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EDITED BY
E. W. BADGER & W. J. HARRISON, F.G.S.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

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FOSSILIFEROUS HÆMATITE NODULES.

THE MIDLAND NATURALIST.

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ON THE OCCURRENCE OF FOSSILIFEROUS HÆMATITE NODULES IN THE PERMIAN BRECCIAS IN LEICESTERSHIRE,

TOGETHER WITH SOME ACCOUNT OF THEIR ECONOMIC VALUE, &c.

BY W. S. GRESLEY, F.G.S.

The following observations have been written with a twofold view: to make known certain features possessed by some red hæmatite* nodules occurring in the neighbourhood of Ashby-de-la-Zouch, in Leicestershire; and to interest others who have a geological turn of mind, in possibly taking up the questions herein noticed in a more scientific and searching manner than has been possible to the author.

I propose to divide the paper into the following heads:—

DESCRIPTION OF PLATE I.

No. 1.—Fragment of a nodule of red hæmatite showing a peculiar mammillated or "eyed" agate-like structure. Natural size.
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* Often magnetite, and occasionally compact limonite.

1.—The manner in which, and the localities where the nodules occur.
2.—A more detailed description of the stones.
3.—Remarks upon certain individual specimens.
4.—Origin of the hæmatite.
5.—Uses in the arts and manufactures. Value, &c. Mining notices.
6.—Concluding observations.

1.—It is in studying the superficial geology (the recent or drift deposits) of the district that these hæmatites are brought more especially into notice.

They occur in the shape of nodular lumps and angular or broken fragments from the size of one's fist to mere specks or the smallest of pebbles. They appear to be distributed rather indiscriminately over a considerably large tract of country in certain districts around the town of Ashby-de-la-Zouch, especially on the south, south-west, and west sides, from one to five or six miles distant. They are met with immediately beneath, as well as mixed up with, the surface soil, and here and there have been turned up in considerable numbers at various depths in making excavations of different kinds; the beds of streams also have yielded quantities of them. They are reported to have been picked up at some distance from the Ashby-de-la-Zouch area, namely:—In Nottinghamshire; at Newton Solney, near Burton-on-Trent; Spondon, near Derby; at Ashbourne, Over Haddon, Sandiacre; at Hugglescote, near Coalville, where they occur in a deposit of consolidated calcareous breccia, which was noticed in this Magazine (see Vol. VIII., 1885, p. 237), &c. Thus they contribute to form the alluvium or most recent period of the physical geology of the district. Secondly, they occur in precisely similar forms and sizes in the Permian series of the same neighbourhood, in a breccia.* In these Permian strata,—called by Prof. Hull "meagre traces,"—I suppose because they are only a few yards in thickness,† the hæmatite pebbles and fragments are mixed up promiscuously with a variety of other rock-fragments, sub-angular boulders, &c., amongst which are sandstones, in colour, white, yellow, brown, red, purple, &c., often micaceous; quartz (vein-quartz), enclosing patches of greenish slate; quartzite boulders and pebbles; puddingstone, granitic rocks; clay slate of red and of green tints, fragments of igneous rocks, coarse jasper, hornstone, chert, lumps of silicious and of red

* See "Memoir of the Geological Survey of Great Britain—Leicestershire Coal Field," by E. Hull; p. 57, *et seq.*

† Thirteen yards thick at Measham, Derbyshire.

earthy cone-in-cone formation; pebbles of indurated clay and slaty rocks (sometimes much weathered), sand, clay (in lumps), &c. The mass is usually loose, but at one or two places is consolidated, and is locally termed "small pox gravel," "poxen rock," and "grouse." This condition prevails at Measham, Oakthorpe, and Wooden Box. Again, it is commonly found to contain a large proportion of clay or mud, sometimes of an orange colour, but more usually red or variegated. At the Coton Park and Linton Colliery a few years since a drift was made to win the main coal of Moira, and in driving it, at a depth of about 155 yards from surface, the Permian breccia was passed through. It contained blocks of rock as much as half a ton in weight, and I obtained one round nodule of hard hæmatite from it. The localities that have hitherto furnished the largest number of specimens most rich in iron, and the hardest, are Measham, Packington, Overseal, Willesley, and Blackfordby. At Measham the stones (hæmatite) seem to occur in the breccia in patches or clusters rather than to be regularly distributed in the mass. As I have not met with hæmatite, of the peculiar mineralogical characters represented in these stones, in any other beds besides the Permian breccias, I conclude that the whole of this gravel-ore has been derived from these deposits of the district, and that those that occur in the alluvial accumulations have been washed from the outcrops of the so-called Permian series and carried or rolled far and wide by water, possibly assisted by ice. And now we will proceed to

2.—A more detailed description of the stones.*

(*a*) Shapes and sizes.

(*b*) Structure, colour, hardness, fracture, magnetism, organic contents, &c.

(*a*) These pieces of ore occur in a great variety of outward forms, the most common being those having a rounded or water-worn aspect. They are occasionally nearly spherical, finger-shaped, egg-shaped, more or less flat or disc-shaped, potato-shaped, angular, subangular, variously chip or splinter shaped, having usually at least one side more or less rounded and smooth. Their surfaces are often very smooth and even greasy-looking, and bright; but, as a rule, rough and uneven, also pitted, wrinkled, grooved, chipped, dimpled, scratched and bruised, and occasionally are completely perforated. Wart-like excrescences, weather-crusted (showing concentric zones of oxidation), cracks or flaws, cavities, &c., are not

* By "stones" in this article is meant a vast variety of fragments, &c., of rock partaking or composed more or less of the mineral *hæmatite* which I consider has had a common origin.

common, though now and then a nodule consists merely of a thin shell or crust of hæmatite. For a typical set of these stones see Plate I., Figs. 1, 2, 3, 4, 5, 6, 7, 8, 12, and 13. In size they vary, as already stated, from mere grains or minute bright shot-like morsels of about $\frac{1}{20}$ of an inch in diameter to masses weighing some two to three pounds (the weight of the largest I have yet discovered or heard of). I possess the greater part of a nodule which when whole probably weighed about 56oz. The average of all specimens would probably be from 1in. to 1¼in. across, or, in weight, about 2½oz. The prevailing colour of the weathered fragments is a reddish brown; iron black and grey are not common, but various tints of red, chocolate, purple, yellow, &c., are frequently noticed. Occasionally they possess a very bright red coating. A few are variegated. Very rarely they seem to be composed entirely of yellow ochre (pure limonite). Those occurring *in situ* in the breccia are mostly either of a red, or yellow and red, and have a metallic or steel grey appearance. Freshly fractured samples exhibit various reds, purples, browns, blue-blacks, and greys. Sometimes a white softish substance is found in them occupying hollows and cracks, which I conclude to be either sulphate of baryta or hydrous silicate of alumina. In the limonite (or göthite) nodules, streaks or veins of manganite sometimes are present.

(*b*) *Structure.*—Some seem to exhibit no structure—to occur massive. We have bedded, granular, concretionary, cellular, mammillated, stalactitic, geodic, columnar, cone-in-cone, banded, porphyritic, scoriaceous (?), compact, coarse-grained, fine-grained, brecciated, &c., specimens. In some samples we find two or three of these forms in a greater or less degree united. The botryoidal or mammillated forms occur in specimens of ore usually resembling vein iron-ore. Micaceous samples are usually earthy, and are often used as "raddle" or "red-rud" in the district. The sp. gr. of the most compact ore, *i.e.*, the steel grey variety, = 4·62.

Hardness.—Say 6½ to 7 for the most compact variety. This characteristic is perhaps the chief point or peculiarity possessed by the nodules, and it is this that qualifies them for employment as "burnishers." When thus used, excessive hardness must be accompanied by absence of cracks or flaws of any kind. It is, however, only a small proportion of the pebbles or fragments of ore that are found to be commercially valuable.

Fracture and Lustre.—Beautifully perfect conchoidal fracture in the hardest and faultless specimens, to irregular, flinty, dull and earthy. The lustre is metallic adamantine (rarely), more often greasy, dull and earthy.

Streak.—The usual *streak* is red. The brown hæmatite or limonite nodules, &c., of course, give a brown streak,* but we do not find the proportion of stones having a decidedly brown streak at all numerous. There is, nevertheless, a considerable percentage of nodules which give streaks varying between red and brown, or rather between yellow ochre and blood red, passing through various shades of brown. In two specimens only have I detected a black streak; one of them, in appearance, is singularly like some of the celebrated magnetic black oxide of iron so largely wrought in Sweden. It bears an impression of the fossil *Calamites.* The other is a small nodule of magnetite, with a shiny black anthracite coke-like fracture, and of low sp. gr.

Magnetism.—Probably about two per cent. of the lumps may be classed as magnetite, *i.e.*, they possess polarity. Where this property is displayed the specimens almost invariably have their poles residing, not at opposite ends, corners, or sides (or diametrically opposite), but apparently in points having no particular relation to one another; they are often on the same edge, or side, or end of a stone. It is not only in the hardest or brightest nodules, &c., that polarity exists, but it is équally strongly present in specimens the most worthless or earthy. In fact, this property seems to be present only in those specimens that have been exposed to the action of air, rain, &c. I have tested many hundreds of pieces, and have found only one which is simply magnetic or non-polaric; whereas all others that will at all affect the needle display polarity. I am puzzled to account for this fact, and I may also add that this singular individual (a remarkable stone in other respects) possesses its magnetic iron concentrated all in one particular spot—a projecting point on its surface about the size of a pea—the nodule itself measuring about two inches long.

Fossils.—Careful and diligent search has revealed the presence of a goodly number of organic remains belonging to both the animal and vegetable kingdoms in these hæmatites. They are unquestionably of coal-measure age, and, as Permian fossils, are of course only *derivative;* no true forms of that series have, I believe, yet been discovered in this district. The plant-remains—of which a list is appended—occur both upon the outside as well as enclosed in the stones. This is of course natural, as the majority of the specimens are *fragmentary*, and *whole nodules* are not common. Now and

* All limonites, however, do not give the brown streak, *e.g.*, the iron ore of Bilbao, in Spain, so largely employed by our steel and iron manufacturers, gives a *red streak*.

then fossils may be met with showing beautifully delicate structure or nervation of the leaves, scales, &c., of ferns, trees, and allied plants. A reference to Plate I., Figs. 10, 14, and 15, will probably render unnecessary any further description of these organisms. Fig. 11 shows a shell.

Striæ.—Certain parts of the surfaces of some of the stones in question are marked by polishing, by scratches, dimplings, and by deep grooves or worn-away depressions running across or partly round the nodule. The plough and harrow have in many instances produced certain of these, but that ice has been instrumental in forming the greater number of them is, by some geologists, thought to be probable. Sir A. C. Ramsay, some thirty years since, first attributed the striæ observed on rock fragments in the Permian breccias to ice action. Fig. 5 shows a striated pebble. Many specimens exhibit abrading, rubbing, and grinding actions, their rounded edges being worn flat as if by a rasp. It is probably to the work of ice that the angular or chip-like fragments owe their shape, pressure or frost having broken up larger masses. Certain fragments of the ore bearing striations have been examined by Prof. T. G. Bonney and Prof. J. W. Judd, who both agree in considering that these particular markings are not due to ice action. Quite recently I have discovered rock fragments associated with the iron ore nodules in the breccia, the striæ on whose surfaces cannot possibly, to my mind, have been produced by movements of the rocks *en masse.* One or two nodules exhibit *faulting.* The stones themselves are fractured, but have been re-cemented. To great squeezing of the stones one amongst another, when in the breccia, I consider this fracturing to be due. Again great pressure must have produced a singular comparatively large and deep depression or smooth hollow upon the exterior of one of these fragments. Now, this cup-shaped hole has probably been made by another and harder pebble lying in contact with it in the original deposit, which has gradually forced, or as it were, screwed or rubbed itself into its neighbour's side. This depression, which fits the finger end, has been formed since the stone was originally broken up and came to rest in the breccia, because folded or turned back over the fractured side of the fragment is part of a kind of lip or thin edge standing out beyond the general surface of the mass in an irregular ridge or wall of hard hæmatite, which forms the rim of the said dimple. It seems to me that this peculiar feature has been brought about by the more or less continual action of great dynamical pressure—in other words, pressure resulting from the oscillations or earth-movements possibly continued through long periods of geological time, which the position of the Permian series proves to have taken place. But we must pass on and next notice some

Agates.—Under division 2 (*b*) *Concretionary structure* was noticed. This is very common. Certain very hard and flawless specimens of the ore are, by people in the district who trade in them as *burnishers*, termed "agates," although they may display no visible concretionary markings such as agates proper possess. The term, I fancy, has been applied to signify *excessive hardness*, and adaptability to uses in burnishing, to which the ordinary Scottish, German, and other agates are often put. My reason for calling certain of my specimens "agates" is this. Their *structure*, I maintain, in a great measure resembles that of the true agate. It is true we do not in these hæmatitic forms meet with any transparent or semi-pellucid and variegated kinds, but generally speaking with only two shades of the same colour, and with alternating bands or zones of different density of two kinds; in other words, I have only noticed the parallel or concentric layers to be composed of two shades of red, purple, or blue, as the case may be, however many times repeated. Figs. 1, 3, and 4 illustrate forms possessing agate-like structure. It often happens that good agate-like markings or layers occur in some of the most brittle and worthless specimens. These concretionary markings are occasionally very beautifully and minutely developed; the forms known as "fortification," "eyed," "folded," and "banded," being present. Some of these forms probably owe their origin to minute cracks in the stone which have in some way regulated the development of the peculiar structure seen. Again, we occasionally find specimens (weathered stones) which at first sight look like the remains of nodules, but as a large portion of each of them is composed of a mass of quartz grains cemented together (with red hæmatite inside and brown hæmatite outside the nodule) I am inclined to look upon them as having once been fragments of grit or of quartz rock. The most peculiar feature about them, however, seems to me that the parallel or concentric zones of oxidation not only run through the ore devoid of visible quartz grains, but through the gritty part of the stone as well. The pittings, cup-shaped or conical hollows with "pin-holes" in the bottoms of them, the wart-like and eyed excrescences, and other surface markings on the stones are generally traceable to this kind of concretionary structure in a greater or less degree of perfection of development on some part of the specimen. A few specimens of the brown hæmatite of cone-in-cone structure seem to be closely allied to a concretionary formation.

(To be continued.)

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

At first, perhaps, an apology seems needed for the appearance of a paper on this subject in the "Midland Naturalist," but a moment's thought will remind our readers, first, that this publication is the organ of the Midland Union, which includes several Archæological Societies, and next, that Archæological notes have already from time to time appeared in these pages.

Only a few short prefatory notes on Monumental Brasses in general will be given here; those who wish complete information on this subject are advised to consult the Rev. H. Haines' "Manual of Monumental Brasses," the Rev. C. Boutell's "Monumental Brasses and Slabs of the Middle Ages," and Messrs. Waller's "Series of Monumental Brasses."

A monumental brass may be described as a plate of brass with an effigy or inscription or both engraved upon it, inlaid in a stone slab, and firmly fixed there by being imbedded in pitch and rivetted. The earlier specimens usually take the form of effigies; later brasses are generally quadrangular. At the head of the figure a canopy is sometimes placed; and armorial bearings, evangelistic symbols, and other ornaments are not uncommon additions. The accompanying inscriptions are found on scrolls, on strips of metal placed round the edges of the slab, but most often on plates at the feet of the effigies. The engraved plates were sometimes gilt, but generally burnished, and the incised parts were filled up with a black or coloured resinous substance.

