of form, and beauty of colour, and beauty of sound, and there may be also beauty of expression and beauty of adaptation.

One of the most original and yet one of the most abused authorities of the present century on the Fine Arts, John Ruskin, tells us "that Beauty has been appointed by the Deity to be one of the elements by which the human soul is continually sustained; it is, therefore, to be sustained more or less in all natural objects, but in order that we may not satiate ourselves with it, and weary of it, it is rarely granted to us in its utmost degrees. When we see it in its utmost degrees we are attracted to it strongly and remember it long, as in the case of singularly beautiful scenery or a beautiful countenance. On the other hand absolute ugliness is admitted as rarely as perfect beauty; but degrees of it are more or less associated with whatever has the nature of death and sin, just as beauty is associated with whatever has the nature of virtue and life. (*Architecture and Paintings*, page 26.)

We see here the recognition of the great principle that the beautiful is in all things the natural expression of the true and good. Not only is this wonderful habitation, of which man is the tenant, provided with all the requirements of his physical, intellectual, and moral nature furnishing him with all the materials for food, raiment, shelter, and social surroundings, exercising his mind, muscles, and feelings, anticipating all his wants, whilst in motion or at rest, sleeping or waking, in sickness or in health, in prosperity or in adversity, so long as life shall last, but there is one class of Nature's productions which seem to be more especially set apart for man's enjoyment of the beautiful. These are flowers, which are Nature's Fine Arts, and her own delicate objects of Painting and Sculpture. Whether we look at the beautiful colouring in the flowers, which are scattered over the surface of the earth, or at the exquisite tinting of the clouds, the rainbow and the setting sun in the skies, we must ask with the Poet—

"Who can paint
Like Nature? Can imagination boast
Amidst his gay creation, hues like these?
And can he mix them with that matchless skill,
And lay them on so delicately fine,
And lose them in each other?"

And who is Nature's Painter? Why the same brawny Vulcan that drives our locomotives, turns our waterwheels, makes our gas, and lights our fires. The great Industrial Workman, who can always tell us that—

"I blow the bellows, I forge the steel
In all the shops of trade;
I hammer the ore, and turn the wheel
Where my arms of strength are made.
I manage the furnace, the mill, and the mint,
I carry, I spin, I weave;
And all my doings I put into print
On every Saturday eve."

And who is he? The same little ray of light which visits us from a distance of 92 millions of miles; and is only the two-millionth part of its fellow-forces which leave the sun, and is the great fountain of physical power, of colour, and of beauty on the surface of this earth. It is he who paints the flowers and tinges the clouds, as well as drives the locomotives and turns the water-wheels. Who will say, then, there is not a very near blood relationship existing between the Fine Arts, Natural Science, and Industrial Productions?

We have here an illustration of another of the great principles which pervade the Divine Works in Nature. The same agent is made to serve some great end compatibly with ten thousand lesser and remoter interests which are served at the same time.

In reference to heat, which is the constant companion of light, and which has been included with it in our previous observations, as energies of the sun, our greatest scientific authority says: "In these days unhappily the news of battle is familiar to us, but every shock and every change is an application or misapplication of the mechanical forces of the sun. He blows the trumpet, he urges the projectile, he bursts the bómb; and remember, this is not poetry, but rigid mechanical truth. He rears the whole vegetable world, and through it the animal world The lilies of the field are his workmanship, the verdure of the meadows, and the cattle upon a thousand hills. He forms the muscle, urges the blood, and builds the brain. His fleetness is in the lion's foot, he springs in the panther, he soars in the eagle, and he slides in the snake. He builds the forest and he hews it down—the power which raised the tree and wields the axe being one and the same. The clover sprouts and blossoms, and the scythe of the mower swings by the operation of the same force. The sun digs the ores from our mines, he rolls the iron, and rivets the plates ; he boils the water, and draws the train. He not only grows the cotton, but he spins the fibre and weaves the web. There is not a hammer raised, a wheel turned, nor a shuttle thrown, that is not raised and turned and thrown by the sun. This energy is poured freely into space, but our world is a halting-place, where this energy is conditioned. Here the Proteus works his spells, the self-same essence takes a million shapes and hues, and primarily dissolves into its primitive, and almost formless form. The sun comes to us as heat, he quits us as heat, and between his entrance and his exit the multiform powers of our globe appear. They are all special forms of solar power, the moulds into which his strength is temporarily poured in passing from its source through infinitude."

In the midst of all this manifestation of physical force, Nature is full of painting, and poetry, and music. Not only does "day unto day utter speech, and night unto night show knowledge," but every part of the earth's surface is full of interest and enjoyment to the observant mind. The poet tells us

"The wise
Read Nature like the manuscript of heaven,
And calls the flowers its poetry. Go out
Ye spirits of habitual unrest,
And read it when 'the fever of the world'
Hath made your hearts impatient ; and if life
Hath yet one spring imprisoned, it will be
Like a beguiling music to its flow."

Let us adopt the poet's advice, and picture to our imagination a fine landscape before us, and let us place before our minds all the sights and sounds of those hours and seasons which most delight us. Let a person consider his own feelings. He beholds, for instance, the sky coloured with the decline of evening, and the blue, which has been so unmixed all day, deepen upon the horizon into the transparent, tender, and glorious hues of the setting sun. He sees the mists rise slowly, and float over the waters, and a freshness comes over the whole air of the heavens, redolent of woods and flowers. There is no need for him to go farther for pleasure. There is already touched a chord in his heart which wants no impulse to make it vibrate.

The effect of scenery upon the mind of the spectator is similar to that which a few flowers had upon Mrs. Hemans in her sick bed. "Often during this weary illness of mine," she wrote to her friend, "have I looked upon new books with perfect apathy, when, if a friend has sent me a few flowers, my heart leaped up to their dreamy hues and odours, with a sudden sense of renovated childhood, which seems to me one of the mysteries of our being." Now, the artist may transfer all these scenes to canvas, but he cannot transfer all the emotions that went with them. Still,

"A thing of beauty is a joy for ever,"

whether it be found on canvas or in Nature, in a piece of poetry, of painting, or of sculpture. Now, all true art is the embodiment both of thought and emotion. "Noble art is nothing less than the expression of a great soul (says Ruskin), and great souls are not common things." Here is one of the distinctions between the fine arts and industrial productions—the works of industry are common things, but great souls cannot be manufactured to order by machinery, and their work cannot be taught to everybody like carpentering and joining, spinning and weaving, or tailoring and shoemaking. Therefore works of art fetch a high price, because nobody else can do the same work but the artist who did it. Hence the poet only requires the help of his pen, the painter of his brush, and the sculptor of his chisel; whilst the industrial workman has ten thousand helpers in machinery to assist him in his operations. Hence the rarity of the one kind of work and the abundance of the other.

We have already said that Nature is equally interesting to the thoughtful mind, whether looked at collectively or in detail—whether we contemplate the beauty of a landscape, of a single flower, or of a tree. Trees are the grandest productions of the vegetable kingdom, and are full of interesting associations to man. To estimate their worth we must imagine what the world would be without them. We can scarcely picture to our imagination the effect of a treeless world. Our houses, our ships, our furniture, our carriages, our machinery, and our agricultural implements all owe their existence to that of trees. Without their aid the arts and sciences could not have progressed, nor could the world scarcely have been civilized. From the very earliest times both music and language have been poetically ascribed to trees. One of the Hebrew prophets calleth upon "all the trees of the forest to sing," and a modern poet beautifully asks—

"What are the green trees saying?
  In the forest's cloistral aisles,
Those glorious branches swaying
  'Neath summer's golden smiles?
Those voluntaries rolling
  At morn and twilight dim?
What means the solemn music,
  Is it prayer or vesper hymn?
What are the green trees saying?
  To such harmonious sounds
  I feel there must be words;
O have the trees their language
  Like the joyous-hearted birds?"

Here we have the true poetic spirit, looking on Nature, the same vivid imagination which is the laboratory of art, and out of which may be compounded "Sermons in stones, books in the running brooks, and good in everything."

The Lecturer then showed how mathematical laws underlie all the operations of Nature, and illustrate the truth of Plato's opinion that "The Creator geometrises continually," and all modern investigators of Nature still record

Plato's answer from her "that none can enter her temple who are ignorant of Geometry."

If Mathematical Science be the key which unlocks the Temple of Nature, then no man can either purchase or pick up that key ready made. He must forge it with his own hands, and file it to the lock himself. You cannot pour the contents of one mind into another like water is poured from one vessel into another. Wealth does sometimes relieve a man from the necessity of gaining his bread by the sweat of his brow, but neither wealth nor birth can relieve him from gaining his knowledge by the sweat of his brain. In the same manner as muscular exercise re-acts upon the health of the body, so does mental exercise re-act upon the health of the mind. All the works of man's hands, whether they be Fine Arts or Industrial productions, are but the embodiment in matter of the architypal ideas which existed in his own mind. In this respect the plans of the Architect and the Engineer are but feeble imitations of the plan of the Divine Architect in building up creation, with this great difference : the Divine plan and its execution were perfected at once. "Let there be light and there was light." But to the limited mind of the human architect, the embodiment of his ideas in a material form re-acts like the knowledge of language and of mathematics upon the improvement of his own mind and of his own plans at the same time.

The old University founders of Oxford and Cambridge were "wise in their generation," when they made classical and mathematical studies the corner stones upon which the superstructure of human knowledge should rest. Whether their successors allowed these stones to remain too long on the foundation without building up the structure may be another question.

It is however certain that the study of language generally develops the powers of expression, and gives an expansion to thought, whilst the study of mathematics promotes a concentration of attention, a power of abstraction, and gives a rigid connection to consecutive thought absolutely essential to the pursuit of truth.

These studies then discipline and drill the faculties of the mind and unfold both human thought and the laws of nature at the same time.

Those principles were then applied by the Lecturer to several departments of Natural Science and Industrial Productions, illustrating the action and re-action continually going on between the human mind and external nature, and showing the reciprocal and beautiful relations existing between mind and matter. We may naturally expect all Science to have like that "unruly member" the tongue, its material and its mental relations, and we accordingly find that Science has its phenomenal facts and its general laws, or as the logicians may term it, the concrete and the abstract states. Therefore, those branches of Science which have not a geometrical basis, must sooner or later have a logical basis before they can be admitted into the full dignity of a Science. There can be no doubt that the mathematics themselves ultimately rest upon a logical foundation. If, for our present purposes, we define Logic to be the relations of thought, Grammar the relations of words, Arithmetic the relations of numbers, and Geometry the relations of space, then we shall find that these Sciences have all come down to us, a precious legacy, through the changing scenes of twenty centuries, from the ancient Greeks.

After tracing the differences between ancient and modern Art and Science, and showing the imperfections in existing classifications of the Sciences, the lecturer stated that the old belief in the transmigration of souls was not half so wonderful as the transmutation of matter, constantly going on, into and out of its solid, liquid, and gaseous forms. Not a particle of matter is created or annihilated. Hence the whole province of Natural Science and Industrial Productions lies in this narrow compass, "to note the changes of matter, and to ring those changes again."

He then alluded to the mysterious influence exercised over matter by the presence of life in the building up of structure and the discharge of functions, for the preservation of the individual and the perpetuation of the species. When life ceases, functions cease, and structure falls back to dead matter, and is again controlled by its laws. Professor Huxley, at a recent meeting of the British Association, somewhat reluctantly admitted that there is no evidence that dead matter ever originated life.

Hitherto we have only glanced at the relations which man sustains to things in space. He also sustains relations to things in time, and to things in eternity, and the sum total of human knowledge may be included under the three heads of Philosophy, Theology, and History, with their subordinate branches.

Now, as a concluding question, we ask for what purpose was man endowed with this capacity of mentally digesting the external world? The deepest thinkers of all ages have arrived at nearly the same conclusion, that he might assimilate the good, the true, and the beautiful, in order that he might live in harmony with the relations he sustains to God and Nature. Does the boasted civilization of this age come up to that standard? Natural science has given England mechanical powers and appliances of force equal, nominally, to the united muscular labour of all the adult males in the world. Is this immense auxiliary power giving her people more time and inclination to assimilate the good, the true, and the beautiful, and to become men in the highest sense of the word?

When we look at our sanitary and social condition, instead of being vain of our knowledge, we should be humbled that mankind have so long been living on the surface of the earth, and yet know so little practically of their relations to the world in which they are living. Men still think of living as they did in Lord Bacon's day, as if there were in knowledge a couch whereupon to rest a searching and restless spirit; or a terrace for a wandering and variable mind to walk up and down with a prospect; or a tower of state for a proud mind to raise itself upon; or a fort or commanding ground for strife and contention; or a shop for profit and sale; and not a rich storehouse for the glory of the Creator and the good of man's estate. (The Lecturer sat down amidst applause.)

The ordinary monthly meeting of this society was held in the Grand Jury Room, at the Town Hall, on Tuesday, the 6th of December, at 8 p.m.; Mr. Wm. Adams, F.G.S., president, in the chair. We also observed Dr. Taylor and Mr. Franklen G. Evans, M.R.C.S., F.M.S., &c., vice-presidents, Captain Bedford, R.N., Messrs. John Morgan, Edward Payne, Tomlinson, Gooch, Bradley, hon. secretary, &c., &c. The usual routine business was transacted. After this, John Boyle, Esq., and G. W. Nicholl, Esq., of the Ham, Mayor of Cowbridge, and Mr. Reynolds of Neath Abbey, were proposed as new members. W. H. Nicholl, Esq., also of the Ham, was proposed by Mr. Adams and seconded by Mr. Franklen G. Evans as an Honorary Member, in complimentary recognition of the valuable collection of Silurian fossils presented by him to the society. This will not preclude Mr. W. H. Nicholl's joining the society as an ordinary member if so disposed. All these gentlemen will be elected at the next ordinary meeting. Mr. Franklen Evans then moved the adoption of several alterations and additions to the rules, for the better government of the society, which were all carried. The only change of public interest was the annual subscription to the club. The fee hitherto has been 5s. for simple membership, and the volume of transactions for the past year has been charged for extra. Mr. Evans very justly urged that it was most unnecessary to collect so small a sum in two payments, and advocated a single charge for membership and "transactions." He was not wedded to any particular figure, but seeing that the excellent volume now issued, including the map of the district, with rain gauges, &c., marked, and the valuable plates contained in it, actually cost the society 2s. 6d. a copy, he thought the subscription should be 7s. 6d., to *include* the annual volume. It is desired before all things to make the society popular and an instrument of scientific education, so a low fee for membership was fixed upon. It was therefore with great reluctance that even an *apparent* increase in the cost should be adopted. No society can possibly be carried on at a loss, and it was felt that no member worthy of the name could object to pay the prime cost of the yearly publication. The resolution was accordingly adopted. The next business was the following paper, by Mr. W. Vivian, which had been prepared for the Field Meeting in July, was read on

The Mwyndy Mines.

The working of these mines was undoubtedly of ancient date. The name "Mwyndy" is a compound word, and is made up of "mwyn" which means in the Welsh language, I believe, ore or mineral, and "dy," a mutation of "ty," which means house; so that we have the name mineral-house remaining, when it was only known as a farm place, and long after the knowledge of its connection with mines was lost. Besides the evidences of ancient mining which have been seen about, it seems also that iron was smelted here a long time ago by the use of charcoal only. Considerable beds of slag and cinder have been seen about and even below the loam soil of the garden which now surrounds the house. Smiles, in his "Industrial Biography," tells us that in Glamorganshire, as well as in parts of England, before iron was made by mineral coal as fuel, the people got to be alarmed at the rapid destruction of the woods in iron making, and about 200 years ago they succeeded in getting an Act of Parliament to prohibit the further manufacture of iron with charcoal, fearing that there would not be fuel enough left for domestic purposes. All this is rather amusing to us who live in this age and place of coal and iron, sending as we do our fuel by millions of tons to distant nations, and crying out in sorrow, if not in anger, because they do not take more of us. It shows also how wonderfully the resources of Nature—the bounties of Providence—are successively developed to meet the wants of man. The ore found here is a brown hematite, of an average yield of metal, in bulk, of about 50 per cent., and exists geologically in the carboniferous or mountain limestone, just at the points where the limestone dips down northwards below the southern edge of the great coal basin; the shales in which the coal beds mainly lie commencing here, and extending back to the hills, north and west. The ore is not stratified in a bed like coals, nor is it found in a regular vein like metallic ores, but it lies in irregular masses in the limestone, as if the cavities in the limestone had been afterwards filled with the ore. I am informed by those who were more early acquainted with it, that mining recommenced here in May, 1855, fifteen years ago. I have not been able to obtain accounts of the yield of ore obtained by the late proprietor, Mr. Vaughan, and his immediate successors; but the Mwyndy Company, as at present constituted, have raised, since the year 1861, 422,000 tons, irrespective of its immediate neighbour, the Bute hematite mine, on the west; and the Mwyndy alone has probably yielded since 1855 not less than half a million tons of ore. As to the future of the mine, I can only say it will probably continue to be worked for a long time to come. At first, near the surface, the ore conformed to the dip of the limestone—that is, a dip of about 35° from the horizontal, northwards, and was worked by open cuttings, as may be seen; but latterly it has fallen more or less vertically into the limestone, and is now worked by underground mining. The vertical depth of the mine is 47 fathoms. Some of the ore is very hard, and requires blasting with powder or gun-cotton; while other parts are soft enough to be worked by the pick. In winter the water is very abundant. After heavy rains we have to pump not less than 2,300 gallons per minute. The ore is brought to the surface by vertical shafts and inclined planes, and is taken by the broad and narrow gauge system of railway direct from the mines to the iron works.

The paper was read, at the President's request, by Mr. Franklen G. Evans; and after it was concluded, a vote of thanks to Mr. Vivian was proposed by Dr. Taylor, and carried unanimously.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

DECEMBER.

The weather of the past month was of a very pronounced and decisive character, and elicited equally strong opinions from those who were subjected to its influence. Decision of opinion, however, was the only point on which people were agreed, and views differed widely as to the opinion itself according to the temperament of the individual. Some were delighted with what they mildly termed the bracing air, and their eulogy reached its climax in the expression, "a good old-fashioned winter." Others—a majority, I fear—shivered at the bare idea, and could hardly find words to express their horror of a degree of cold that penetrated everywhere, and could not be excluded even from the fire-side. The month commenced with frost. This was followed by an interval of rain and milder temperature. This again yielded to the renewed sway of an iron frost, and the festive season of Christmas had an appropriate accompaniment of thick ice, and pure white mantle of snow. The last feature is a peculiarly favourable one for the interests of agriculture. From its remarkable non-conducting property, snow furnishes the very best protection—a top-coat in fact—to cereal plants, grasses, and vegetables in general. When the temperature of the air is twenty or more degrees below the freezing point, all vegetable growths under this genial covering enjoy a climate of comparative warmth, and emerge from their retreat looking bright and green. This explains why some farmers are disposed to regard it as a manure. Of course it does not really contain anything more than the same quantity of rain, but it furnishes the necessary shelter from cold, which is quite as important as food.

The barometer was unsteady, and fluctuated from a very high to a low point, through limits exceeding an inch and a half. The maximum hight, 30·67, occurred on the 2nd, and the minimum, 28·99, on the 14th, giving a range of 1·68. The instrument stood below 30 inches on 17 days.

The temperature of December was very low, and much less than the average. The highest reading of the day thermometer was 56° on the 13th, and the lowest night record 9° on the 31st, showing the large total range of 47 degrees. The greatest daily range was 21° on the 5th, the least variation 2° on the 21st, and the mean daily range 11·6°. The mean of the maximum temperatures amounted to 40·1°, and of the minimum to 28·5°. The mean heat of the whole month was only 34·3°. This is 6·8° less than my own average, and 5·5° below the Greenwich mean temperature of the last fifty years. The 31st was the coldest day of the month, the minimum thermometer registering 23° of frost, and the mean temperature only 18°. This is four-tenths colder than the coldest day in December during the past half-century. It is interesting to compare an exceptionally cold month with a corresponding one of a directly opposite character. This December furnishes just such a contrast with that of 1868. The figures were 34·3° and 46·2° respectively, which show a difference of 11·9° in the mean temperature; an amount seldom equalled. There was frost on 21 occasions.

The general direction of the wind was more or less westerly on 8 days, and easterly on 22 occasions. Southerly and northerly currents were combined in the proportion of 9 to 20. These figures give a large predominance of easterly and northerly winds. The force sometimes reached eight, but we escaped the greater violence that visited portions of the English coast.

The quantity of moisture in the air was less than the average of the season. The mean degree of humidity was 82, complete saturation being represented by 100.

The rainfall of December was again deficient, and increased the already large arrears due upon the year. The total amounted to 3·44 inches, which is equal to 347 tons, or upwards of 1,420 hogsheads to an acre. This is less than the average fall by 3·04 inches, which raises the deficit upon the year. Rain fell on 12 days, and snow to a slight depth.

Ozone was most scantily developed, owing to the prevalence of north and easterly winds. It was entirely absent on 20 days. Antozone was sometimes noted. The mean degree of ozone was 1·936.

The eclipse of the sun on the 22nd was pretty well seen here. A description of it hardly falls within the scope of this report, notwithstanding its general interest.

The principal diseases of December were pneumonia, bronchitis, sore throats, measles, typhoid and scarlet fevers, and a tendency to croup. Rheumatism was prevalent in all its forms, and some cases of jaundice, and erysipelas occurred. Such cold weather always conduces to disease, and often proves fatal to the very young and old, and feeble constitutions.

The annual meeting of this Society was held at the Town Hall on Tuesday, January 28th, 1871, and was a complete success. The chair was taken by Mr. Franklen G. Evans, M.R.C.S., F.M.S., &c., Vice-President. Amongst those present we observed Captain Bedford, R.N.; Messrs. John Morgan, Waldron, G. C. Thompson, Edward Payne, Tomlinson, Peter Price, Harrison, Wrenn, Boulanger, Gooch, Scott, Stow, Joy, Williams, D. W. Jones, C. Bradley, hon. secretary, R. W. Boyle, &c. The minutes of the last meeting having been read,

The Chairman, in complimentary terms, proposed the re-election of Mr. William Adams, F.G.S., as President, which was carried with acclamation.

Mr. John Morgan moved the re-appointment of the Vice-Presidents, Dr. Taylor and Mr. Franklen G. Evans; and a vote of thanks to all three officers for their services during the past year.

The Committee was the same as the previous one, with a few alterations. John Boyle, G. W. Nicholl (The Ham), and — Reynolds, Esqrs., were balloted for as members; and W. H. Nicholl, Esq. (The Ham), was elected an hon. member.

The Chairman proposed T. W. Booker, Esq., Velindra; Charles T. Vachell, Esq., M.B., Cardiff; and Ll. Llewellyn, Esq., for election at the next meeting. The Secretary then read the annual report and financial statement.

The alterations in the Rules passed at the previous meeting were confirmed, and the Chairman proposed an addition to the Rule defining the objects of the Society, in order to embrace subjects of interest not strictly belonging to Natural History. This was done to include churches, antiquities, &c., for although the Society does not profess Archæology, it does to some extent practise it. Mr. Evans thought the publication of an annual volume of transactions furnished a desirable opportunity for describing and photographing any ancient remains in the Counties of Glamorgan and Monmouth. The Hon. Secretary then requested Mr. Franklen G. Evans to read his

METEOROLOGICAL REPORT, 1870.

Mr. Evans, who was received with much applause upon rising, said,—Gentlemen—The perpetual recurrence of Spring and Summer, cold and heat, seed time and harvest, Autumn and Winter, in a never-ending, always-changing cycle of Seasons, brings us once more to the conclusion of another year, and it is my duty and privilege to lay before you, to the best of my ability, a retrospect of the Meteorology of the past twelvemonths. Having paid our last tribute of respect and regret to the departed year, and before we are too much engrossed with the interests of the present one, we may derive pleasure and profit from gathering up the fragments of twelve monthly reports, and endeavouring to reconstruct them into a complete and harmonious whole. Remembering the adage that we should say "Nothing unless good of the dead," we will do this in a kindly spirit, and deal as gently as possible with the faults and shortcomings at which it is the privilege of Englishmen to grumble. In my last annual report I referred to the general features of my neighbourhood, the instruments employed, the mode of mounting, height above sea level, and special surroundings. All these points you will find duly set forth in our "Transactions for 1869," of which I may say that—although not protected from criticism by the sanctity of death, for it is in a high state of vitality—it is a volume of which I hear "Nothing but good." The following is a condensed summary of facts and figures for 1870:

ANALYSIS AND SUMMARY OF THE METEOROLOGY OF 1870.

WIND-DIRECTION, BAROMETER, RAINFALL, &c. OZONE AND TEMPERATURES.

1870.	More or less Westerly, Days.	More or less Easterly, Days.	Combined with Southerly, Days.	Combined with Northerly, Days.	0·01 in. or more of Rain fell, Days.	Barometer below 30 inches, Days.	Mean degree of humidity, Days.	Rainfall, total inches.	Maximum fall in 24 hours.	Mean degree of ozone.	Maximum temperature	Minimum temperature.	Total range.	Greatest daily range.	Least daily range.	Mean daily range.	Mean of Maximum temperatures.	Mean of Minimum temperatures.	Mean temperature of the whole month.	Difference from average of 50 years.
January	15	15	11	17	17	15	89	4·00	0·88	3·645	53	21	32	19	2	10·8	44·2	33·4	38·8	+ 1·9
February	10	17	10	15	17	16	81	3·09	1·55	4·643	56	21	35	22	2	11·0	42·8	31·8	37·3	— 1·4
March	10	21	5	25	10	11	78	2·88	0·88	3·581	56	23	33	26	4	14·5	49·1	34·7	41·9	+ 0·3
April	14	14	11	14	6	4	70	0·28	0·11	4·067	74	30	44	40	12	24·2	62·0	37·7	49·8	+ 3·6
May...	17	13	12	15	9	9	75	3·01	1·57	5·613	78	28	50	35	12	23·0	65·3	42·3	53·8	+ 0·9
June	20	9	3	27	8	3	69	0·79	0·46	4·800	84	41	43	37	11	21·7	71·6	50·0	60·8	+ 1·7
July	21	9	10	18	11	6	71	3·69	1·29	4·935	90	44	46	34	9	21·1	75·1	54·0	64·5	+ 2·7
August	11	17	10	21	7	6	66	2·59	1·09	4·290	84	39	45	31	14	22·6	73·6	51·0	62·3	+ 1·1
September	15	14	11	13	13	8	74	3·22	0·57	4·233	71	40	31	31	10	19·9	66·7	46·7	56·7	+ 0·1
October	19	12	14	16	23	20	85	8·53	1·24	4·000	68	30	38	26	7	15·8	58·8	43·0	50·9	+ 0·7
November	15	15	14	14	16	17	88	5·02	1·13	2·000	55	27	28	23	3	14·4	49·2	34·8	42·0	— 1·1
December	8	22	9	20	12	17	82	3·44	0·82	1·936	56	9	47	21	2	11·6	40·1	28·5	34·3	— 5·5
Totals, Means, &c.	175	178	120	215	149	132	77	40·54	11·59	3·979	90	9	81	40	2	17·5	58·2	40·6	49·4	+ 0·4

This table has been compiled in a similar manner for some years past, which gives great facility for comparison of the various elements. In the first two columns, winds are divided into two principal directions—westerly and easterly. The third and fourth give the proportion in which southerly and northerly currents were combined with the two chief quarters. Some meteorologists give the first place to polar and equatorial winds, and to treat the others as subordinate. I adopt the other course for these reasons. In common parlance the terms westerly and easterly are always used in a chief sense, and northerly and southerly in a secondary one. Thus we say north-east and south-west, not the reverse. So much for custom. Then as a matter of fact, the air moves in mass, as indicated by cyclones, from west to east, and much more rarely from east to west, which harmonizes with our ordinary expressions. By this I mean that in our latitudes storms usually come to us from the Atlantic, and reach our shores at a definite rate of progression, without reference to the force of the wind. Nevertheless, apart from the question of the mode of expression and storms, polar and equatorial winds are highly important elements, and always receive their due share of prominence. The poles of the cardinal points, estimated by their influence as factors in regulating the weather, would be the north-east and south-west. The figures in these four columns show a very large preponderance of easterly and northerly winds. The usual proportion of easterly winds is rather more than one day in three, but in the past year they were absolutely in excess in the ratio of 178 to 175. This far exceeds any previous record of mine. North winds also had an extensive prevalence, and a combination of these two kindred powers furnished the key-note of the meteorology of the year. There is generally a rough numerical relation between westerly winds, and the number of days on which 0·01in. or more of rain fell, but this year the associated northern currents diminished the proportion of wet days.