The plate of which brasses are made, and the art of engraving them, was probably brought from Flanders or France; indeed, some of the early brasses in England, on comparison with existing Continental examples, betray unmistakable marks of foreign production. Foreign brasses consist of large quadrangular plates, engraved with elaborate back-grounds and certain conventional ornaments; English brasses represent effigies without backgrounds. With the few exceptions suggested, however, the brasses extant in England are the work of English artists; and the metal itself was made in England at least as early as 1565, when Queen Elizabeth granted a patent for its manufacture. It is much to be regretted that, while we may feel confident that certain groups of brasses are the work of the same artists, we are unable to discover who the artists were.

The origin of the use of brasses may perhaps be accounted for in the following way. Marble monuments, with their carved canopies and life-size effigies, however majestic, took up a great space. Effigies in low relief, placed on the floors of churches, were in the way, and, like incised slabs, liable to wear; Limoges enamels were still less suitable for use in a similar position. Hence, about the thirteenth century, monumental brasses came into use, following the incised slab in treatment, and the Limoges enamel, to a certain extent, both in treatment and material, and were at once cheap, convenient, and durable.

To the archæologist the use of the study of brasses is manifold. They accurately represent the vesture of the ecclesiastic, the armour of the knight, and the less extravagant fashions of civil costume. They supply the herald with armorial bearings; and in the mouldings and tracery of their canopies afford valuable data for the history of Architecture. The inscriptions acquaint the genealogist with facts of family history, and the palæographer with the forms of letters in use at different periods; while all may learn from them something of the thoughts and aspirations that have swayed the generations of the past.

Fac-similes of Monumental Brasses may easily be obtained by laying paper (paper-hangers' lining paper is most convenient) upon the brass, and rubbing the paper with shoemakers' heel-ball. Care should be taken to first brush out all dust from the incisions in the brass, and to fix the paper securely by weights or wafers. Rub hard so as to produce a good black impression; a result which will be further facilitated by carrying the heel-ball in the trousers' pocket previous to use, by which method the heel-ball is slightly warm.

Many pleasant holidays may be spent in collecting rubbings of these interesting memorials. This pursuit invigorates the body, quickens the imagination, and links one more closely with the bygone. There is the refreshing walk through country lanes far from smoke and noise, and then in some remote church, whose windows have let in the light of centuries, one stoops down in the quiet aisle and with rustling of paper and rattle of heel-ball takes a rubbing of the effigy of some warrior who haply fought at Creçy or of a courtier who once kneeled to hand the signet-ring to a Tudor.

In succeeding papers will appear a list of places in Warwickshire where brasses are to be found. The notice in Haines' "Manual of Monumental Brasses" will in each case be quoted, and a minute description of extant brasses derived from rubbings made by the writer will be given, together with any interesting details concerning the person commemorated which can be obtained.

ASTLEY. I.—*A lady of the Astley family (?), circa* **1400,** *in mantle, lower half of effigy and inscription lost. Haines.* —This brass is lying loose on a tomb near the west door. Its length is 2ft. 6in. by 13in. The head, lower part of the effigy, inscription, and canopy, if it had one, are all lost. The lady wore upon her head a veil or kerchief, the ends of which fall upon the shoulders. Her outer garment is a mantle reaching to the feet and drawn together across the chest by a tasselled cord passing through two metal loops *(fermailes)*, one fastened in front of each shoulder by a jewelled metal stud. Beneath the mantle is seen the kirtle, a long close-fitting dress with sleeves reaching to the knuckles. Over the kirtle is a dress with the sides cut away from the shoulders to the waist, leaving large openings through which the arms pass. The edges of these openings were generally trimmed with fur. In the present example this border was represented by enamel, which has all disappeared. The front of this garment is ornamented or fastened with metal clasps. The hands of the effigy are in the attitude of prayer. A similar brass is figured in "Haines' Manual, " p. 169.

In "Dugdale's Warwickshire," p. 118 (edit. 1730), is figured a lady under a canopy, with the following imperfect inscription: " . . . morust le primer jour d'aprill l'an de grace mill: cccc et . . . del alme de quele dieu eit mercy: Amen." This may be translated: " . . . died the first day of April in the year of grace one thousand four hundred and . . . on whose soul God have mercy: Amen." Possibly this inscription belongs to our brass, though this is mere conjecture.

The other brasses in the church which are figured in "Dugdale," *l.c.*, are gone; their matrices are, however, visible.

II.—At the west end of the nave, over a pew, is a mutilated plate with an inscription in black-letter or Gothic characters, which reads as follows:—

............charite pray for ye sowlle of John Crugge som........ | ...... Exest' gentilmã & Barbara his wif whiche John Crug.... | ....n ye Countie of Midd ye xviii day of december Ano dnī Mo vcxxxiv | ..f ye reign of Kyng Henry ye Eight xxvth & ye said Barbara died | ....ay of Ano dnī Mo Vc ō whose sowlle Jhū have m......

It is evident that the husband died first, and that the blank spaces were left in order that the date of the wife's death might be filled in when it occurred. Many similar instances will be found.

III.—Near the last inscription is a small quadrangular plate, 12in. by 8in., bearing the following inscription in Roman letters:—

I AM SURE THAT MY REDEEMER
LIVETH AND THOUGH WORMES
DESTROY THIS BODYE YET I
SHALL SEE GOD IN MY FLESH.

Here lyeth the body of William Beck
of Aftley whoe departed this life
March 21 An° Domini 1623
and hath giuen yerely vi[s] viii[d]
to the saide parish of
Astley for euer.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.*

BY T. A. WALLER, B.A., B.SC.

When, twelve months ago, you did me the honour of electing me to a second term of the presidency of this society, the great kindness which I had already received in the discharge of the duties of the office left only one aspect of the situation which appeared at all formidable, which was that when the year had expired I should have to deliver a second "retiring address," and, my choice of subjects

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*Transactions of the Birmingham Natural History and Microscopical Society. Read April 28th, 1885.

being very limited, I was afraid that I might fail to find anything which would interest you among the Geological problems of the year.

The kind and hearty co-operation and assistance which have been afforded me since then have made all the functions of the office not only easy of fulfilment, but pleasant in the performance, and I can only tender to all those with whom I had the good fortune to be associated, the expression of my heartfelt thanks for the unfailing courtesy with which they have supplemented my many deficiencies. The work of a society such as this can only be satisfactorily carried on by those who have help to give extending it to all those who wish it; such, I take it, is the object of our association, and I believe it is to a very considerable extent fulfilled. It seems, however, worthy of consideration whether we might not, by a little more thought for the requirements of our younger members, make our meetings still more generally useful. The papers which are read frequently appear to mark the furthest point of knowledge on the subject treated of, and although this is, of course, a most important part of our work, and one which can by no means be lost sight of, there are many evenings which might suitably be filled up either with quite elementary papers on Natural History subjects, or with some rather more systematic "exhibition of specimens" than is usually provided for us. After all, the meetings depend entirely on those who attend them, and the remedy for a deficiency which any member feels is, to a great extent, in his, or her, own hand. The Committee is always most anxious for the maintenance of the interest of the meetings, and would, I am sure, welcome any promises of papers or specimens from others than the comparatively few members who at present furnish most of them.

As to Geological subjects, to which I may make reference, I am again fortunate, for although there have been no great volcanic eruptions such as that which made the year 1883 memorable, we have had reminders even in our own quiet island that our quiescence is only relative and temporary. During the year two of the most severe shocks of earthquake which have happened in these islands for probably a century or two have affected the east and north-west of England respectively. The latter seems to have attracted comparatively little notice; the former caused an excitement all through the country which some persons who saw the effects thought to be rather disproportionate to them, but which was an undoubted boon to the many poor people whose property had suffered. At any rate, more damage was done than has been caused by any earthquake in England within living memory, so that perhaps we are justified in making much of it. We have had the pleasure of seeing photographs of some of the effects of the earthquake, taken within a day or two of its occurrence, which clearly showed the direction of the wave which passed through the ground. I have only seen the record of one observation which gave any idea of the amount of vertical displacement. This was, that a man was enabled at the moment of the shock to see through opposite windows in his workshop from the ground outside, and measurements showed that he must have been lifted at least 2ft. 9in. Another man describes the appearance of the movement over the level salt marshes as like the wind passing over a field of corn, only quicker. A curious effect of the movement of the strata was the increase in the town water supply of Colchester. For some time previous the supply had been diminishing, so that the suction pipe, which had been already somewhat lengthened, was about to receive another addition, but immediately after the shock the water had risen seven feet in the wells, enabling about two hours more supply daily to be given, at the same cost of pumping. Whether this increased supply has continued to the present time I have not heard, but all the wells in the district seem to have been similarly affected. If the failing of the supply was produced by the opening by subterranean movements of cracks which tended to drain the wells, the closing of these cracks by the settling down which produced the earth wave would very likely permanently increase the available supply. If, on the other hand, the earthquake opened cracks in the chalk so that the water flowed down more freely, as is suggested by Mr. de Rance, the increased flow would probably be only temporary.

As to the limits over which the shock was felt, it is recorded from South Yorkshire, Boulogne, and Street, in Somersetshire. A rather curious suggestion has been made as to the relation of this shock to the floor of Palæozoic rocks which is known to underlie not only the Midland district but the Thames valley and the Eastern Counties; deep borings having reached them in Harwich, near the centre of the disturbance, London, and at various points about due North and on to Northampton, while they come to the surface in the Mendip Hills south of Bristol, and in patches across the Midland and North Midland counties. Now it is almost certain that the shock originated far below the upper surface of these hard and compact rocks, and shocks of any kind are naturally much more readily propagated in such rocks than in the looser and softer strata of chalk, sands, clays, &c., which overlie them. It is known that the superincumbent rocks are much thicker in the south-east of England, in the district of the Weald of Kent, and it is possibly owing to this circumstance that only very few records of observations of the shock from that district are forthcoming. From this cause, too, may arise the double shock noticed in many places; the first being due to the more rapidly transmitted wave in the harder, the second to the slower one in the softer rocks.

It was noticed that the cracks in the walls of buildings were at an angle of about 30°, while in the chimneys this was increased to 40° or 45°. In one of the churches two cracks, at angles of 32° in opposite directions, met over the door. One house was rent spirally, and the observation of chimneys having been twisted was made in several instances; in one case the side that had been to the south was facing almost south-east. Whether this twist is due to an actually changing direction of the shock or to the centre of gravity of the building not coinciding with the centre of figure is still undecided; the more general opinion being the former, while Mr. Mallet holds the latter. That there was more than one shock is made probable by the fact that one man described the movement which he felt as being like "three seas." There is also a good deal of evidence of varying direction in places quite near each other; but this may very probably be due to the damage having been done in the one case by the direct throw and in the other by the backward movement. Altogether it seems probable that the shock originated a short distance to the south-east of the village of West Mersea, where, emerging nearly vertically, it did but little damage, and travelled outwards from that centre with a velocity and a violence dependent upon the nature of the material through which it was propagated. At Kew, the magnetographs recorded the shock, and from the fact that the magnets which showed the greatest disturbance were those which lie east and west, it was inferred that the shock was more nearly north and south than at right angles to this.

The interest awakened by this occurrence in earthquake measuring in general produced a series of papers in "Nature," Vol. XXX., on the subject, to which I may refer any who would like further information. Our own little tremors seem, however, scarcely worth mentioning by the side of the terrible disturbance in the south of Spain, where so many lives have been lost—as many, perhaps, by privation and exposure to most unusually inclement weather as by the actual fall of the buildings in the towns and villages destroyed by the earth movements.

In this case the phenomena appear to have been definitely related to the line of the mountain chain, so that we are probably justified in assuming that they are the concomitants of the great process of mountain making which seems to be constantly going on at one place or another of the earth's surface, in that almost imperceptible way which is so calculated to teach us patience and show us how little we can actually pretend to know of the processes which have gone to fashion the surface of the earth, however much we may feel ourselves justified in deducing them from the present state of things. The geological clock ticks centuries; we hear one; who will hear the next, and how are we to combine the experience of our predecessors with our own to obtain a notion of the course of geologic change?

In my address last year I mentioned the controversy which was then being carried on with so much vigour as to the proper interpretation of the record of the rocks in the north-west of Scotland. At that time the question seemed likely to furnish matter for discussion for a long time to come. In the issue of "Nature" for 13th November last, however, there appeared a communication from Dr. A. Geikie, the Director-General of the Survey, accompanying the report of the field observers specially detailed by him for the service of examining the district over again, and, if possible, finally determining the matter. He confesses that their report so much surprised him that it was not until he had himself been over the ground with the observers that he was able to accept their conclusions. As to these conclusions it is sufficient to say that they almost unreservedly, and in many cases verbally, corroborate the views which have been strenuously advocated by what may be called the unofficial geologists of late years. They even go beyond them in some details—for instance, they mention a case in which the thrust of rock has been so enormous just at the fault plane that there is proof of a movement of ten miles along that plane, a patch on the top of a mountain having been originally connected with other masses at that distance from it, although denudation has since then removed the intermediate portions. The "Geological Magazine" for March of this year contains a summing up of the whole affair from the pen of our member, Professor Lapworth, under the title of "The Close of the Highland Controversy." He shows that in almost every individual conclusion to which the officers of the Survey have now found themselves driven, they are but endorsing an opinion of some one or other of the unofficial geologists who have for many past years studied and described the Highland rocks. It is, therefore, an excellent instance of the power of a name and official position when we find the *Times*, which, of course, we usually look upon as omniscient and infallible, gravely stating, in a summary of the scientific events of the year, that the Geological Survey had at length discovered the true relations of these old rocks.

Perhaps I may, somewhat at the risk of repeating what I said last year, give a general outline of the final results of observation.

The unaltered rocks which occur in north-west Sutherland and Ross are the Torridon sandstone, the quartzite, the fucoid group, and the Durness limestone. This limestone, which contains fossils of species which point to a Lower Silurian age, is the newest sedimentary rock of the district, the so-called upper quartzite and limestone being repetitions of the corresponding beds mentioned above. Over this mass of rocks the eastern metamorphic rocks (the so-called newer gneiss) have been thrust by earth movements which have of course acted since Lower Silurian times, and the schists and gneisses which in Sango Bay, &c., appear to lie upon the limestone have really faulted junctions. These correspond to the similar rocks in the zones of pressure schists in Eriboll, about ten miles to the south-east. Up to this point there is now substantial agreement, but as to the nature of the metamorphism of the eastern series and the original material from which it has been elaborated there is still some difference of opinion. Are we to look upon these rocks merely as a division of the old Archæan gneisses, which, as I stated before, is the opinion of Dr. Callaway, or, with Professor Lapworth, consider them as an intimate and to some extent recrystallised mixture of all the rocks in existence n the region prior to those terrific movements of the earth's crust which have been spoken of above? In this case the planes of schistosity, lamination, and foliation are not planes of bedding, but of shearing and cleaving, along which the rocks have yielded to the lateral pressure. From this it will be evident that in the words of Professor Lapworth "The results already attained in the north-west are merely the preliminary sketches for a great and a most necessary work, namely, the detection of the chief laws of mountain stratigraphy and the discovery of the more important processes of regional metamorphism. It seems to me that these are the conclusions that every one who knows the facts is certain to draw for himself from the startling and sudden collapse of the brave Murchisonian hypothesis in our midst, and that they ought to have the effect of banishing partizanship and of teaching us scientific toleration and mutual respect. At the present time the several groups of students of these old rocks are all met together upon one and the same elevated platform of a common opinion, having climbed up painfully thereto from many different directions. Continental geologists, British amateurs, and the officers of the Geological Survey are now at one and the same point. They stand together on the shore of a new world of geological discovery, full of the richest promise."

I have ventured to copy these sentences from the paper in the "Geological Magazine" before indicated, because they appear to me to describe this almost unique position in the history of geological inquiry in words so far superior to any at my command that anything which I might have attempted to write could only have seemed like the mutilated echo of them.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 314.)

The rock-bed has been quarried both right and left of the railway, but I need only refer to one section just south of the line, and about a mile west of Byfield Station, and this only because the transition-bed is fairly well developed there. The following fossils were obtained:—

Ammonites acutus	*Actæonina Ilminsterensis*
,, *Holandrei*	*Cryptænia consobrina*
,, *fonticulus ?*	*Chemnitzia semitecta ?*
,, *spinatus* (small specimen).	,, *foveolata*
Astarte subtetragona	*Trochus sp. ?*
,, *striato-sulcata*	*Rhynchonella tetrahedra*
Plicatula spinosa	*Terebratula, &c.*

North of Byfield there is a small quarry on Blackdown Farm, about half a mile beyond Iron Cross, towards Hellidon. The rock is a ferruginous sandstone about five or six feet in thickness, and about midway in the section is an irregular layer, full of ossicles and broken shells of many kinds; just above this layer is a hard bed containing many specimens of

Waldheimia resupinata. There is no clay capping to the rock here, a fact which might with certainty have been predicted from the deep red colour of the soil around.

A little beyond the last-mentioned quarry, and about a mile and a half from Hellidon, there is another showing about six feet of the rock-bed. It is situated on STIRCH FARM, parish of Priors Marston, and we find the Lower Cephalopoda-bed, Fish-bed, Transition-bed and Rock-bed, all very much the same as at Byfield.

A good deal of Marlstone has been quarried around HELLIDON, but most of the quarries are now obscured. One, however, has been recently re-opened in a field just south of the village. The Serpentinus-beds are particularly well shown, but the Fish and Insect-beds are represented, if at all, by a thin marly layer containing numerous ammonites, only one inch in thickness, and the Transition-bed seems entirely absent. The Rock-bed is found here in large blocks, very little broken up by fissures, and would probably make a good building stone. *Terebratula punctata*, *Rhynchonella tetrahedra*, and *Pecten liasinus* were fairly abundant.

At UPPER CATESBY, just opposite the Staverton Road, is an old quarry showing about five feet of Rock-bed, with, at the top, a very fair development of the Transition-bed, some two inches, the latter yielding *Ammonites acutus* and *gastropods*. The soil above contains many pieces of limestone belonging probably to both the Fish-bed and Cephalopoda-bed.

Following the road from Catesby to Badby we came across a small quarry near to ARBURY HILL; the section consists of the Rock-bed, capped by fragments of the Transition and Cephalopoda-beds; the fragments of the former are rather hard, and the fossils in consequence fairly well preserved. *Ammonites acutus* is found, and many small *gastropods*; one uncommon form, a *Trochus* approaching *T. mysis* (d'Orb), is found here. The following fossils were obtained from the rock-bed at this place:—

Belemnites	*Rhynchonella tetrahedra*
Pecten liasinus	*Terebratula punctata*
Cardinia concinna (Sow.) or *C. philea* (d'Orb), large specimens	*Waldheimia resupinata*

A little nearer to BADBY the rock-bed may again be seen in a small section presenting its ordinary characters, and I mention this in particular because to the east of Badby we meet with a rock which, from its position, would certainly be taken to be the rock-bed, but which I believe is only partly that; it is probably just at the commencement of the extensive "fault" which runs right to and most likely beyond Northampton, a "fault" which cuts out much of the Middle Lias on one side of the Nen Valley between the points named.

At STAVERTON, situated about a mile north of Catesby, there are several ponds in the village the water of which is thrown out and held up by the clays immediately below the rock-red, the rock-bed itself being seen around them. It is this character of the underlying clays that makes the rock-bed itself such a reliable source of water supply. The "*Margaritatus*" clays and marls seem all of them to be very pervious to water; we have, therefore, in this character of impermeability a rough means of distinguishing the "*Spinatus*" clays from the "*Margaritatus*" ones, although the two are very similar in appearance. Of course these remarks only apply to the district under discussion.

The ponds at Staverton are situated as follows:—First, about a quarter-of-a-mile along the Daventry Road; second, just at the corner of the Daventry Road, and in the village; third and fourth, close to each other on the N. side of Staverton; fifth, about the centre of the village.

Some four miles north-east of Staverton we came across some very fair sections of the "*Spinatus*" *Zone*, near to the village of WELTON. Here an outlier of Middle Lias is met with, in which a small patch of Upper Lias has been preserved by a "fault." About a quarter-of-a-mile from Welton, towards Braunston, near to the junction of two roads, is a small pond, one side of which shows the following section:—

SECTION AT WELTON.	Feet	In.
1.—Soil and sandy clay, not calcareous	2	0
2.—Irregular rubbly ironstone, somewhat concretionary, containing *Myacites*, *Pleuromya costata* (*rather abundant*), *Protocardium truncatum*, *Aviculæ*, *&c.*	1	3
3.—Sandy and highly micaceous clay, not calcareous, containing *Avicula inæquivalvis*, *Protocardium truncatum*, *Gasteropods* (*Actæonina?*), *Terebratula?*	3	0

This section is situated near to two others, showing only the rock bed, and can be only a little below them; also the lower bed seems to be fairly impervious to water. Hence, I conclude, they belong to the "*Spinatus*" *Zone*, and that they may be "C" of the typical section. None of the fossils found were sufficient to decide the zone to which the section belonged, though I think that one of the fossils I managed to spoil in extracting from the soft matrix was *Terebratula punctata*, and this I have never yet found in the "*Margaritatus*" *Zone* of the district.

Some little distance from the section just described there is a clay pit, where the "*Communis*" *beds* of the Upper Lias are worked for brick-making, and some two hundred yards north of this is a very fair section of the rock-bed.

Section at Welton Stone Pit.

	Feet	In.	Feet	In.
1.—Soil and marly clay, light coloured, containing a few small ammonites			2	6
2.—Cephalopoda-Bed, sandy, light yellowish colour, containing very many *Ammonites, of the falcifer group*, and also a fair number of *planulate ones. Ammonites acutus? Belemnites* (*many*), *Gasteropods, Astarte, Pentacrinite joints* ...			0	8
3.—Rock-Bed. No very decided break between this and bed above.				
Ferruginous sandy bed	0	10		
Band almost made up of small pebbles or concretions	0	6		
Ferruginous sandy bed, most sandy towards bottom; in places almost made up of shells...	2	6		
			3	10

Rhynchonella tetrahedra, Terebratula punctata, Ostrea (*large*), *Pecten æquivalvis* (*large*), *Aviculæ, Belemnites* (*large*).

Shows bedding planes well in places; joints numerous, some filled in with lenticular crystals of carbonate of lime.

On the south side of the clay pit another small opening showed a section very similar to the above.

There are also two or three very interesting sections along the L. & N. W. Railway between Long Buckby and Crick Stations, showing that the Middle Lias is well developed there. The first is not far from Watford Village, and is as below.

Section at Watford.

Upper Lias.

	Feet	In.
1.—Lower Cephalopoda-Bed, a rather sandy limestone, containing many large *Ammonites of the falcifer group*, and numerous *Gasteropods*, including the rather rare *Nerinea liassica*	0	6
2.—Shale. Very red in lower part. No fossils detected	0	2½

3.—FISH-BED. A semi-nodular limestone, whitish, containing *Euomphalus minutus* and many *Fish fragments*, *Wood*, *&c.*	0	3

MIDDLE LIAS.

4.—RED SANDY CLAY, not persistent. One large specimen of *Pleurotomaria araneosa* found, but no other fossils	0	2½
5.—TRANSITION-BED and ROCK-BED. A rather soft stone, having the same reddish mottled appearance so characteristic of the rock-bed on the Dorsetshire coast. The upper part is very full of *Gasteropods* and small specimens of *Rhynchonella tetrahedra*, and also contains *Ammonites acutus*, *Falcifer ammonites*, *Belemnites*, *&c.*, and *a large number of small pebbles*, and so is probably the representative of the Transition-bed, although it cannot be separated from the bed below. *Ammonites communis* is met with on the Rock-bed several inches below the surface	0	10

This section is in several respects peculiar. In some places, and within a few feet of that where the above section was taken, we find the Rock-bed, Transition-bed, Fish-bed or Cephalopoda-bed (and perhaps in some cases both), forming only one block of stone, just as the Rock-bed, Pleurotomaria-bed, and Cephalopoda-bed may be found combined in the coast sections west of Bridport. At a depth of about ten inches from the top the Rock-bed becomes suddenly shaly, bluer, and more like clay further down still, and totally unlike the Rock-bed as usually found. In one or two places there seemed to be an indifferent kind of separation between the hard rock and the shale.

I certainly feel doubtful whether this is a part of the Rock-bed; or, indeed, a part of the "*Spinatus*" *Zone*. It only yielded a few aviculæ itself, but just at the junction with the undoubted Rock-bed *Protocardium truncatum* was met with, and this is exceedingly rare in the Rock-bed of the district. The beds above and below those given in the section were too much obscured to admit of easy examination.

A little further along the line towards Rugby, and perhaps less than a mile away, there is a short tunnel through a Middle Lias Hill, and on each side of the tunnel several of the hard beds can be fairly well examined. A section is given below.

SECTION ON THE LONDON AND NORTH WESTERN RAILWAY, NEAR TO WATFORD LODGE.

	Feet	In.
1.—Soil, &c.	3	0
D.2.—Calcareous and ferruginous sandstone, shaly, and abounding in fossils, though not many can be got out whole—a fair amount of comminuted shell. On east side of tunnel divided about midway by a thin soft shale about 3in. thick. *Ammonites margaritatus (a single poor specimen), Belemnites paxillosus and others, Pleurotomaria heliciformis, Ostrea sportella, Ostrea cymbium var. obliquata, Pecten æquivalvis, Pecten liasinus, Protocardium truncatum, Cardita multicostata, Astarte striato-sulcata, Wood*	2	3
E.3.—Reddish sandy clay, as far as could be made out very much resembling soft beds, at Staverton	13	7
F.4.—Reddish mottled ferruginous limestone, containing argillaceous nodules, shaly in places, and in others very much resembling the bottom bed "L." Very fossiliferous. *Ammonites margaritatus, Belemnites (few), Gasteropods (abundant in places, but mostly casts), Turbo aciculus, Ostrea cymbium var. obliquata (abundant), Ostrea submargaritacea? Pecten liasinus, Plicatula spinosa (abundant), Avicula inæquivalvis, Protocardium truncatum, Cardita multicostata, Cardinia lævis (rather abundant), Astarte striato-sulcata, Pholadomya, Pleuromya costata, Ditrypa circinata*	3	0
G. H. I. 5.—A light brown sandy, micaceous, and ferruginous clay or shale. Not calcareous, very porous, few fossils. This description given from a very slight exposure	19	6
J.6.—Rather soft, shaly, micaceous, and calcareous stone, a little ferruginous, containing *small Gasteropods, Pecten liasinus, Protocardium truncatum, Limea acuticosta (abundant), Circa liasina, Fucoids markings (abundant)*	3	0

The measurements for the beds were made on the incline and an allowance afterwards made for an inclination of 35°.

It will be noticed that I have included in the 19 ft. 6 in. three beds. This plan seems best because it is a great thickness for one bed, and, moreover, the bed H. is so soft in some other places that it could scarcely be expected to form a conspicuous feature in a railway bank. The bed "L" appears to be absent altogether here, for although the section extends down some 35 feet further, measured on the slant, no trace of it is to be found; moreover, on the north side of the line, at a depth of about 4 feet (7½ feet on the slant) below bed "J," there is a tolerably good spring of water, shown by the line of rushes and the swampy condition of the ground, and this would appear to be the base of the set of beds I am describing as Middle Lias. The spring is well marked in the tunnel itself on the north side, for the brickwork is exceedingly wet to a height of seven or eight feet, and all overgrown with lichen. The pipes let into the side seem quite inadequate to carry off the water; indeed, the water runs out of the tunnel in quite a stream. The south side of the bank and tunnel seem quite dry, no doubt owing to the inclination of the beds, and singularly the spring cannot be detected in either bank on the side of the tunnel nearest Crick Station.

(To be continued.)

Review.

Phillips's Manual of Geology, Vol. II.; Stratigraphical Geology and Palæontology. By R. ETHERIDGE, F.R.S. 8vo., XXII. and 712 pp.; ——— woodcuts, and thirty-six plates. Published by C. Griffin and Co., Exeter Street, Strand; price 34s.

THE first volume of this excellent manual (written by Prof. Seeley) we noticed some few months back, and we have now great pleasure in announcing the completion of the work by the pen of Mr. Etheridge.

The frontispiece consists of a coloured geological map of the British Isles, which, though necessarily small, is very clear and distinct. In the preface the author compares the number of British fossils now known—16,000 species, belonging to 3,680 genera—with the list given by Prof. Morris in his "Catalogue of British Fossils," published 1854, and which included 4,000 species, belonging to 1,280 genera. So great an advance clearly demanded an entirely new treatment of the subject, and we are glad to say that the book which lies before us may be taken as entirely Mr. Etheridge's own work; "the plan of Phillips has been adhered to; but of the *text* itself, few pages of the edition of 1855 now remain."

Of all our English writers on geology, Mr. Robert Etheridge was probably the best fitted to undertake the description of the extinct life whose remains are contained within our rocks. For many years palæontologist to the Geological Survey, the labour of cataloguing and describing the fossils collected in every part of England and Wales has given him an extreme familiarity with fossils belonging to the kingdom and sub-kingdom of Nature. The richness of the knowledge so accumulated was evidenced in the two remarkable addresses given by Mr. Etheridge to the geological world when he was President of the Geological Society; but he was there limited by space, and in the manual he has now written Palæontology finds, almost for the first time, a careful and detailed chronicler.

In the first chapter the author explains the general principles of historical geology, and gives a succinct account of the strata forming the earth's crust, including a very useful and detailed table of the known fossiliferous formations. Commencing, then, with the lowest and oldest rocks—the Pre-Cambrian—all the strata are dealt with in turn up to, and including, the period when man enters on the scene.

The thirty-six plates are beautifully executed on tinted paper, and include the characteristic fossils of each formation. Besides these, there are "one hundred and sixteen tables of organic remains, brought down to 1884, embracing the accumulated wealth of the labours of past and present investigators during the last thirty years. Eleven of these tables contain every known British genus, zoologically or systematically placed, and with the number of species in each, showing their broad distribution through time. The remaining one hundred and five tables are devoted entirely to the analysis, relation, historical value, and distribution of specific life through each group of strata."

These tables will be simply invaluable to the earnest student of palæontology. The whole book stands alone; we have nothing else like it, or equal to it in its own field, in our geological literature.

W. J. H.

METEOROLOGICAL NOTES.—November, 1885.

Barometric pressure underwent some great changes during the month, the range amounting to 1·308 inches. After an unimportant fall, the mercury rose to 30·3 inches, fell rapidly to 29·7 inches, rose again, suddenly, to 30·4 inches, and then fell gradually to 29·1 inches, rising again at the close of the month. Temperature was also variable; the mean was about the average. The diurnal range was as much as 22 degrees; as little as 1 degree. The highest readings were 58·0° at Henley-in-Arden, and 56·0° at Coston Rectory, on the 28th; 57·4° at Loughborough, and 55·7° at Strelley, on the 2nd. In the rays of the sun, also on the 2nd, 92·9° at Loughborough, and 89·5° at Strelley. The lowest readings were 22·0° at Loughborough, on the 17th; 24·5° at Coston Rectory, on the 16th; 25·0° at Henley-in-Arden, on the 17th and 18th; and 26·5° at Strelley, on the 18th. The thermometer on the grass recorded 18·2° at Strelley, on the 18th; 19·5° at Loughborough, on the 17th. Rainfall was slightly above the average, the totals reaching 3·97 inches at Henley-in-Arden, 2·91 inches at Coston Rectory, 2·69 inches at Strelley, and 2·35 inches at Loughborough. The amounts were not large, the collection being extended over a period of from 18 to 21 days. The weather was generally dull and damp. A lunar halo was observed at Loughborough on the 13th.

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Natural History Notes.