The maximum height of the barometer, 30·67, occurred on December 2nd, and the minimum, 28·93, on October 23rd, giving a total range of 1·74 inch. The instrument stood below 30 inches on 132 days. This almost exactly corresponds with the figure of the previous year, and both are lower than the average, which is 153 days, thus showing a very high barometer.

The year 1870 was remarkable for a scarcity of rain—a most necessary, but hardly appreciated meteorological feature. The spring and summer months were especially dry. The total fall registered amounted to 40·54 inches. This is equal to 4,094 tons, or upwards of 16,930 hogsheads to an acre. The average of the previous four years was 52·05 inches; thus showing a mean deficiency of 11·51 inches. All the records that have been sent in indicate a similar deficit, varying from 7·5 inches to 12 inches. The departed year, therefore, died in debt; but we may rest assured that provision has been made in its last will and testament for payment in full, and no pluvial creditor need fear the loss of his claim upon the resources of nature in the future. The sum of the maximum falls in 24 hours usually exceeds a fifth of the grand total, but last year it was more than one-fourth, showing that heavy rain storms maintained about their general average, notwithstanding the diminished quantity in the aggregate. The rainfall at Tynant always surpasses that of Cardiff and the neighbouring lowlands by about ten inches, and sometimes more; and this also occurred on the present occasion. This brings me to consider the rainfall over our whole field, which differs greatly in different parts of it. A glance at the returns of the various observers will reveal at once an increase, speaking roughly, in proportion to elevation; and where this is departed from I feel sure that local peculiarities will account for it. A few words of explanation of the manner in which rain is produced will make this clear. I will begin with an apparent paradox. A rain gauge elevated on the top of a high pole receives less than one on the ground, whereas one placed on a mountain-mass registers much more than that on the level. Those who remember the results of Mr. Glaisher's balloon ascents will see their way to an answer wholly or in part. Rain drops are not formed all at once as we see them when they strike the earth. They begin as fine drizzle, and steadily augment as they fall, and their maximum increase takes place very near the ground. So much is this the case that a gauge on the summit of a pole 100 feet high will receive only half the quantity caught by another at the base. A massive hill, on the contrary, not only gets as much as flat ground, but considerably more, by virtue of the attraction due to its elevation. Trees, also, have a powerful influence in attracting rain; hence the desirability of information being given on this point by rainfall observers. It was long since noticed by the celebrated aeronaut, Green, that when rain occurred there were always two layers of cloud, one above another, some distance apart, and this observation was fully confirmed by Mr. Glaisher. It is more than probable that these two strata of clouds are in opposite electrical states, and by their mutual action constitute the first link in the chain of rain-causation. The small drops formed increase in descent by aggregation, and, when near the earth, it is probable that that body exerts some electric action and completes the process. The trees and hill-tops act as so many advanced outposts of the electric forces, and intensify the result. The quantity of rain, then, depends upon the configuration of a country, proximity to the sea, and, perhaps, the direction of the valleys, &c. Again, the amount received by different parts of it will be influenced by mountains and woods. Applying these views to our own field, we should find an increase, speaking roughly, with elevation. A bare mountain-top should give less than a wooded one. Hills, too, though high, will lose if commanded by higher summits, and particularly if some of them intervene between them and the rain-bearing winds. The wettest place in our district is Treherbert, which surpasses the few stations we have upon higher ground. The local bearings of these places would probably explain the departure from the general rule. It would be satisfactory if the gentlemen who kindly take charge of the gauges would note these points, and let us know precisely the nature of their surroundings. This would add to the interest and value of the observations recorded.

The mean degree of humidity was 77, complete saturation being represented by 100.

The development of ozone was much below the average of the year, and remarkably so during the last two months of it. The maximum occurred in May, and the minimum in December. The principle is most abundant with strong moist S.W. winds, and least so in cold N.E. ones; hence the small manifestations in 1870, with its N.E. winds and dry air.

The temperature of 1870 was slightly above the annual mean, and the excess exhibited in every month but February, November, and December. The maximum reading of the day thermometer in the shade reached 90° on July 24th, and the lowest night record 9° on December 31st, giving the very high range of 81 degrees. This is 13 degrees more than the limit of deviation in the two previous years. The maximum and minimum temperatures referred to are the highest and lowest respectively that I have recorded, hence the extreme range. The mean daily range was 17·5°. The mean heat of the whole year was 49·4°, which is 1·6° less than my average, and 0·4° above the mean temperature of 50 years as determined by Mr. Glaisher. This is without correction—a knotty point that was dwelt upon in last report published in the "Transactions."

I have now touched upon the most prominent features in the Meteorology of 1870, which seem to hang well together and to show a mutual dependence upon each other. The prevalence of north-easterly winds caused drought, and kept the temperature of the summer months to near the average point. The barometer exhibited a corresponding elevation. The scarcity of rain harmonised with these conditions, and led to a deficiency in the hay crop almost unexampled. Ozone was unusually scanty for the same reason. In conclusion it only remains for me to wish you all a delightful meteorological year, happiness individually and collectively, and the highest prosperity and usefulness to the Naturalists' Society. (Cheers.)

This was followed by another paper by the same gentleman on

The Aurora Borealis.

The recent occurrence of Aurora Borealis upon several occasions naturally suggests it as an interesting topic to bring before the Society. The principal display took place on the evening of October 24th, and was the most magnificent that has been seen for many years. It is a singular coincidence that the last auroral appearance of equal magnitude occurred on the very same day in 1848—exactly 22 years before. In this locality, on the evening in question, the streamers issued mainly from the north-east and north-west, and converging as they passed upwards, met beyond the zenith and formed a splendid corona, suggestive of the visible, celestial throne of Omnipotence. The colours varied from carmine, crimson, and rose-colour to nearly white; the red tints predominating, and tinging the minds of many beholders with ideas of bloodshed, war, and general calamity. The space contained within the triangle thus formed was occupied by fainter radii of a pale bluish-white colour. The phenomenon commenced at 6 o'clock, and continued until nearly 9, and the maximum intensity was reached at 10 minutes to 8 o'clock. I need not dwell further upon a spectacle which was seen and enjoyed by most people, and has been abundantly described in all the newspapers. I shall therefore pass on to consider the probable causes of these interesting phenomena—that are also known by the names of northern lights and the merry dancers—and briefly indicate the chief points to form a conclusion. The appearances are almost certainly due to currents of electricity in the highest regions of the atmosphere, as will be manifested from the following considerations.

It is a well-ascertained law that currents of electricity excite magnetism, and the magnetic needle is always placed at right angles to their course. The solar rays constantly produce electric currents in an easterly and westerly direction, and cause the needle to point north and south. The force of the magnetism thus excited increases as we approach the pole, and the northern end of the needle dips down as well as points north; so that the instrument, which is horizontal on the equator, is strongly inclined in northerly regions. In southerly latitudes the needle dips south from precisely the same cause. We have therefore, easterly and westerly currents of electricity, and northerly and southern manifestations of magnetism. The same conditions may be produced experimentally. Currents of electricity passed through a horse-shoe shaped piece of steel convert it into a magnet, and strange to say this same magnet has the power of exciting electric currents in iron arranged for the purpose, and this constitutes the principle of the induction coil. We thus prove that electricity and magnetism are convertible into each other, and are really only different developments of one and the same force. We find an analogous case in the mutual convertibility of heat and motion; and these reciprocal relations lead to the belief that the ministering agents of Nature—heat, light, electricity, and motion—all spring from a common origin, and are diverse manifestations of a great, uniform, fundamental principle.

I commenced with a statement of the probability that the production of nothern lights depended upon electrical discharges in the highest regions of the atmosphere, where the air is extremely thin and rarified. Having briefly indicated the source of the electricity, I will now endeavour to point out the significance of the light atmospheric medium in relation to this subject. This will be best explained by referring to an experimental illustration. When glass tubes are exhausted under an air-pump a partial vacuum is formed, and the remaining air in them is expanded to a high degree of tenuity. If electrical currents are now passed through the vessels, a luminous appearance is occasioned that resembles very closely the aurora borealis. The rarified medium in Nature is produced in the following manner. The heat of the tropics causes the air to ascend, and its place is supplied by cold currents from the polar regions. This causes a constant circulation of the atmosphere in two streams—a cold arctic one proceeding nearly southwards, and a hot equatorial one travelling more or less northwards; the latter being light and rarified, and its upper stratum furnishing a suitable medium for the production of the aurora. This equally applies, the names being changed, to the Southern

Hemisphere, which exhibits precisely the same phenomenon and is called aurora australis. This has occasionally been seen in this country, and its northern twin-sister as far south as lat. 45°. They should therefore be spoken of as the Polar Lights, and each distinguished by its proper adjective.

We have now traced the electric currents, and Nature's partial vacuum for their operation, which together may be taken as the cause of Northern Lights. The result is the beautiful spectacle we are considering, that does so much to illuminate the long, dark night of an Arctic winter. It may be hoped that the light fantastic play of the "merry dancers" is some compensation to the inhabitants of those dreary climates for the total absence of the sun for many months. They certainly may claim priority in the use, though not in the invention of the electric light.

These points indicate the general nature of the subject, although the exact steps of the process have not yet been fathomed. There seems to be much reason to regard the earth as a gigantic electro-magnetic machine, which may be more clearly shown by a reference to another experimental illustration. Let a hollow globe be made of paper, and surrounded within by a copper wire, and a magnetic needle placed on the surface. Then connect the wire with the poles of a galvanic battery, and, varying the position of the needle, all the changes of direction and dip will occur just as they do naturally. These facts prove electric currents that convert the earth into a huge magnet, the poles of which correspond nearly, but not quite, with the extremities of its axis ; and this in turn excites electric discharges, somewhat after the manner of the induction coil, in the highest regions of the atmosphere, which produce the aurora. It is very probable that these phenomena, occurring in regular sequence, serve to maintain the electrical equilibrium of the globe. They may do, constantly and calmly, the same service that is performed, fitfully and violently, by the thunderstorm. This is rendered more probable by the fact that thunderstorms do not generally happen in northern regions. Thus the electricity of the equator is felt in the Arctic circle ; pole speaks to pole, the vast fabric of the earth is kept in a state of perpetual intercommunication, and Greenland's icy mountains hold converse with the burning plains of Africa and India.

Thus far I have spoken only of the ordinary electrical conditions produced by heat, and always varying with every change of temperature ; but the most powerful effects are occasioned by the tremendous storms which take place in connexion with sun-spots on the surface of the solar disc. These disturbances are periodical with a maximum intensity about every 11 years, and we are now passing through one of them. Similar effects were observed in 1859, showing the same interval. The aurora of 1848, previously mentioned, must have corresponded with another such period. The greatest annual frequency of Northern Lights occurs in March, September, and October—in fact, the equinoctial periods. It is at such times as these that the earth vibrates with electricity, all the telegraph wires in the kingdom are violently agitated, and the most brilliant displays of aurora are manifested. These visitants to our latitudes should remind us of the arctic winter, which is so difficult for us to realize. We may well regard it as a type of the sunless veil of ignorance that has so long enveloped humanity, and now is only gradually being lifted up; and trust it may be succeeded by the light of an Arctic summer, when the sun of knowledge will never set, but shed his glorious beams upon a wiser and a happier world.

Upon the conclusion of the papers, an interesting discussion took place, in which Messrs. John Morgan, Thompson, Tomlinson, and other members joined. Mr. John Morgan suggested a very interesting calculation to determine the amount of coal that would be required to evaporate all the rain that falls on the earth—the equivalent in fact of the work done by the sun in that respect—and the Chairman hoped that Mr. Morgan would himself undertake the computation, and present the results to a future meeting.

Mr. MORGAN then proposed, and Mr. THOMPSON seconded, that the best thanks of the Society be given to Mr. Evans for the highly interesting papers he had contributed, and the motion was enthusiastically carried.

Mr. EVANS, in acknowledging the vote, said he was very much obliged to the Society for their kind expressions of regard for him upon that as upon all other occasions. He need hardly say that he was at all times ready to do anything in his power to promote the interests of the Society, but he thought it was not desirable to hear too much of one trumpet, even with a change of tune. He congratulated the Club upon the good attendance that evening, and thought it satisfactory that, notwithstanding the length of time since their meetings were suspended, the members did not seem to require an introduction to each other. The Society, though for some time dormant, was not dead, and the lethargy was more apparent than real, for they had merged their identity with that of the Committee of the Exhibition, and had thrown all their energies into the promotion of the success of the Exhibition scheme. If they could accept the doctrine of the Transmigration of Souls, he might say that the soul of the Naturalists' Society occupied for a time the body of the Exhibition Committee, and he felt sure that no one would regret a circumstance which had enabled them to make such a capital raid upon the pockets of the people of Cardiff and the surrounding district. For himself he hoped that another opportunity of disembodiment, or perhaps he should say vicarious embodiment, would occur again shortly with a similar result. Their dormancy had not been that of the dormouse, which consumes in sleep the sustenance stored up in times of activity. It was rather that of the frost-bound earth in winter, which accumulates materials and recuperates its energies for renewed vitality in the coming Spring. That Spring has now arrived for the Naturalists' Society, and it behoved them to show a reason for their existence, and to make fresh efforts for the promotion of the objects they had in view. In this connexion he would derive an illustration from natural history. It was well known that many insects passed through four distinct phases of being—the germ, the larva, pupa, and imago. He (Mr. Evans) was not responsible for the original egg, which had been oviposited by the President and a few other gentlemen, but he could vouch for the excellence of its quality from the vigorous brood that has been hatched from it. The product thus obtained was like many other larvæ, very active and jerky in its movements, and endowed with a voracious appetite which devoured and digested everything it could get. In due course the state of pupa arrived—the exhibition period—during which it withdrew apparently from public life, but really spent its time in spinning a most profitable cocoon. It had now entered upon the state of fully developed imago, and must exhibit the power and strength of the mature condition. Mr. Evans then asked the Society to make greater efforts to carry out their objects. He said the activity of a corporate body was only the sum of the activity of its individual members, and, if he might be permitted for a moment to resolve the meeting into a court of equity, he would file a bill calling upon the different members to show cause why they should not render a larger amount of assistance in the future than they had done in the past. He then, in very humorous terms, which caused much merriment, mentioned the names of several gentlemen who might be of service in the way proposed. We are bound to say that no answer to the bill was filed upon the spot, not, we trust, because it does not admit of a reply, but rather from the necessity of taking legal advice, or, better still, from an intention to quash the bill by writing the papers required. In conclusion, Mr. Evans referred to the constitution of the Society, which, from its connection with the Free Library, differed from all other clubs of the like nature. It consisted of three distinct groups—some who were more or less naturalists, others who desired to become so, and many gentlemen of the town and district who gave it their assistance and support to promote an interest in physical science and natural history. The latter section, although perhaps not taking an active part in the proceedings, had a bond of union with the Society in the annual volume of "Transactions," and testified their interest in the most tangible manner—that of paying their subscriptions. Such members were sometimes tempted to think that they were of no use to the Club, and to desire to withdraw; but to his mind they constituted a very valuable element, and rendered most important services in helping to diffuse an acquaintance, which is every day becoming more necessary, with the vast domain of Nature. (Prolonged applause.)

This concluded the business, and the meeting separated.

No. of Gauge on Map	1. D. M. McCullough, Esq., M.D., Abergavenny.				2. F. J. Mitchell, Esq., Llanfrechfa Grange.				3. Rev. J. Rees Jenkins, Cwmbrân Vicarage.			
Latitude	... ...				... ...				N. 51° 39′ 38″.			
Longitude	... ...				... ...				W. 3° 1″ 35″.			
Diameter of Receiver	5 inches.				5 inches.				5 inches.			
Height above Ground	1 ft. 3 in.				1 ft. 0 in.				1 ft. 0 in.			
Height above Mean Tide Level	220 ft.				360 ft.				350 ft.			
1870.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.	
January	2·96	·42	8th	17	4·07	·98	8th	14	4·45	·77	13th	17
February	4·24	1·32	6th	14	4·27	1·86	6th	11	4·35	1·50	6th	14
March	1·96	·74	1st	7	1·90	·70	1st&15th	8	2·71	·99	1st	7
April	·35	·18	9th	6	·33	·11	29th	6	·27	·09	29th	4
May...	2·08	1·09	11th	9	2·62	1·75	11th	5	2·81	1·37	11th	10
June	·17	·12	16th	5	·22	·09	16th	3	·43	·32	16tb	5
July...	1·92	·57	9th	10	3·31	1·62	9th	12	2·51	·82	9th	9
August	1·39	·90	22nd	7	3·85	1·96	22nd	6	3·61	2·06	22nd	6
September...	1·50	·42	8th	10	2·79	·67	8th	13	2·19	·59	1st	9
October	6·22	1.19	7th	19	8·25	1·24	7th	16	9·32	1·45	7th	17
November	4·68	·90	20th	16	4·64	1·10	22nd	12	5·91	1·25	22nd	12
December	2·43	1·16	13th	13	2·54	·94	13th	15	2·99	1·08	13th	15
Totals	29·90			133	38·79			121	41·55			125

No. of Gauge on Map	5 PHINEAS JAMES, Esq., Ebbw Vale.				6 R. JORDAN, Esq., Sirhowy.				7 T. J. DYKE, Esq., M.R.C.S., Merthyr Tydfil.			
Latitude	... ...				... ...				N. 51° 44′ 30″.			
Longitude	... ...				... ...				W. 3° 22′ 45″.			
Diameter of Receiver	5 inches.				5 inches.				6 inches.			
Height above Ground	1 ft. 0 in.				1ft. 0 in.				2ft. 0 in.			
Height above Mean Tide Level	918 ft.				1055 ft.				550 ft.			
1870.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest Fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.	
January	5·67	·95	7th	19	5 088	·800	7th	17	3·52	·87	8th	15
February	6·07	1·52	1st	14	6 260	1·395	1st	20	5·63	1·70	7th	18
March	3·11	1·40	1st	11	2·885	1·040	1st	10	2·86	·94	16th	9
April	·59	·28	16th	7	·868	·255	8th	8	·46	·20	9th	5
May	3·96	1·34	11th	12	3·522	1·400	11th	10	3·40	1·07	12th	10
June	·53	·28	16th	8	·630	·315	16th	8	·46	·21	17th	9
July	3·52	1·36	31st	9	3 782	1·210	31st	12	3·30	2·17	9th	7
August	3·45	2·13	22nd	8	3·595	2·110	22nd	8	3·74	2·04	2nd	8
September	4·05	1·17	1st	11	3·513	·905	1st	12	3·26	1 11	1st	10
October	11·24	1·41	7th	23	11·131	1·510	15th	22	11·76	2·00	15th	19
November	7·85	1·68	23rd	16	7·595	1·630	24th	16	7·78	1·46	24th	11
December	2·93	1·27	13th	14	2·685	1·095	13th	9	2·56	1·19	13th	9
Totals	52·97			152	51·554			152	48 73			130

No. of Gauge on Map	8. Messrs. Morris and Roberts, Plymouth, Merthyr-Tydvil.				9. Franklen G. Evans, Esq., Tynant, Radyr.				10. T. G. South, Esq., Ely, Cardiff.			
Latitude	... ...				51° 31′ N.				... ...			
Longitude	... ...				3° 15′ W.				... ...			
Diameter of Receiver	8 inches.				5 inches.				5 inches.			
Height above Ground	8 inches.				1 ft. 0 in.				2 ft. 0 in.			
Height above Mean Tide Level	579 feet.				100 ft.				45 ft.			
1870.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which 0·1, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.	
January	4·805	·76	8th	16	4·00	·88	8th	17	3·77	·74	9th	16
February	6·440	1·710	7th	16	3·09	1·55	6th	17	2 91	1·57	7th	12
March	3·155	·930	2nd	11	2·88	·88	15th	10	2·54	·67	16th	8
April	·535	·205	8th	7	·28	·11	9th	6	·16	·06	10th	4
May	3·500	1·360	11th	7	3·01	1·57	11th	9	2·93	1·89	12th	6
June	·405	·170	16th	7	·79	·46	16th	8	·66	·48	17th	5
July	3·860	2·280	9th	9	3·69	1·29	31st	11	2·27	·82	6th	9
August	2·845	1·790	22nd	7	2·59	1·09	22nd	7	3·11	1·33	1st	6
September	3·760	1·220	1st	11	3·22	·57	1st	13	3·12	·63	9th	10
October	11·220	1·650	15th	21	8·53	1·24	15th	23	7·17	1·17	16th	17
November	7·605	1·660	24th	12	5·02	1·13	22nd	16	4·46	1·24	23rd	13
December	2·700	1·090	13th	10	3·44	·82	13th	12	2·50	·65	14th	10
Totals	50·830			134	40·54			149	35·60			116

No. of Gauge on Map	11. T. G. South, Esq., Lisvane, Cardiff.				12. W. Adams, Esq., Tredegarville, Cardiff.				14. G. W. Nicholl, Esq., The Ham, Cowbridge.			
Latitude	... ...				N. 51° 29′ 10″.							
Longitude...	... ...				W. 3° 9′ 55.							
Diameter of Receiver	5 inches.				5 inches.				8 inches.			
Height above Ground	2 ft. 0 in.				1 ft. 0 in.				1 ft. 2 in.			
Height above Mean Tide Level	100 ft.				40 ft.				50 ft.			
1870.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
		Depth.	Date.			Depth.	Date.			Depth.	Date.	
January	3·78	·75	9th	14	3·405	·765	8th	17	3·41	·93	8th	15
February	2·89	1·39	7th	13	1·880	1·050	6th	13	1·55	·40	6th	12
March	2·32	·78	16th	10	2·535	·680	15th	9	1·82	·53	2nd	6
April	·15	·07	10th	4	·182	·082	9th	5	·06	·04	29th	2
May	2·34	1·20	12th	5	2·250	1·120	11th	9	1·26	·48	11th	8
June	·60	·42	17th	5	·400	·295	16th	4	·35	·35	5th	1
July	2·26	·82	6th	8	3·265	·740	5th	13	2·49	·78	5th	7
August	3·07	1·26	1st	8	1·960	·700	27th	9	2·24	·60	1st	9
September	2·74	·51	9th	9	2·855	·620	1st	10	1·56	·50	6th	9
October	6·90	1·14	16th	20	6·925	1·080	19th	21	6·98	1·21	20th	19
November	5·65	1·07	24th	11	3·645	·800	22nd	12	3·27	·82	22nd	12
December	2·54	·81	14th	7	2·450	·650	13th	11	1·42	·70	16th	7
Totals...	35·24			114	31·752			133	26·41			107

No. of Gauge on Map	15. T. FORSTER BROWN, Esq., Glyncorrwg, Briton Ferry.				16. W. T. LEWIS, Esq., Treherbert, Pontypridd.			
Latitude	... ...				... ...			
Longitude	... ...				... ...			
Diameter of Receiver	5 inches.				5 inches.			
Height above Ground	1 ft. 0 in.				1ft. 0 in.			
Height above Mean Tide Level	730 ft.				634 ft.			
1870.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
		Depth	Date.			Depth	Date.	
January	8·07	2·43	7th	18	7·694	1·290	7th	18
February	7·94	2·43	1st	17	9·464	3·140	1st	17
March	5·30	1·91	15th	10	6·009	2·050	15th	13
April	·81	·23	9th	7	·895	·365	9th	7
May	4·60	1·37	11th	12	7·400	1·955	11th	13
June	1·48	·61	17th	8	1·107	·450	17th	10
July	3·98	1·11	5th	10	3·306	·950	5th	10
August	4·01	1·63	22nd	8	4·892	1·800	22nd	8
September	5·09	1·87	1st	12	2·500	·890	4th	11
October	13·57	1·85	15th	21	16·675	3·225	15th	23
November...	7·40	1·79	20th	16	8·936	1·970	20th	16
December	3·28	1·13	13th	10	3·728	1·600	14th	10
Totals...	65·53			149	72·606			156

No. of Gauge on Map	17. W. T. LEWIS, Esq., Mardy, Aberdare.				18. EVAN JONES, Esq., Ty Mawr, Aberdare.			
Latitude	... ...				... ...			
Longitude	... ...				... ...			
Diameter of Receiver	5 inches.				5 inches.			
Height above Ground	1 ft. 0 in.				1 ft. 0 in.			
Height above Mean Tide Level	431 ft.				450 ft.			
1870.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total fall.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
		Depth	Date.			Depth	Date.	
January	6·193	1·030	7th	17	6·93	1·30	7th	17
February	7·036	1·900	1st	15	7·36	1·90	1st	15
March	3·787	1·510	15th	10	3·78	1·51	15th	10
April	·616	·286	9th	7	·61	·28	9th	7
May	4·341	1·455	11th	11	3·87	1·77	12th	10
June	349	·180	16th	6	·41	·21	1st	3
July	2·545	1·130	9th	11	3·48	1·10	10th	7
August	3·613	2·120	22nd	11	4·55	2·35	23rd	8
September	5·053	1·700	1st	12	4·45	1·85	2nd	4
October	13·571	2·460	15th	21	7·98	2·74	16th	8
November...	8·065	1·630	24th	10	6·75	1·78	21st	7
December	2·610	1·170	13th	10	2·88	2·06	18th	2
Totals...	57·779			141	53·05			98

REGISTER OF RAINFALL IN 1870.

Time of Observation, 10 *a.m.*

Kept at Ynis-y-Bro Reservoir, 103 *feet above coping of Newport Dock.*

Date.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
1	·09	·50	·70	...	...	...	...	·11	·46	...	...	...
2	·35	·28	·55	...	...	...	...	...	·04	...	...	...
3	·07	...	·18	...	...	...	·03	...	...	...	...	...
4	·19	·06	·03	...	...	...	·22	...	·45	...	...	...
5	·28	·07	...	...	...	...	·63	·11	·23	...	...	...
6	·28	1·15	...	...	...	...	...	·15	·28	...	...	...
7	·83	·26	...	...	...	...	...	·09	...	·93	...	...
8	·69	·20	...	·10	...	...	·20	...	·59	·17	...	...
9	...	...	...	...	...	...	·15	...	·23	...	...	...
10	...	...	...	...	·65	...	...	...	·05	...	...	...
11	·20	...	...	...	1·17	...	...	...	...	·23	...	·66
12	·34	...	...	...	·19	...	...	...	·15	·36	...	·33
13	·55	...	...	...	·19	...	...	...	...	·10	·05	1·00
14	·40	...	...	...	...	...	...	...	...	...	·58	...
15	·09	...	·83	...	...	...	...	...	...	1·42	·18	...
16	...	...	·17	...	...	·07	...	...	...	·40	...	·23
17	...	...	...	...	...	·07	...	...	...	...	...	...
18	...	...	...	...	...	...	...	...	...	·40	...	·10
19	...	...	...	...	...	...	...	...	...	·76	...	...
20	...	·07	...	...	...	...	...	...	...	·09	·69	...
21	...	...	...	...	...	...	...	...	...	...	·33	...
22	...	·04	...	·04	...	...	...	1·25	...	·63	·95	...
23	...	·05	...	...	...	...	...	...	...	·44	·76	...
24	...	·08	...	...	...	...	...	...	...	...	·57	...
25	...	...	...	...	...	...	...	...	...	...	·13	...
26	...	...	...	...	...	...	...	...	...	·12	...	...
27	...	...	...	...	...	...	...	·58	...	·11	...	...
28	...	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...	·45	...	...
30	·10	...	...	...	·21	...	...	...	...	·19	...	...
31	·11	...	...	...	...	...	·43	...	...	...	...	...
Totals...	4·57	2·76	2·46	·14	2·41	·14	1·66	2·29	2·48	6·80	4·24	2·32

Total from Jan. 1st... ... ... 32·27

NOTICE.

The Committee of the Cardiff Naturalists' Society determined to print the Reports and Transactions for 1870-71—unfortunately in arrear through circumstances beyond their own control—in one Volume, containing the two yearly parts. The first of these having been completed, it is thought best to issue it at once to the members, without waiting for the second part, which, however, is in course of publication, and will be brought out with as little delay as possible. The list of Members for both years will appear in the second part. The two parts are arranged to be bound together, to form one volume. The transactions of the Society are now printed off immediately after each Meeting, therefore the record of the proceedings of 1872 will be ready for distribution immediately after the Annual Meeting next January. The Society is now in good working order, and it is hoped that the difficulties and delays of the past will not recur in the future.

CARDIFF NATURALISTS' SOCIETY.

REPORT AND TRANSACTIONS.

VOL. IV.

1872.

PRICE 2s. 6d.

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1873.

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CARDIFF NATURALISTS' SOCIETY.

ESTABLISHED 1867.

OFFICERS FOR 1873.

PRESIDENT.

WILLIAM ADAMS, C.E., F.G.S.

VICE-PRESIDENTS.

FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.
J. WALTER LUKIS.

HON. SECRETARY.

WILLIAM TAYLOR, M.D., &c.,

TREASURER.

PETER PRICE.

COMMITTEE.

JOHN MORGAN,
CAPT. PITMAN,
PETER PRICE,
EDWARD PAYNE,
E. C. DOWNING,
H. DEACON,
C. T. VACHELL, M.B.,
J. A. LE BOULANGER,
P. R. SCOTT,
H. GOOCH,
A. C. CRUTTWELL, F.G.S.,
F. STOW.

506
CARD
1872

REPORT.

The Committee have the pleasure of presenting the 5th Annual Report of the proceedings of the Society for the year ended December 31st, 1872.

The number of Members at this date was 190.

At a meeting of the Society, held at the Town Hall, on the 30th January, 1872, after the election of Officers and Committee for the year, and the general business of the Society having been transacted, Mr. Franklen G. Evans, M.R.C.S., F.M.S., &c., read a Paper on the Meteorology of 1871.

On the 22nd of February, a Paper, prepared by Mr. Frederick Pratt, was read, in which he described "What he saw of an Ant under the Microscope."

Mr. Scott read a Paper on the "Will-o'-the-Wisp," and Mr. Franklen G. Evans exhibited under the Microscope, specimens of Algæ, Diatomaceæ, Desmidaceæ, and other simple cellular structures, illustrating his previous Botanical Lecture.

On the 19th of March, Mr. Franklen G. Evans read a Paper on "Structural Botany."

On the 23rd of April, a Paper, prepared by Mr. R. W. Griffith, was read on "Reason and Instinct."

May 23rd, a Translation, by Miss Adams, of an extract from the "Courier de Menton," (a paper sent from Nice to the President of the Society, by one of the Honorary Members, W. H. Nichol, Esq., of The Ham), relating to the discovery of a Skeleton, was read by the Hon. Secretary.

Mr. A. C. Cruttwell, F.G.S., read a Paper, on "The Record of Geology and the Record of Genesis compared."

A letter from the President of the Woolhope Club, Elmes T. Steele, Esq., was read, inviting the Members of this Society to join their Field Meeting at Pontypool, on the 21st June, which was responded to by the President—A. C. Cruttwell, Esq., and the Rev. J. R. Jenkins attending.

Mr. Franklen G. Evans gave a "Microscopical demonstration of the Minute Tissues of Plants," in illustration of his Lectures.

On the 18th of June, Mr. J. W. Lukis delivered a most interesting Lecture on "Chambered Tumuli," illustrated by diagrams and flint implements.

A Field Meeting was arranged to take place at Aberthaw, on the 30th of July, but it did not take place in consequence of the small number of members who sent in their names to the Honorary Secretary. The Meeting of the Royal Agricultural Society of England having been held in Cardiff during this month, probably prevented members from attending.

On the 25th of November, Mr. C. Heywood delivered a Lecture on "The Chemical Constituents of Water," illustrated by a number of experiments.

Several Specimens of interest have been added to the Museum during the year.

Cardiff Naturalists' Society.

Statement of Accounts for the Year ending 31st December, 1872.

Assets.	£	s.	d.	Liabilities.	£	s.	d.
To Subscriptions in arrear considered good	20	3	0	Due to Mr. Adams, for cash advanced by him to pay for Reports 1868-69 £20 0 0 Less received from Special Subscriptions... ... ...12 4 6	7	15	6
,, Value of Reports unsold...	14	14	0	Due to "Cardiff Guardian"	25	12	3
,, Due from Mr. Wm. Jones for Reports sold	0	7	8	,, Thomas Jones	0	4	6
,, Value of Furniture, Fittings, and Stationery ...	1	10	0	,, F. S. Lock	0	10	8
,, Cash in Treasurer's hands	6	19	2	Balance of Asset	9	10	11
	£43	13	10		£43	13	10

Revenue Account from 1st January to 31st December, 1872.

Disbursements.	£	s.	d.	Receipts.	£	s.	d.
To Cost of Lectures...	1	14	4	By Balance in hand per last year's Account	30	13	0
,, Incidental Expenses	1	13	11	,, Cash received for Field Day Tickets	2	9	6
,, Stationery	11	7	7	,, Subscriptions	57	10	6
,, Annual Reports (for two years)	45	7	7	,, Special Subscription to pay off debt to Mr. Adams	12	4	6
,, Commission on Collection of Subscriptions ...	3	19	8	,, Valuation of Effects... ...	1	10	0
,, Debt—Bradley	3	3	6				
,, Ditto Buckley	27	10	0				
,, Balance in hand towards next year...	9	10	11				
	£104	7	6		£104	7	6

The Cardiff Naturalists' Society in Account with the Treasurer.

Feb. 16th, 1872, to Jan. 16th, 1873.

Dr.	£	s.	d.	Cr.	£	s.	d.
Transactions of 1870 and 1871	28	8	8	To Balance...	19	19	5
Use of Hall...	1	4	0	,, Subscriptions	45	3	6
Stationery, Printing, and Advertising :—				,, Field Days	1	2	6
Messrs. Lewis and Williams...	17	2	2	,, Transactions	0	15	6
W. Jones	0	3	0				
"Western Mail" ...	2	8	6				
"Cardiff Guardian" Company	5	10	3				
D. Duncan...	0	2	6				
Collector's Commission	3	19	8				
Incidentals...	1	2	0				
Balance in Treasurer's hands	7	0	2				
	£67	0	11		£67	0	11

The Cardiff Naturalists' Society in Account with the Honorary Secretary.

Dr. 1872, Feb. 15th, to 1873, Jan. 16th.	£	s.	d.	Cr. 1872, Feb. 15th, to 1873, Jan. 16th.	£	s.	d.
Paid Treasurer	45	19	6	Received—Subscriptions ...	45	3	6
,, Incidentals	0	14	0	,, Field Days	1	2	6
Repaid—Field Day Ticket ...	0	8	0	,, Transactions... ...	0	15	6
	£47	1	6		£47	1	6

MONTHLY METEOROLOGICAL REPORTS, 1872.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

JANUARY.

The month of January was remarkable for extreme disturbance of the elements, and violent perturbation of the atmospheric ocean at the bottom of which we live. The most prominent characteristics were a depressed and perpetually changing barometer; mild temperature; variable, cyclonic winds; excessive humidity; heavy rainfall, and moderate manifestation of ozone. Wind, rain, hail, thunder and lightning united their restless forces to form a meteorological pandemonium that inflicted much injury upon many localities, and impressed us with a vivid conception of the power of the latent resources of Nature. The turmoil was continuous throughout the month, and some places were visited with much severity, which merit a passing notice. On the 1st, Scotland was the seat of a strong gale, that caused accidents in the streets of Edinburgh, and blew down a foundry in the neighbourhood, involving a loss of thousands of pounds. On the 4th, Falmouth had a storm of wind, and Manchester also, with the addition of thunder and lightning, which set fire to a church. The same storm appears to have visited York; Sheffield, where a horse was killed by the lightning; Horbury, where a mill chimney was destroyed; Malton, flooded by the torrents of hail and rain; Highbridge, near Burnham, the scene of an earthquake. Portsmouth and Maiden Newton were similarly affected, and also a cottage at Hartland, Devon, was destroyed by the lightning and a child buried in the ruins. The middle of the month was again marked by tempestuous winds, and later on gales of great violence raged in some parts. In London a portion of the Westminster Palace was hurled down, and one of the elms enclosed in the Exhibition building of 1851 was uprooted. Floods occurred at Northampton, Peterborough, Market Harborough, and Oxford, and compelled the inhabitants in extreme cases to take refuge in their bedrooms. Inundations and landslips prevailed on the Severn, Thames, and in other places, but are too numerous to be detailed. It is a singular fact that this neighbourhood has escaped the worst of these evils. The heavy rains have saturated the soil, and put a stop to all active agricultural operations. The floods in the Taff have caused some damage and loss of life, and on one occasion a tree washed away by the stream struck Mr Booker's suspension bridge under Castell Coch, and placed it in much peril, but fortunately the branches broke, and the bridge was set free. Lightning and hail were several times noted, but no actual thunderstorm. We have therefore reason to congratulate ourselves upon a comparative immunity from the disasters which have been so widely prevalent.

The barometer was unusually low and fluctuating, and its indications were highly interesting in demonstrating the existence of circular storms of great violence at a distance, which we felt but little because of our proximity to the centre of the cyclone. The maximum height, 30·21, was reached on the 12th, and the minimum, 28·62, on the evening of the 23rd, showing a total range of 1·59 in. There were three periods of marked depression—viz., 28·93 on the 4th p.m.; 28·91 on the evening of the 17th; 28·68 on the 23rd, and 28·62—the lowest point—the same night; the 24th and 25th, 28·65 and 28·84 respectively. I have only once recorded a lower pressure than the present minimum, and that was 28·55, on February 11th, 1866. In my experience the glass has never been so low on several days in the same month, and considerably under 29 inches on three consecutive days, as on the present occasion. The instrument stood below 30 inches on 25 days.

The temperature of January was very mild, and in strong contrast with the corresponding period of last year. The highest reading of the day thermometer was 56°, on the 30th, and the lowest night record, 27°, on the 15th, giving a range of 29 degrees. The greatest daily range was 21°, on the 10th, the least variation, 6°, on the 5th, and the mean daily range, 12°·7. The mean of the maximum temperatures amounted to 48°, and of the minimum to 35°·4. The mean heat of the whole month was 41°·7, which is 3°·2 in excess of my own average, and 4°·8 above the Greenwich mean of 50 years. The temperature was more than the average value on every day but two. Slight frosts occurred on several occasions. Vegetation showed signs of activity in the blooming of snowdrops, crocuses, mezereon, barren strawberry, &c.

The general direction of the wind was more or less westerly on 26 days, and easterly on four occasions. With these directions southerly and northerly currents were combined in exactly equal proportions. The force was often considerable, but nothing in comparison with the violence of the wind in other places. The lowest readings of the barometer were associated with almost calm weather, which is in accordance with my usual experience; for it is to fill up the area of low pressure in which we are more or less situated that the wind is circulating with such fierce velocity in distant localities.

The quantity of moisture in the air was large, and much above the average. The mean degree of humidity was 93, complete saturation being represented by 100.

The rainfall of January was very heavy, and amounted to 8·81 inches. This is equal to 889 tons, or upwards of 3,670 hogsheads to an acre, and has only twice been exceeded—in September, 1866, and December, 1868. Rain fell on 26 days.

Ozone was present to a moderate extent, and five times reached the maximum of the scale. Autozone was occasionally noted. The mean degree of ozone was 4·323.

The sanitary state of the country is not satisfactory, and there is no immediate prospect of improvement. Typhoid and scarlet fevers, measles, and chicken-pox were prevalent; also colds and inflammatory disorders, rheumatism, neuralgia, herpes, &c. Many people in good health suffered from lowered vitality and general *malaise*, consequent upon the depressing effects of wet and relaxing weather. The month was altogether a remarkable one, and the salient points only can be touched upon, as it would be impossible to do justice to all its details of interest within anything like reasonable limits.

The ordinary monthly meeting of the Society was held in the Grand Jury Room at the Town Hall, on Thursday, February 22nd.

The chair was occupied by Mr. Franklen G. Evans, Vice-president.

There were also present, Messrs. Thompson, Le Boulanger, Scott, Peter Price, H. Deacon, Blessley, Tomlinson, Fisher, T. Webber, A. P. Fiddian, hon. sec., &c.

The following gentlemen were elected members:—Messrs. J. W. Lukis, St. James's, Roath; Robert Y. Evans, Crockherbtown; E. E. Yearsley, Quay-street; and J. J. West, Duke-street.

An interesting description of an Ant as seen under the microscope, by Mr. F. Pratt, surgeon, was read by Mr. P. Price, after which the following paper was read by Mr. Scott on the

Will o' the Wisp.

Mr. President and Gentlemen,—The Will o' the Wisp, or Jack o' Lantern, is a light which appears in dark, warm, quiet, autumn evenings, as a flickering, wandering flame, hovering in the air from 6 inches to 1 foot 6 inches above the surface of stagnant pools and other places containing vegetable and animal matter in a state of decomposition. The flame, or light, generally appears similar to the flame of a candle—sometimes of the size of the hand, and as a complete body of flame. It moves rapidly in a dancing manner for a few seconds, then disappears, when other flames make their appearance near the same place. This effect goes on for a considerable period, several flames being frequently seen at the same time. Their colour is of a yellowish tinge, sometimes bluish or slightly red. These flames are of a peculiar character, and have often deceived travellers who have lost their road, and who, thinking they are actually lights carried by some person at a distance, have attempted to follow, and suddenly found themselves in a pool or bog. These appearances have been attributed by the peasantry in old times to evil spirits, and have given rise to many superstitious ideas. The Will o' the Wisp is most probably mentioned, under the name of the Ignis fatuus, as early as 1300.

Shakespeare mentions it in "Henry IV.," where Falstaff speaks of Bardolph's red nose as an "Ignis fatuus." "When thou run'st up Gadhill to catch my horse I did think thou hadst been an Ignis fatuus." Newton mentions them as ignited vapours from stagnant pools. In Scotland they are termed elf candles; in North Wales, corpse candles. It is not certain if they are mentioned by ancient Latin or Greek authors. These lights are very different from that produced by fireflies; neither do they appear as phosphorescent lights. In the places where seen, on plunging a stick into the mud, bubbles of gas escape which appear to be carburetted hydrogen; or as it is frequently termed marsh gas. The gas producing these lights is most probably phosphuretted hydrogen combined with carburetted hydrogen. The former gas has the property of bursting into flame when a bubble is allowed to escape into the air, and phosphorus is contained in many plants, seeds, and animal substances, from which by decomposition this gas may be evolved. This gas is no doubt necessary for the production of the flame; and also decayed animal matter; as the gas obtained from simple decomposing vegetable matter does not appear to have the property of taking fire without the application of flame; a small quantity of phosphuretted hydrogen being evolved with other gases is sufficient to give the mixture the property of taking fire on exposure to the air. There is no reason to suppose that the flames are extinguished during the day, but they can only be seen in the dark. It is very difficult to get near the flames as the least current of air will cause them to move away; but in some sheltered places, with great care, they may be approached, and if thin white paper be then brought in contact with them they will tint it a brown colour. If an observer endeavours to approach these lights by walking towards them at the usual pace, the flames always recede, and sometimes when he walks from them they will follow him; hence these appearances have been ascribed to evil spirits. There is very little doubt that animal matter must be present to cause these lights, so that when the Will o' the Wisp is seen it is probably owing to the decomposed remains of some animal or fish, or perhaps some unfortunate traveller! These lights are by no means common, and comparatively few persons have ever seen them. The localities in which they are generally found are marshy districts, damp old churchyards, battle-fields, and stagnant water; in damp valleys, heaths, or moors, old pools surrounded by thick foliage and full of decayed rushes, weeds, toads, &c. In the lake district of Westmoreland, in a small pool surrounded by trees and bushes, between Penruddock and Threlkeld, on the Penrith and Keswick Railway, they have been frequently seen in great perfection, three or four flames being visible at the same time. They have been also seen near Ulverston and Carlisle, but seldom in the South of England. One of the best places for seeing them is stated to have been an old churchyard at Gibraltar. A similar light has been seen in a churchyard in Warwickshire, and described as a phosphorescent blue light playing over a grave. Such lights may have given rise to some of the tales of churchyard ghosts. The Will o' the Wisp is said to have been seen in the valley of the Taff River. Some of the old naturalists have attributed these lights to luminous insects hovering in clusters over the place; but those who have seen large quantities of fire flies, as in India, would see the difference immediately. Neither are these flames to be mistaken for ignited naptha springs, as they have been in Italy, in the East, and in other places.

Upon the conclusion of the paper, which was very attentively listened to, Mr. G. Thompson proposed a vote of thanks to Mr. Pratt and Mr. Scott for their contributions. He said that he had always had a strong though ungratified wish to see a Will o' the Wisp, but he thought that the next best thing to seeing one himself was to meet with a man who had seen one.

Mr. P. Price seconded the vote, and remarked that the superstition of the "corpse candle" existed also in South Wales.

In putting it to the meeting, the Chairman said that the fact that the curious phenomenon under discussion was simply luminous, and not attended by any appreciable manifestation of heat, convinced him that it was mainly dependent upon phosphorus, which burnt slowly in the air at common temperatures. Carburetted hydrogen would not do this, but would give off a dangerous flame. The presence of decaying animal as well as vegetable matter in the favourite haunts of the Jack o' Lantern strengthened this view. In this connection, he mentioned a very singular circumstance that occurred many years ago in one of the London hospitals. A poor man who had led a drunken, dissipated life, was dying in one of the wards, and some hours before death the nurses observed a pale bluish flame issuing from his mouth. They were much alarmed, and fancied, perhaps naturally, that the torments of the nether regions had already commenced in the still living body. This, of course, was the result of ignorance and a hasty judgment of probabilities in the case of the sufferer. The true explanation was a production of phosphuretted hydrogen, the result of incipient decomposition, very similar to the exhalations that cause the Will 'o the Wisp.

The Chairman then gave an instructive and agreeable microscopic demonstration, illustrative of minute vegetable structure, and the physiology of the lowest forms of plant life.

A cordial vote of thanks to Mr. Franklen G. Evans for his interesting exhibition, as well as for presiding, concluded a meeting which was much enjoyed, notwithstanding the extremely wet weather.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

FEBRUARY.

The singular turmoil and wild unrest of the elements that distinguished January extended into February, and lasted in some degree throughout the month. The weather was suggestive of the propriety in a physical sense on British soil of the name of February, which was originally derived in another sense in Roman lands from *Februa*, the festival of purification and expiation. The pressure of the atmosphere was low, variable, and much disturbed; the temperature extremely mild; winds were strong and moist; the rainfall was heavy and continuous, and the development of ozone considerable. The month opened with a fierce gale from the S.W., which raged with greater fury in Cornwall, and blew two houses at Mevagissy over a cliff, with only just sufficient crackling notice to enable the inmates to make their escape. The mines in the same county were flooded and injured by the constant rain. The same cause has been very detrimental to the surface of the country generally, by producing a continuance of floods, and putting an almost complete stop to agricultural operations. A speedy return to drier weather is required to enable farmers to fetch up lee-way and complete spring ploughing and sowing. The mildness and moisture have stimulated the opening of vernal vegetation, and many flowers are in bloom. Primroses and violets appeared on the 3rd, coltsfoot, celandine, mercury, and henbit dead nettle a little later. The inflorescence of the hazel, willow, alder, and wych elm also came out to welcome the return of Spring. Amongst other flowers and shrubs in bloom were the daffodil, alyssum, wall-flower, box, gorse, and pyrus japonica. A periwinkle was seen in bloom on the 29th, and gooseberry and elder trees were already in leaf. In the fungus family the scarlet-hued peziza and microscopic æcidium were interesting objects. Lambs now dot the fields in fair numbers, and the thrush and other songsters enliven the country with their sweet melody.

The barometer was depressed and fluctuating within moderate limits. The lowest point reached and the extremes of oscillation were much less marked than in the previous month. The maximum height, 30·26 was attained on the 27th, and the minimum, 29·53, on the 24th and 25th, making a total range of 0·73. The instrument stood below 30 inches on 23 days.

The temperature of February was remarkably mild, and in excess of the average on every day of the month. The highest reading of the day thermometer way 57° on the 25th, and the lowest night record, 31° on the 3rd and 17th, giving an entire range of 26 degrees. The greatest daily range was 22° on the 3rd, the least variation, 3° on the 11th and 12th, and the mean daily range 13°·2. The mean of the maximum temperatures amounted to 51°·4, and of the minimum to 38°·2. The mean heat of the month was 44°·8, which is 2°·1 above my own average, and 6°·1 higher than the Greenwich mean of fifty years. There were a few slight frosts.

The general direction of the wind was more or less westerly on 21 days, and easterly on six occasions. With these quarters, southerly and northerly currents were combined in the proportion of 18 to 7. These figures show a large predominance of westerly and southerly winds, which accounts for the mild, moist character of the month. The force was often considerable.

The quantity of moisture in the air was very large. The mean degree of humidity was 91, complete saturation being represented by 100.

The rainfall of February was heavy, and distributed over 22 days. It amounted to 5·07 inches, which is equal to 512 tons, or upwards of 2,100 hogsheads to an acre. It exceeded the average by a little more than half an inch. The rainfall of the last three months measured 16·98 inches, which is a large total; but it was much surpassed in the corresponding period of the winter 1868-9, when it amounted to 22·23 inches. Some people will hardly realize this because the discomforts of the past are so speedily forgotten in the more vivid consciousness of the miseries of the present. Facts and figures are necessary to correct the impressions derived from our sensations, which are very misleading. It is certain that the public generally were never more thoroughly possessed with the idea of "complete saturation"—mentally true at all events—than on the present occasion.

Ozone was most abundantly developed, and many times reached the maximum of the scale. It was observed on every day but three, and antozone was sometimes noted. The mean degree of ozone was 6·448.

The diseases of February were similar to those of the previous month, with some signs of amelioration. The trying winds of Spring, however, have yet to be encountered.

A very curious and brilliant aurora was seen on the evening of the 4th. It commenced at 5.30 p.m., while still light, as a rich rosy colouring to some soft clouds stretching from E. to W. to the S. of the zenith, in which position a splendid corona soon formed. From this point red and white streamers radiated to the E. and W., and appeared to compel the clouds to assume the same shape as radiant cirrus. A little later, as darkness came on, radii were noticed throughout the N. horizon, and some in a southerly direction. My impression was that the streamers passing downwards from the corona, instead of contrariwise, was apparent, not real; and I had no doubt that the radii from the N., subsequently seen, were present all the time, but concealed by the daylight, and rendered visible beyond the zenith by the effect produced in the clouds before mentioned. The southern manifestations indicated the co-existence of a southern aurora. In a paper on the northern lights, of Oct. 24, 1870, I pointed out that an aurora at one pole has probably always a corresponding one at the other, as its natural complement, which, on the occasion referred to, was subsequently verified by observations in southern latitudes. The phenomenon of February was, I believe, an example of a northern and southern aurora both visible at the same time. The sky soon became overcast, and prematurely veiled the beautiful display.

The usual monthly gathering of the Society took place on Tuesday, March 19th, in the Nisi Prius Court of the Town Hall, and was well attended. The chair was filled by Mr. William Adams, President. There were also present Mr. Franklen G. Evans, Vice-President; Mrs. Matthews, Glan Ely;

Mr. and Mrs. Clement Lucas and party; Mr. John Morgan, Mr. Holst; Miss Adams, Mr. Robert Y. Evans and Miss Fanny Evans; Mr. Ivor Vachell; Mr., Mrs., and Miss Downing; Mr. P. Price, Mr. Deacon, Mr. Cruttwell, Mr. Blake, Mr. J. O. Riches, Mr. Fear, Mr. Parry, &c.

The minutes of the last meeting having been read, and Mr. T. Webb, Woodfield-place, elected a member,

Mr. Peter Price's motion for the abolition of Rule 6 was proceeded with, but ultimately withdrawn in favour of an amendment by Mr. Franklen G. Evans, which met the views of the mover of the resolution and the members generally.

Mr. Adams then called upon Mr. Franklen G. Evans, who delivered a lecture, of which the following is a condensed summary, on

Botany: The Structure of Plants.