New British Fungi.—In this month (December) I have had the pleasure of finding, among others, two fungi belonging to a group hitherto little known in Britain, viz.: the *Gymnomyceteæ*. These two species were *Gymnomyces Ruber*, Van Tieghem, and *G. Reesii*, Baranetzky.—W. B. Grove, B.A.

A Neolithic Implement.—In the summer of 1884, a curious stone implement was found in the alluvial gravel of the Trent, at Carlton, about three miles north-east of Nottingham. It was found at the depth of about a foot in the alluvial plains half a mile from the present course of the river, by Mr. W. Stevenson, of Scarborough, during the progress of excavations there, and although it was dug up so long ago, no record of it has, I believe, up to the present time been made. I may, therefore, perhaps be permitted to make some mention of it here. The implement is about 12¼ inches in length, slightly curved, and thicker at one end than the other, being not much unlike a cucumber in shape. It is about seven inches in circumference at the end that is thickest, both ends being rounded, however, after the style of a pestle. The implement has evidently been ground and smoothed into its present shape, though it has suffered considerable surface disintegration since, and is pitted all over. It has been made apparently out of greenish grey metamorphic ash, resembling some of the Charnwood rocks and contains rounded crystals of quartz, a few minute fragments of purple slaty rock, and bits of greenish claystone. The implement appears to belong to the class of polished celts described in the sixth chapter of Mr. Evans's "Ancient Stone Implements of Britain," though it is not exactly like any that are there figured. Implements of this character, observes Mr. Evans, "are most numerously represented of all in collections of antiquities. There is great range in size and variation in form, though the general character is in the main uniform, among these polished implements." He divides them into four classes according to the section presented by the middle of the blade, thus (1) those sharp or but slightly rounded at the sides, &c., (2) those with flat sides, (3) those with oval section, (4) those presenting abnormal peculiarities. The implement in question, I should say, belongs to the third division rather than to any other. It resembles the lateral view of Fig. 66, more than any other given by Evans, except that it is round in section and more elongated compared with its diameter. This relic of Neolithic times is to be handed over, I understand, to the Natural History Museum, at Nottingham University College.—J. Shipman, F.G.S.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Biological Section, Meeting December 8th.—Professor Hillhouse, M.A., in the chair. The Rev. H. Boyden, B.A., read a paper on "The Flora of the Rea Valley," in which he gave first a graphic description of the course of the river, the physical features of its valley, and its geological formation, and then went on to call attention to the leading characters of its flora, the rare plants he had found, with their distribution. The paper, which was most interesting, was illustrated with an extensive series of flowering plants, ferns, and mosses, noticeable among which were *Sagittaria sagittifolia*, *Epipactis media*, *E. latifolia*, *Blechnum boreale*, and *Lycopodium clavatum*, a rare Midland plant, not before recorded from that district. Prof. Hillhouse made some very interesting and instructive remarks on the subject, and a discussion ensued in which Messrs. J. Morley, J. E. Bagnall, and others took part. Mr. J. Morley exhibited on behalf of Mr. S. Walliker the cast skin of a snake. Mr. J. E. Bagnall, A.L.S., exhibited for Mr. J. B. Stone, J.P., *Racomitrium atro-virens*, *Philonotis fontana*, and other mosses from Teesdale; from Dr. Braithwaite, *Leptodontium recurvifolium* from South Wales, and *Philonotis calcarea* from Teesdale; and an interesting series of plants from Colorado, U.S., collected by Miss Watkins, daughter of Mr. Leonard Watkins, late of this town; and an extensive series of rare plants from various British stations, with microscopical preparations to show modes of reproduction observable in mosses.—GENERAL MEETING, December 15th. Mr. R. W. Chase in the chair.—Mr. W. P. Marshall, M.I.C.E., gave his paper on "The Yosemitè Valley: its Geological and Botanical Features;" in illustration of which he exhibited various specimens of rock, granite, &c., and 120 plant specimens, besides maps and plans showing the outline, sections, and position of the valley. The paper, which will appear in the "Midland Naturalist," was much enjoyed by a large assembly of members.—SOCIOLOGICAL SECTION.—At a meeting held in Mason College on the 3rd inst., Mr. E. F. Morley very effectively read Chapter IX. of the "Study of Sociology," on "The Bias of Patriotism." On the 17th inst., Professor W. Hillhouse, M.A., F.L.S., commenced the exposition of the Sixth and following chapters of Part IV., Vol. II., of Mr. Herbert Spencer's "Principles of Biology," on "Morphological Differentiation in Plants." The President, Mr. W. R. Hughes, F.L.S., Mr. W. B. Grove, B.A., and others took part. The subject will be completed on the next ordinary meeting of the section, on January 21st.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 19th. The discussion on "The Ice Age" was brought to a conclusion, Messrs. Rodgers, Insley, Hawkes, and Sanderson taking part.—October 26th. Mr. Beale exhibited two pipes and a pipe-head quaintly carved in a species of soap-stone, used as calumets or peace-pipes by the Dacotah Indians, also a number of arrow and spear-heads and knives in flint, chalcedony, quartz, quartzite, and jasper from the grave mounds in the Central States of America. Mr. Evans, a specimen of *Amphioxus lanceolatus*, a vertebrate, from the Mediterranean. Under the microscope, Mr. Tylar showed anthers of *Erica hyemalis*; and Mr. J. W. Neville, *Catenicella aurita*, an Australian polyzoon. A paper was then read by Mr. Beale on "How a Map is Made," which described the various instruments used, and the necessity of testing their accuracy before commencing the survey; also the importance of getting a good idea of the district from an elevated station. The whole district is then cut up into triangles, and every line between the various stations measured, and copious notes of every detail made in the field book. The process of plotting or drawing a map from the field book was described, and the necessity of exactness in every measurement, as the total of all areas added up must correspond with the district surveyed. The paper concluded by describing the difficulties of an urban compared with a rural survey.—November

2nd. Mr. Evans exhibited a polished rock from Lyme Regis, containing caudal vertebræ of Ichthyosaurus, and specimens of *Cyrena obovata* from the Mid. Eocene, Bentley. Mr. Moore, under the microscope, stomach and gizzard of beetle, *Colymbetes fuscus*; Mr. J. W. Neville, foraminifera, etc., from chalk washings.—November 9th. Annual meeting. The reports of the Secretary, Treasurer, and Curator were read and adopted. A hearty vote of thanks was passed to the President, Mr. C. Beale, C.E., who was re-elected for the ensuing year. Messrs. W. Dunn and J. A. Grew were elected Vice-presidents, and Messrs. H. Insley and P. T. Deakin, Hon. Secs. An address was delivered by the President. The speaker dwelt at length upon the utility of a knowledge of natural science, and the effect it necessarily has upon the formation of the character, giving a tone to the mind, and forming, without exception, a healthy and hopeful trust and faith in the power that formed and sustains the universe. The various sciences were passed in brief review, and their essential nature and specific work remarked upon. A resumé of the work of the year, and good wishes for the future, brought the address to a close.—November 16th. Mr. Deakin showed specimen of spider crab, *Maia Squimado* and *Portumnus puber;* Mr. Madison, specimens of *Limnæa reflexa* var. *exilis* from America; Mr. Evans, *Orthis Budleighensis* in a pebble from Moseley; Mr. J. W. Neville, several rough and polished specimens of "coal balls" from the Lancashire coal measures, a material unknown in our local coal-fields, and remarkable for the perfect preservation of enclosed plant remains. Under the microscope, Mr. Moore showed odontophore of *Zonites cellarius*, stained; Mr. Dunn, Nais worm; Mr. J. W. Neville, section of coal ball with transverse section of *Rachiopteris oldhamium*. Mr. Sanderson then read a paper on "The Yorkshire Dales." The writer regretted so picturesque a district was so little known, but thought the dialect spoken there might to some extent account for it. The paper described the geological features of the fells and dells, subterranean streams, the peculiar features locally known as "pots" and "pot-holes," and the abundant evidences of glacial action. The tarns were spoken of as beautiful in their loneliness, their silence only being broken by the cries of the snipe, lapwing, and coot. The paper concluded by surmising that the district was getting colder, from the fact that cereal crops were grown fifty years ago on sites that will not produce them now. The paper was illustrated by a series of photographs of the Whernside and Chapel-le-dale districts.—November 23rd. Mr. C. F. Beale exhibited a specimen of *Magilus antiquus*, a shell found among corals, &c., from the Red Sea. Mr. J. Madison, specimens of the following foreign helices:—*H. candicans*, *H. depressula*, *H. explanata*, and *H. muralis*. Mr. Corbet, fossil wood from Portland. Mr. Deakin, cocoon of puss moth, *Cerura Vinula*. Under the microscope, Mr. J. W. Neville, section of bone of cuttle fish, *Sepia officinalis*.—November 30th. Mr. Moore showed a collection of *Helix nemoralis*, including type specimens, and a large number of varieties. Mr. Hawkes, a collection of dried plants from South Africa, including a large number of heaths, and remarked that these plants were only distributed through Europe and Africa. Mr. Hawkes also exhibited a collection of plants from Llandudno. Under the microscope, Mr. J. W. Neville showed antenna of *Bombyx pernyi*. A paper was then read by Mr. J. Madison, "Notes on the Eocene," which explained the meaning of the name and described the situation of the beds in the London and Hampshire basins. The Thanet beds, Woolwich beds, London clay, and Bagshot series were passed in review, and their typical fossils enumerated, and the fine section at Alum Bay referred to for its richness in leaf impressions. The writer concluded by hoping these beds would be well worked for the light they might throw on the origin of some of our land and freshwater shells. The paper was illustrated with specimens and diagrams.—December 7th. Mr. J. Madison showed a large specimen of *Paludina contecta*, also specimens of *Aviculopecten* from the coal measures. Under the microscope, Mr. J. W. Neville showed the sheep tick, *Ixodes reduvius;* Mr. Dunn, *Isthmia enervis* and *I. nervosa in situ* on alga.—December 14th. Mr. J. Madison exhibited specimens of the following land shells :—*Balia perversa, Vertigo antivertigo, Clausilia biplicata*, and *Testacella haliotidea*. Mr. Evans, a spine of fish, *Asteracanthus minor*, from Rhætic beds, Axmouth. A paper was then read by Mr. J. W. Neville on "Insects and Evolution." The writer regretted that this subject was so rarely judged on its own merits, from the difficulty of considering it apart from certain impressions with which we are all more or less associated. The life of an insect was described in its several stages and the evidence of evolution pointed out in each. It was held to be particularly strong in the embryonic stage where organs sometimes appeared for a short time and were then absorbed, and in the larval stage, where adaptation to circumstances had made a great variety of forms. The looper caterpillar was instanced as a remarkable departure from a normal form. Some loopers had come down to us without a remaining trace of six ancestral claspers, while others belonged, perhaps, to a more recent time, and the rudimentary claspers, from their stages of development, showed that they had been disused in pairs. The mouth organs of the imago were held to afford evidence of great modifications, if not of development, from a common origin. The paper was illustrated with drawings.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, December 16th; attendance seven (three ladies). The following objects were exhibited, viz.: By Dr. Cooper, a fine copy of Stevenson and Churchill's "Medical Botany," 1834, two handsomely bound volumes, the coloured plates of which were much admired. By Mr. W. A. Vice, a collection of fungi, chiefly on bark, as *Corticium, Nectria*, &c., and a curious specimen of the rather rare *Lentinus lepidens*, with its hard and solid stem curved into a semicircle. By the chairman, a copy of De Puydt's "Orchids," in French, with fifty fine coloured plates; a copy of Edgeworth's "Pollen;" drawings in pen and ink and pencil of hairs and epidermal cells of the sunflower, and of an unnamed orchid, from the island of Tobago, in the collection of J. G. Ward, Esq., of Belgrave; also a mass of petrified moss, from the Cropstone Waterworks, where a slight leakage of water, escaping through the masonry of a stone wall, carried lime, probably derived from the mortar, and deposited it on the moss on which it dropped. Some experiments were made in the measuring of heads and faces, according to the formulæ given by Mr. Smith in the December number of the "Midland Naturalist." Among the seven members present, one was dolichocephalic, five mesocephalic, and one brachycephalic; four were narrow-faced and three broad-faced; five were orthognathous and two hyperorthognathous. It was found that Mr. Smith had scarcely given sufficient details to enable learners to use his formulæ with certainty, and there appeared to be some printer's errors in the text. It would be interesting if Mr. Smith would revise and elaborate them.

ON THE VARIOUS CLASSIFICATIONS OF THE MAMMALIA.*

BY F. T. MOTT, F.R.G.S.

SYSTEMS of classification may be more or less natural, but can never be entirely or completely so. Nature knows nothing of our definitely limited orders, genera, and species. The actual plan of the universe is as much misrepresented by these artificial groups as the gallop of a horse is misrepresented by an instantaneous photograph, which fixes a momentary position but gives no idea of the graceful bounding movement as a whole.

A system of classification, as understood at present, resembles the instantaneous photograph in attempting to paint Nature as a man may see her. But the essence of her being is perpetual change, perpetual movement; and a human life is a smaller fraction of a cosmic cycle than the hundredth of a second is of the full stride of a galloping horse. What presents itself to our eyes, or to the eyes of successive individuals for a century, is only a passing phase. The phenomena were different yesterday; they will be different again to-morrow. Our senses are not delicate enough to register the daily change. Even in a hundred years we can scarcely recognise that Nature's hour-hand has moved by a hair's breadth. It seems to us, therefore, as if the forms we see around us were fixed and permanent; as if each generation precisely resembled its predecessor; as if species, genera, and orders had been created from the beginning just as they are, and would go on for ever unless extinguished by despotic power. From the days of Aristotle until those of Darwin—some 2,200 years—students of Nature were content with such views of her as they could get by the instantaneous photograph method. Observation, indeed, became gradually more complete, comparison and analysis more close and searching, but nothing was attempted beyond representing things as they appeared; there was scarcely any reference to what they had been, or what they would be.

The most modern systems are just beginning to take into account the past and the future, but a complete revolution in our ideas of classification is no doubt imminent. It is

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read May 21st, 1884.

interesting and instructive, however, to study the development of thought in this direction during the past 2,000 years. It might be illustrated equally well by nearly every branch of natural history. I confine myself to-night to the Mammalia.

Within the scope of history the first man who studied biology as a science was Aristotle, about 350 years before Christ. He divided the Mammals into four orders, viz.:—Man, Quadrupeds with Claws, Quadrupeds with Hoofs, and Whales. For that period, and as a first attempt, this division was not unworthy of the wonderful genius of Aristotle. He saw that, as a matter of fact and science, man and the beasts of the field were inseparably allied; and his four orders were founded on correct though superficial observation. For nineteen centuries Aristotle was the one only great master and teacher of natural history in the civilised world.

There is no other notable name till 1550, when the German Gesner published an original work on zoology, in which he classifies the Mammals somewhat more elaborately than Aristotle had done. He divides the clawed quadrupeds into such groups as monkeys, dogs, cats, &c.; and the hoofed quadrupeds into horses, cattle, deer, &c. This was a step forward, but not a very large step, as the result of education for 1,900 years. A hundred years later (1650) came the Englishmen John Ray and his friend and colleague Willoughby. Their arrangement of Mammals did not differ much from Aristotle's, but they gave the name of Unguiculates to the clawed quadrupeds, and that of Ungulates to the hoofed ones; and these names have been universally adopted.

Yet another century brings us to Linnæus—about 1750. In his treatment of the Mammals he adheres to Aristotle's three great sections—of Unguiculates, with claws; Ungulates, with hoofs; and Whales, which he calls "Mutica," or creatures without claws or hoofs of any kind. He, for the first time, includes man with the clawed animals, instead of placing him in a separate division. His arrangement is:—

	ORDER.	
Unguiculates...	Primates...	Man, monkeys, bats.
,,	Bruta	Elephants, rhinoceroses, &c.
,,	Feræ	Dogs, cats, &c.
,,	Glires	Hares, rabbits, rats, &c.
Ungulates	Pecora......	Oxen, deer, &c.
,, ...	Belluæ.....	Hippopotamus, horses, pigs, &c.
Mutica	Cete	Whales and dolphins.