Mr. President, Ladies, and Gentlemen,—In the first elementary lecture on Botany, delivered at a former meeting of the Society, I explained the circumstances under which the course was undertaken, and the plan to be pursued; pointed out the necessity of systematic arrangement, and briefly defined what we are to understand by a plant. The primitive cell as the unit of structure was then described, and the various forms that cells assume detailed in relation to their different conditions with regard to pressure, axis of growth, and function. The manner in which cells are strengthened internally in a variety of ways, to enable them to resist pressure, and to perform their allotted duty in the vegetable organism, was also referred to and illustrated by examples. It was further mentioned that the lowest orders of plants were made up entirely of cellular tissue, which is quite equal to the fulfilment of all their requirements of composition, circulation, and nutrition. We will now resume the subject from this point, and after a few more remarks with reference to cells, proceed to the consideration of the other components of vegetable tissues.

Cells multiply very commonly by a process of sub-division, which is thus effected:—The contents of the cell collect around the nucleus, and a line of separation is formed across the latter. The wall of the cell then puckers in towards the divided part, until the opposite sides meet, and two cells are produced, each possessing one-half of the original nucleus, which now constitutes its own nucleus. This process may go on indefinitely, and furnishes an unlimited capacity for rapid growth. The mushroom affords a very striking example, for in it the cells increase at the rate of many millions a minute; and this is in accordance with our ordinary experience, for we know that the whole plant may be the growth of only a single night. The new cells may, in due time, divide again, and they are apt to be irregular in shape. Indeed, this method of increase may be enumerated as another cause that modifies the form of such bodies. The size of cells varies from 1-50th to 1-1,000th of an inch in diameter. In the orange and lemon they are easily seen by the naked eye; but in most vegetables they require the employment of a moderate magnifying power. Some plants consist solely of a solitary cell, such are the *diatomaceæ* and *desmidiaceæ*. The skeletons of the former are made up so entirely of silica as to closely connect them with the mineral kingdom. But, whether solitary or aggregated, cellular tissue is sufficient for all the purposes of life in the lowest organisms.

It will naturally occur to us that the higher types of vegetation must stand in need of some advance in structure over the sketch previously given, and this we shall find to be the case. In addition to the cellular tissue of their lowly relations they possess for their more elaborate circulation, and the important uses for which they are destined, certain vessels, and tubes or ducts, constituting vascular tissue. These consist first of wood fibres, which are much longer than cells, taper to each end, and overlap each other. When young they are pervious to sap and play an active part in circulating it. As they get older they are gradually thickened by a deposit of lignine internally, and thus form the bulk of the timber we employ for so many valuable purposes. In the *coniferæ*—the larch, fir, yew, &c.—the woody fibre is of a very peculiar character, being marked on its surface with circles and dots in a single row on each fibre. This is called glandular or punctated woody tissue. The use of these markings is unknown, but they furnish a ready practical means of identifying the wood of coniferous trees, and are thus serviceable to microscopists, botanists, and geologists. Fossil specimens of these trees may be recognized by them, and I have now here a silicified piece of wood in which the dots are almost as clear as in the most recent timber. Wood fibres, after they cease to be pervious to sap, are chiefly useful to the plant in giving support to more delicate structures, and even annuals are supplied with them for this purpose. Their presence may often be recognized by the "stringy" state of some vegetables, such as celery; but this probably is a mode of recognition that is more interesting to the botanist than agreeable to the epicure. (Laughter.)

We next come to spiral vessels which have the elongated spindle-like form of the woody fibres, and are strengthened and rendered elastic by an internal spiral fibre—hence the name. This fibre is coiled up in much the same manner as the spiral wire in modern india-rubber tubes, and with the same object—to keep them open and elastic. These vessels are most interesting objects under the microscope, and can be seen in their natural position in many plants, such as the rhubarb, potato, hazel nut, &c. The fibre can be unrolled from the vessel and exhibited separately. To do this all that is necessary is to cut a leaf-stalk of a strawberry or geranium all round, but not quite through, and draw the ends gently asunder. Now place it on a glass slide and put it under the microscope, and the coil will be distinctly seen. Spiral vessels contain air, and sometimes water, but of this more anon.

The next structures I would direct your attention to are those known as ducts, which consist of tubes composed of cells placed end to end, and their partitions removed. These afford a more direct kind of circulation, and a more active movement of the sap; they may be simply membranous, but more commonly, they are variously strengthened internally, which gives them their characteristics. Thus some are dotted or pitted, as in the elm, willow, &c. Others are spiral and sometimes annular. Occasionally a kind of net-work is formed when it is called reticulated. In other cases bars are placed on the walls like the steps of a ladder, hence these vessels are called scalari-form or ladder-like. This form is characteristic of the ferns, and produces the well-known appearance of an oak when the stalk is cut across. An oblique section of the stem of the common brake fern put under the microscope shows this remarkably well, and is a very pretty object.

The points of distinction between vessels and ducts are that the former are tapering and the latter not so. The spiral fibre in the vessel can be unwound without breaking, but it is fixed to the wall of the duct, and consequently gives way.

There is another kind of vessel termed laticiferous, containing a granular fluid, and having a circulation resembling that of the frog's foot.

I stated at the outset that all plant structures were composed of cells and their modifications, and we are now in a position to see how far that statement has been verified by the facts that have been adduced. We have seen that there are simple cells, ringed cells, spiral cells, dotted cells, &c. ; and there are analogous forms of vessels and ducts. Again, cells are thickened and consolidated by a hard material called sclerogen, as in the stones of fruit, and woody tissue is similarly strengthened by a deposit of lignine. Woody fibres and spiral vessels are really elongated cells, and ducts are made up of cells placed end to end, and their partitions removed. We are thus justified in affirming that plant structures are built up entirely of *cells and their modifications.*

When the ultimate end to be attained, and the means of attaining it are so simple, we may be tempted to ask—whence comes the necessity of the amount of diversity we actually find? One answer to this question at once presents itself in that boundless profusion of nature which seems to revel in the idea of variety for its own sake, and to give pleasure to the senses of the animal creation by the infinite production of new and different forms, which make monotony impossible. Another, and perhaps a higher, purpose is served in adapting the numerous families of the vegetable world to the mani-fold kinds of soil and climate in which they have to live, and to the objects of utility for which they are employed by the human race. The influence of soil as regards its mineral composition, and the amount of moisture it contains, is very great. Thus we find a wide difference in the characteristics of land and water plants, and considerable scope for variety in the vegetable forms that occur in association with changes of geological structure. The qualities possessed by various kinds of timber are in strict conformity with the nature of the cells and vessels that enter into its composition. I need hardly mention the hardness of the oak and the toughness and flexibility of the yew. The latter is a peculiarly interesting tree in every respect—in its associations, slow growth, and high antiquity, and microscopical structure.

As a member of the *Coniferæ* it has the glandular markings which are so characteristic of that order. It also possesses beautiful spiral vessels in which there are two fibres coiled in opposite directions so as to form a double spiral tube. It is the abundance of spiral vessels that gives the great flexibility and strength to the yew, and wound it round the sentiments of Englishmen, young and old, and connected it with the historical reminiscences of this country. The "good yew bow" is a household word with us, and occupies a prominent place in our lyrical literature. You all know, and many perhaps have sung,

"Oh! bold Robin Hood was a forester good
As ever drew bow in the merry green wood."

But the goodness of Robin's forestry depended upon the quality of the instrument on which he exercised his skill, and that derived its excellence from the peculiar arrangement of its minute structure which I have mentioned.

It is interesting to note how the power of England, dependent primarily upon the bravery and skill of her sons, has been sustained by the natural productions of her soil. The trained defenders of the country, as well as Robin Hood and his merry men, had long to rely upon the bow, which was of vegetable origin. Then, this was superseded by gunpowder, derived partly from the vegetable and partly from the mineral kingdom. The hardness and durability of timber is perhaps nowhere better seen than in the heart of oak, which for centuries carried the flag of Britain safely over every sea. It is a singular circumstance that when the vast forests of the New World began to enable the children to compete dangerously with the mother country in the cheap building of ships of all kinds, the sovereignty of the seas was transferred to the mineral kingdom, iron took the place of wood, and enabled us to maintain our superiority in ships of every description. The materialist may call this Chance, but we will call it Providence, to which we trust the future.

The lecture gave great satisfaction, and was frequently interrupted by applause. The vegetable tissues mentioned were illustrated by excellent representations of the natural objects in clearly executed diagrams.

Upon the conclusion of the lecture, Mr. John Morgan proposed a vote of thanks to Mr. Evans for his admirable address, and remarked that people walked through life with their eyes shut to the beauties around them, until their mental vision was cleared by such instruction as they had then received.

Mr. Peter Price, in seconding the motion, said he was sure it was only modesty that prevented the gentlemen from rising in a mass to second a vote which was so much approved of. He hoped Mr. Evans would continue his lectures, and that Mr. Drane also would resume his lessons in the Sophia Gardens.

The President said it was quite unnecessary to put the resolution to the meeting. He attributed the improved attendance to a desire to hear Mr. Evans, and hoped he would go on with the lectures. (Applause.)

Mr. Evans thanked them most cordially for their kind reception of any effort of his to give them pleasure. Mr. Price had referred to the modesty of the members, but he (Mr. Evans), while agreeing with the copy-book maxim that "modesty is a quality that highly adorns a woman," thought that it sometimes ruined a man. (Laughter.) He hoped that modesty, real or affected, would not induce members to hide their lights under a bushel, and deter them from writing papers for the society. For himself he could not accept the President's flattering solution of the augmented audience, but he rather attributed it to the notice given by the hon. secretary that "Lady members are requested to attend." The presence of ladies conduced to the success of the meetings, and he hoped they would continue to lend their aid to the society, and its prosperity would be ensured. (Cheers.)

The microscopical illustrations of the lecture will be given at the next meeting.

METEOROLOGICAL REPORT.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

MARCH.

March hardly maintained its traditional reputation for dust, cold, and violence, and its name was not quite appropriate in a meteorological point of view. Instead of the austerity and pugnacity we are accustomed to associate with the idea of strife-loving Mars, we had softness and moisture befitting Jupiter in his weak and lachrymose moments, when he is known by the additional designation of Pluvius. Perhaps the mythical "immortals" of Mount Olympus—like the sublunary denizens on this world's stage—are in the habit of playing various parts, and to assume different characters, like the actors in a masquerade. When the temporary drama is over we may expect to see the performers reappear in their proper persons, and revert to their usual habits. But to return from the celestial æther to the earthly atmosphere, we may note that barometric pressure was very fluctuating; the temperature mild, and above the average; winds were changeable and shifting; the air was damp, the rainfall rather copious, and ozone moderate. The season is a forward one; indeed, too much so for the well-being of some fruit trees. The scarlet currant bloomed on the 1st, the butter bur on the 3rd, wood anemone on the 8th, geranium Robertianum on the 10th, lady's smock on the 14th, and wood sorrel on the 15th; pear, plum, and peach trees blossomed about the middle of the month. The inflorescence of the ash and common elm also appeared, and the larch, thorn, and poplar put forth their leaves. Amongst microscopic fungi the *Puccinia Anemones*, *Uromyces Ficariæ*, and *Puccinia Compositarum* were found. The brimstone and small tortiseshell butterflies were observed on the 3rd. They had probably emerged from their pupa cases at an earlier date, but were deterred from showing themselves by the very wet weather, and until enticed from their secluded retreats by a sunny day. The pastures are abundant, and a large mortality amongst lambs in Wiltshire is attributed to excessive luxuriance in this respect; but I have not heard of any such result here. Although the month was generally mild, there were a few very cold nights with hard frost, which cannot fail to damage early bloom.

The barometer was rather low, and very unsteady. The maximum height, 30·40, was attained on the 10th, and the minimum, 29·32, on the 30th, giving a range of 1·08. The instrument stood below 30 inches on 17 days.

The temperature of March was mild on the whole, and above the average on 22 days. The highest reading of the day thermometer was 61° on the 3rd, 4th, and 30th, and the lowest night record 24° on the 26th, showing a total range of 37 degrees. The greatest daily range was 29° on the 27th, the least variation 6° on the 1st and 29th, and the mean daily range 16°. The mean of the maximum temperatures amounted to 53°9, and of the minimum to 38°1. The mean heat of the month was 46°, which is 3°6 higher than my own average, and 4°4 in excess of the Greenwich mean of 50 years, without correction. There was frost on nine nights, and it was a few times severe, but the nocturnal temperature was usually favourable.

The general direction of the wind was more or less westerly on 18 days and easterly on 13 occasions. With these quarters southerly and northerly currents were combined in the proportion of 17 to 12, showing a preponderance of south-westerly winds. The force of it was sometimes a moderate gale, but the wind was less boisterous than it often is in March.

The quantity of moisture in the air was decidedly large. The mean degree of humidity was 82, complete saturation being represented by 100.

The rainfall of March was heavy for a dry month, and was distributed over 17 days. It amounted to 4·10 inches, which is equal to 414 tons, or upwards of 1,710 hogsheads to an acre. This total is nearly an inch above the average. A lunar halo 45 degrees in diameter was noted at 1 a.m. on the 24th.

Ozone was moderately developed, and antozone occasionally noted. The mean degree of ozone was 4·484.

The principal diseases in March were bronchitis, pneumonia, quinsy, acute and chronic rheumatism, scarlet and typhoid fevers, erysipelas, herpes, abscesses, &c. The chief complaint of the month, and almost the only one productive of mortality, was scarlet fever, which is very prevalent and of a severe type. Some incurable cases of chronic disease terminated in a welcome death; and it may be observed that March is often the month of harvesting the results of disease germs sown long before.

The monthly meeting of this Society was held on Tuesday, April 23rd, at the Town Hall, under the presidency of Mr. Franklen G. Evans, Vice-President. There were also present, Captain Bedford, R.N., Dr. Taylor, Mr. P. Price, Mr. C. T. Vachell, Mr. Ivor Vachell, Mr. Fiddian, M.B., Mr. Cruttwell, Mr Plain, Mrs. and Miss Adams, Miss E. Adams, Mrs. Price, and Miss Fiddian. Mr. R. Short, of Roath, was unanimously elected a member.

There was only one paper on the agenda to be read, but Mr. Fiddian read a paper on a "Skeleton in the Caves of the Red Rocks," which had been translated from the French by Miss Adams. The paper appeared in *Le Courrier de Menton*, of Sunday week, a copy of which had been sent to Mr. Adams; and as the subject was one exciting some considerable attention among scientific men in France, Miss Adams translated the paper for the meeting of the Naturalists' Society. As no notice had been given that the paper would be read at that meeting, the reading of it was considered as informal, and the paper would be again read at a future meeting. The Chairman read a paper on "Reason and Instinct," by Mr. R. W. Griffith, B.A., and afterwards explained his own views on the subject to promote discussion, combatting Mr. Griffith's principle that instinct never erred, and that the reason of man was not different in kind, but only in degree, from that of animals. A cordial vote of thanks was passed to Miss Adams and Mr. Griffith, for their papers, and to the Chairman for presiding, and for the explanation he gave of the more usually adopted theory of the difference between human and animal reasoning.

The following is the substance of Mr. R. W. Griffith's paper:

Certain broad rules have been empirically assumed to define the distinctions between instinct and reason. 1. It is laid down by Lord Brougham that "brutes act from a principle, a thinking principle, a mental principle—something different from their bodies and from surrounding objects; but that they act towards an end of which they are ignorant, and accomplish that end without design, though very possibly they may, in so acting, accomplish some immediate end of which they are aware, and which they intend to attain."* And this rule is supported by the instance of the bee forming hexagons and rhomboids in the production of the honey-comb, and thereby gratifying some instinctive sense, whilst it unconsciously serves the more important purpose of propagating the species. 2. "The broad distinction," says Dr. Whewell, "of instinct and reason, however obscure it may be, yet seems to be more simply described by saying that animals do not apprehend their impressions under general forms, and that man does."† 3. A third rule sometimes insisted upon is that the peculiarity of reason consists in a liability to mistake—in fact the old adage, "Humanum est errare," is supposed to define the boundary between man and the brute, as well as between himself and the Supreme Being. 4. Once more, the essential distinction of reason is said to be progress, instinct admitting of no development. The construction of the honey-comb is identical with that observed by the earliest naturalists; and to quote the words of Dr. Johnson, "Birds build by instinct; they never improve; they build their first nests as well as any one they ever build."‡ Instinct, it is averred, is wholly devoid of inventive

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* Nat. Hist. i., p. 70. † Plurality of Words, p. 187.

‡ Boswell's Life of Johnson, i., 334,

power, whilst reason is simply the faculty of drawing inferences from given premisses, or in other words the powers of reasoning and invention are identical. 5. Almost as a corollary to this stands the dogma that the purely instinctive animal has no moral qualities whatever, whilst in the higher scale of intelligence reason is entirely dependent upon an imperious and responsible will. We will attempt briefly to examine these doctrines in their order, but before doing so it may be well to clear the ground by two or three general observations.

Without pausing to advert to the repugnance naturally felt to every theory which would sweep away any of the old landmarks that separate man from the brute creation, we remark that, although we can rigorously analyze the processes of human reason, those of instinct can only be studied by the slow and unsatisfactory steps of synthetical investigation. True it is that many of our commonest acts are regarded as simply instinctive, but amongst these are classed only such as so slightly tax the intellect that they fail to leave any available records in the memory.

Our meaning will perhaps be best illustrated by an illustration which, though exhibiting the inverse course of reason degenerating into mere habit, will define the difficulty we refer to. "A postman," says Sir W. Hamilton in his Lectures on Metaphysics, "was in the habit of traversing a road between Halle and a town some eight miles distant. A considerable part of this way lay across a district of unenclosed champaign meadow land, and in walking over the smooth surface the postman was generally asleep. But at the termination of this part of his road there was a narrow foot bridge over a stream, and to reach this bridge it was necessary to ascend some broken steps. Now it was ascertained as completely as any fact of that kind could be—the observers were shrewd, and the object of observation was a man of undoubted probity,—1st, That the postman was asleep in passing over this level course. 2nd, That he held on his way in this state without deflection towards the bridge; and 3rd, That just before arriving at the bridge he awoke." This is given on the authority of Junker, a celebrated physician and Professor of Halle, who flourished about the first half of the last century. In this case the postman could not by any appeal to his own consciousness supply the materials for explaining the facts narrated. We learn similar truths from observation of our fellow-men, the method of the bee, in collecting honey, the accumulations of human knowledge, in books, through the medium of language, &c. The general doctrine of average applies to our rarest as to our commonest acts with almost equal correctness. The annual number of poets, suicides, theatregoers, &c., &c., may be made the subject of very trustworthy prediction. It is true that the doctrine of the necessary coincidence of supply and demand may be offered to explain many of these results, but it is far from being the full solution, and this is enough for our present purpose. Is it granted that, whilst we pride ourselves on the unfettered gratification of our several tastes, —intellectual as well as physical—each is contributing his share to the aggregate of society, which is as methodical in its development as are many of the operations of instinct, the regularity of which is magnified to us, who look down upon them from a higher stage of intellectual existence? If this be admitted, Lord Brougham's ingenious distinction falls to the ground.

Again, we cannot shut our eyes to the fact that it is more than doubtful whether the favourite application of the differential calculus to the question of the construction of the honeycomb has not been one of the numerous mirages by which philosophers have been so often deceived. It may be true that the hexagonal form of the cell secures the greatest amount of space with the least expenditure of material; but the question still remains—does the bee construct the cell according to this type; as originally moulded, is it not cylindrical, and is it not *accidental*, so far as the bee is concerned, that it afterwards assumes another shape? Observation must decide. If it is so, what becomes of the idea that instinct is blindly accomplishing what reason, after centuries of labour, has only recently proved to be best for the purpose?

2. The learned dictum that "Animals do not apprehend their impressions under general forms while man does" increases rather than solves our difficulty. Take the case of a human being in a rude state of civilization, and it will be found that he exercises that power of abstraction, which is necessary for the purpose of classifying subjects under general types in few cases, that in this particular distinguish him from the brute creation around him. The grand philosophical division of all things under the two heads of the ego and non-ego—the objective and the subjective—he certainly recognizes, but this he does to a certain extent in common with the brute; for there is every reason to believe that a consciousness of existence is not in essence confined to man, however differently he may be affected thereby. Once more, it cannot be questioned that brutes are all in some way able to draw inferences from the frequent recurrence of certain events. The instances of punishment long remembered, of food secreted, &c., by dogs and other animals, are too familiar to require repetition. Much in the same way the savage every morning of his life observes the sun rising in the eastern sky, and infers that this order of things will continue. In these cases the third term is supplied by the classification of past observations under a general form. In fact, Sir Wm. Hamilton lays it down that "Judgment and reason are rendered necessary by the imperfection of our nature." If this be the case, the inferior orders of animals would seem to require these faculties in ruder development rather than to possess a peculiar faculty more simple and yet more certain. This by the way, but if th assumptione above made be objected to, still so little do we know of the mental faculties of any beings, save our own, that we are driven to dismiss the rule with the question, What evidence have we of its truth?

3. Another peculiarity frequently attributed to instinct is invariability. We have already referred to the doctrine of average, and on this we should be content to rest our argument as to the *essential* identity of reason and instinct. Still, lest we should appear to overlook objections, it is necessary to notice the fact that these invariable instincts are displayed only in the exercise

of the most elementary *appetites.* There is no invariablity in the development of those canine instincts which approach most nearly to human sagacity; whilst, in the gratification of his sensual pleasures, man is now in no way distinguished from the earliest of his species. With this remark we dismiss this branch of the subject, to which we shall have occasion briefly to return as we draw this paper to a conclusion.

4. There is no art amongst animals, say some, and in this they contend consists the secret of our difficulty. But this we are prepared emphatically to deny. How else than artificial are we to regard the endless tricks which certain animals may readily be taught, or the contrivances that they all more or less make use of to accomplish their objects? It would be tedious to adduce instances, for those which have occurred in the experience of every one will be much more convincing than any which we could relate. And again, the general idea of instinct presents no intelligible explanation of the fact that the many very valuable habits of certain animals when once acquired descend to their offspring. Thus a pointer pup will, when taken into the field, immediately and without any training point with great accuracy. But if it be admitted that there is no art amongst animals—if there is no sign of the development of the superior powers of their sentient existence—are we to be surprised at this, for what would become of art and civilization amongst the lords of creation if there was no *necessity* for either? To some extent we can answer this question by a reference to savage life, where nature readily supplies all that excites the human appetites, and where reason, as tested in the crucible of development, would be found sadly wanting.

The distinction above stated is very specious, its simplicity being its greatest recommendation, but in common with the rest we think it will bear but slight investigation. The fallacy lies in the ideas which we attach to the term art, which may simply be defined to be the adaptation of the laws of nature to secure certain objects which left to itself it would not produce. It is true that the manufacture of machinery and all the appliances of daily life are confined to man, but the cause which produces these results is the same in principle as that which directs the hunted beast of the forest to hide himself in the secluded cave or the deserted hut to avoid his pursuer. In the intellectual as in the physical world man creates nothing: he observes and imitates, and the result in either case is what we style art.

5. This brings us to the moral distinction, which for the sake of completing our survey of the subject, we will notice without discussing.

To sum up our argument:—Peerless though the mind of man may be in the domain of intelligence, it is false to assume the existence of a deep hiatus between it and the instinct that marks the brute creation. As there is in the physical world an infinite number of steps in the gradation from the earliest forms of organic life to man, the highest type of animal, but each step is minute, in some cases imperceptible, so in the world of mind man is not distinguished as *alone* possessing the faculties of reason, but possesses these faculties in vastly higher development than any of the inferior orders of creation. In a word instinct differs only in degree and not at all in kind from reason.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

APRIL.

The weather of the past month was fine on the whole, and sometimes brilliant, and suitable to the season. It justified the name of *Aprilis* (contraction of *Aperilis* from *aperio)* given by the Romans from the earth opening at this time for the growth of plants; for this year the ground teems with vegetation, and all nature seems to rejoice in breaking the chill fetters of winter, and in awakening from the dreary lethargy of that dull period. The temperature was generally mild and above the average, and coupled with a sufficient amount of moisture to stimulate the productions of the soil, and enrobe the country in the verdant glories of hope-inspiring Spring. The season continues—as it began—to be very early, and leaves and blossoms are more forward than usual. The horse-chestnut was in leaf on the 8th, the sycamore on the 10th, and nearly all trees by the end of the month. The cowslip bloomed on the 1st, the wild hyacinth on the 4th, stellaria, wood pimpernel, and garlic on the 5th, vetch on the 18th, red campion and lilac on the 21st, white thorn on the 23rd, early orchis on the 24th. There were also in flower, speedwell, apple, garden iris and narcissus, marsh valerian, wood sanicle, &c. The microscopic fungi, *Trichobasis Scillarum* and *Æcidium Urticæ*, were also found. The swallow appeared on the 13th, and the cuckoo about the same date. The pastures and meadows are very luxuriant, and seem to promise an abundance of grass and hay. Fruit trees are too advanced, and will suffer in many instances from the destructive effect of winds and occasional frosts.

The barometer was for the most part high, but oscillated through the wide limit of a full inch and a half. The maximum height, 30·59, was attained on the 6th, and the minimum, 29·05, on the evening of the 21st, giving a range of 1·54. The instrument stood at or above 30 inches on 18 days.

The temperature of April was often warm, and the usual mean was exceeded on 20 days. The highest reading of the day thermometer was 68° on the 12th, and the lowest night record 29° on the 20th, showing a total range of 39 degrees. The greatest daily range was 33° on the 30th, the least variation 6° on the 2nd, and the mean daily range 26°·6. The mean of the maximum temperatures amounted to 58°·6, and of the minimum to 37°·8. The mean heat of the month was 48·2 degrees, which is 1°·6 less than my own average of the previous five years, and 2°·0 above the Greenwich average of 50 years without correction. The temperature therefore did not differ much from the mean value. There was frost on four nights.

The general direction of the wind was more or less westerly on 16 days, and easterly on 11 occasions. With these directions southerly and northerly currents were combined in the proportion of 13 to 17, showing a preponderance of north-westerly winds. The force was sometimes a full gale, but not of extreme violence.

The quantity of moisture in the air was very moderate, and ranged from 55 to 98. The mean degree of humidity was 71, complete saturation being represented by 100.

The rainfall of April was light, and distributed over 13 days. It measured 2·08 inches, which is equal to 210 tons, or upwards of 860 hogsheads to an acre. A showery May would be very beneficial.

Ozone was sparingly developed, and only reached a mean of 3·067.

The sanitary aspect of April was much the same as that of the previous month. There is a great deal of sickness. Scarlet fever and its complications is still the dominant disease. The experience of last autumn should remind us of the possibility of a cholera invasion in the coming summer, and we should now prepare accordingly.

MAY MEETING.