Linnæus had a much clearer and more comprehensive notion of classification than his predecessors. He referred all divisions of one rank to one standard, and as, in botany he took the stamens as the standard of classes and the pistils as that of orders, so in the Mammalia he founded his primary divisions on the form of the extremities—whether clawed, hoofed, or unarmed—and his secondary divisions on the arrangement of the teeth. Among his Unguiculates, while the Primates have teeth of the three forms, molars, canine, and incisors, equally developed, the Bruta depend upon the molars, the Feræ upon the canine, and the Glires upon the incisors.

Fifty years after Linnæus came Cuvier, the great French naturalist. Freeing himself from the Aristotelian views, he studied the anatomy of animals, and founded a new classification upon the relationship of species in more fundamental matters than mere external organs. He divided the Mammalia into nine orders, viz.—

Bimana........	Man.
Quadrumana..	Monkeys.
Carnaria.......	Flesh-eaters: Cats, dogs, &c.
Marsupialia...	Marsupials: Opossum, kangaroo, &c.
Rodentia.......	Rodents: Hares, rabbits, &c.
Edentata......	Toothless animals: Sloths, &c.
Pachydermata	Thick-skinned animals: Horses, elephants, &c.
Ruminantia...	Ruminants: Oxen, sheep, &c.
Cetacea........	Whales, &c.

At first sight this does not seem very different from the system of Linnæus. But, in reality, although the names of the orders are still taken mostly from external organs and characters, the groups are much more accurately assorted, and two new ones—the Marsupials and Edentates—are established, whose anatomy is so distinct and remarkable that one wonders how Linnæus could have found place for them in any of his orders.

During the present century rapid progress has been made in comparative anatomy by such men as Owen, Milne-Edwards, and Huxley; and even Cuvier's system is now left far behind.

The arrangement adopted by Professor Flower in the new edition of the "Encyclopædia Britannica" makes eleven orders, distributed thus:—

Primates	Man and monkeys,
Carnivora	Dogs, cats, &c.
Ungulata.......	Hoofed animals: Horses, oxen, deer, elephants, &c.

Rodentia	Rodents: Hares, rabbits, &c.
Cheiroptera.....	Bats.
Insectivora......	Moles, hedgehogs, &c.
Cetacea	Whales, dolphins, &c.
Sirenia	Dugongs, &c.
Edentata	Sloths, anteaters, &c.
Marsupialia ...	Opossums, &c.
Monotremata ..	The Ornithorhynchus and Echidna.

In this arrangement physiology and anatomy have been largely aided by the modern sciences of palæontology, the study of extinct and fossil forms; embryology, the examination of the young in their progressive stages; and histology, the microscopic investigation of tissues. Yet it is still but an instantaneous photograph of Nature as she appears at a given moment, and makes no attempt to represent the stream of Mammalian life in its entirety.

About the beginning of this century a curious system was propounded by Mr. Macleay, and adopted by the naturalist Swainson. It was called the quinary system, the idea being that organic nature consisted of a network of circular groups, related to each other by affinities and analogies in a very complicated manner. There is a certain attractive truth in this idea, but the system based upon it was too rigidly mathematical for Nature's work, and could not live in the broadening light of science. Swainson and his followers maintained that the organic world was dominated by the number 5. That the ideal genus had 5 species, the ideal family 5 genera, the ideal order 5 families, and the ideal class 5 orders. To the class Mammalia they assigned the five following orders, and attempted to show their symbolical relationship with the 5 orders of Birds, and in the same manner with the Reptiles, Fishes, &c:—

MAMMALIA.		BIRDS.
Feræ	Carnivorous	Raptores.
Primates	Omnivorous	Insessores.
Glires	Frugivorous	Rasores.
Ungulata	Moisture-loving	Grallatores.
Cetacea	Aquatic	Natatores.

Swainson's works were published fifty years ago, and are now little known or read, but they are full of suggestive thought and well worth referring to.

If ever we are to break away from the instantaneous photograph method, if ever we are to take a broader view of classification, to get a more comprehensive grasp of Nature as a whole, it must be by tracing the lines of blood relationship far back into the past, showing by what steps each group has reached its present position, and how it is related to its neighbours by descent and by cross-breeding; showing also how the force-waves, whose courses are represented by these material groups, tend always to rise to a climax and decay, and indicating the position of each group in the cycle of its own wave, whether in its ascending or descending phase, at its climacteric, or extinct.

Such a picture of Nature would be immensely more true, more interesting, and more instructive than the instantaneous photograph. At present our knowledge of the past is too fragmentary for any such picture to be drawn except in roughest outline, but knowledge is accumulating fast, and probably the present method of classification will be as antiquated fifty years hence as Aristotle's is now.

ON THE OCCURRENCE OF FOSSILIFEROUS HÆMATITE NODULES IN THE PERMIAN BRECCIAS IN LEICESTERSHIRE,

TOGETHER WITH SOME ACCOUNT OF THEIR ECONOMIC VALUE, &c.

BY W. S. GRESLEY, F.G.S.

(Continued from page 8.)

3.—We will next notice one or two rather remarkable features possessed by individual specimens,—forms which are very uncommon in hæmatite such as we are considering. **1.** A porphyritic or coarse gritty combination of hæmatite and quartz, &c.; the latter occur in various stages of decomposition or transformation of silica into peroxide of iron, and are of various colours, viz.: transparent, purple, yellow, pink, red, &c. This fragment has been cut through and polished. A few cavities are seen where the grains have been so rotten as to crumble away. The specimen is exceedingly hard; quartz will not scratch the irony portions. The wavy parts seem to indicate a gradual inflow or filtration of iron that has replaced nearly all the original matter in those particular regions. **2.** Another very similar specimen contains minute pseudomorphous iron ore of soft texture and of red and yellow tints, exhibiting concretionary structure. These seem to have been formed in pre-existing hollows, originally occupied by some other mineral: the hæmatite with which the grains and inclusions are cemented together is of two kinds,—a softish brown or yellowish material, and a compact steel-grey ore taking the usual polish. 3. A nearly whole nodule and one of great hardness, which exhibits on its weathered surface the fortification type of agate,—also indistinct traces of fossils. This is the specimen already mentioned as being magnetic at one point only. 4. A brown, rather hard, flinty-fractured, siliceous variety of the ore, exhibiting, as many of the specimens do when polished, grains or little shiny patches of siliceous (?) hæmatite disseminated through the mass. A small hollow in this specimen has a coating of mammillated fibrous hæmatite, with a lustre approaching metallic adamantine. 5. A very singular, if not unique, form of columnar structure, shown in Fig. 9, Pl. I. It is of very hard iron-black hæmatite (?) (manganite ?)—streak brownish-red, fracture clean to uneven, lustre dull, weathered surface, dark brown or like the majority of the nodules. It appears to be a fragment of a nodular mass of ore, but what the original size may have been is impossible to say. It shows signs of having been water-worn to some extent, and subsequently fractured at three different times. Upon the original or most weathered and water-worn (?) part of the surface no signs of columnar structure are seen, but from the different fractured faces of the lump it is evident that this structure extends in all probability through the whole of it. The columns vary between $\frac{1}{24}$ of an inch in width at one end of the specimen and $\frac{1}{48}$ at the opposite end, as seen in the figure. Some are four-sided, some have more sides, but, owing to weathering, the precise forms are not readily distinguishable. The wavy formation is especially curious. This specimen is magnetic and possesses polarity, the poles being situated at right angles to the axes of the columns. There are no traces of fossils upon it. It takes a good polish, and is very heavy. Again, we occasionally find enclosed in lumps of the most compact blue ore, small streaks or spots of bright red powdery ore. Less often, specimens, when cut and polished, exhibit minute branch-like veins of bright compact metallic iron running through a body of ore of much more earthy character. These may be looked upon as veins of "segregation" or "exudation" in miniature. Very rarely nodules are found containing cavities lined with groups or bunches of crystals of calcite, &c., one-quarter of an inch in length, sometimes encrusted or rendered partially pseudomorphous with a light brown irony mineral. Other hollow nodules contain a globular aggregate of soft rounded grains, resembling roe, of a brown tint.

4.—*The Origin of the Hæmatite.*—Having described in general terms the leading features of these nodular fragments—namely, what they are, where they occur, whence derived, contents, both inorganic and organic, and other points, I will now endeavour, firstly, to show that there appear to me to be two ways of accounting for their *origin:* and, secondly, to state my grounds for accepting one in preference to the other, as being more in accordance with observed facts.

It has been shown that these stones have been derived from, or occur *in situ*, in the brecciated conglomerate of the Permian series. From the character of the rock fragments, of which these beds are to a great extent composed, we naturally conclude that they were deposited at no great distance from a shore. The rock fragments are said to represent rocks from the West of England of the Silurian and carboniferous series. Professor Hull seems to have regarded the deposits as "marginal," and Mr. Harrison says* they were formed along an old coast line, and were not brought from Wales as Sir A. C. Ramsay has supposed.

There are also the following facts before us:—That the nodules are to some extent water-worn; that they have been subjected to a considerable amount of rough treatment—abrasion, scratching, squeezing, &c.—before (?) coming to rest in the breccias; that they present a great variety of forms, quality, mineral composition, and so on; that they are of carboniferous (coal measures) origin or age, and therefore derivative. Now, do we find deposits or lumps of hæmatite in the coal beds of similar characters as these? The writer knows of none. Hæmatite, however, does occur occasionally in these strata. The following instances may be cited:—At Pontefract, Yorks, nodules of hæmatite are stated to occur in one of the uppermost beds of the coal measures.† In the Cumberland coal field, Mr. J. D. Kendall, of Whitehaven, writes‡ that in the upper coal measures, at Millyeat, near Frizington, hæmatite occurs in thin bands, interstratified with layers of clay or soft shale. This ore, in places, is as pure as any to be found in the district. In the Leicestershire and South Derbyshire

* See Proceedings of the Birmingham Philosophical Society. Vol. III., "On the Quartzite Pebbles contained in the Drift, and in the Triassic Strata of England," p. 187.

† See "Memoir of the Geological Survey of England and Wales, Geology of the Yorkshire Coal Field," page 757.

‡ See Transactions of the North of England Institute of Engineers, Vol. XXVIII., Part iii., 1879.

coal field, at Swadlincote, nodular red hæmatite (to be referred to in the sequel) occurs in the "blue binds" overlying the "fire-clay" measures. At a depth of 75yds. in the shafts of the Shireoaks Colliery, near Worksop, a seam of red ironstone (hæmatite) about 15in. thick was passed through. This is very high up in the coal measures of the district.*

A singular seam of red hæmatite exists in the lower measures of the Cheadle coal field, near to Leek, Staffordshire. At Torkington, near Stockport, it has been noticed; also at Beswick Lodge, and at Patricroft, near Manchester, In the coal field of Pennsylvania, U.S.A., hæmatite sometimes occurs interstratified with coal shales, &c.

Hæmatite and limonite almost always occur either in pocketty masses, generally in limestone (as in the Furness and Whitehaven districts, in Glamorganshire, Monmouthshire, Gloucestershire, &c.; in Sweden, at Dannemora; Bilbao, in Spain; Hartz, &c.), or in veins, as at Brendon, Somerset, in Cumberland, and elsewhere.

Why, therefore, may not our fragments and pebbles have had a like origin? Perhaps the presence of the *fossils* will be said to preclude the possibility of such an origin, as they are seldom found in masses of metallic minerals of this kind. Instances, however, are known of veins and pockets of metallic ore occurring in coal strata. How then are we to try to account for this seeming anomaly? I have suggested the following theory as a possible explanation of the origin of the stones in question. I admit that it does not in all points satisfactorily accord with all the observed facts. There is good reason to believe† that during the coal period certain tracts of land stood out high and dry above the general level of the then vast swamps, or forests, or coal-growing regions, now transformed into the British Isles and seas. Let us suppose that there existed at that time in the cliffs or sloping shores of this elevated tract, probably not very far removed from what is now the centre of England, natural open fissures or cavernous places, not dissimilar to those which we have upon our present-day shores, &c., the floors or wide cracks of which were just about on a level with the waters of the said coal-forming estuary or expanses. Conditions would thus be favourable for the leaves, twigs, and other parts of the then green things upon the earth obtaining access to such secluded spots, being brought thither by either wind or water. The fauna, too (mollusca, crustacea, worms, &c.), became dwellers in or visitors to these places. And let it be also supposed

* See Geological Survey Memoir or Quarter Sheet 82 N.E. p. 5.

† Quart. Jour. Geol. Soc., Vol. XII., p. 53.

that there went on, simultaneously with these accumulations in organic matter from without, a more or less regular inflow or deposition of iron, &c., derived possibly from a volcanic source (hot springs), or by percolation out of rocks containing much iron, situated at a higher level. But in whatever way the mineral did get into the place, it would, I imagine, be in a state of solution, and was gradually precipitated or deposited upon the bottoms and sides of the rocky openings in such a manner as to produce the various structures noticed in the fragments and organised nodules. The magnetic properties were possibly introduced during the progress of this formation, probably by electric currents set up along certain lines or cracks having some relation to a magnetic meridian. To account for the gritty and porphyritic varieties of the hæmatite we must presume that the enclosing rocks were partly composed of quartz—vein-quartz was probably there. Now the oxide of iron would naturally act upon the quartz, and to a greater or less degree actually replace it. In this kind of way we may, I think, reasonably conclude that the group of forms which seem to pass by insensible gradations from the ore of almost chemical purity to the very earthy kinds has been brought about. This state of things went on until the deposit of hæmatitic matter either filled the cavities in the rocks or a change of conditions came on which terminated it. The rest of the story is soon told. After a lapse of time (thousands of years perhaps), the tremendous earth-movements which bent and in other ways disturbed the coal measures and their surroundings, caused the breaking up of the deposit of hæmatite, and the waves obtaining access to its remains tumbled and rolled them about for long ages; large masses of ice bore down upon them, crushing and breaking them still smaller, even to powder; and, lastly, having been thus shaped as we now find them, they became buried in a kind of clay or muddy mixture along with fragments of other rocks of probably more than one geological period, of older date than the coal measures.

The above theory is, of course, purely hypothetical. It is based solely upon negative evidence, and as such our readers will be able to draw their own conclusions. The chief objection to it I take to be—the external forms of many of the specimens, their even outline, and the character of the hollows, wrinkles, and cracks both upon the surface and in the interior of many. The source of the chief ingredient—iron—too, is extremely difficult to account for.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.
BY HERBERT SPENCER.

Exposition of Part III. Chapter IV.

BY DR. WILLIAM L. HIEPE.

In the two first chapters of the third part, Mr. Herbert Spencer gives the general aspect of the theory of evolution, and contrasts it with the older belief in special creation. The next four chapters, which form the subject of our present discussion, are devoted to the investigation, how far certain zoological phenomena are in harmony with the evolution theory. These phenomena are those of classification, embryology, morphology, and distribution. So far from finding that these phenomena are not in harmony with the theory of evolution, we shall find that they cannot be satisfactorily explained by any other; that they follow as a necessary consequence from this theory, and they form, therefore, the basis of the most convincing and powerful arguments in favour of it. We shall now consider these arguments a little more in detail.