The monthly meeting of this Society was held at the Town Hall, on Tuesday evening, May 28, Mr. W. Adams, C.E., President of the Society, in the chair. There was a good attendance of members, and much interest was taken in the proceedings. Mr. Fiddian, M.B., the Hon. Secretary, read a very interesting paper on the "Skeleton of the Red Rocks." An article on the discovery made by M. Rivière appeared some short time since in *Le Courier*, a paper published at Menton, and sent to the President by W. H. Nicholl, Esq., of the Ham ; and Miss Adams, the daughter of the president, translated the paper.

The Skeleton of the Caverns of the Red Rocks.

In our last number we announced the discovery of a skeleton by Mr. E. Rivière, in one of the caverns on the Italian frontier. It is right, in the first place, that our readers should know that Mr. Rivière is appointed by the French Government to a scientific mission, having for its object the study of the natural history of Liguria, both fossil and prehistoric. After the discovery in the neighbouring quarries of an immense number of bones, teeth, and fossil horns, belonging to the bear, gigantic reindeer, rhinoceros, hyæna, and other quadrupeds of the Jurassic epoch, which have been sent to the Government museums, Mr. Rivière has lately set to work to search the caverns. The skeleton that he has just discovered was found buried under a bed of earth several metres in height.

Its state of preservation is extremely remarkable and astonishing, seeing that its age, which it is impossible to ascertain exactly, goes back to ages beyond historic times. Besides, our idea has been that this extraordinary preservation will probably be explained by an analysis of the ground in which it has been discovered, and the state of the uninterrupted dryness owing to the shelter in which it is found placed.

We have examined this skelcton in the greatest detail. The care with which it has been disengaged from the earth surrounding it has preserved its original position. Excepting the ribs, which are very brittle and have been broken by the pressure of the earth, the subject is perfect. The legs crossed in a natural position, the two arms folded close by the head, lead us to infer that the man to whom they belonged died during his sleep, and that he was carefully covered with the earth just as he lay. The thigh bones measured 47 centimetres long, the rest in proportion—that is to say, the skeleton is that of a man of a good height.

The teeth arc very well preserved, as well as the lower jaw-bone. The skull, which is tolerably large, is of a dark red brick tint, and the part touching the ground is split by the pressure. No cause can be assigned for the difference of colour.

We must state, however, that there is an infinite number of small shells adhering to it, and one is inclined to make this conjecture—that the little shells, all pierced with holes, served as an ornament, whether they were strung in the hair, or whether they made part of another head-dress.

Around the skeleton has been discovered a large quantity of tools in flint, of the stone age—scrapers, points, hatchets, and bone needles, the curious work of which seems to have been done by friction on a hard body. Bones of animals have also been found there, and amongst others the lower jaw-bones of herbivorous animals.

Behind the head a stone was found, also one behind the loins; and two implements in stone were found between the first stone and the head, the largest discovered in these caverns.

Is it by chance that these arrangements have been produced, or must it be attributed to the care taken in its interment? There is a doubt about it which science will probably solve. We shall limit ourselves for the present to give these summary details to our readers, not wishing to trespass on the domain of science. It is probable that Government will send learned men to investigate the important discovery made by Mr. Rivière, and it does not become us to anticipate them. We shall conclude by saying that at Menton we have already heard several versions. Each time that a discovery has been made, which is useful to science, there are numerous questions found: Is it a Troglodyte? Is it perchance a Saracen, a Roman, or even a Smuggler? &c., &c.

Do as we do, learned public men—wait until science shall have passed judgment.

All the curious pieces discovercd by Mr. Rivière are photographed by a very able photographer, Mr. Anfossi, of whom the "Album of Menton" has for the last three years perpetuated his reputation. Up to the present time only one skeleton of a Troglodyte has been found in France.

Mr. Rivière will publish in a fortnight from now a memoir with photographs of its discovery.

A discussion followed on what was the cause of death, and an idea prevailed that it was probably the result of a natural interment.

THE RECORD OF GENESIS AND THE RECORD OF GEOLOGY COMPARED.

Mr. Cruttwell, after introducing the subject of his paper, and describing the theories of Dr. Mantell and Dr. Chalmers, proceeded as follows :

Since McCausland wrote his book (in the year 1856) the science of Geology has advanced with such prodigious strides that many of his data and facts have to be altered in the following paper, but his principles remain the same. In fact, what I have written is simply a very short abstract of his book, put into my own words, and corrected and revised in accordance with our present increased knowledge of Geology.

"In the beginning God created the Heaven and the Earth," &c. This opening passage of the Mosaic Record shows us that there was a beginning, and a Creator of the heaven and the earth, but it affords us no direct information as to the time of the commencement of the Creation. From geological and astronomical discoveries, however, we learn that an inconceivable series of ages must have passed away since the heavens, including the heavenly host of sun, moon, and stars, and this terrestrial globe, were ushered into existence. The first picture of our planet disclosed by the Mosaic Record is, that it was without form and void; which correctly translated means invisible and unfurnished—invisible inasmuch as it was covered with water or vapour, and enveloped in the darkness which was on the face of the deep; and unfurnished inasmuch as no organic forms of plants and animals had yet been called into being. Let us now turn to the Record of Geology, and see how it corroborates the foregoing picture.

1st. Geology teaches us that there was a time when the first series of sedimentary rocks were deposited on the primordial granite; and during the enormous period of the formation of the first, or primordial formations, there is every reason to believe that the waters of the deep were spread over the whole surface of the globe, and continued so until the Silurian system, at which time we find the first traces of fossil remains of land, vegetation, or animals : the waters prevailed everywhere, and "over all the face of the earth main ocean rolled."

2nd. As to the Darkness which is stated to have rested upon the face of the Deep. The principal ingredient of the bottom rocks is evidently mud, mixed in its earlier stages with the detritus of granite, and the granite crust of the earth was formed by the gradual cooling down of the molten mass of terrestrial matter; so that when the first strata of these bottom rocks were being laid down on this crust the strong internal heat must have kept the watery surface which was spread over it in a continual state of evaporation, and, in the absence of an atmosphere,—which was not created till the "second day"—such evaporation would take place even at a very low temperature. The vapour of the boiling ocean mingled with the gaseous exhalations emitted from the heated earth, and the torrents of mud out of which the bottom rocks were then being formed, must have made a canopy of darkness over the face of the deep as long as the chaotic turmoil was in action. By the gradual cooling down of the earth's crust, the muddy vapour must have subsided, until at last it became sufficiently pellucid for the admission of light. Till then all must have been darkness upon the surface of our planet.

3rd. At and during this period, viz., the period of the formation of the Azoic Rocks, the earth was unfurnished with physical life, for in none of the rocks, no matter in what part of the world they are found, have organisms ever been discovered.

"And the Spirit of God moved upon the face of the waters." We have now arrived at the Lower Laurentian period. Our globe was invisible, unfurnished, and enveloped in a seething watery canopy. But now these boiling waters had cooled sufficiently for the lowest forms of animal life to live in them; accordingly the Spirit of God went forth into the waste of waters that rolled around the globe. Throughout the Laurentian, Cambrian, and probably Lower Silurian periods, the waters covered the face of the earth, and the Spirit of God kept brooding over them, and furnishing them with life. Entombed in the massive folds of these old old rocks we find the vast coral reefs formed by eozoon canadense (the oldest known fossil), in the Lower Laurentian seas; the countless millions of corals, molluscs, and crustaceans of the Cambrian and Lower Silurian seas. But amidst all this abundance of submarine animal life, we find no trace of any kind of vegetable or plant.

We now come to the beginning of the Cambrian system. "And God said, let there be Light," &c. The divine command and the result of it does not negative the previous existence of light as a part of the original creation, or as one of the primitive qualities of the sun, and others of the heavenly bodies. It only conveys the information that light was commanded to shine where darkness was before. The sun had sent forth his rays from the date of the creation, but the black misty envelope of the deep was impenetrable for his light until the opaque gaseous vapours that were circling round the earth, while the mud of which the bottom rocks were formed was in progress of deposition, had subsided; and that light did penetrate through a pellucid medium during the earlier epochs, commencing with the Lower Cambrian, is proved by the trilobites of that period being furnished with eyes, although of imperfect organization. But though we have now arrived at a period when the darkness was lifted from off the face of the deep, and there was light, we must not think that the light was like the light of our day; no, for the sun and all the host of heaven were invisible to any earthly eye for millions of millions of ages after the Cambrian formation; it was only a dim twilight—the same day and night, for the black envelope of vapour still rolled around the world, although now it was sufficiently pellucid for the admission of light, but no single ray could yet penetrate it. Our earth through the course of countless ages was gradually cooling down, and consequently the evaporation grew less and less, and so the black vapoury envelope became less and less dense. We must now picture to ourselves our earth one vast expanse of tepid water, swarming with zoophytes, mollusca, and crustaceans, a dim twilight over all the face of earth, thick black vapours above, a dark rolling ocean below.

"And God said, let there be a Firmament in the midst of the waters," &c. We have now arrived at the Silurian system. Previous to this, during the Laurentian and Cambrian formations, the heaven and the earth had been mingled together, that is to say, that the steam arising from off the boiling ocean which flowed round all the world rose to a certain height, and then got condensed again into water as it got into the cooler regions of the air and poured down again upon our earth. The earth, therefore, during these ages was like a tepid shower bath, the waters above and the waters below mingling together. But as time went on, and our earth got cooler and cooler, the evaporation became less and less, the black vapoury clouds rose higher up, and, instead of a shower-bath state of things, the waters above the firmament, or atmosphere, only occasionally poured down their contents upon the earth beneath. There was thus established an empty space between the waters which were above the heaven and the waters which were below, and this empty space was the firmament, or atmosphere, dividing the waters from the waters.

"And God said, let the Waters under the Heaven be gathered together into one place," &c. We have now arrived at the close of the Silurian or beginning of the Devonian system, and here for the first time we find any evidence of land. Geology teaches us that the Devonian period was ushered in by great volcanic outbursts, upheaving the bed of the sea into mountains and islands. "The mountains huge appear emergent, and their broad bare backs upheave into the clouds." Now also we find the first traces of land vegetation and fauna. Still not a single sunbeam had reached this earth; still also were the sun and heavenly hosts invisible to an earthly eye; consequently there was no luminous principle (which makes vegetation firm and hard), but only the calorific and actinic principles in existence at this time. The first of these principles is that which regulates temperature and excites motion throughout the world; and the second is a chemical principle which quickens life in the plant. The air was saturated with moisture and carbonic acid, the food of vegetation. In this state the world was like a vast humid hothouse; and the luxuriant vegetation of the coal measures was the consequence. Which vegetation geology proves to us was soft and succulent, in accordance with the want of the luminous principle, from the want of the direct rays of the sun. "Stage upon stage, high waving o'er the hill, or to the far horizon wide diffused, a boundless deep immensity of shade."

"And God said, let there be Lights in the Firmament of Heaven," &c. We have now arrived at the commencement of the Permian epoch. During all the preceding periods the sun was not,—"She in a cloudy tabernacle sojourned the while;" but during all this lapse of time the earth had been gradually cooling, and the vapoury canopy above the firmament getting less and less dense, until now the sun for the first time pierced through the clouds, and shed its glorious rays upon the rising world ; and the sun, moon, and stars, and all the hosts of heaven were for the first time seen by an earthly eye. Geology proves this ; for it is in the Permian system that we first find plants with season rings, which could only be due to the direct rays of the sun, for before there were no seasons, our earth receiving more heat from itself than it did from the sun ; but now it had cooled down sufficiently to be influenced by the heat of the sun, and seasons were the consequence. It is in the Permian system also that we first find fishes and reptiles with the full organization of eyesight. So now for the first time "uprose the sun, the mists were curled back from the solitary world which lay around." We now for the first time also find plants with a hard fibrous woody tissue, proving the presence of the luminous principle, which could only be due to the direct rays of the sun.

"And God said, let the waters swarm forth the Reptile that hath the breath of life, and let Fowl fly over the earth, upon the face of the Firmament of Heaven. Then God created great sea monsters, and every soul of the creature that creepeth, which the waters swarmed out, after their kind ; and all flying of wing, after its kind," &c. Such is the literal translation of the original Hebrew. We have now arrived at the end of the Permian system, and beginning of the Triassic, ending with the Oolitic system ; and we have only to glance over the stony record of the rocks to see how fully confirmed Scripture is by geology. In the lowermost beds of the trias or the Connecticut Sandstone we meet with the first traces of the class Aves, and also of true reptiles in the Bunter Sandstein, in the form of labyrinthodont. As, however, we advance higher up in the series into the triassic and oolitic beds, everyone, even those who have only casually examined them, is struck with astonishment at the number and enormous size of the reptilian remains. Truly has this age been called the Age of Reptiles.

"And God said, let the Earth bring forth the Living Creature after his kind," &c. We have now, in our upward march through the history of the rocks, arrived at the Cretaceous era ; the Epoch of vast Land Reptiles. "When the distant wealdes ye gaze upon once swarmed with monsters rare. There ranged the vast iguanodon, the hylæosaurus there." Advancing still farther, we at length reach the Tertiary period ; and what is the scene which now meets our wondering gaze ? Still vaster continents and islands than before are seen covered with noble forests of dicotyledonous trees, through which roam sagacious and gigantic mammals. There the huge mammoth, mastodon, and many more gigantic quadrupeds live, and sport in their native forests, lords of creation. It is the Age of the Great Mammalia, or Cattle.

"And God said, let us make Man in our own image," &c. We have now arrived at the Alluvial and Recent deposits ; at the Epoch of Man. And now we find in the rocks the first trace to show us that man has appeared upon creation. "A creature immeasurably superior to all the rest, and whose very nature it is to make use of his experience of the past for his guidance in the future."

An interesting "Microscopical Demonstration" by Mr. Franklen G. Evans brought an agreeable meeting to a close. The usual votes of thanks were heartily given.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

MAY.

May opened auspiciously with a couple of warm days, which seemed to proclaim a bright career for the flowery month; but the dark shadows of cold and threatening clouds speedily nipped the buds of meteorological hope, and veiled the golden rays of promise behind the leaden canopy of nimbus, thunderstorm, and hail. The month was characterized by a chilly, unhealthy atmosphere, heavy showers, great electrical disturbance in divers places, and a feeble manifestation of ozone. Thunderstorms were unusually prevalent and destructive for the season. On the 8th there was a thunderstorm at Great Grimsby and a man killed. At 5.20 p.m. on the same day, Dr. George Wyld, crossing Wimbledon Common in heavy rain and carrying an umbrella with iron frame and wooden handle, received a smart electric shock, and observed a ring of sparks round the points of the umbrella. On the 9th, thunder, lightning, and hail at Bampton, where the church tower and many trees were struck and much injured; a storm also at Bristol. Mashbury church, Essex, was set on fire, with damage £200. Rainham church, Kent, 800 years old, was also struck and fired twice, and narrowly escaped destruction. The next day, though fine here, the sky was very dark and lowering, and at Merthyr at 2 35 p.m.—as I was informed by a literary gentleman residing there—hail fell in small lumps of ice. At Frome on the 11th there was a storm of snow, hail and rain with great darkness. On the 22nd, at Frodingham, near Beverley, six men were struck by lightning and one killed; and Beeston Church, St. Mary's, Norfolk, was burnt by lightning. Frosts were very injurious in Yorkshire and Kent, and in our own neighbourhood potatoes and fruit trees have suffered considerably. The past month has given a severe check to the previous earliness of the season, but it was too late to be a salutary one. Cereals require warm and dry weather to put on a satisfactory appearance. Hay crops and pastures are extremely luxuriant, and furnish a good opportunity for farmers to keep instead of killing their lambs and calves. This is the only way to make up the serious deficiency in our live stock caused by disease and the destructive droughts of recent summers. The oak came into leaf on the 2nd, and early ash trees on the 12th, but many late ones had scarcely a leaf at the end of the month. The bloom of the horse-chestnut, guelder rose, and hawthorn arrived at perfection. Garden flowers and their wild relations are now too numerous to be recorded. Amongst the microscopic leaf-fungi, the *Uromyces Ulmariæ*, *Uredo Confluens*, *Lecythea Ruborum*, and the *Ræstelia Lacerata* were observed. We are now coming to a critical time of year, when the hay has to be harvested, and the fate of the wheat crop, now trembling in the balance, will be to a large extent determined.

The barometer, though not very low, was unsteady, and oscillated through limits exceeding an inch. The maximum height, 30·50, was reached on the 27th; and the minimum, 29·46, on the 7th, giving a range of 1·04. The instrument stood below 30 inches on 15 days.

The temperature was cold and ungenial, and below the average on 21 days. The highest reading of the day thermometer was 71° on the 1st, and the lowest night record 30° on the 19th, showing a total range of 41 degrees. The greatest daily range was 32° on the 1st and 23rd; the least variation 13° on the 4th, 14th, 17th, and 29th; and the mean daily range 20°·4. The mean of the maximum temperatures amounted to 61°·3, and of the minimum to 40°·9. The mean heat of the month was 51°·1, which is 2°·6 less than my own average, and 1°·8 below the Greenwich mean of 50 years without correction. Frosts occurred on several nights, but the principal damage was done on the morning of the 19th.

The general direction of the wind was more or less westerly on 21 days, and easterly on nine occasions. With these quarters southerly and northerly currents were combined in the proportion of 6 to 20, showing a predominance of northerly and westerly winds. The force was often considerable.

The quantity of moisture in the air varied from 55 to 90. The mean degree of humidity was 73, complete saturation being represented by 100.

The rainfall of May was moderate in amount, but distributed over 19 days. It measured 2·87 inches, which is equal to 289 tons, or upwards of 1,200 hogsheads to an acre. It generally fell in heavy showers, sometimes accompanied with hail and thunder; but we escaped the violent storms that prevailed in many other places.

Ozone was very sparingly developed for a month usually rich in this principle. The mean degree of ozone was only 2·484.

The sanitary condition of this neighbourhood is similar to that of the past few months, and is still defective. Inflammatory and zymotic diseases are still rife. The only change to note is the occurrence of several cases of smallpox, of which one proved fatal; but it is satisfactory to be able to state that the subject of it had never been vaccinated, so that he was exposed to the full force of the malady, which has shown more virulence in the present epidemic than at any previous time since the valuable discovery of vaccination by the illustrious Jenner.

JUNE MEETING.

The usual monthly meeting of this Society was held in the Nisi Prius Court, at the Town Hall, on Tuesday, June 18th. The chair was occupied by Franklen G. Evans, Esq., vice-president. There was a large attendance. The routine business having been transacted, and some gentlemen elected members, the following

Lecture on Chambered Tumuli

was delivered by Walter Lukis, Esq. After some appropriate introductory remarks on the objects of the Society, and the value of a well-arranged Museum as a means of imparting instruction, the Lecturer proceeded as follows:

Mr. President, Ladies, and Gentlemen,—The subject upon which I have undertaken to address you to-night is replete with interest. It is interesting as forming a portion of the vast field of tumular sepulchres, as relating to those feelings of the human heart which find expression in monuments of bereavement and sorrow, in gigantic monumental works, and in the performance of funeral ceremonies, altogether different from those to which we are accustomed now, and as belonging to a very remote period of human history.

It is a "grave" subject, and on that ground I shall endeavour to enliven it so as to preclude, if possible, the chances of some of the grim and mysterious forms upon the walls rising up in magnified horror to disturb your night's sleep.

After explaining that the word cromlech—derived from the Welsh *crom* and *lech*, curved stone, or *grymlech*, stone of strength—was not applicable to the subject, and was used in a different sense on the Continent, the Lecturer continued,

I have preferred giving the title of "Chambered Tumuli" to this lecture, because it will convey to your minds at once the subject matter. It tells of a chamber and of a tumulus, the former being the cromlech, if we must use the word, and the latter its outer covering, without which the former never existed as a building complete in itself. The fact is that what has been called a cromlech is nothing else than a dilapidated chambered tumulus. Now, with this firmly impressed on your minds, I will proceed to describe the original construction—refer you to a few dilapidated examples, and then explain some early forms of interest which have come to my knowledge from a personal examination of many of these primeval tombs.

Tumular sepulchres may be divided into two great classes—viz., unchambered or single barrows, which are the most common, and chambered barrows, which, from the gigantic labour necessary for their construction, are less common and belong to a higher class of architecture. Each of these again may be subdivided into circular and long barrows; and in the case of those which are chambered, a distinction may be drawn between those which are simple kists or stone chests, closed on all sides, and those which have a covered way or passage leading from the outside of the barrow to the inner chamber. It is probable that all these forms were contemporaneous, and that they indicate class or family distinctions among the primitive races who constructed them. We may suppose that those tombs which required the greatest amount of physical labour to erect, were the receptacles of illustrious dead; that, as among the more civilized Egyptians of the same era, there were the pyramids, those marvellous stone barrows of royal personages, and the more humble sepulchres of the lowly subjects, so in Western Europe there were the gigantic tumuli and the richly-sculptured chambers of Celtic heroes and distinguished families, and the simple barrows of small dimensions, and the unmasked graves of more humble individuals.

I purpose to confine my remarks to the chambered class of barrows and their contents.

The prevailing notion respecting so-called cromlechs has been this—that they were rude artificial stone structures, always visible, as many are now, but complete in themselves and altogether distinct from barrows; and this notion has settled down so firmly in the minds of men that some archæologists cannot divest themselves of it, and in recent works have classified cromlechs and barrows under different heads. We need not travel far from Cardiff before we find two splendid examples precisely similar to those we meet with in other parts. These are to be met with in the parish of St. Nicholas, about six miles from here, on the Cowbridge road, on Mr. Bruce Pryce's property. The one is totally denuded of its tumulus, which appears to have been composed of earth; the other still shows traces of its original mound, which was of small stones. These are sometimes called galgals.

I may here mention that when I visited these interesting remains, I removed some of the ground and stones around them, which had been thrown out from the interior, with a small geological hammer, and found the human remains now before you, and also some small pieces of coarse pottery, fully proving that these monuments had been used as burial places. The finger bones and toe bones can be easily recognized. There is a third cromlech in Llantrisant parish, on this side of the iron ore mines now being worked there. The spot is called in Welsh Caer-arfa, or the Field of Arms. A Roman camp crowns the hill north of it. There are many others in Wales, Ireland, &c.

It is a remarkable circumstance that no distinct allusion is to be found in Anglo-Saxon documents to cromlechs as visible stone structures.

This absence of allusion to cromlechs affords a fair negative proof of what I shall presently show, viz., that these structures were the chambers of tumuli, and in Anglo-Saxon times hid from sight. They are very commonly supposed to be altars erected by the Druids for human sacrifices, but this is quite incorrect.

I will now describe the erection in its original and perfect condition. A mound of earth or small stones, of a conical or long form, enclosing a chamber composed of rude stones placed on end, bearing large stones laid across them, the whole surrounded sometimes by stones placed at intervals, and sometimes by a fosse and vallum at the base of the barrow. Erections of this kind and in this state may be seen in Great Britain and Ireland, the Channel Islands, France, Norway, Spain, Africa, &c., and in other countries.

You will observe that this was the rude attempt of a primitive people to construct a sepulchral vault, or dark chamber, in which they might securely deposit the mortal remains of honoured relatives and friends. They were unacquainted with metal, and therefore were incapable of fashioning their blocks of stone. They were ignorant of the art of splitting rocks and could not reduce their masses. The very fact of their employing such colossal blocks as they often did is a proof of their limited knowledge of the art of building, and testifies at the same time to their prodigious physical energy and perseverance, and to their mechanical skill. You may wish to know how such structures could have been raised by a people who had no knowledge of metal tools and of mechanical appliances with which we are familiar. The builders were compelled to use such stones as they found on the surface of the ground, selecting those which were best adapted for the purpose. Sometimes they brought them long distances, across an uneven and rough country, which must have been a work of time and labour.

The late King of Denmark, who bestowed a good deal of time and attention on archæology, wrote, a few years ago, a very interesting article on the construction of these sepulchres, in which he suggested two methods, the one or the other of which he thought was adopted according to circumstances.

1. A mound of earth and small stones well rammed together, was raised to the required height, and an incline of earth, of a gradual ascent, was formed on one side. Up this slope the large block destined for the roof was drawn on rollers (boughs of trees, &c.) The earth was then excavated beneath the stone, and one by one the stones which were to form the side walls were inserted. When this had been accomplished, the interior was cleared out, and the chamber formed.

2. The stones intended for the side walls were first set up, each stone touching its neighbour. Earth and small stones were then well rammed round them, until they were buried to their tops. An incline was added, as in the other method, and the roofing stone was drawn up, and made to rest on the upright ones. The chamber was cleared out afterwards. In either case the outer circle was placed last.

The latter method commends itself rather than the former, as being more simple, more easy of construction, and more safe.

In some instances, cap-stones are observed to be resting on a stone at one end and on a dry walling at the other. In the Tumiac two of the roofing stones rest upon dry walling only. The period during which chambered barrows were erected must have extended through a long series of years, in the course of which the art of building them improved.

I will now point out in what manner the great engineering difficulty of roofing large spaces without the necessity of employing ponderous stones was achieved; and will refer you to a well-known Barrow, *i.e.*, New Grange, in Ireland.

This is a barrow or cairn of large dimensions, originally 100 feet high, covering about two acres of ground, and having a circle of stones at its base.

The stones of the chamber are supposed to have been conveyed a distance of 11 or 12 miles from the coast. There are three chambers in the middle of the barrow, access to which is gained by a long covered passage. The side walls are formed in part of flag-stones, set up on end, those at the entrance being only about two feet high—their height increasing as you advance along the passage, until you reach the central chamber, where they are about seven feet in height.

This passage has also an increase of height given to it by a dry walling and is roofed over with stone slabs, some of them being of large size.

But the vestibule, which is common to the central chambers, instead of being covered in the same way with a large roofing stone, is arched over by a number of flat slabs overlapping each other, forming a dome.

There are instances in the West of England of a similar construction (Stoney Littleton), and it appears to me that this mode of building belongs to a later period than those to which I have before referred. Its architecture is of higher standard, and must be the result, I think, of an improved state civilization.

We will take another instance of still higher construction of art, although based on the same general principle as that of the Chambered Tumulus of Maes How, in the Orkneys, about one mile and a half from the celebrated stones of Stennis.

This barrow is supposed to have been erected as late as A.D. 780, and to have had side chambers added 300 years later. This is said to be intimated by the "runes" inscribed on its walls.

As these inscriptions have been variously interpreted by northern antiquaries who are learned in the language, it is possible that the barrow may be of much older date, and that it was taken possession of and added to by a later race of men.

Here we have a covered passage, leading to a centre chamber, or square vestibule, on three sides of which is a smaller chamber or cell.

Here, too, we have the vestibule roofed over by overlapping slabs of stone. But the masonry of the walls is of a higher class than that at New Grange and Stoney Littleton; the stones are squared and fitted together with as much care and precision as any modern masonry could be. The great defect of the construction is the absence of any bonding at the angles of the building; the importance and necessity of which to render the work sound and firm does not appear to have presented itself to the mind of the primeval architect. No one would certainly say that this building belongs to the same age as New Grange. Mr. Petrie thinks it was originally erected as a chambered tomb for some chief, or person of great note, probably long before the arrival of the Norsemen in Orkney.

Unfortunately it was rifled and partially destroyed by early treasure seekers, so that all chance of ascertaining from the contents the age to which the tumulus belongs has been lost.

It is not improbable that the singular many-chambered tumulus, once existing in the Island of Jersey, belonged to the same class as these. Up to 1785 the tumulus was supposed to be one of the ordinary unchambered kind, but in that year was cleared away and the stones left standing bare. On the same hill stood another chambered barrow and a stone circle, the whole of which were swept away. The form of this structure is quite unique. There is a covered passage leading to the inclosure or vestibule which was no doubt arched over in the same manner as at New Grange and Stoney Littleton. This monument now stands in a park near Henley-on-Thames.

There are structures of a much ruder character than the above, to which subsequent additions of external side chambers were made from time to time. These additions are more frequently found than is commonly supposed. Sometimes one side only occurs, at other times there are three or four. There are four, two on either side of a large chambered tumulus, still to be seen in Guernsey, in one of which a remarkable interment was found. There are two, one outside and another inside of the Pouquelaye, in Jersey.

There are three if not four attached to two so-called cromlechs at Carnac, in Brittany. There are two at Wayland Smith's Cave, in Berkshire, and I feel confident that there are two if not three attached to a large chambered long barrow near Silbury Hill, in Wiltshire, which have never been explored.

The difference between these side chambers and those at New Grange, Stoney Littleton, &c., is that they appear to have been added to the main building at different times, perhaps at long intervals, whereas there is every reason to suppose that those at New Grange, &c., were all erected at one time.

These side chambers, although generally of small dimensions, were not intended for receptacles of one or two bodies only, as in the instance of the kneeling skeletons, of which I will speak presently; nor to be filled in with earth at the time of the interment, as in the same instance. They were often sepulchral vaults, in the same way that the main structures were, and used for a considerable period for successive burials as in another Guernsey example, where there were as many as three distinct layers of interments.

Having mentioned that the action of the elements and agricultural improvements were the probable causes of denudation and dilapidation of these stone chambers, which, when thus exposed, became objects of superstitious dread to the peasantry, the lecturer proceeded. A monument of this kind near Marlborough, Wiltshire, is called "The Deist's Den." Another, in Berkshire, was believed in Saxon times to be the workshop of their mystic blacksmith Weland, and is to this day called "Weland's Smithy," or

Wayland Smith's cave. I will tell you what the country people say of it. "At this place lived formerly an invisible smith; and if a traveller's horse had lost a shoe on the road, he had no more to do than to bring his horse to this place, with a piece of money, and leaving both there for some little time, he might come again and find the money gone, but his horse new shod."

You will remember that Sir Walter Scott has availed himself of this tradition, and introduced it into his tale of "Kenilworth."

Fairies are also believed to have had a hand in the construction of these places, for tables and grottoes—one of the popular beliefs is, that as they descended the mountains, spinning by the way (which, I conclude, is the regular and constant occupation of the fairies), they brought down these huge stones in their aprons, and placed them as they are now found. They are constantly called in many countries fairies' tables, and fairies' holes or grottoes. The stones of Stonehenge, in Wilts, are said to have been brought over from Ireland by the fairies. In Brittany, cromlechs dolmens are supposed to be haunted by the dur or dwarf, a hideous little old man, who on Wednesday nights, in company with the korrigs, or female fairies, dance around about the dolmen, singing songs. The korriggwen or korrigan, a female fairy, is believed to be the spirit of the druidess, and haunts the mossy well which springs up near the dolmen.

These beliefs are common to Brittany, Ireland, Scotland, Wales, and all the north of Europe, and form the subject of ballads in the poetry of all. The day I visited the cromlechs on Mr. Bruce Pryce's property, I met two children playing near one of them. On my asking the name of the spot, they at once replied, Castell Korrig. I was particularly struck with this word, having so often met with it in Brittany when visiting the Celtic remains of that country.

I will now direct your attention to the contents of these sepulchres, and exemplify this portion of the subject by referring to the personal investigations of my father, brothers, and myself. I do this in preference to relating the discoveries of others, because few explorers happen to have had such opportunities as we have of examining primeval structures in which the interments had not been previously disturbed; and although these investigations were conducted principally in the Channel Islands, it has been found that the burial customs, as far as has been ascertained, were probably similar in many respects in Great Britain, in Brittany, and in other countries, and I may add even in this neighbourhood, for I have before you this evening a few bones and pottery picked up by myself at the two cromlechs I have already spoken of.

After digging through a mass of rubbish, the accumulation of many centuries, the floor of the tomb was reached. It was observed that it consisted of a flat pavement of rude flags of granite, on which were placed human bones, burnt and unburnt, sun-burnt jars of coarse earthenware, of various sizes and shapes, clay, stone and bone beads, bone pins, flint and arrow heads, stone and bone implements.

In several instances in Brittany the principal chamber was paved with one large flat stone only.

There were two general modes of disposing of dead bodies. 1, burying the bones entire ; 2, by burning the bodies and collecting the ashes.

The only instance of an entire skeleton was in the side chamber of Détrus (kneeling figures) in Guernsey.

I will now describe the manner in which several of these heaps of bones and jars were deposited. Sometimes the jars were found to be empty, in which case it is supposed that they must have contained at one time food for the departed souls. In other cases they held the bones reduced by fire to small fragments.

The sepulchral chambers contained several layers of interments. In one there were as many as three. In another instance (Heren) it was observed that the lower interments must have lain undisturbed for a considerable time before the next layer covered them. This was shown by a skull being found covered with snails' shells (Helix nemoralis), which had hibernated upon its surface, and had died there and become fixed to it, when the second layer of interments was added. A proof, if any were required, that the interior of the chamber was not filled in with earth at the time of each interment, as was the case in Denmark, according to Professor Worsaae.

The following were points which were particularly noticed by us : 1. The jars in the lowest stratum were of a plain, simple, and coarse description. 2. Those in the upper strata were of a better form and of a better material, denoting an improvement in manufactures, some being ornamented with markings. 3. Several of the jars bore marks of use previous to interment, showing that the most valuable and useful articles of daily use were deemed worthy of accompanying the remains of the departed.

These facts lead to the conclusion that the sepulchres must have been in use for a very long period of time.

I have said that some of the jars were supposed to have contained food originally. The depositing of food-vessels is a very ancient custom, and had its origin in a belief of the immortality of the soul. It is supposed that the sepulchres were visited occasionally by the relatives who revered the memory of their ancestors, and performed certain rites and ceremonies there, as if in the presence of the residing spirit of the departed, to whom they then gave a share of their food.

You will be somewhat surprised to learn that this custom still lingers amongst us. My brother was informed not very long ago of the following incident at a Yorkshire funeral feast ! A gentleman was carving a joint of meat for the invited relatives and friends at the house of a deceased gentleman, when he was requested by the widow to cut some for her departed husband, for whom a place had been reserved at the table, and a plate and knife and fork provided.

But a more remarkable instance of the indulgence of this feeling is to be found in the custom prevailing in the family of Victor Hugo, who is residing in the Island of Guernsey.

In his dining-room there is a chained and empty chair, wherein the ghosts of the dead Hugos are supposed to sit at the table of their descendants. Whether this be really a superstition of the poet, or only the play of an intense imagination, or whether it be a sad monument of later and no imaginary sorrow, I know not.

It were easy to ridicule the indulgence of such a fancy; easy also to speak of it severely as morbid; but there is a fine thought in it. "The dead are gone from us," says the chained chair, "but we have not forgotten them; and if they would come and sit at our table again and occupy their old seat, they would be welcome."

The chair has several inscriptions carved upon it, of which one is, "*Les absents sont la.*"

I have said that stone implements—i.e., "Celts" and other articles—were found together with human remains in these sepulchres. They are supposed to have been hatchets or knives for slaying oxen, &c.

Some persons digging in the peat near the village of Rêche, in Burwell-Fen, found a head of an extinct ox (Bos Primigenius) at a depth of four feet. When they came to examine the skull, they discovered a portion of a flint celt firmly fixed in a fracture of the frontal bone. The celt had penetrated to the depth of nearly three inches, and broken with the blow. A portion of the frontal bone had been carried inward with the celt. One feature of great interest connected with this discovery is the positive evidence it affords that this extinct animal was hunted in England. There had been abundant evidence of another extinct ox (Bos Longifrons) having served as food for man, both in Ireland and in England, but little of this other species. Hugh Miller, in his "Sketchbook of Popular Geology," mentions another instance. "The cervical vertebræ of a native ox (Bos Primigenius) having been found deeply scarred by a stone javelin of a primitive hunter;" but he does not say whether the stone weapon was found with the bones.

It is very remarkable that in every country where these ancient implements are found, superstition in one form or other is connected with them. They are universally called "Thunderbolts," being believed to be fashioned by the shock of thunder precipitated from the clouds. In Brittany the peasants throw them into wells to purify or sanctify the water. They are also laid up in their houses as preservatives against lightning, or against the unwelcome intrusion of evil spirits! In the Alps, shepherds tie them over the shoulders of the bell-wether, to preserve their sheep from small-pox. In Cornwall, rheumatism is attempted to be cured by a "boiled thunderbolt." The celt is boiled for hours, and the water then dispensed to rheumatic persons! One old woman, it is said, who adopted this practice expressed her surprise that boil the celt as long as she would, it would never boil away!

After contemplating these stupendous structures, or monuments, and learning the uses to which they were applied, we are naturally led to inquire by whom they were raised, and at what period? It is much more easy to ask than to answer this question, because it irresistibly carries us back to an age long anterior to any historical record of our country. But, although we know very little indeed about the matter, still I should wish you to have some idea, however indefinite it may be, of the remote period of man's history to which we may perhaps attribute their erection, and of the races by whom we may suppose them to have been erected.

Even in the gloom which pervades, we seem to catch here and there glimpses of certain landmarks, whose outlines, though faint, are yet tolerably safe as guides. One of these landmarks is the total absence of metal in these primitive tombs; another landmark is the primitive rudeness of the structures themselves; another is the extreme simplicity and small number of their personal ornaments.

Now, if we follow the course which these landmarks direct, we shall be led to an era far anterior to the Roman invasion; and to a period, it may be, anterior to the commercial intercourse of the Britons with the Phenician traders; and this will bring us to the era of the Trojan war, or 1,200 years B.C.; and that these are tolerably safe guides is evident, because it is admitted by antiquaries that the contents of barrows can alone identify the people, or the period to which they belong.

What I have said will give you therefore some notion of the period to which these structures may be ascribed. I do not say that they all belong to this remote era, but my own belief is that many of them do.

Now, with regard to the people who erected them, I can only tell you what I have read in history, and what you already have learned about the origin of the Western nations of Europe, viz.: That they have sprung in the first instance from emigrants from Asia, whom the earliest Greek Historians called Celts.

But at what period Great Britain was occupied by them is uncertain, though scholars and chronologists have supposed it was as early as 1,600 years B.C.

These graves (of the "voiceless dead") are imperishable epitaphs of men of giant wills and energetic actions; records silently, yet more correctly, descriptive of what they were than many of those boastful tablets which too often deface the walls of our churches, and tombstones which crowd our church-yards, and are too often miserable witnesses of those who have gone before us.

METEOROLOGICAL REPORT.

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

JUNE.

The weather of June was for the most part of a similar general character to that of May, with the exception of a few hot days about the middle of the month. There were the same cold, unwholesome atmosphere, heavy rains, and violent electrical disturbances—the latter associated with the period of heat. Ozone, however, was much less deficient. Thunderstorms and floods were sadly prevalent, and productive of serious mischief over a wide tract of country; but their principal fury was manifested with concentrated energy on the 17th, 18th, and 19th. On the 17th a severe storm visited Leeds. On the 18th two storms of terrific thunder, lightning, hail and rain at Leamington; shop struck, exit of the lightning through the door, the plate glass of which was broken, and *fused* by the intense heat. Cottage struck in the second storm. At Northwich the flood waters were from 4ft. to 5ft. deep in some streets, the cellars full, goods much damaged, and occupants got out in boats. Fields and roads under water. The County Court was inundated, and the judge, officials, and the public—after a temporary survey of the scene from the top of benches and other elevated positions—were got off in carriages and on hurdles and rafts. The salt works were flooded, and a child was drowned. Two men were struck by lightning at Appleby. In every part of West Yorkshire there were thunderstorms and rain and hail. On the Midland Branch Railway a part of a tunnel fell in and blocked up the line, and the tunnel was deluged with water through the injured parts. The difficulty was increased by the bursting of a mill reservoir some miles off, and the contents, favoured by the gradient, rushing into the tunnel. The accident caused great detention of passengers. Wharfe Valley, Pudsey, and Bradford severely visited, a child struck and stunned, and a cow killed. A fisherwoman, at Fisherrow Links, killed. At Derby there was a series of violent storms, houses were struck, and there were heavy floods. At Market Harborough there was a tremendous storm, and four inches of rain in three hours, which caused floods in which a farmer was drowned, and landslips. Henley-in-Arden had 3½ inches of rain in less than two hours. Storms occurred at Bath and Plymouth, where a horse was killed. At Walsall a mother and child were killed, and at Northampton loss of life took place. Macclesfield had a storm of twelve hours' duration, and received 4·27 inches of rain. On the 19th we had a severe storm in this neighbourhood, and at St Nicholas some cottages and a stable were struck, and a cow was killed. These are, in brief outline, some of the phenomena which distinguished the month, and many others of a similar kind might be noted, but space forbids. It is very rare to have two months consecutively marked by so many and destructive thunder-storms and floods, and those of May were without the usual accompaniment of warm weather to account for them. The continuous rains converted the previous early promise of good hay crops into an assurance of a superabundant yield. Some few fields were cleared in good condition during an interval of fine weather towards the end of the month. In other respects the position has been reversed, the forward Spring having retrograded into a rather late Summer. Cereals were somewhat behind in coming into ear and bloom, and the latter critical process was not altogether favoured by the elements. The smut fungus *(Ustilago Segetum)* has appeared sparingly, but there is great freedom so far from rust. It is not too late to anticipate an average yield, though it is perhaps too much to expect a heavy corn and hay harvest in the same year, the requirements of each being so very different. Aphides are very numerous and curl up the leaves, of some trees into grotesque forms.

The barometer was not very low, and fluctuated through limits of nearly an inch. The maximum height, 30·39, was attained on the 16th, and the minimum, 29·41, on the 9th; giving a range of 0·98. The instrument stood at or above 30 inches on 18 days.

The temperature of June was below the average, very variable, and had a wide range. The highest reading of the day thermometer was 87° on the 18th, and the lowest night record 36° on the 1st; giving a total range of 51°, which is the highest I have registered. The greatest daily range was 33° on the 17th, the least variation 10° on the 19th and 25th, and the mean daily range 20°. The mean of the maximum temperatures amounted to 67°·8, and of the minimum to 47°·8. The mean heat of the month was 57°·8, which is 1°·3 below the average temperature of 50 years.

The general direction of the wind was more or less westerly on 25 days, and easterly on 4 occasions. With these quarters southerly and northerly currents were combined in the proportion of 13 to 15, showing a large excess of westerly and a small one of northerly winds. The force was moderate.

The mean degree of humidity was 75, complete saturation being represented by 100.

The rainfall was very heavy for the season, and amounted to 5·52 inches. This is equal to 557 tons, or upwards of 2,300 hogsheads to an acre. Rain fell on 19 days. The large falls in a few hours at some places, previously mentioned, are very unusual, if not unprecedented, in this country. If we may assume that Juno is the presiding genius of June, it must be admitted that the "better-half" of Jupiter Pluvius is equal to himself as a cloud-compeller and rain-producer. This is suggestive of storms, and perhaps tears, in the usually serene atmosphere of Mount Olympus; and of a suspicion that the ladies there, like some of the strong-minded ones here, are desirous of at least equality, if not to get the upper hand.

The development of ozone was much improved, and reached a mean of 4·533.

The sanitary aspect of June was very similar to that given in recent reports, but towards the end of the month a tendency towards improvement was apparent.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

JULY.

July was another most singular month in a meteorological point of view, and formed with May and June a thunderstorm-ridden period which has rarely if ever been equalled. We may well believe that since the days when Julius Cæsar launched his thunderbolts of war, and *Quintilis*, the ancient name of the month, was changed to *Julius* in his honour, July has never been more loaded with the battles of contending electrical forces, or so completely rivalled the repute of its great military namesake. Thunder-storms and concomitant heavy rains were the key-notes of the muttering, plashing chorus of the angry elements, with a running accompaniment of the roaring flood-waters of the swollen brooks and rivers. The storms and inundations were spread over a wide area, and the centres of greatest disturbance were shifted in rapid and unsparing succession. About mid-day on the 6th the sky was covered with a black canopy of low-lying clouds, and at 1 p.m. a darkness about equal to twilight came on. Shortly afterwards a thunder-storm commenced, of great severity, with unusually heavy rain. The waters of the Taff rose suddenly like a great tidal wave, and carried away pigs, cattle, timber, trams, &c. Near Rhŷdyhelyg the roads were submerged, and a man and cart, with a valuable horse, were carried away and were unhappily drowned. This did not occur from any attempt to cross the river as has been reported. In the course of the night the storm reached its height and the rain was terrific. The village of Tongwinlais was much flooded. The brook overflowed its banks, ploughed up the roadway, and formed a temporary river through the street, which could only be crossed on horseback or in a carriage. A great many houses were flooded, some from the brook, but most merely from the torrents that rushed down the surrounding hills. Similar results occurred at Merthyr, where a large reservoir above Plymouth Works burst and flooded collieries, damaged offices and books, and caused a limekiln to explode. A blast furnace would have shared the same fate, but it was luckily out at the time. A patent fuel works is said to have sunk completely out of sight into an old coal pit. There were narrow escapes, but no lives lost. The village of Troedyrhiew was four or five feet under water. The most grievous private misfortune from the storm occurred at Duffryn House, the seat of J. Bruce Pryce, Esq. The flood was 10 feet deep in the cellars, and destroyed many dozens of valuable wines. Cartloads of gravel were drifted into the standing hay crops. On the ground floor the water was four feet deep, and spoiled books, carpets, furniture, and china, and made the lower parts of the house quite uninhabitable. Valuable papers were also ruined; so that in addition to a very large pecuniary loss, there was another loss which cannot be measured in coin, or compensated for in money, and can only be realised by those who value old records and the interesting memorials and relics of the past. All must sympathise with the venerable proprietor in his heavy calamity. On the afternoon of the 7th the storm was renewed, and intensified the previous effects. A very destructive thunderstorm visited London on the evening of the 23rd, and caused fires, floods, and loss of life. The most brilliant storm for many years happened on the night of the 25th and morning of the 26th. The rain was heavy, the thunder continuous, and the lightning so vivid and incessant that the heavens were constantly lit up with a marvellous display of dazzling electric light. The workmen in the Pentyrch Forge were so blinded by the lightning that they were obliged to give up work. These are some of the most interesting events of the month, but the whole country teems with others of equal interest in their respective neighbourhoods. Many fields of hay are still ungathered in consequence of the wet. The wheat is turning rapidly, and will soon be ready for the sickle. Vegetation of all kinds is very abundant and affords ample keep for cattle and sheep, but the difficulty is to get the stock to eat it. Amongst microscopic fungi *Æcidium Tussilaginis*, *Trichobasis Labiatarum*, and *Coleosporium Tussilaginis* were found.

The barometer was fairly high and steady throughout the month. The maximum height, 30·37, was reached on the 4th, and the minimum, 29·84 on the 30th, giving a range of only 0·53. This is another illustration of the fact that electric commotions do not much influence atmospheric pressure. The instrument stood at or above 30 inches on 20 days.

The temperature of July was marked with some bursts of great heat, but the mean of the month did not much exceed the usual value. The highest reading of the day thermometer was 85° on the 21st, and the lowest night record 43° on the 31st, showing a total range of 42 degrees. The geatest daily range was 32° on the 21st, the least variation 13° on the 11th and 29th, and the mean daily range 20°·9. The mean of the maximum temperatures amounted to 73°·4, and of the minimum to 52°·5. The mean heat of the month was 62°·9, which is exactly my own average, and 1°·1 above the Greenwich mean of fifty years. On 13 days the temperature was below the average. In 1868, 1869, and 1870, July was much hotter than the present month. Some people are fond of calling a little burst of heat "tropical weather," which is an exaggeration. Mungo Park's negroes could not sleep from the *cold* at a temperature many degrees higher than the hottest night we have recently experienced.

The general direction of the wind was more or less westerly on 21 days, and easterly on nine occasions. With these quarters southerly and northerly currents were combined in the proportion of 18 to 11, showing a large predominance of south-westerly winds. The force was very moderate.

The quantity of moisture in the air, although sometimes great, was not excessive on the whole. The mean degree of humidity was 73, complete saturation being represented by 100.

The rainfall of July was remarkable for the short time in which it fell, as well as for the large total. It amounted to 5·92 inches, which is equal to 598 tons, or upwards of 2,450 hogsheads to an acre, and is 2½ inches above the average of the month. Rain occurred on 13 days, and 18 were fine and dry. The greatest fall in 24 hours was 2·36 inches on the 6th, which is the highest I have recorded. On the afternoon of the 7th, 0·90 (nearly an inch) fell in 50 minutes. Adding these together, and taking the time from the beginning to the close, would give the vast total of 3·26 inches in 27 hours. Hence the floods!

Ozone was not highly developed. The mean degree was 3·677.

The health of the neighbourhood is good on the whole, but a tendency to diarrhœa is beginning to manifest itself.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

AUGUST.

The weather of August was of the same general character as that of the previous month; but the manifestations of conflict were less intense, and the fierce powers of the air seemed inclined to give place to a rule more like the beneficent sway of Augustus, from whom the month derived its name, in lieu of the more ancient one of *Sextilis*. Thunderstorms still occurred, and some of them were of much severity. The most notable took place on the 2nd and 7th. That of the 2nd raged with great violence in and around Cardiff. A cow was killed at Penarth, and a house struck at Splottlands. According to the reports of the latter accident a ball of lightning, with unusual complacency, remained in the middle of the room until the door was opened for its easy exit; but this is evidently a mistake, and must have arisen from the lightning having dazzled the eyes and bewildered the judgment of the narrator. During the same storm Mr. Francis Powell, of Groes Farm, Southerndown, and his horse, were killed in crossing the hill to his house. The storm of the 7th was severe and widespread. Houses were struck and flooded in the Staffordshire Potteries. Part of the Newcastle Branch of the North Staffordshire Railway was washed away, and the main line submerged. There was a storm also at Rhymney, &c. A fair breadth of cereal crops and the fag end of the hay harvest have been secured in good condition. The wheat yield in this neighbourhood appears to be satisfactory, but that of the country generally will prove decidedly below the average. Peas, beans, oats, roots, and lattermaths are most abundant, and will more than compensate in value for any deficiency in wheat. The potato crop is most extensively diseased, and in some localities almost destroyed. The cause of this malady, judging from the newspapers, is not so well known as it ought to be. It is produced by a fungus called in scientific circles *Peronospora Infestans.* It first appeared in this country in 1845, and a year or two earlier on the Continent. The spores of the fungus—which are equivalent to the seeds of flowering plants—have never been wholly absent since the first attack, and the greater or less prevalence of the disease in any given year has depended upon predisposing causes, most of which seem to act by lowering the vitality of the plant, which is favourable to the development of the fungi. The causes that predispose to the disease are much rain, damp soils, heavy dressings of stable and farmyard manures applied too closely and immediately to the crop; the practice of always growing from the tuber, instead of sometimes reverting to the seed; the constant employment of the same sorts in the same ground; planting tubers more or less diseased, &c. The avoidance of these conditions would I believe reduce the disorder to a minimum, and perhaps, with a few other precautions, altogether get rid of it. The injurious effect of thunderstorms is due to the heavy rains and damp close atmosphere which accompany them, rather than to the electricity itself. To be brief, I may say that the actual cause of the disease is a fungus, which can be much diminished by a timely sorting out of diseased tubers in store, giving them plenty of room and frequent examination, and dressing them with quicklime, &c. The predisposing causes can only be dealt with by attention to such points of cultivation as I have mentioned. In addition to the potato fungus, *Coleosporium Rhinanthacearum*, *Tilletia Caries*, *Melampsora Betulina*, *Uncinula Bicornis*, *Puccinia Graminis*, and *Erysiphe Tortilis*, were found during the month. Of these the *Puccinia Graminis* and *Tilletia Caries* are of economic importance, the one being the "mildew" and the other the "bunt" of corn crops. Three out of the four fungi which infest cereals reveal themselves by well marked outward signs, but the "bunt" would be unnoticed by the passer-by, because it is the inside of the grain that is affected. When crushed the disease shows itself by a black colour and a fetid odour, and I fear that much flour is rendered nauseous by this unpleasant parasite. The miller ought to be able to detect the damaged grains before grinding; but the baker and the public simply loathe, and wonder why the bread is so disagreeable.

The barometer was fairly high, and its extreme limit of oscillation a little exceeded three-quarters of an inch. The maximum height, 30·43, was attained on the 28th, and the minimum, 29·62, on the 7th, giving a range of 0·81. The instrument stood at or above 30 inches on 20 days.

The temperature was below the mean on 18 days, and above it on 13 occasions. The low values chiefly occurred in the first half of the month. The highest reading of the day thermometer was 80° on the 17th and 18th, and the lowest night record 42° on the 1st, showing a total range of 38°. The greatest daily range was 32° on the 17th, the least variation 12° on the 5th and 11th, and the mean daily range 20°·7. The mean of the maximum temperatures amounted to 71°·4, and of the minimum to 50°·6.

The mean heat of the month was 61°, which is a small fraction below the Greenwich average of 50 years.

The general direction of the wind was westerly on 15 days and easterly on 13. With these quarters southerly and northerly currents were combined in the proportion of 17 to 12, showing a slight preponderance of westerly and southerly winds. The force was very moderate.

The mean degree of humidity was 73, complete saturation being represented by 100.

The rainfall was distributed over 16 days, and measured 3·50 inches. The wet days exceeded those of July in number, but yielded a much smaller amount. The total is equal to 353 tons or upwards of 1,460 hogsheads to an acre. The maximum fall in 24 hours—1·09 on the 1st—was nearly a third of the whole quantity.

Ozone was not abundant, the mean degree having been only 3·129.

The sanitary condition of this neighbourhood is satisfactory, especially with regard to diseases of a preventable character. The zymotic class was represented solely by a slight prevalence of typhoid fever and diarrhœa. The new Public Health Act presents a golden opportunity for dealing energetically with nuisances in country places, which have hitherto been less cared for than towns. Epidemics have sometimes called forth temporary measures of a cleansing nature, but they have usually been discontinued on the disappearance of the scourge. It is to be hoped that the arrangements now made will be permanent and effective, and always in action without needing the stimulus of a periodical panic.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

SEPTEMBER.