When we study the system of classification of the organic world, we find that the whole is divided into two main groups or kingdoms; animals and plants. Each of these main groups is divided into a number of secondary groups or sub-kingdoms. Each sub-kingdom into classes, and so on till we come to species and varieties. Calling, with Mr. Spencer, a division of high degree a group, and one of a relatively lower degree a sub-group, we find, further, that the differences which distinguish groups are great in degree and radical in kind, *i.e.*, they concern, as a rule, physiologically important organs. Differences of sub-groups are small in degree and do not concern important organs; in fact, they are often so small that it is impossible, or nearly so, to detect them. As an example, Mr. Spencer mentions the groups and sub-groups of the human species. The different nations which form the group of the Scandinavian races do not differ so much from each other as the whole of the Scandinavian races differ from the whole of the Celtic races. Again we find a greater difference between the northern races and the southern races, and finally we find the greatest difference between the largest groups, *i.e.*, the Aryan stock, the Mongolian stock, and the Negro stock.

We find the same with the different languages, from the most nearly related dialects to the widely different eastern and western languages. In languages we know that the subordination of groups has arisen by evolution, and we have here, therefore, a very strong argument that in the creation of organic beings the same laws have prevailed. In the comparison between the division of organisms and that of languages we find yet another similarity. We find that in both the differences between members of the same group have not always the same value. For example, if we take several species belonging to the same genus, we may find some very much alike and others much more different. The same is the case with orders of the same class, with classes of the same sub-kingdom, and so forth; likewise we find in languages that dialects of the same language differ in a variable degree from each other, as also the different languages belonging to one group, &c.

Another strong argument in favour of the evolution theory is derived from the fact that allied groups of animals or plants show their relation most by resemblances of their lowest representants. When you compare the species of one group with those of an allied one, you find the greatest difference in the most modified and specialised, whilst the simplest and least changed forms will show a greater similarity. Now that is exactly what follows as a necessity from the theory of evolution. Two groups which are allied will by descent and divergent modification give rise to a number of sub-groups, and it is in the least modified members of each sub-group that we should look for the most numerous points of similarity, which, as we have seen, is actually the case.

With these facts and the different analogies between languages, known to have arisen by evolution, and organisms, we must come to the conclusion that the latter, too, have been produced by a process of evolution, and the truths derived from classification form at least a very strong argument in favour of that conclusion.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 23.)

To the north and north-east of Watford there are very few Middle Lias Sections to be seen. Of those mentioned in the "Memoirs of the Geological Survey," I have only been able to find one, that at Elkington. A little north of Elkington a is of two kinds,—a softish brown or yellowish material, and a compact steel-grey ore taking the usual polish. 3. A nearly whole nodule and one of great hardness, which exhibits on its weathered surface the fortification type of agate,—also indistinct traces of fossils. This is the specimen already mentioned as being magnetic at one point only. 4. A brown, rather hard, flinty-fractured, siliceous variety of the ore, exhibiting, as many of the specimens do when polished, grains or little shiny patches of siliceous (?) hæmatite disseminated through the mass. A small hollow in this specimen has a coating of mammillated fibrous hæmatite, with a lustre approaching metallic adamantine. 5. A very singular, if not unique, form of columnar structure, shown in Fig. 9, Pl. I. It is of very hard iron-black hæmatite (?) (manganite ?)—streak brownish-red, fracture clean to uneven, lustre dull, weathered surface, dark brown or like the majority of the nodules. It appears to be a fragment of a nodular mass of ore, but what the original size may have been is impossible to say. It shows signs of having been water-worn to some extent, and subsequently fractured at three different times. Upon the original or most weathered and water-worn (?) part of the surface no signs of columnar structure are seen, but from the different fractured faces of the lump it is evident that this structure extends in all probability through the whole of it. The columns vary between $\frac{1}{24}$ of an inch in width at one end of the specimen and $\frac{1}{48}$ at the opposite end, as seen in the figure. Some are four-sided, some have more sides, but, owing to weathering, the precise forms are not readily distinguishable. The wavy formation is especially curious. This specimen is magnetic and possesses polarity, the poles being situated at right angles to the axes of the columns. There are no traces of fossils upon it. It takes a good polish, and is very heavy. Again, we occasionally find enclosed in lumps of the most compact blue ore, small streaks or spots of bright red powdery ore. Less often, specimens, when cut and polished, exhibit minute branch-like veins of bright compact metallic iron running through a body of ore of much more earthy character. These may be looked upon as veins of "segregation" or "exudation" in miniature. Very rarely nodules are found containing cavities lined with groups or bunches of crystals of calcite, &c., one-quarter of an inch in length, sometimes encrusted or rendered partially pseudomorphous with a light brown irony mineral. Other hollow nodules contain a globular aggregate of soft rounded grains, resembling roe, of a brown tint.

4.—*The Origin of the Hæmatite.*—Having described in general terms the leading features of these nodular fragments—namely, what they are, where they occur, whence derived, contents, both inorganic and organic, and other points, I will now endeavour, firstly, to show that there appear to me to be two ways of accounting for their *origin*: and, secondly, to state my grounds for accepting one in preference to the other, as being more in accordance with observed facts.

It has been shown that these stones have been derived from, or occur *in situ*, in the brecciated conglomerate of the Permian series. From the character of the rock fragments, of which these beds are to a great extent composed, we naturally conclude that they were deposited at no great distance from a shore. The rock fragments are said to represent rocks from the West of England of the Silurian and carboniferous series. Professor Hull seems to have regarded the deposits as "marginal," and Mr. Harrison says* they were formed along an old coast line, and were not brought from Wales as Sir A. C. Ramsay has supposed.

There are also the following facts before us:—That the nodules are to some extent water-worn; that they have been subjected to a considerable amount of rough treatment—abrasion, scratching, squeezing, &c.—before (?) coming to rest in the breccias; that they present a great variety of forms, quality, mineral composition, and so on; that they are of carboniferous (coal measures) origin or age, and therefore derivative. Now, do we find deposits or lumps of hæmatite in the coal beds of similar characters as these? The writer knows of none. Hæmatite, however, does occur occasionally in these strata. The following instances may be cited:—At Pontefract, Yorks, nodules of hæmatite are stated to occur in one of the uppermost beds of the coal measures.† In the Cumberland coal field, Mr. J. D. Kendall, of Whitehaven, writes‡ that in the upper coal measures, at Millyeat, near Frizington, hæmatite occurs in thin bands, interstratified with layers of clay or soft shale. This ore, in places, is as pure as any to be found in the district. In the Leicestershire and South Derbyshire

* See Proceedings of the Birmingham Philosophical Society. Vol. III., "On the Quartzite Pebbles contained in the Drift, and in the Triassic Strata of England," p. 187.

† See "Memoir of the Geological Survey of England and Wales, Geology of the Yorkshire Coal Field," page 757.

‡ See Transactions of the North of England Institute of Engineers, Vol. XXVIII., Part iii., 1879.

coal field, at Swadlincote, nodular red hæmatite (to be referred to in the sequel) occurs in the "blue binds" overlying the "fire-clay" measures. At a depth of 75yds. in the shafts of the Shireoaks Colliery, near Worksop, a seam of red ironstone (hæmatite) about 15in. thick was passed through. This is very high up in the coal measures of the district.*

A singular seam of red hæmatite exists in the lower measures of the Cheadle coal field, near to Leek, Staffordshire. At Torkington, near Stockport, it has been noticed; also at Beswick Lodge, and at Patricroft, near Manchester, In the coal field of Pennsylvania, U.S.A., hæmatite sometimes occurs interstratified with coal shales, &c.

Hæmatite and limonite almost always occur either in pocketty masses, generally in limestone (as in the Furness and Whitehaven districts, in Glamorganshire, Monmouthshire, Gloucestershire, &c.; in Sweden, at Dannemora; Bilbao, in Spain; Hartz, &c.), or in veins, as at Brendon, Somerset, in Cumberland, and elsewhere.

Why, therefore, may not our fragments and pebbles have had a like origin? Perhaps the presence of the *fossils* will be said to preclude the possibility of such an origin, as they are seldom found in masses of metallic minerals of this kind. Instances, however, are known of veins and pockets of metallic ore occurring in coal strata. How then are we to try to account for this seeming anomaly? I have suggested the following theory as a possible explanation of the origin of the stones in question. I admit that it does not in all points satisfactorily accord with all the observed facts. There is good reason to believe † that during the coal period certain tracts of land stood out high and dry above the general level of the then vast swamps, or forests, or coal-growing regions, now transformed into the British Isles and seas. Let us suppose that there existed at that time in the cliffs or sloping shores of this elevated tract, probably not very far removed from what is now the centre of England, natural open fissures or cavernous places, not dissimilar to those which we have upon our present-day shores, &c., the floors or wide cracks of which were just about on a level with the waters of the said coal-forming estuary or expanses. Conditions would thus be favourable for the leaves, twigs, and other parts of the then green things upon the earth obtaining access to such secluded spots, being brought thither by either wind or water. The fauna, too (mollusca, crustacea, worms, &c.), became dwellers in or visitors to these places. And let it be also supposed

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THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 23.)

To the north and north-east of Watford there are very few Middle Lias Sections to be seen. Of those mentioned in the "Memoirs of the Geological Survey," I have only been able to find one, that at ELKINGTON. A little north of ELKINGTON a sandy marl may be seen forming the bank of a stream, but little can be now made of the section; it has yielded *Rhynchonella tetrahedra*, and so probably belongs to the "*Spinatus*" *Zone*, though the hard bed over which the stream runs belongs, I believe, to the "*Henleyi*" *Zone*.

At Market Harborough there are two brickyards in which the Middle Lias clay is used; the one in the town shows the following section:—

Section in Market Harborough.

	About Feet	In.
1.—Soil	1	6
2.—Light blue or grey clay, containing some mica. Thickness varies owing to inclination of beds	8	0
3.—Band of concretionary ironstone, upper surface sharply defined, but not the lower, containing: *Belemnites, Gasteropods, Pecten æquivalvis, Protocardium truncatum, Terebratula, &c.* ...	1	0
4.—Light coloured clay, similar to (2). No fossils seen	5	0
5.—Yellowish sandy shale	1	0

The beds have a general inclination to the S.S.W., but it is variable in amount. The identity of beds 2 to 5 in this section, with 4 to 7 in the one below, is, I think, very evident.

Section near to Market Harborough Railway Station.

	Feet	In.
1.—Soil and Boulder clay	2	0
2.—Brown clay	5	0
3.—Ironstone band, containing concretionary ferruginous nodules, and many fossils	0	6
4. –Light blue and brown clay	7	0
5.—Ironstone band, similar to (3)	6 or 8 inches	
6.—Clay, similar to (4)	3	0
7.—Yellowish sandy shale, micaceous, and containing: *Ammonites margaritatus, Protocardium truncatum, Limea acuticosta, &c.*	1	0
8.—Clay, the character of which could not be seen owing to water covering it.		

The ironstone bands contained the following fossils:—
Belemnites, Myacites unioides (*Pleuromya costata*), *Pecten æquivalvis, Ostrea cymbium, Astarte striato-sulcata, Protocardium truncatum, Rhynchonella tetrahedra, Terebratulæ* (rather abundant).

And the Clay-beds below contain about the same fossils, but the material is so soft that they are difficult to get out whole.

I think beds 3, 4, 5, and 6 must be regarded as belonging to the "*Spinatus*" *Zone*, and 7 and 8 to the "*Margaritatus*," using the *brachiopods* as indicators. This course of using the *brachiopods* seems to be the best in Northamptonshire, where the characteristic ammonite of the "*Spinatus*" *Zone* is almost entirely absent, and *A. margaritatus* not very abundant nor having well-defined vertical limits.

On comparing the section given above with Prof. Judd's "Geology of Rutland," page 76, I think I must conclude that the laminated ferruginous sandstone, which he thought represented the Rock-bed, is worked out; there seemed to be nothing like it on the occasion of my visit. In other respects the section seems to have changed considerably.

We have so far been considering sections situated near the westerly limits of the Middle Lias outcrop; there are several others within the Middle Lias area that are worth noticing, and first let us take the one at Badby. This section I have found rather puzzling, for under undoubted Upper Lias, and where I expected to find the Rock-bed, was a bed containing a number of Rock-bed fossils, together with others that I had usually looked upon as characteristic of lower beds, so that the following arrangement is given provisionally.

Section, East of Badby.

1.—Soil, passing into a light-coloured marly clay containing many little *ammonites*. Communis-beds ... . 2 to 3

2.—Cephalopoda Bed, fragmentary, nodular, containing:—*Ammonites communis*, *&c.*, *Belemnites*, *Lucina Bellona*, *Aviculæ*, *Serpulæ*, *Pentacrinite joints*.

3.—Transition-bed. In one spot, between the Cephalopoda-bed and Rock-bed, there is a thin patch of soft stone, containing an immense number of dwarfed *gasteropods* and other fossils—at least twenty species of fossils were obtained—and this I have very little doubt represents the Transition-bed.

4.—Rock-bed, a thin layer of highly-fossiliferous stone capping, and passing without any break into the next bed, containing:—*Pecten liasinus* (rather large and abundant), *Ostrea cymbium*, *Plicatula sp.?* *Terebratula punctata*, *Terebratula Edwardsi*, *Rhynchonella tetrahedra*, *Rhynchonella fodinalis*.

5.—HARD-BED, much thicker, but not nearly so fossiliferous as 4, containing:—*Belemnites* (fairly plentiful), *Cryptænia consobrina*, *Pecten æquivalvis*, *Pecten textorius*, *Ostrea*. *Modiola*, *Protocardium truncatum*, *Pholadomya ambigua*, *Monotis papyria? Astarte striato-sulcata*, *Cardinia sp.? Pleuromya costata*, *Terebratula punctata* (a few), *Rhynchonella tetrahedra* (one large specimen), *Pentacrinite*.

The last four beds occupy about four feet altogether, and, judging by the nature of the fossils, there seems to be here a fusing together of two or three of the hard beds of the Middle Lias. The Rock-bed a little more than a mile to the west of this has its normal characters.

It is probable that the great "fault" which extends so far along the Nen Valley, and cuts out the Middle Lias entirely at WEEDON, less than four miles away, commences near Badby, and has allowed the elimination of the upper Clay-beds and almost the Rock-bed there, as it has allowed the entire destruction of both hard and soft beds further eastward. It is necessary for me to mention, however, that about a third of a mile further eastward there is a shallow pit showing a ferruginous shaly rock, dipping at an angle of five degrees northwards, and containing:—*Belemnites*, *Pecten liasinus*, *Terebratulæ*, and a good amount of *Calc-spar*, which seems to be the Rock-bed.

Of the numerous Marlstone quarries that formerly existed south, east, and north of Badby, few remain; and these few are very insignificant. A little of the Rock-bed with a capping of Upper Lias may be seen to the north of PRESTON CAPES. Between DODFORD and NORTON, two or three sections of the Rock-bed may be still seen; one just to the north of Dodford yielded the following fossils:— *Belemnites*, *Pecten liasinus*, *Pecten æquivalvis*, *Plicatula spinosa*, *Rhynchonella tetrahedra*, *R. tetrahedra*, var. *Northamptonensis*, *Terebratula punctata*. The other sections are very similar.

The neighbourhoods of BUGBROOK and ROTHERSTHORPE have been very good ones for the study of the Marlstone, the Rock-bed has been extensively worked, and it is very fossiliferous, but there is not one good section near these villages now. On Ward's Farm, at a point about three-quarters of a mile to the south-east of Bugbrook, near to the canal, there is a shallow pit. The rock is very ferruginous, and red or green, according to the amount of weathering it has undergone, and a good many of the common fossils can be still obtained, *Rhynchonella tetrahedra* being particularly abundant. The following were also obtained :—*Belemnites*, *Pecten dentatus*, *Pecten liasinus*, *Lima punctata ?*, *Rhynchonella tetrahedra*, var. *Northamptonensis*.