The weather of September was very unfavourable for the season, and added yet another wet month to the numerous train of weeping predecessors. The principal meteorological features were a low and fluctuating barometer; variable temperature of about the mean value ; moist, fresh, westerly winds ; heavy and almost daily rainfall, and but moderate development of ozone. The electrical manifestations which so strongly characterised the summer were continued in the beginning of the past month ; and, amongst others, a thunderstorm at Manchester resulted in the loss of four lives from the falling of a wall struck by the lightning, in a building previously damaged by fire. The constant rain has been very injurious to outstanding crops in late localities. Cereals, especially barley, are much damaged by discolouration and growth from the prolonged exposure. Second crops of clover and rye-grass are still uncut for want of opportunity, and in their overripe condition look like brown and dismal monuments of a departed harvest time. The crops in

England were earlier and fared better, and when it is remembered that the wheat-yield of Scotland, Ireland, and Wales together is only one-tenth of that of the United Kingdom, it is evident that the loss will be more detrimental to the individual owners than to the general prosperity of the country. The potato disease continues its ravages, and excites more public attention than it has done on any previous occasion since the famine in Ireland. The agitation will do good, and has already stimulated the President of the Royal Agricultural Society to offer a prize of £100 for the best essay on the subject. Agriculture on the largest scale and the smallest cottage garden will alike benefit by the information elicited. Amongst the microscopic fungi, *Lecythea Rosæ*, *Aregma Mucronatum*, *Lecythea Populina*, and *Aregma Bulbosum*, were found. These fungi do not do much harm, but possess great scientific and microscopic interest.

The barometer was rather low, and very unsteady, through limits not exceeding an inch. The maximum height, 30·45, occurred on the 13th; and the minimum, 29·52, on the 24th; showing a range of 0·93. The instrument stood below 30 inches on 17 days.

The temperature for the first half of the month was generally above the average, and during the latter part was below it. The highest reading of the day thermometer was 76° on the 3rd, and the lowest night record 34° on the 22nd and 23rd, giving a total range of 42 degrees. The greatest daily range was 25° on the 22nd, the least variation 7° on the 11th, and the mean daily range 16°·5. The mean of the maximum temperatures amounted to 65°, and of the minimum to 48°·6. The mean heat of the month was 56°·8, which is a fraction in excess of the Greenwich average of 50 years without correction.

The direction of the wind was more or less westerly on 27 days, and easterly on only one occasion. With these quarters southerly and northerly currents were combined in the proportion of 11 to 16. These figures show a large predominance of westerly and northerly winds. The force was often fresh to a strong gale. A storm of much violence took place on the 27th and 28th, which did considerable damage.

The air was very damp for the time of year. The mean degree of humidity was 80, complete saturation being represented by 100.

The rainfall was heavy, and distributed over 25 days. It measured 5·14 inches, which is equal to 519 tons, or upwards of 2,140 hogsheads to an acre. We are now receiving from Dame Nature, with scrupulous honesty and exactness, repayment of some of the arrears—principal and *interest* most people think—accumulated during several previous dry summers. This is a very painful, but not "a new way of paying old debts," and we must hope that the elements will not often go into Court and resolve themselves into atmospheric *liquidation*.

Ozone was deficient and below the average of the month. The mean degree was 3·467.

The prevailing diseases were chills and inflammatory disorders, and rheumatic fever; a few cases of a typhoid type, and a moderate amount of diarrhœa. The copious rains tended to increase complaints that are usually commenced by "catching cold." On the other hand they conducéd to the removal of zymotic diseases by their cleansing and flushing properties. The more we can imitate this natural process by obtaining and using an abundance of pure water, the more closely will our sanitary arrangements conform to the dictates of Nature and the theories of Science.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

OCTOBER.

October was another wet, chill, miserable month, and it rivalled the unenviable repute of its dismal predecessors for everything unwholesome and disagreeable. The barometer was low and remarkably unsteady; the temperature less than the average; the air very damp; rainfall heavy and continuous, and ozone deficient. The adage says:

"A good October and a good blast,
To blow the hog acorn and mast,"

but the ancient wisdom and robust tastes of our forefathers probably intended to picture to the imagination a dry windy month, with a crisp carpet of leaves in the woods; and not the sodden, slushy mass of miry soil and decaying vegetation in which acorns and masts now lie concealed under the oaks and beeches. Such an uninviting mixture must form a repast that would hardly tempt the appetite of any animal less voracious than the hog. The weather has been most trying to agriculturists, and much hindered their operations. Barley, clover, and rye-grass still lie out in discoloured heaps in many fields —melancholy memorials of an inclement summer and autumn. The preparations for the crops of next year, too, are now claiming attention; but the state of the soil is quite unfit for the plough or any other implement. There has been a singular scarcity of mushrooms this year, which may seem strange to some people who are unduly impressed with the importance of moisture in the production of these delicacies. Rain is certainly necessary, but sunshine is equally so. A fair proportion of dry heat is requisite to ripen the mycelium from which the crop springs. Happening to mention this to a gentleman of archæological tastes, who manages a large industrial undertaking in this county, he told me of an interesting fact in corroboration. Having occasion to lay a heat-conveying pipe through a portion of soil he was pleased to observe soon afterwards that the over-lying land had produced a crop of mushrooms. The artificial application of warmth had thus supplied a natural deficiency. Even common fungi, of the higher types, are sensitive to an excess of moisture, and thrive more luxuriantly when moderate rains follow a summer of hot forcing weather.

The barometer was unusually low, and oscillated incessantly through a range of nearly an inch and a quarter. The variation from day to day was also very great, and often exceeded a quarter and sometimes half an inch. The maximum height, 30·42, was reached on the 6th, and the minimum, 29·20, on the 25th, showing a deviation of 1·22. The instrument stood below 30 inches on 25 days.

The temperature of October was chilly and ungenial, and failed to attain the average value on 21 days. The highest reading of the day thermometer was 66° on the 2nd, and the lowest night record 28° on the 15th, giving a total range of 38 degrees. The greatest daily range was 25° on the 6th and 7th, the least variation 4° on the 30th, and the mean daily range 16°·3. The mean of the maximum temperatures amounted to 55°·9 and of the minimum to 39°·7. The mean heat of the month was 47°·8, which is 2°·4 below the Greenwich average of 50 years. There were a few frosts.

The general direction of the wind was more or less westerly on 21 days, and easterly on 10 occasions. With these quarters southerly and northerly currents were combined in the proportion of 15 to 13. These figures show an excess of westerly winds. The force was often considerable, and sometimes amounted to a strong gale of a destructive character.

The quantity of moisture in the air was large, and ranged from 97 to 64 degrees. The mean degree of humidity was 85, complete saturation being represented by 100.

The rainfall of October was very heavy, and reached a total of 5·97 inches. This is equal to 603 tons, or upwards of 2,490 hogsheads to an acre. Rain fell on 27 days, so that there were only 4 days entirely dry. The rainfall for the year already exceeds 50 inches.

There were electric disturbances in some places.

Ozone was sparingly manifested, in consequence of its having been used up in oxidizing the superabundant decaying vegetable matter. The mean degree was 2·484.

The sanitary state of the district is quite equal to any reasonable expectation after so much miserable weather. There was a small prevalence of zymotic diseases, and a greater one of rheumatic and inflammatory disorders. A general depression of vitality was a noticeable feature, and consumption made rapid progress. The constant rain has excited a positive craving for a change to a drier period.

NOVEMBER MEETING.

The usual monthly meeting of this Society was held in the Nisi Prius Court at the Town Hall on Thursday, Nov. 28th, and was well attended. The chair was occupied by Mr. Downing. After the usual preliminary business had been transacted, and Messrs. C. and J. Heywood and J. S. Hollyer elected members, and Mr. Jackson, Wauntroda, proposed for election, a lecture was delivered by Mr. Charles A. Heywood—of which the following is a summary—on "The Chemical Constituents of Water."

The Lecturer explained that water was composed of oxygen and hydrogen gases, and proceeded to exhibit them separately, and to demonstrate their principal properties. Beginning with hydrogen, he showed that it was a permanent gas, and the lightest body known, being 14½ times lighter than the atmosphere. It was therefore the most buoyant agent for filling balloons, and this was practically illustrated to the audience. It was a combustible body, and burnt with a pale flame of high temperature, but of small illuminating power. The product of its combustion was simple water. It was obtainable in many ways. The existence of the gas in water was made evident to the senses by the pleasing experiment of burning the metals potassium and sodium on the surface of the water, when the oxygen being appropriated by the metals, the hydrogen was set free and burnt spontaneously; in the former case by the heat evolved by the chemical action, and in the latter case it required the application of flame. Oxygen was next taken and shown to be a much heavier gas than hydrogen, but instead of being combustible it was the great supporter of combustion. This was proved by the brilliancy with which sulphur, phosphorus, charcoal, and iron burnt in the gas, and the rapid consumption of a taper in the same medium, and its speedy relighting after it was blown out when burning in the air. The two gases when put together in a strong bottle exploded on the application of flame, and re-united to form water. Absolutely pure water contained nothing but these two gases, but natural waters were impregnated with carbonic acid, lime, &c., to which they owed their sparkling qualities. When lime was present to a moderate extent it was an improvement to drinking water, and the Lecturer spoke highly of that supplied by the Cardiff Water Works Company as containing a salutary degree of hardness.

Upon the conclusion of the lecture, which was illustrated with instructive experiments, and very attentively listened to throughout, Mr. Franklen G. Evans, at the request of the Chairman, proposed a vote of thanks to Mr. Heywood for his interesting lecture. He made some observations on the portion of the lecture that he had heard—having been prevented from being present at the beginning—and mentioned many facts bearing on the subject, and corroborative of the general views of the lecturer on an important branch of natural science. The motion was seconded by Mr. Peter Price, who trusted that Mr. Heywood would favour the Society again on many future occasions.

A vote of thanks to the Chairman concluded an agreeable evening.

METEOROLOGICAL REPORT,

By Mr. FRANKLEN G. EVANS, M.R.C.S., F.M.S., &c.

NOVEMBER.

November was another very cheerless month, and it not only maintained the dismal character of the season for great and peculiar unrest of the meteorological elements, but seemed rather to play a yet wilder tune upon the same key-note as the previous months. The whole year has been most remarkable, and on the principle of *vires acquirit eundo* it appears to have attained such prodigious momentum that it is unable to stop itself in its headlong career. Barometric pressure was very unstable, and the whole atmospheric sea which surrounds us reeled to and fro like a drunken man, causing violent tempests that lashed the aqueous ocean into sympathetic fury, and strewed our storm-beaten coasts with the fragments of the resulting wrecks. On land the incessant rains have continued to retain the soil in a state of quagmire, and—with a few favourable exceptions—prevented the formation of a good seed bed for the crops of 1873. This is a serious state of things, and combined with a scarcity of live stock, and the wide prevalence of epizootic disease, suggests unpleasant alarms for the food prospects of the present winter and the coming year. The season is mild as yet, and many wild flowers are still in bloom. Amongst those noticed were the gorse, geranium, vetch, scabious, willow-herb; ragwort, millefolium, pyrethrum, knapweed, and other composites; potentilla, lesser spearwort, prunella, clinopodium, catchfly, ivy-leaved toad flax, &c. A foxglove was observed in blossom 500 feet above the level of the sea.

The barometer was very low and remarkably fluctuating. The maximum height, 30·38, was attained on the 8th, and the minimum, 28·72, on the evening of the 30th, giving a range of 1·66. The instrument stood below 30 inches on 22 days.

The temperature of November was rather above the average. The highest reading of the day thermometer was 58° on the 1st and 6th, and the lowest night record, 28° on the 17th, showing a total range of 30 degrees. The greatest daily range was 23° on the 4th, the least variation, 4°, on the 5th, and the mean daily range, 13°·9. The mean of the maximum temperatures amounted to 51°·7, and of the minimum to 37°·8. The mean heat of the month was 44°·7, whichis 1°·6 above the Greenwich average of 50 years without correction.

The general direction of the wind was more or less westerly on 21 days, and easterly on nine occasions. With these quarters, southerly and northerly currents were combined in the proportion of 14 to 13. These figures indicate a predominance of westerly winds. The force was often very great, particularly during the heavy gales at the beginning and end of the month. Shipping disasters were consequently wide-spread and numerous.

The quantity of moisture in the air was considerable, ranging from 70 to saturation. The mean degree of humidity was 86, complete saturation being represented by 100.

The rainfall was again large, and distributed over 24 days. It amounted to six inches, which is equal to 606 tons, or upwards of 2,500 hogsheads to an acre. The total rainfall up to the end of November, was within a trifle of 55 inches, and the number of days on which a measurable quantity fell was 221. There were therefore 114 days without any rain, or rather more than one day in three. These data indicate rain enough in all conscience, but I find that the damp has so depressed the mental barometer of the public that an impression prevails that we have only had about fifty fine days this year. This, of course, is an exaggeration, and the fallacious estimate of nervous sensation, and not borne out by the prosaic and unfeeling record of the mercury and the rain gauge.

The development of ozone—favoured by strong westerly winds—was above the usual value for the month. The mean degree was 3·867.

The health of the neighbourhood was very much the same as that of the previous month, but with a greater tendency to typhoid fever.

A remarkable shower of meteors occurred on the evening of the 27th from 5.20 to 10.30 p.m. Mr. E. J. Lowe, of the Highfield Observatory, estimated the number at fully 51,660. There have been vague rumours for some months past that our earth was likely to come into collision with a comet in the course of the year, and these reports excited a little alarm. The meteoric shower constituted the fulfilment of the hazy prediction. In 1826 the comet of Biela was discovered to be periodic, and its revolution in its orbit to take about 6¾ years, and to be very near the earth's path. The smallest distance was less than 20,000 miles, so that if the two bodies should happen to traverse the same region together, the planet might be involved in the nebulosity of the comet, which had a diameter of more than 40,000 miles. The comet re-appeared in 1838. Again, in 1846, when it was found to be separated into two parts, with two distinct orbits. In 1852 the two heads were seen with difficulty, and afterwards lost altogether at the time of subsequent revolutions. After the great meteoric display of November, 1866, and a discovery that the orbits of some comets corresponded with those of meteors, it was thought that the missing comet of Biela had been resolved into a system of meteors. This was the more probable from a recent belief that comets were only aggregations of meteors. Some astronomers, therefore, anticipated a meteoric shower about this period, and the result harmonizes with, and seems to strongly confirm the justness of their conclusions.

December, the tenth month in the old Roman calendar, and the tenth of the Jewish sacred year, was called *Tebeth*—which signifies *miry*—by the Hebrews. Its Christian counterpart did not belie the character thus assigned to it, but rather surpassed itself in sloppy attributes, and formed a fitting conclusion to a singularly stormy, wet, miry, miserable year. A spirit of turmoil seemed to brood over the face of the earth, and to whirl the air into fierce gales, that unloosed the fountains and lifted up the waves of the deep, crushed the frail tenements of our modern towns, and roared in mournful cadence through the storm-tossed branches of the trees in forest, mountain, and plain. Many a strong trunk was broken, and lofty head laid low, and the ground was strewn with the dismembered fragments. The windows of heaven were opened, and the flood waters covered the land in several counties, causing alarm and anxiety for the still-unsown crops of the coming season. Fear and doubt have obscured the brightness of the promise that seed-time and harvest, cold and heat, summer and winter *shall not cease while the earth remaineth.*

The barometer was unusually low throughout the month, and fluctuated perpetually. The maximum height, 30·06, was reached on the 12th; and the minimum, 28·74, on the evening of the 8th, the day of the great gale, showing a range of 1·32. The instrument stood below 30 inches on 28 days.

The temperature of December was very mild, and above the average on 22 days. The latter half of the month was especially so, and sometimes showed an excess of from 8° to 12°. The highest reading of the day thermometer was 55° on the 22nd, and the lowest night record 23° on the 12th, giving a total range of 32°. The greatest daily range was 24° on the 5th, the least variation 3° on the 28th, and the mean daily range 10°·9. The mean of the maximum temperatures amounted to 47°·9, and of the minimum to 37°·1. The mean heat of the month was 42°·5, which is 2°·7 above the Greenwich mean of 50 years. There was frost on 7 nights.

The general direction of the wind was more or less westerly on 19 days, and easterly on 12 occasions. With these quarters southerly and northerly currents were combined in the proportion of 19 to 11, indicating a large excess of south-westerly winds. There were many heavy gales, but the most notable was that of the 8th and 9th, which raged in this district with almost unexampled fury. A list of the casualties on sea and land would far exceed the limits of this report, and is unnecessary, as full and interesting accounts have appeared in the local newspapers. The destruction of life and property was considerable, and trees were uprooted in great numbers.

The quantity of moisture in the air was large, and exceeded that of every month but January. The mean degree of humidity was 92, complete saturation being represented by 100.

The rainfall was again very heavy, and amounted to the large total of 7·75 inches. This is equal to 782 tons, or upwards of 3,230 hogsheads to an acre. It was distributed over 22 days, but the small amount of evaporation when no rain occurred in measurable quantities made the drip appear almost continuous.

Ozone was fairly developed, and four times touched the maximum of the scale. Antozone was several times noted. The mean degree of ozone was 3·323.

The chief diseases were bronchitis, pneumonia, croup, quinsy, rheumatism and its allies, jaundice and other hepatic complaints, and a few cases of typhoid fever and diarrhœa. There was a great deal of common sickness with mental and bodily depression, but no serious epidemic disorders. It is a sad reflection upon our civilization that meteorological conditions which lower vitality, make people feel ill, and, as they themselves often express it, "as miserable as gravediggers," are nevertheless favourable to low bills of mortality. Why? Because abundant rains, particularly with high winds, cleanse the atmosphere from *man*-engendered impurities; wash *human* pollutions from streets and roadways, and courts and alleys; and scour every conceivable abomination, human, porcine, and equine, urban and rural, from sewers, brooks, and rivers. In the new sanitary era that is approaching it is to be hoped that a state of things which is repugnant to the dictates of reason and common sense—to say nothing of science—will be abolished. It may then be possible to enjoy fine weather without the consciousness that we are accumulating filth, nursing fevers, and breeding pestilences, to break out at the first suitable opportunity.

THE ANNUAL MEETING.

The annual meeting of this society was held at the Town Hall on Thursday evening, January 30. Mr. W. Adams, in the chair. There were also present, Dr. Taylor and Mr. Franklen G. Evans, Vice-presidents; Messrs. C. Thompson, John Morgan, G. C. Thompson, Peter Price, H. Deacon, H. Heywood, Henry Gooch, P. R. Scott, A. C. Cruttwell, T. Evens, C.E., J. J. West, T. Webber, &c. Mr. Fiddian, the hon. sec., sec., was unable to attend, and Dr. Taylor acted in his stead.

The routine business having been transacted, and Mr. Jackson, Wauntreoda, balloted for and elected, the annual report was read and adopted. The financial position of the Society is very satisfactory, and will soon recover the losses sustained by the defalcations of a former collector. The officers and committee for the ensuing year were then elected. Mr. W. Adams, C.E., President; Messrs. Franklen G. Evans and J. W. Lukis, Vice-presidents; Dr. Taylor, Hon. Sec., and the same Committee as last year, with a few fresh names to fill up vacancies caused by removals. A cordial vote of thanks was unanimously accorded to the officers and committee for the past year's services. A spirited discussion then took place on the past working of the Society, and its future prospects. The officers lamented the uncertainty that attended all their efforts to carry on the operations of the Club with vigour, more especially in reference to the field meetings. When a field day was fixed, the members neglected to comply with the rule of giving due notice of their intention to attend, and the result was an excess or deficiency of the accommodation provided. If the meeting did not take place from bad weather, or any other cause, the Committee were left to meet the expenses already incurred as best they could. It is determined to limit the carriage and supply accommodation in future strictly to the number who have given notice to the Secretary of their desire to be present.

The President then called upon Mr. Franklen G. Evans to read his Annual Meteorological Report for 1872, of which the following is a summary :—

METEOROLOGICAL REPORT FOR 1872.

The rapid revolution of the seasons of the natural year brings us once more to our annual meeting, and the hand on the dial of the Naturalists Society's proceedings indicates the necessity of an account of our stewardship, and devolves upon me the customary and pleasant duty of furnishing my meteorological report. The records of the past twelve months are like so many tidal waves that have dashed up and broken on the shores of our field, and left their traces upon rock, memory and journal, and perhaps fragments of wreck behind. We will now take advantage of the ebb, and wandering on the beach look out for waifs and strays to be chronicled in our Transactions—for our periodical volume is the museum of facts and opinions, as the collection at the Free Library is of objects and illustrations.

The year 1872 was a very remarkable one from beginning to end, and would overtax greater skill than mine, and utterly exceed all reasonable limits to give anything like an adequate account of it. January, February, and March were mild, windy, and very wet. April was warm, with less rain. May cool, moderately wet, and very thundery. June cold, with heavy rains, and much thunder. July warm, extremely wet, with violent thunderstorms and floods. August cool, thundery, but with less rain. September wet and thundery. October, November and December, generally mild, with some thunder, heavy rains, and most tempestuous winds.

A bird's eye view of the principal factors that made up the tremendous weather of the year is contained in the following table :

ANALYSIS AND SUMMARY OF THE METEOROLOGY OF 1872.

WIND-DIRECTION, BAROMETER, RAINFALL, &c. OZONE AND TEMPERATURES.

1872.	More or less Westerly—Days.	More or less Easterly—Days.	Combined with Southerly—Days	Combined with Northerly—Days.	0·01 in. or more of Rain fell—Days.	Barometer below 30 inches, Days.	Mean degree of humidity.	Rainfall, total inches.	Maximum fall in 24 hours.	Mean degree of ozone.	Maximum temperature	Minimum temperature.	Total range.	Greatest daily range.	Least daily range.	Mean daily range.	Mean of Maximum temperatures.	Mean of Minimum temperatures.	Mean temperature of the whole month.	Difference from average of 50 years.
January	26	4	14	14	26	25	93	8·81	1·23	4·323	56	27	29	21	6	12·7	48·0	35·4	41·7	+ 4·8
February	21	6	18	7	22	23	91	5·07	0·99	6·448	57	31	26	22	3	13·2	51·4	38·2	44·8	+ 6·1
March	18	13	17	12	17	17	82	4·10	0·96	4 484	61	24	37	29	6	16·0	53·9	38·1	46·0	+ 4·4
April	16	11	13	17	13	12	71	2·08	0·42	3·067	68	29	39	33	6	20 6	58·6	37·8	48·2	+ 2·0
May...	21	9	6	20	19	15	73	2·87	0·60	2 484	71	30	41	32	13	20·4	61·3	40·9	51·1	— 1·8
June	25	4	13	15	19	12	75	5·52	0·68	4·533	87	36	51	33	10	20 0	67·8	47·8	57·8	— 1·3
July	21	9	18	11	13	11	73	5·92	2·36	3·677	85	43	42	32	13	20·9	73·4	52·5	62·9	+ 1·1
August	15	13	17	12	16	11	73	3·50	1·09	3 129	80	42	38	32	12	20·7	71·4	50·6	61·0	— 0·2
September	27	1	11	16	25	17	80	5·14	0·74	3·467	76	34	42	25	7	16·5	65·0	48 6	56·8	+ 0·2
October	21	10	15	13	27	25	85	5·97	0·76	2·484	66	28	38	25	4	16·3	55·9	39 7	47·8	— 2·4
November	21	9	14	13	24	22	86	6·00	0·91	3 867	58	28	30	23	4	13·9	51·7	37·8	44 7	+ 1·6
December	19	12	19	11	22	28	92	7·75	1·18	3·323	55	23	32	24	3	10 9	47·9	37·1	42·5	+ 2 7
Totals, Means, &c.	251	101	175	161	243	218	81	62·73	11·92	3·774	87	23	64	33	3	16 8	58·9	42·0	50·4	+ 1·4

In this table, which is compiled in exactly the same manner as in previous years, winds are primarily divided into westerly and easterly, and are set down in the first two columns. The third and fourth columns contain the number of days on which southerly and northerly currents were combined with the other two directions. These figures show a very large preponderance of westerly and southerly winds. The W. exceeded those from the E. in the proportion of 251 to 101, and the S. outnumbered the N. in the ratio of 175 to 161. This is the largest excess of S.W. winds that I have hitherto recorded, and accounts for the mild temperature and excessive rainfall and humidity which characterised the year. In reading the table it will be noted that the sum of the first two columns is 352, so that 14 days (being leap year) seem to be excluded from the reckoning. This indicates that the wind on the missing days was direct N. or S. Similarly the total of the 3rd and 4th columns is 336—30 days having been due E. or W. The approximate numerical agreement between the westerly winds and days on which 0·01 inch or more of rain fell that I have generally observed again occurred, the figures were 251 to 243.

The barometer was low and remarkably unsteady for the greater part of the year. The maximum height, 30·59, was reached on April 6th, and the minimum, 28·72, on the evening of Nov. 30th, showing a range of 1·87. The instrument stood below 30 inches on 218 days, indicating a greater and more continuous depression than any previously chronicled in these reports.

The quantity of moisture in the air was excessive, and in my experience unprecedented. The mean degree of humidity was 81, complete saturation being represented by 100.

The rainfall was the most extraordinary feature of the year, and it exceeded considerably the highest previous record, both in quantity and frequency. Prior to 1872 the greatest total for 130 years was that of 1852, which was 38 per cent. above the average. The measurements in the past year exhibit, in most localities, a much higher percentage, and we may safely assert that our departed friend shed more tears than any of its predecessors since rainfall observations were first taken—about 200 years ago. It might well claim to have its high preeminence in this respect inscribed on monumental marble; but we need not, I think, add to the moisture by any tears of ours, which would be of rather a "crocodile" character. The rains of 1872 were not only heavy, but with very short intermissions. The longest intervals were one of 10 days in April and 8 days in August. Although every month was wet, the most conspicuously so were January and December. The total rainfall amounted to 62·73 inches, which is equal to 6·335 tons, or upwards of 26,200 hogsheads to an acre, and is 13·37 inches above my own average. This is an enormous quantity, and all together would cover the ground to a depth of 5 feet 2¾ inches. It is suggestive of another deluge, and sufficiently alarming to make the prismatic "bow in the heavens" a welcome token that the waste of waters would be kept within due limits. The whole quantity was distributed over 243 days, so that there were 123 days without a measurable amount of rain. This is the result of an accurate debtor and creditor account with the elements, and differs, I believe, from the popular impression which is much exaggerated. Many people seem to think that there were only about 30 days without rain in the past year. If this had been the case the agricultural interest would have been half ruined by this time. A moment's reflection will show that a great many fine days are absolutely necessary to the growth of crops. In the Spring dry weather is required to evaporate the floods of winter; to plough the land and sow the seed. In the early summer many weeks are necessary to secure clover, rye grass, and the general hay crop. In the late summer and autumn a considerable time is requisite to gather in the harvest of various kinds of grain in different localities, and with unequal times of ripening. In the late autumn potatoes and roots have to be dug up, and first wheat crops sown. These are the principal operations of the farm, and no time has been allowed for harrowing, rolling, hoeing and other matters so essential to a profitable result. With only 30 days—2½ days a month on an average—without rain none of these things could have been done, and the millions' worth of produce obtained from the soil last year would either not have been sown, or would have rotted in the fields. The sum of the maximum falls in 24 hours bore the usual proportion—a little more than a fifth—to the grand total. The rainfall at Tynant is generally 10 or 12 inches in excess of that Cardiff and its neighbourhood. This ratio was maintained on the present occasion. The relative amounts of rain in the different parts of the Society's Field will be best seen in the following table:

1872.	Feet above sea level.	Inches.
Brown and Adams, Glyncorrwg	730	117·63
W. T. Lewis, Treherbert	634	126·63
T. J. Dyke, Merthyr	550	75·00
Evan Jones, Aberdare	450	95·50
W. T. Lewis, Mardy, do.	431	96·58
F. J. Mitchell, Llanfrechfa Grange	360	62·27
Dr. McCulloch, Abergavenny	220	52·20
Henry Gooch, Lisvane Reservoir	142	55·03
Geo. B. Gething, Ynisybro, Newport	120	55·66
F. G. Evans, Tynant	100	62·75
G. W. Nicholl, The Ham	50	46·58
Henry Gooch, Ely	45	56·38
Wm. Adams, Cardiff	35	50·36

These are all the returns which have been received, and our warmest acknowledgments are due to these gentlemen for taking the observations, and for their kindness in forwarding them.