The Rock-bed around Bugbrook is so little below the surface that it can be seen in several of the ditches; this is the case in a lane just to the east of Bugbrook, and again in the lane to the west of the church. At this latter spot the bank is rather high, and the Marlstone is capped by several feet of Upper Lias clay, in which one of the Cephalopoda-beds may be seen. On the south side of the railway and canal, near to the 66th milestone of the railway, there is a small quarry, or perhaps, having regard to its present condition, I should say a pond, where the Rock-bed may still be found; the upper portion of the bank is in the Communis-beds of the Upper Lias. In the village, a heap of stones yielded, amongst a number of common Rock-bed fossils, *Ammonites acutus*, *Eucyclus concinnus*, and *Actæonina Ilminsterensis*, from which I inferred that the Transition-bed was developed in the neighbourhood, although I had not been fortunate enough to discover it.

ROTHERSTHORPE now yields nothing, every quarry has been grassed over, but I may mention that a large proportion of the Middle and Upper Lias fossils that were collected by Miss Baker—sister to the Northamptonshire historian—were collected here. They are now distributed in various museums over the country, many being in the Natural History Museum at South Kensington.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENT'S ADDRESS.

BY T. A. WALLER, B.A., B.SC.

(Continued from page 17.)

In the same region occurs the rock which has furnished the material for what will, I think, prove another investigation of primary importance for the coming geology, viz., that of Mr. J. J. H. Teall into the changes, chemical and mineralogical, which have been effected in a dyke traversing the gneiss of Sutherland. The paper on the subject was read in December, and will not, I suppose, be published in full till May, but abstracts have appeared, and Mr. Teall has very kindly shown me sections from the different parts. The result may be broadly stated to be the transformation of an ordinary plagioclase-augite rock, similar in general character to the Rowley stone, with a hornblende-schist scarcely, if at all, distinguishable from that of, say, the Lizard district. This appears a startling assertion, but the details are so worked out that there seems no possibility of doubt on the matter. A curious circumstance is that the process has so gone on that the parts of the rock which are most nearly unaltered have the most altered appearance. There is a good deal of alteration in the felspar and augite, and the general aspect is rather of that unsatisfactory stage in the history of a rock when the constituents have become too full of apparently dusty opaque material to be properly transparent in thin sections. The next stage shows us hornblende in well-developed crystalline masses taking the place of the augite which proportionately disappears, and in place of the felspar there comes into notice a granular crystalline mass which seems to contain both quartz and felspar. Where this has gone on to the full extent the original constituents have completely disappeared, both as to substance and form, which latter in many cases of change remains after the substance is completely altered, but the rock is still quite devoid of any schistose structure; it might be classed as a diorite containing quartz. In certain parts, however, the freshly-arranged mass has become involved in some of the great earth movements, of which mention has several times been made, which have been such potent factors in the formation of the highland region, and here the crushing has resulted in the production of the hornblende schist with well-marked layers of hornblende in a colourless ground of grains of quartz and felspar. Chemical investigation shows that there has been comparatively little removed or added, and we seem to have at last traced a case of what has often been suspected, what indeed has seemed probable, a series of changes not of substance but of arrangement; the production of what has always been held to be a metamorphic rock, but out of an igneous not out of an ordinary sedimentary one.

This case shows very conclusively how considerable an amount of molecular mobility there is in the silicates in presence of water, even at comparatively low temperatures; and prepares us for the very low temperature at which it seems almost certain that the granites have finished their crystallisation. The matter seems to have a very important bearing on certain points in the nomenclature of rocks. Ought such a mass to receive different names in its different parts, or should it all be called by the name descriptive of its original state. In this case, where proof is at hand, it is easy to call the rock both massive and schistose, an altered dolerite; but how are we to do with cases where there is no certainty of the kind? Very frequently the probability is very great that something of the sort has gone on. I may mention the cases of rocks from south Devon, Dolgelly, and Arran, which I have examined; and indeed one of the rocks from Nuneaton has a very suspicious appearance. A recent writer on the other side of the Atlantic, however, answers unhesitatingly that the original state of a rock is that which should give it its name; and he expresses his hope that the name diorite may soon be dropped as being only an alteration product of the plagioclase augite rocks, which he classes together as basalt, stating his conviction that hornblende is not a product of consolidation from fusion, but of changes subsequently induced; meeting such cases as the hornblende in the andesites and trachytes by the proposition that it is only what is left of a previously altered rock on being melted up. That hornblende is the result of processes which differ from simple crystallisation by the cooling of a molten mass at ordinary pressures is very probable indeed, as shown by the experiments of MM. Levy and Fonqué, which I mentioned last year, but that it is not an orignal crystallisation product of a rock mass may well be doubted, when we consider how (1) it occurs so regularly, and apparently unaltered in syenites and some granites; and (2), that the argument from the failure of laboratory experiments would equally prove orthoclase and mica to be secondary.

The question as to the formation of minerals in rocks, and their subsequent changes, presents some interesting points when viewed from another direction. The mineral leucite only occurs, so far as is at present known, in the recent, or at most late, Tertiary-lavas; and the question naturally arises whether there have been old leucite rocks which, by change of arrangement, have lost their characteristic mineral. The crystalline form of the mineral has presented many difficulties. Apparently belonging to the regular or cubic system of crystals, it was found on examination in polarised light to possess feeble double refraction, and indeed to be twinned in a highly complicated pattern. Hence a grave doubt was thrown on its true position in the crystallographic system; and careful measurements seem to establish that it is really tetragonal, but with axial proportions which make its planes approximate very closely to those derived from a cube. Recent observers, however, have found that by cautiously heating a slice of a leucite crystal there arrives a time when the double refraction, and therefore of course the twinning lamellæ, disappear, and the plate becomes singly refractive as a cubic crystal. At its time of formation, therefore, leucite is probably a cubic crystal, but cooling induces other conditions, and the crystal changes to accommodate itself to them. Orthoclase is another mineral which undergoes great changes on heating, though in this case the results as observed by ordinary means are not so immediately striking.

Closely connected with this most interesting subject is the grand work of Dr. Lehmann on the origin of the crystalline schists, with special relation to the Saxon granulite region. The schistose rocks of this district have of late been classed as Archæan, but the author of the work considers that they are metamorphosed Palæozoic sediments of which the metamorphism probably took place between the Devonian and Carboniferous periods, when the district was crumpled and upheaved. Among them, however, he traces various masses of gabbro, evidently eruptive, through their various changes of substance and arrangement, until they result in hornblende schists in just the same way as the Scotch dyke which I have already mentioned. Another important observation of Lehmann's is the increased quantity of biotite, as the rocks are followed inwards from the less altered slates and shales from which he considers them to have been derived. The magnificent atlas of plates which illustrate the work is not its least important part. The photographs, to the number of more than 150, represent typical hand specimens, and are, in many cases, either reduced in size, or of about the natural dimensions. Those which show the effect of pressure upon solid rocks, grinding them and making them flow, as if liquid, around the more intractable pieces, are strikingly like some examples which Professor Lapworth has on a microscopic scale from northern Scotland. The deforming of the felspar crystals which yet have survived the crushing is exactly similar to that which I have had the honour of exhibiting to the society in this room.

The meeting of the British Association in Montreal last autumn was one of those experiments of which the success is the great justification. Of the success there seems to be no doubt whatever, in spite of all the dismal prognostications which greeted the decision of the committee. The special facilities for travelling and the generous hospitality of the

Canadians induced large numbers of English men of science (and others) to cross the Atlantic, and our own society has already had experience of the benefits derived from the innovation. In the very country where the specimens in dispute were first found, and which still furnishes the best specimens, we might have expected the controversy as to the organic or purely mineral character of eozoon to have formed a conspicuous feature of the geological discussions. There seems, however, to have been a truce between the parties, both, I suppose, feeling their own case impregnable, and waiting for the discovery of new facts which shall unmistakeably put their opponents to silence.

The various geological problems of which I have spoken to-night show us, it seems to me, very clearly how necessary it is for us to keep our judgments very much in suspense even on questions which appear to us demonstrated almost to certainty. It seems frequently to be forgotten that after all many of these so-called laws are only the attempt to collect phenomena in some order which appears to us natural. The sequence of rocks in Sutherland appeared as regular and normal as possible, and on the strength of such observations Murchison and his followers were entitled to found the views which they held; what they were not justified in, as it has turned out, was the assumption that theirs was the only explanation of the sequence.

So perhaps I may say, with trembling at my presumption, it seems to be with what we are ordered to believe of evolution. That it is quite a probable explanation of certain phenomena is quite true, but that the supporters of it bring forward anything which can be called proof—I speak as one without the slightest special knowledge, having only that which can be derived from what may be called popular presentations of the subject—I fail to see. They say, it must be so, or, it is, which of course is final but not altogether satisfactory. That certain flowers, for instance, have developed their colours, &c., with special reference to the preferences of different classes of insects, which of course may be true, but which appears to me quite incapable of proof, and yet is asserted with the utmost certainty and appearance of infallibility. I should, perhaps, apologise for travelling so far out of the special subjects of my address, but it seems to me to arise somewhat naturally from the subjects treated of, and I simply ask that those who do not recognise the necessary truth of such speculations may enjoy that toleration which ought to arise from a feeling of our own proneness to error.

BARIUM SULPHATE AS A CEMENTING MATERIAL IN SANDSTONE.*

BY FRANK CLOWES, D.SC.

Bischof mentions instances of foreign sandstones in which the material cementing the sand grains together is barium sulphate, but it appears that up to the present time no such sandstone has been met with in the United Kingdom. Having learned from my colleague, Professor Blake, that opinions differed regarding the calcareous nature of certain New Red Sandstone beds in the neighbourhood of Nottingham, I undertook to examine the chemical composition of these sandstones.

At the spot in question the sandstone appears as two hills, known as Stapleford and Bramcote Hills, and in the intervening valley there is a pillar of rock called the Hemlock Stone. The hills are conical in shape; the Hemlock Stone is a mushroom-shaped pillar some twenty feet in height. Professor Blake visited the spot with me some short time since, and we procured specimens of the sandstone from different levels of the hills, and of the Hemlock Stone. One of these portions was placed in the hands of two senior students for careful analysis, with the result that the sandstone was reported to contain about thirty per cent. of barium sulphate. I have recently found that the whole of the sandstone specimens from the two hills already mentioned contain this sulphate in varying proportions, which are at present being determined with care, whilst some of the lower beds also contain calcium carbonate. Those geologists who collected their specimens from the lower portions of the Hemlock Stone would undoubtedly detect a carbonate by the ordinary test with an acid, and would therefore consider the sandstone to be calcareous; but if they had procured samples of the mushroom-shaped top of the stone they would have found no carbonate, and would have failed to detect by the acid test the true

* A Paper read before Section B, British Association, Aberdeen Meeting.

cementing material, which is barium sulphate. It seems probable that the protective cap of the pillar owes its comparative permanence against weathering action to the presence of a very large quantity of this almost insoluble sulphate.

In some of the sandstone beds the barium sulphate is very unequally distributed, forming a network or a series of small masses more or less spherical in shape: in such sandstone the sand grains between the sulphate streaks and patches is quite loose, the result being that the weathered surface presents a honeycombed or mammillated appearance. In one bed which caps the Bramcote Hill the barium sulphate is present in little isolated patches about the size of a hazel-nut, and the weathering of this sandstone accordingly yields little pebble-like masses of sand held together by the sulphate; this bed is accordingly usually described by the geologist as a pebble bed, although this name is not strictly appropriate.

I have attempted to detect some evidence of the way in which this barium sulphate has been introduced into the original sand-bed. It may possibly have been deposited together with the sand, but if this is its origin it has certainly undergone physical change, since it exists now in a firm, compact, and crystalline condition. It seems certain, therefore, that it has either been originally deposited from aqueous solution, or has been rendered crystalline by the slow percolation of a solvent liquid through the sedimentary deposit, or else that it has been formed by the action of water containing calcium sulphate percolating through sandstone originally cemented with barium carbonate.

This double decomposition between calcium sulphate and barium carbonate has been artificially carried out by Bischof, and the presence of calcium carbonate together with barium sulphate in some of the beds in question may indicate such an origin. With regard to the possibility of barium sulphate being deposited from solution, or being rendered crystalline by a solvent, it must be remembered that barium sulphate stalactites exist: the origin of these stalactites is undoubtedly similar to that of ordinary calcium carbonate stalactites, and one which I have recently examined consists wholly of the sulphate. I have also received sand-pebbles bound together with large and well-formed crystals of barium sulphate; and that such crystals have been deposited from solution and not from fusion has been demonstrated by Bischof almost beyond doubt.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 11.)

ASTON. I.—*Thos. Holte, Esq., late justice of North Wales and lord of this town,* **1545,** *head lost, and wife Margery, with one son and two daus., Marg. inscr. pecul. Haines.*—This brass lies on a slab on the floor in the N. aisle of Aston church. Its length, to the outside of the marginal inscription, is 6ft., and its width 2ft. 3in. The effigies of Thos. Holte and his wife are 2ft. long, those of the children about 8in. The inscribed plate beneath the effigies is 2ft. by 3in. Haines (pp. 29, 243) considers this brass and those at Coleshill, Hampton-in-Arden, Middleton, Whitnash, Solihull, and Shuckburgh to be the work of local artists.

At the four corners of the slab are the four evangelistic symbols, an angel for St. Matthew, a winged lion for St. Mark, a winged ox for St. Luke, and an eagle for St. John. The common use of these symbols in this position is supposed by some to be the origin of the well-known rhyme:

Matthew, Mark, Luke, and John
Bless the bed which I lie on, &c.

Between these symbols, on strips of brass, is the following inscription in black letter:

✠ Of yō charitye praye for th.... | soolles of Thomas Holte esquyer late Justice of North Wales and lorde of this towne of Aston And | Margerye his Wyfe wich Thomas | deceased the xxiii daye of Marche Anno dñi Mccccccxlv whose soolles God pardon.

Above the effigies, on a shield, are the arms of Holte, Az., two bars, or, in chief a cross pattée fitchée, of the second; impaling Willington, Gu., a saltire vaire, arg. and az.

Thomas Holte, whose head is unfortunately lost, is attired in the robes of a justice. Possibly he wore a coif, or close skull-cap. (Compare the brass at Middleton.) On his shoulders is a tippet and hood, under which is a cloak fastened on the right shoulder. Beneath this is a gown with wide sleeves. The last two were generally lined with a fur called minever, but there is only a faint suggestion, if any, of this in the present example. The justice holds in his hands, which are raised in prayer, a scroll, the symbol of his office; at his right side he wears a tasselled pouch or purse called a *gypcière*, attached to his girdle. His feet are encased in wide shoes.

Margery Holte wears the dress in fashion during the first half of the 16th century. Her head-dress is that called, from its shape, the kennel or diamond-shaped head-dress. It was a sort of bonnet having a round cap at the back, and in front long lappets which hung down each side of the face, and were supported by wires so as to form an angle over the forehead. In the present example there are additional lappets or streamers. The lady's gown is high-necked and has a deep pointed collar, and is confined at the waist by a belt with a metal clasp. The sleeves are very large, and are ornamented with two rows of puffs, four bands, and wide scalloped cuffs. The voluminous folds of the dress, and the way in which it is tucked up at the side, are marks of the style of a provincial artist.

Beneath the effigies of the justice and his wife is the following inscription in black letter:

Thomas Holte here lyeth in graue, Jhu for thyn passion
On hym thou haue compassion, And his soole do saue.

Under this inscription, on separate plates, are the effigies of a son in a gown like his father's, but without the cloak, and of two daughters attired like the mother. There is a poor representation of the brass in Dugdale (p. 879). Dugdale (p. 872) says that Thos. Holte "being a learned Lawyer and Justice of North Wales in Henry VIIIth's time, as also in Commission for the peace in this Shire the greatest part of that king's reign, wedded Margerie the eldest of the seven daughters and co-heirs to William Willington of Barcheston Esquire (a wealthy merchant of the Staple) who survived him, and afterwards became the wife of Sir Ambrose Cave, Knight. And by her he left issue Edward Holt, Esquire, which Edw. having had his education with Sir John St. Leger (then of Weoley Castle in Com. Wigorn,) as by his father's will appears, was in 14 Eliz. constituted one of the Justices of Peace for this County, and in 26 Eliz., Shiriff; and dyed 3 Febr. 35 Eliz."