The figures show a large excess over previous years, and the usual increase more or less in proportion to elevation. Treherbert still maintains its watery pre-eminence, and warns all people who are not amphibious to steer clear of it as a residence. The Ham, on the sea coast, takes an enviably low position, and is a recommendation of that line of shore to those who are not rain-proof, and desire a mild climate and a comparatively dry dwelling-place.

In previous reports I have had occasion to remark that there was a deficiency in the rainfall account, which would be honestly paid in due season. The past year has given us a pretty good instalment of arrears, and most of us would be glad to give a receipt in full for the entire debt without scrutinizing the figures too closely to ascertain whether we have been paid the uttermost drop.

The development of ozone was less than the average, notwithstanding the prevalence of winds favourable to its production. This may have been due to a real deficiency, but more probably to an excess of organic matter in the atmosphere, in association with smallpox, cattle plague, foot-and-mouth disease, potato disease, &c. The mean degree of ozone was 3·774.

The temperature of 1872 was above the average on the whole. The principal excess was in the first four months and the last two. May, June, August, and October were below the usual mean. The highest reading of the day thermometer was 87° on June 18th, and the lowest night record 23° on December 12th, showing a total range of 64 degrees. The greatest daily range was 33° on two occasions, the least variation 3° several times, and the mean daily range was 16°·8. The mean of the maximum temperatures was 58°·9, and of the minimum 42·°. The mean heat of the year was 50°·4, which is 1°·4 in excess of the mean temperature of 50 years, as determined by Mr. Glaisher, without correction.

Thunderstorms prevailed to a greater extent than I ever remember before, and were equally violent and destructive. These were briefly chronicled in the monthly reports, so I will only now mention a curious instance of the fearful power of the lightning flash. At 7.3 a.m. on Thursday, July 25th, seven telegraphic instruments, 30 miles apart, were destroyed by one electric discharge. The electricity struck the wires which cross High-street to the Post-office, at Alton, in Hampshire, and destroyed the telegraphic instrument in the Alton Post-office. The remainder of the discharge did the same thing at Medsted Royles, Alresford, Winchester, and Southampton. The clerk at Alresford was knocked down. Most of the thunder-storms were accompanied by excessive rains, which caused widespread and disastrous floods.

The comet of Biela, which left a part of its tail behind in the shape of a meteoric shower in November, and was supposed to have been so dissipated as to have lost its cometary aspect, has been observed at Madras; so we may hope to have another whisk of its tail at the completion of another revolution.

Auroræ were of frequent occurrence. The most important was that of February 4th, which nearly equalled the display of October 24th, 1870, in brilliancy, and exceeded it in some points of interest. It was an example of an aurora by daylight, the possibility of which had been previously denied by many. It was also in the main a southern aurora visible in these high latitudes, but it was not exclusively so, for I saw an abundance of streamers in the N. as the evening closed in. I do not believe it is possible to have an aurora from either pole by itself, although circumstances of time and place may not admit always of the double event being seen.

Many will be inclined to ask, What is the cause of the extraordinary weather we have so long experienced? I had proposed to myself to contribute my mite towards the solution of this question, but it would be too voluminous a subject to add to a summary of a year's meteorology, and had better be dealt with separately in a paper or lecture upon another occasion, if such is your good pleasure. In previous papers I have referred to the influence of sun-spots in producing earth currents of electricity, declination of the magnetic needle, and auroræ; and have long noticed that these disturbances are almost invariably followed by wet and stormy weather. This much seems clear, but the sun's action is so intimately bound up with and modified by terrestrial causes that it is very difficult to strike a fair balance between them. Even in the past year different parts of the world would give opposite accounts of the weather actually experienced, and consequently of the facts to be explained. Thus, while we have been suffering from excessive rainfall, the New Zealanders have been equally so from drought, and prayed for rain in their churches. Again, the end of May and beginning of June were cold and damp here, but there was great heat in Sweden, which a resident there, who has lived in many parts of the world, and for some years not many degrees from the equator, characterised as tropical. A little later the heat was intense—almost 100° daily—in the United States, and great mortality resulted. In New York nearly 1,000 cases of sun-stroke occurred, and 200 deaths. Mr. Whymper, the Alpine explorer, states that the weather in Greenland from June to September, with the exception of one week, was glorious and all that could be desired. Finally, while we were lamenting the absence of old-fashioned weather at Christmas, hearing of ripe strawberries and—to quote an old joke of Punch's—of acorns growing on the wooden legs of Greenwich pensioners, the people of the United States were shivering and some dying from fearful storms of wind, snow, and intense cold—40° below zero.

The foregoing observations meagrely touch on some of the more notable events of a most memorable year. They embrace a period of unusual disturbance in our meteorological surroundings, causing bad harvests and deficient potatoes and fruits, and crops nearly all unsown for the coming season. The year has been one of storm and cloud, and the serene atmosphere of the Society has suffered from the perturbations of the physical one. But hope springs eternal in the human breast, although it does sometimes tell a flattering tale; therefore we trust we see a silver lining to the cloud canopy around us, and that the present will be a year of harmony, prosperity, and usefulness to the Naturalists' Society. (Prolonged applause.)

On the motion of Mr. G. C. Thompson, seconded by Mr. P. Price, a cordial vote of thanks was passed to Mr. Evans for his excellent paper. Mr. Adams, in putting the motion to the meeting, said it was impossible for persons unacquainted with the subject to estimate the very great amount of time and trouble given by Mr. Evans year by year in preparing these reports. Dr. Taylor mentioned that a member present offered to give a lecture fortnightly in the Museum, as he was desirous that the working classes should be invited to attend them. Mr. Heywood also expressed his willingness to join in the movement, and give lectures on Chemistry alternately. A vote of thanks to the Chairman closed the proceedings.

RAINFALL OBSERVATIONS IN THE SOCIETY'S FIELD.

No. of Gauge on Map	1. D. M. McCullough, Esq., M.D., Abergavenny.				2. F. J. Mitchell, Esq., Llanfrechfa Grange.				4. Geo. B. Gething, Esq., Ynis y bro Reservoir, Newport.			
Latitude												
Longitude												
Diameter of Receiver	5 inches.				5 inches.							
Height above Ground	1 ft. 0 in.				4 ft. 0 in.				1 ft. 6 in.			
Height above Mean Tide Level	220 ft.				360 ft.				120 ft.			
1872.	Total depth.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total depth.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total depth.	Greatest fall in 24 hours.		Days on which ·01, or more fell.
	Inches.	Depth.	Date.		Inches.	Depth.	Date.		Inches.	Depth.	Date.	
January	7·01	1·20	23rd	25	9·85	1·75	17th	19	8·32	1·17	23rd	19
February	5·42	·83	1st	21	5·29	0 90	22nd	21	5·25	0·94	22nd	18
March	3·41	·94	27th	16	5·34	1·94	28th	15	4·08	1·18	28th	12
April	2·84	·69	27th	11	2·20	0·49	21st	9	1·95	0·55	27th	8
May...	1·19	·36	11th	17	2·06	0·36	7th	15	2·06	0·53	7th	12
June	3·50	·95	8th	20	4·18	0 60	8th	16	4·49	0·87	19th	13
July...	4·34	1·91	6th	12	3·68	1·13	6th	13	3·00	0·98	25th	7
August	2·09	·69	7th	14	2·68	0·71	7th	12	3·61	1·00	7th	10
September...	2·25	·52	6th	17	3·29	0·72	1st	18	4·01	1·03	23rd	7
October	4·91	·66	25th	23	6·90	0·94	29th	24	5·77	0·84	29th	18
November	7·58	1·09	22nd	24	9 67	1·06	4, 24, 26	22	6·79	1·19	4th	16
December	7·66	1·15	16th	22	7·13	1·40	16th	20	6·33	1·17	16th	15
Totals	52·20			222	62·27	12·00		204	55·66			155

No. of Gauge on Map ... Latitude ... Longitude ... Diameter of Receiver ... Height above Ground ... Height above Mean Tide Level	7 T. J. DYKE, Esq., F.R.C.S., Merthyr Tydfil. N 51° 44′ 30″. W. 3° 22′ 45″. 6 inches 4ft 0 in. 550 ft.				9. FRANKLEN G. EVANS, Esq., M.R.C.S., F.M.S., Tynant, Radyr. 51° 31′ N. 3° 15′ W. 5 inches. 1 ft. 0 in. 100 ft.				10. H. GOOCH, Esq., Ely, Cardiff. 5 inches. 2 ft. 0 in. 45 ft.
1872.	Total depth.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total depth.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total depth.
	Inches.	Depth.	Date.		Inches.	Depth.	Date.		Inches.
January ...	13·92	2·20	18th	25	8·81	1·23	23rd	26	7·51
February ...	6·82	1·05	18th	25	5·07	0·99	22nd	22	4·65
March ...	5 18	1·40	27th	17	4·10	0·96	28th	17	3·57
April ...	2·56	0·85	25th	12	2·08	0·42	27th	12	1·99
May ...	1·85	0·50	4th	12	2·87	0·60	7th	15	2 18
June ...	3 66	0·97	18th	15	5·52	0·68	24th	12	3 96
July ...	8 15	3·95	6th	10	5·92	2·36	6th	11	5 53
August ...	2 98	0·42	1st	16	3·50	1·09	1st	11	4·13
September ...	4·76	0·51	6th	25	5·14	0·74	1st	17	4·30
October ...	7·00	1·45	29th	24	5·97	0·76	29th	25	5·76
November ...	10·85	1·94	22nd	23	6·00	0·91	24th	22	5·13
December ...	11·04	2 08	27th	25	7·75	1·18	27th	28	7·57
Totals ...	78·77			229	62·73	11·92		218	56·28

No. of Gauge on Map	11. H. Gooch, Esq., Lisvane, Cardiff.	12. W. Adams, Esq., F.G.S., 53, Crockherbtown, Cardiff.				14. G. W. Nicholl, Esq., The Ham, Cowbridge.
Latitude		N. 51° 29′ 10″.				
Longitude...		W. 3° 9′ 55″.				
Diameter of Receiver	5 inches.	5 inches.				8 inches.
Height above Ground	2 ft. 0 in.	1 ft. 0 in.				1 ft. 2 in.
Height above Mean Tide Level	100 ft.	35 ft.				50 ft.
1872.	Total depth.	Total depth.	Greatest fall in 24 hours.		Days on which ·01, or more fell.	Total depth.
			Depth.	Date.		
	Inches.	Inches.				Inches.
January	7·50	7 79	1·05	23rd	26	6·10
February	4·32	4·24	1·06	22nd	23	3 78
March	3·70	3·16	0·66	28th	17	2·95
April	2·22	1·83	0·58	27th	11	2·38
May	2·37	2·11	0·61	7th	19	1·56
June	4·42	3·71	0·68	18th	20	3·51
July	5·64	4·67	2·23	6th	12	4·62
August	3·86	3·12	0·96	1st	14	3·08
September	4·00	3·67	0·81	3rd	21	3·42
October	5·52	4·45	0·45	29th	26	5·05
November	4·99	5·56	0·91	24th	22	4·59
December	6·39	6 05	0·95	16th	20	5·54
Totals...	54·93	50·36	10·95		231	46·58

No. of Gauge on Map	15. Messrs. Brown and Adams. Glyncorrwg, Briton Ferry.				16. W. T. Lewis, Esq., Treherbert, Pontypridd.				17. W. T. Lewis, Esq., Mardy, Aberdare.				18. Evan Jones, Esq., Ty Mawr, Aberdare.
Latitude													
Longitude													
Diameter of Receiver	5 inches.				5 inches.				5 inches.				5 inches.
Height above Ground	1 ft. 0 in.				1ft. 0 in.				1 ft. 0 in.				1 ft. 0 in.
Height above Mean Tide Level	730 ft.				634 ft.				431 ft.				450 ft.
1872.	Total depth. Inches	Greatest fall in 24 hours. Depth.	Greatest fall in 24 hours. Date.	Days on which ·01, or more fell.	Total depth. Inches	Greatest fall in 24 hours. Depth	Greatest fall in 24 hours. Date.	Days on which ·01, or more fell.	Total depth. Inches	Greatest fall in 24 hours. Depth	Greatest fall in 24 hours. Date.	Days on which ·01, or more fell.	Total depth. Inches
January	17·36	1·83	30th	23	21·82	2·74	17th	26	16·55	1·76	17th	26	
February	10·62	1·50	29th	18	13·09	1·53	29th	25	9·64	1·30	17th	23	
March	8·70	1·74	27th	18	7·04	3·33	28th	16	6·91	2·06	28th	20	
April	3·37	0·89	7th	10	3·23	0·94	25th	10	2·81	0·68	23rd	10	
May	4·42	0·77	7th	18	4·27	0·81	6th	14	3·21	0·57	6th	15	
June	9·71	1·68	18th	19	9·21	1·34	18th	20	5·13	1·11	8th	14	
July	6·40	2·67	6th	13	7·25	4·00	6th	12	7·24	4·51	6th	12	
August	4·99	1·05	21st	13	4·10	0·56	9th	15	2·79	0·39	9th	15	
September	11·90	1·88	27th	24	11·21	1·84	27th	20	6·77	1·33	27th	19	
October	12·09	1·77	30th	23	12·81	3·05	29th	22	8·89	2·24	29th	23	
November	15·82	2·74	4th	22	17·17	2·32	22nd	24	13·97	2·16	22nd	24	
December	12·25	1·56	28th	21	15·42	2·18	27th	25	12·67	2·24	27th	22	
Totals	117·63	20·08		222	126·62	24·64		229	96·58				95·50

CARDIFF NATURALISTS' SOCIETY,

1872.

HONORARY MEMBERS.

Bute, The Most Honourable the Marquis of, Cardiff Castle.
Gagliardi, Rev. Professor, Ratcliffe College, Leicester.
Stainton, Professor H. T., Mountsfield, Lewisham, S.E.
Wood, Colonel, Stouthall, Swansea.
W. H. Nicholl, The Ham, near Cowbridge.

MEMBERS.

Note.—*Those marked* (O) *were the original promoters of the Society.*

Adams, W., C.E., F.G.S., Cardiff ... ... O
Adams, Miss E. M., Cardiff. 1869
Adams, Miss Agnes, Cardiff. 1869
Adams, G. F., Cardiff ... O
Alexander, Wm., Cardiff ... 1869
Angel, Wm., Cardiff ... 1869
Armstrong, F. W., Cardiff. 1869

Bute, Marquis of, Cardiff Castle 1868
Brown, T. Foster, F.G.S., Cardiff 1868
Bassett, Alexander, C.E., Llandaff 1868
Bedford, Captain E. J., R.N., Cardiff 1868
Bell, James, Cardiff ... O
Bell, Robert, Cardiff ... O
Buist, J. J., M.D., Cardiff. 1868
Bush, James, Cardiff ... O
Birbeck, George, Tondû, Bridgend 1868
Billups, J. E., Cardiff ... 1868
Biggs, Robert, Cardiff ... 1869
Biggs, Jacob, jun., Cardiff... 1869
Boyle, R. W., Cardiff ... 1869
Bradley, Charles, Cardiff ... 1869
Barrow, James, Ty Wyth, Maesteg 1869
Brogden, James, Tondû, Bridgend 1869
Brewer, J. W., Cardiff ... 1869
Blake, R. A., Cardiff ... 1869
Blessley, W. D., Cardiff ... 1869
Le Boulanger, J. A., Cardiff 1869
Le Boulanger, Mrs., Cardiff...1869
Boyle, John, 6, Barnard's Inn, London 1871
Booker, T. W., Velindra, near Cardiff 1871

Carne, J. W. N., D.C.L., St. Donats, Cowbridge ... 1868
Cox, James, Plasturton, Cardiff 1868
Coe, J. D., Roath, Cardiff... 1869
Cowell, James, Cardiff ... 1869
Cross, Edward, Cardiff ... 1869
Cross, Thomas, Roath, Cardiff 1869
Corbett, James A., Cogan House, Cardiff 1872
Cruttwell, A. C., Cardiff ... 1872
Cory, John, Cardiff... ... 1869
Cory, Richard, jun., Cardiff 1869
Churchman, W. P., Cardiff. 1870

Deacon, Henry, Cardiff ... 1868
Duncan, John, Cardiff ... 1868
Duncan, David, jun., Cardiff 1869
Drane, Robert, Cardiff ... O
Downing, E. C., Cardiff ... 1868
Davies, Lewis, Cardiff ... 1869
Davies, D. W., Cardiff ... 1869
Davies, William, Cardiff ... 1869
Decandia, L., Cardiff ... 1869
David, C. W., Cardiff ... 1870
Dawkins, M. R., Cardiff ... 1870

Evens, Thomas, C.E., Cardiff 1868
Evans, H. J., Cardiff ... 1868
Evans, E. Hier, Cardiff ... 1868

Evans, Robert Young, Cardiff 1872
Edwards, W. T., M.D., Cardiff 1869
Evans, J. H., Pengam, Cardiff 1869
Evans, Franklen G., M.R.C.S., F.M.S., &c., Tynant, Radyr O
Evans, F. G., Mrs., Tynant, Radyr 1869

Fisher, Henry, Cardiff ... 1869
Fiddian, A. P., Cardiff, M.B. 1869

Gagliardi, Rev. Professor... 1867
Gooch, Henry, Cardiff ... O
Griffith, R. W., B.A., Cardiff ... ... O
Glass, T. G., Cardiff ... 1869
Gething, G. B., Newport, Mon. 1872
Gueret, L., Roath, Cardiff... 1870

Hemmingway, John, Macclesfield 1868
Holst, Johan, Penarth ... 1868
Hybart, Fred. Wm., Canton O
Harrison, Cecil, Cardiff ... 1868
Howells, Edward, Cardiff... 1868
Hill, E. S., Col., Llandaff... 1869
Heywood, Charles, Roath, Cardiff 1872
Heywood, Henry, Roath, Cardiff 1872
Harwood, E. C., Cardiff ... 1870
Hallett, G., Cardiff ... 1871

Ince, Francis, St. Benet Chambers, Fenchurch-street, London 1868
Insole, J. H., Llandaff ... 1869
Insole, T. W., Llandaff ... 1869

James, W. P., Canton, Cardiff 1868
Jenkins, W., C.E., Pontypridd 1868
Jenkins, Rev. J. R., M.A., Islington, Liverpool ... 1868
Jotham, J. W., Cardiff ... O
Joseph, Richard, Durdham Down, Bristol 1868
Jones, Thomas, Cardiff ... 1869
Jones, E., M.R.C.S., Aberdare 1868
Jones, George, Cardiff ... 1872
Jeffries, Henry, Pentyrch... 1870
James, Phineas, Brynderwen, Abersychan ... 1868
James, C. H., Merthyr ... 1871
Joy, F. W., Cardiff ... 1869

Krieger, Maxn., Cardiff ... 1868

Lewis, W. T., C.E., F.G.S., Aberdare 1868
Lewis, L. T., Cadoxton Lodge, Neath 1868
Lucas, Clement, Cardiff ... 1868
Luard, W. C., Llandaff ... 1868
Linden, A., London ... 1870
Llewellyn, D., C.E., F.G.S., Bryn Gwyn-place, Pontypool 1869
Lundie, G. A., Cardiff ... 1870
Llewellyn, L., Aberaman... 1871
Lewis, E., Llandaff-rise, Cardiff 1871
Lean, T. J., Free Library, Cardiff ... ...
Lukis, J. W., Cardiff ... 1872

Milward, J., M.R.C.S., Cardiff 1868
Morgan, Rev. W. Leigh, Llanmaes, near Cowbridge 1868
McConnochie, J., Cardiff ... 1868
Menelaus, W., Dowlais ... 1868
Matthews, Benjamin, Glan Ely, St. Fagans 1871
Morgan, F. W., St. Andrew's-place 1869
Morgan, John, Cardiff ... O

Nixon, Thomas, Cardiff ... 1870
Nicholl, G. W., The Ham, near Cowbridge 1871
Nicholl, W. H., The Ham, near Cowbridge 1871

Ohlsen, L. C., Cardiff ... 1870

Paine, H. J., M.D., Cardiff. 1868
Price, Peter, Cardiff ... O
Primavesi, Fedele, Cardiff... 1868
Primavesi, H., Cardiff ... 1868
Payne, Edward, Cardiff ... 1868
Parry, R. W., jun., Cardiff. 1869
Peake, Wm., Roath ... 1870
Phillips, Griffith, Whitchurch 1870
Parkyn, John, Cardiff ... 1869
Phillips, Wm., Cardiff ... 1870
Parfitt, George, Penylan ... 1870
Plain, T., Cardiff 1870
Prichard, J., Llandaff ... 1871
Prothero, Rev. J. H., M.A., Mountain Ash, near Aberdare 1868
Pitman, Captain, Penhill ... 1871
Page, C. H., Llandaff ... 1872

Riley, William, Penarth ... O
Riley, Mrs., Penarth ... O
Roper, R. T., F.G.S., Newport 1869

Rees, Daniel, Cardiff ... 1869
Riches, T. H., Cardiff ... 1870
Riches, J. O., Cardiff ... 1871
Riches, O. H., Cardiff ... 1871
Reynolds, M., Neath Abbey 1870

Snell, Charles, Cardiff ... 1867
Stainton, Professor H. T., F.L.S., F.Z.S., Mountsfield, Lewisham 1867
Shewbrooks, Henry, Cardiff 1872
Shewbrooks, Mrs., Cardiff . 1870
Short, Richard, Roath, Cardiff 1872
Stephenson, W. P., Cardiff 1868
Spencer, R. E., Llandough 1868
Scott, Phillip Rees, Cardiff 1868
Saulez, Rev. V., Canton, Cardiff 1868
Spiridion, W., Cardiff ... 1868
Sankey, Charles, Cardiff ... 1870
Sankey, John, Cardiff ... 1870
Sankey, Mrs., Cardiff ... 1870
Sloper, John, Cardiff ... 1870
Stow, F., Roath, Cardiff ... 1869

Taylor, William, M.D., Cardiff 0
Thomas, G. F., Cardiff ... 0
Tomlinson, J., jun., Edgeware-road, London ... 0
Truscott, C. J., St. Austell, Cornwall 1868
Thompson, Charles, Preswylfa 1868
Thompson, G. C., Preswylfa 1868
Thomas, D. L., Cardiff ... 1869
Taylor, James, Cardiff ... 1872
Taylor, J. P., Cardiff ... 1870
Thomas, Wm., Cwmaman, Aberdare 1868

Vivian, Wm., Llantrisant... 1868
Vachell, Wm., Cardiff .. 1869
Vachell, Edwin, Penarth ... 1869
Vachell, Ivor G., Cardiff .. 1872
Vachell, C. T, M.B., Cardiff Infirmary 1871
Vaughan, W. E., Cardiff ... 1869

Wood, Col., Stouthall, Swansea 1868
Waldron, Clement, Llandaff 1868
Waller, T. J., Cardiff ... 1868
Williams, E. J., Pengam, Newport 1868
Wilson, J. H., Cardiff ... 1868
Waite, Rev. J., Cardiff ... 1869
Webber, Thomas, Cardiff ... 1869
Webb, T., Cardiff 1872
West, J. J., Cardiff ... 1872
Williams, John, Cardiff ... 1868
Williams, Lewis, Cardiff ... 1868
Wills, G., Cardiff, Roath ... 1868
Williams, J., jun., Cardiff... 1868
Watson, Dominick, Cardiff. 1868
Waring, Thomas, Cardiff ... 1868
Watkins, W. B., Llandaff-place, Cardiff 1869
Williams, Mrs., Cardiff ... 1869

Yellowlees, Dr., Bridgend... 1869
Yearsley, E. E., Cardiff ... 1872

CARDIFF NATURALISTS' SOCIETY.

Rules.

1.—That this Society be called the "Cardiff Naturalists' Society," to consist of Subscribing and Honorary Members.

2.—That Ladies be eligible as Members.

3.—That its objects be the practical study of Natural History, Geology, and the Physical Sciences and other objects of interest; and the formation of a Museum in connection with the Free Library.

4.—That the Society be managed by a Committee, consisting of a President, Vice-Presidents, Curator, and Honorary Secretary, and Twelve other Members of the Society; and that in Committee Meetings, Three form a *quorum*.

5.—That the Annual Meeting be held in the month of January, at which the Committee and Officers be elected for the following year by Ballot.

6.—That the General Meetings be held on the Third Tuesday in every month, at Eight o'clock p.m.; Committee Meetings at the same hour on the First Tuesday in every month; and that a discretionary power be vested in the Committee to alter the times of all meetings when necessary.

7.—That all Candidates for Membership shall be proposed and seconded by existing Members, either verbally or in writing, at any meeting of the Society, and shall be eligible to be Balloted for at the next meeting, provided there be Five Members present. One black ball in Three to exclude.

8.—That the Annual Subscription be Seven Shillings and Sixpence (payable in advance to the Secretary on the First of January), entitling each Member to a copy of the Transactions. Members may commute the Annual Subscription into one payment of Three and a Half Guineas.

9.—That Specimens collected by the Society shall be deposited in the Cardiff Museum, and shall become the Property of the Corporation of Cardiff.

10.—One Month's Notice of withdrawal from Membership is required, such notice to be given in writing to the Hon. Sec.

11.—One Month's Notice to be given of any proposed alteration in the Rules.

Resolved,—"That strangers be invited to attend the Meetings of the Society and to exhibit any Curiosities or Collections which may be in their possession."