Aston Hall was built in 1618 by Sir Thomas Holte, the grandson of the Thomas commemorated by this brass. It will be noticed that the effigy of Margery Holte was placed on the grave before her death.

II.—In the S. aisle, on the floor, is a large stone inlaid with four brass plates. The first is set diamond-wise, and is 15in. square. It bears the crest of Lloyd: out of a five-leaved coronet or, a demi-lion ramp. arg., and the arms of the same:—per fesse, sa. and arg. a lion ramp. counter-changed impaling Bridgeman, Sa., ten plates, four, three, two, one, on a chief arg., a lion pass. of the field.

Beneath this is a plate 18in. by 9in., bearing the following inscription:—

Here Lyeth the Body of *MARY*
Late wife of *ROBERT LLOYD*
Of *ASTON* in the County of *SALOP* Esq.
Eldest Daughter of Sir *JOHN BRIDGEMAN*
Of *CASTLE BROMWICH* in this County Baronett
Who departed this life the 25th day of August
A.D. 1689.

Below this is a third plate 18½in. by 9½in., inscribed:—

Here also Lyeth Inter'd the Body of Charlotte
Bridgeman, *one* other of the Daughters of Sr.
John Bridgeman of Castlebromwich *Baronet*
She Erected that Monument on the south side
of this *Chancel* in Memory of her Parents
She Departed this Life ye 28th day of August
1750 *in* the 76th Year of her age

Close to the above is a lozenge-shaped plate, 14½in. by 12in., bearing the name Charlotte Bridgeman, and the arms of Bridgeman described above.

BARCHESTON. I.—*Hugh Humfray, priest,* 1530, *in academical dress.* *Haines.*

This effigy is in a side chapel; its length is 18in.; the inscr. is on a plate, 14in. by 3in., at the feet of the figure. The brass is in good preservation, no part of it being lost. Hugh Humfray is tonsured, his hair is cut short in front, but hangs down in bushy masses over his ears. He is vested in hood, tippet with a border, probably of fur, cassock, and gown. The last has wide sleeves edged with fur, and large side pockets, and was worn by M.B.'s and Scholars of Divinity. The collar and cuffs only of the cassock are visible. The hands of the effigy are raised in prayer, and are disproportionately large; the shoes are absurdly broad;

indeed, the drawing of the figure altogether is rough and coarse. The inscription, which is in black letter, is as follows:—

Orate pro aĩa hugonis humfray magistri
arciũ nec non in sacra scā theologie bacbelerii
cuius anime propicietur deus. Amen. [*quatrefoil, oakleaf*]

Translation:—

Pray for the soul of Hugh Humfray Master of Arts and also Bachelor of Divinity to whose soul God be merciful. Amen.

A similar figure will be found engraved in Haines' Manual, p. 85.

The living of Barcheston was presented to Hugh Humfray by Robert Throckmorton in 1503, and was vacated by his death in 1530.

II.—In the same chapel is a brass plate 20¾in. by 12in., with these arms:—Arg. on a chev. between three bugle-horns sa. stringed of the same and garnished or, as many mullets of the last; and beneath them this inscription:—

VIVIT POST FVNERA VIRTVS | EXVVIAS HIC DEPOSVIT FLAMOCHVS | COLBVRN, FILIVS JOHANNIS COLBVRN, E | NOBILI FAMILIA IN AGRO WARR ORIVNDVS | VIR FVIT MORIBVS INTEGERRIMVS, NEC NON FIDE | THESEIA QVIQVE SEMPER IN AFFLICTIS REI-PVBLICAE | STATIBVS REGIIS PARTIBVS CONSTANTER ADHAESERAT, | BELLICA LAVDE NVLLI SECVNDVS, INVICTVS MARTIS | ALVMNVS, QVI POST VARIOS VTRIVSQ. FORTVNÆ CA | SVS ET EXOPTATAM REGIS ET REGNI RESTAVRATIO | NEM 18° DIE DECEMB: AO. ÆTAT: SVAE 52 AO. DOÑI 1664 CVM | INGENTI OMNIVM MŒRORE SPIRITVM EFLAVIT.

Translation:—

Worth outlives Death.

Here are laid the remains of Flammock Colburn, son of John Colburn, sprung from a noble family in the county of Warwick. He was a man of the greatest integrity, and of fidelity like that of Theseus, and one who in the troublous times of the State ever remained a firm adherent of the King's party, in military glory surpassed by none, an undaunted warrior, who after various changes of fortune good and ill, and after the longed-for Restoration of the King and Monarchy, expired on the 18th day of December, A.D. 1664, aged 52, to the intense regret of all.

(*To be continued.*)

NOTES ON THE ANKER VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

During the past year (1885) much of my leisure time has been employed in investigating the Warwickshire portion of the Anker valley and working up its flora, and as there are many peculiarities connected with this, it may possibly interest some of the readers of the "Midland Naturalist" to see my record.

This district, to which I have been unable before to give time, forms the north-eastern border of Warwickshire, and is bounded on the north by Staffordshire, on the east by Leicestershire, on the south and south-west by the Sow Valley (a tributary to the Avon), and on the north-west by a portion of the Tame Valley proper.

The Anker originates from a confluence of small streams, the main stream rising in Ryton Gorse, near Bulkington, a stream rising in a pasture a little below Wolvey, which is also joined by one rising on Wolvey Heath; these streams unite near Wolvers Hill, and the amalgamated stream takes a northerly direction past Anker Bridge and Burton Hastings to Sunnyfields. Here its course becomes westerly through Attleborough fields and under both the Trent Valley and Coventry Railways. Near to the latter it receives on its left bank Griff Brook, a stream rising near Shilton Village and draining part of Bulkington, Bedworth, Griff Hollows, part of Arbury Park, and Chilvers Coton. Besides this, minor streams rising near Wigham and Hinckley in Leicestershire have entered its east bank. After its confluence with Griff Brook, the Anker runs through Nuneaton, where it is joined by a stream formed by the union of several brooklets draining Stockingford, Nuneaton, Gulley Common, and Ansley coal-field. The Anker now takes a north-westerly sinuous course through Weddington, Caldecote, Mancetter, and Wetherley to Fielden Bridge, near Atherstone, receiving on its left bank streams from Hartshill Hayes and Oldbury, and on its right bank a Leicestershire stream rising near Fenny Drayton, and a little above Wetherley its most important feeder, the River Sence. The Sence is entirely a Leicestershire stream rising in Charnwood Forest, near Bardon Hill, having a course of about twenty-three miles, and draining a wide extent of the flat land of Leicestershire, including part of Charnwood Forest, Gopsall Park, Twycross, Cadeby, Market Bosworth, and running through Sheepy to its confluence with the Anker, near Wetherley. By the courtesy of Mr. Mott of Leicester, I have had a marked "Catalogue of British Plants" showing the plants enumerated from the Sence basin, by the late Rev. A. Bloxam, Rev. — Coleman, Mr. Mott, and his coadjutors in the Flora of Leicestershire, and all my notes from this district are derived from this source. The list shows a flora of about 650 species, many of them rare plants, and about 112 species and varieties not as yet seen in the Anker Valley proper.

The Anker, now a noticeable stream, continues its northerly course through Grendon and Grendon Park, where it is joined by a small stream rising in Twycross Fields. After leaving Grendon Park its course is diverted in a westerly direction towards Polesworth. Here the country becomes suddenly elevated, and we have a ridge of high land forming Hermitage Hill. This causes the Anker to take an abrupt northerly course, past Alvecote Mill; and then again westerly and north-westerly under Shuttington Bridge, through Amington and Bolehall, to its confluence with the Tame at Ladybridge, Tamworth; receiving in its course, on its left bank, Merivale Brook and streams from Baddesley Ensor and the surrounding district, and on its right affluents from Warton, Austrey, and Seckington.

The course of the Anker from its rise to its mouth is about twenty-five miles. It is everywhere a pretty stream, and for a considerable distance very brook-like in character, limpid and rapid, and calling to one's mind Tennyson's beautiful "Song of the Brook":—

"I chatter over stony ways,
In little sharps and trebles,
I bubble into eddying bays,
I babble on the pebbles."

The beauty of this stream has inspired the verse of one of her sons, the almost forgotten Michael Drayton, who was born at Hartshill, on the banks of the Anker, and who, in a pretty sonnet addressed to this river, thus expresses his appreciative praise:—

"Clear Ankor, on whose silver-sanded shore,
My soul-shrined saint, my fair Idea, lies.
O blessed brook, whose milk-white swans adore
Thy crystal stream, refinèd by her eyes,
Where sweet myrrh-breathing Zephyr in the spring
Gently distils his nectar-dropping showers.
Where nightingales in *Arden* sit and sing
Amongst the dainty dew-impearled flowers.
Say thus fair brook, when thou shalt see thy Queen,
Lo here thy shepherd spent his wand'ring years,
And in these shades, dear nymph, he oft hath been,
And here, to thee, he sacrificed his tears.
Fair *Arden*, thou my *Tempe* are alone,
And thou sweet *Ankor* art my *Helicon*."

On the banks of this river, too, at Atherstone, Nehemiah Grew was born and buried, his father having been vicar of the church there. He was secretary for many years of the Royal Society, and was, if not the first, one of the first botanists who gave attention to the anatomy of plants. His work, "Anatome Vegetabilium," which is illustrated by many plates, is a living monument to his fame.

The district is intersected by the Trent Valley, Leicester, Ashby-de-la-Zouch, and Coventry Railways, and by the Coventry and Ashby-de-la-Zouch Canals, both of which yield an interesting and characteristic flora.

With regard to the physical geography and geology of the district I can say little. The district is generally flat, but on the west side, about Hartshill and Oldbury, the country becomes elevated, the highest point being Oldbury Fort, where we have an elevation of about 500 feet above sea level. And anyone standing here will be rewarded, if the day be clear, with a very beautiful outlook. If he stands looking towards Leicestershire, on his right will be the extensive wood called Hartshill Hayes, and peeping over that he will see the steeple of the small church at Hartshill. In the valley below lies Mancetter (the *Manducssedum* of ancient days), and its quaint-looking square-towered church, that looks like a remain from the remote past; close by, the trim, modern, brand-new-looking Wetherley church, and in the valley the silver streak that indicates the bed of Drayton's "crystal stream." On the right lie the woodlands of Atherstone and Merivale, and standing on the Watling Street, the old-fashioned town of Atherstone; and right before him a wide stretch of land, fertile and sylvan, with numerous little villages and equally numerous churches dotted here and there throughout the stretch, the churches of Seckington and Austrey being most prominent; and away out in the distance lie the Alps of that district—Bardon Hill; and looking over this beautiful scene, with its woods and copses so frequently interspersed, one cannot but feel some sympathy with old Drayton, and concede that his *Tempe*, although it may not vie with the Thessalian valley, is a fair one, and one might for the time forget how the world has changed since Drayton's time, were it not that away out in that flat Leicestershire valley he sees in the dim distance a little silver-like puff of steam, which, owing to the distance comprehended in the view, travels on slowly nearer and nearer until at last he is able to make out all the details of the railway train, bearing its freight of human beings or mineral wealth; and he is suddenly called home to the fact that the world has wagged on, and that he is living in an age of improvements not even dreamt of in Drayton's days.

Extensive quarries of quartzite occur at Hartshill and Caldecote; these have been made greatly interesting by the important discoveries of Professor Lapworth and Mr. Harrison. The rich Warwickshire coalfields which, lie mostly on the left bank of this river include those of Baddesley, Polesworth, Austrey, Hartshill, Griff, Nuneaton, and Bedworth, which yield not only their valuable mineral wealth, but also charge the atmosphere with dense volumes of smoke.

Permian rocks occur at Baddesley, rocks of the Bunter formation are seen at Polesworth, Bramcote Hall, and Warton, but the principal formation is that of the Upper New Red Sandstone, or Keuper. Calcareous beds occur near Bole Hall, but do not seem to in any way influence the flora. Red marl, white sandstone and conglomerate are to be seen near Marston Jabet and Warton, and in the latter village many of the fences and small houses are built of sandstone.

Although the district as a whole is well wooded, woods of any great extent are to be found only on the western side of the river. Here we have what may possibly be a portion of the remains of the old Forest of Arden, the more noticeable being Arbury Woods, Hartshill Hayes, the woods about Oldbury and Atherstone, Bentley Park, Merivale Park, Grendon Woods, and Birch Coppice. On the east side of the river the woods are usually little more than copses, Weddington Wood, formerly extensive, being now a thing of the past.

The woods are by no means prolific in woodland species, even such plants as the Cow-wheat, *Melampyrum pratense*; the Yellow Pimpernel, *Lysimachia nemorum*; the Pendulous Sedge, *Carex pendula*; the Wood Spurge, *Euphorbia amygdaloides*; the greater Wood-rush, *Luzula maxima*, being confined to woods about Bentley, Oldbury, and Arbury. Herb Paris, *Paris quadrifolia*, I have seen in Hartshill Hayes and near Oldbury in a spinney. The yellow Bird's-nest Orchis, *Neottia nidus-avis*, and Lily-of-the-valley, *Convallaria majalis*, both occur in Bentley Park. The wild Service Tree, *Pyrus torminalis*; Water Purslane, *Peplis portula*; the Pale Sedge, *Carex pallescens*; Wood Scorpion Grass, *Myosotis sylvatica*, are, I think, confined to Hartshill Hayes. The Wood Horsetail, *Equisetum sylvaticum*; Great Horse-tail, *E. maximum*, occur abundantly in Bentley Park, the latter also sparingly in Arbury Park; the Wood Club Rush, *Scirpus sylvaticus*, has at present only been observed in Merivale Park; the Wood Small-reed, *Calamagrostis epigejos*, only in a thicket near Wolvey; the Service Tree, *Pyrus Aria*, near Weddington;

and the Purple-flowered Small-reed, *Calamagrostis lanceolata*, recorded by Kirk from near Griff, I have been unable to find; but the Millet Grass, *Milium effusum*, is more or less abundant in many of the woods. The Water Avens, *Geum rivale*, which occurs in the Sence Valley, has not been observed in any part of this district; many parts of Bentley Park seem likely to yield this and other such plants, but the incidental visits of a single season can scarcely exhaust the flora of so large a woodland.

(To be continued.)

METEOROLOGICAL NOTES.—December, 1885.

The barometer was high at the commencement of the month, but fell rather suddenly on the 2nd. A recovery of pressure soon followed, and the mean continued high until the 27th, when another fall took place, succeeded by a slight increase of pressure. On the 23rd, the mercury stood at 30·6 inches; the extreme range was, however, only 1·096 inches. Temperature has been about 2 inches below the average, the highest readings being 53·7° at Hodsock, on the 16th; 52·3° at Loughborough, and 51·9° at Strelley, on the 17th; 51·0° at Henley-in-Arden, on the 1st; and 50·5° at Coston Rectory, on the 17th. In the rays of the sun, 84·8° at Hodsock, on the 31st; 82·2° at Loughborough, on the 3rd; and 79·2° at Strelley, on the 17th. The lowest readings were 13·2° at Hodsock, on the 8th; 15·5° at Coston Rectory, on the 11th; 20·4° at Strelley, on the 8th; 21·0° at Henley-in-Arden, on the 11th; and 21·3° at Loughborough, on the 8th. On the grass, the mercury fell to 10·4° at Hodsock; 14·3° at Strelley, on the 11th; and to 16·7° at Loughborough, on the 8th. Rainfall was exceptionally small, the total values varying from 0·98 of an inch at Henley-in-Arden to 0·50 of an inch at Loughborough. Very little snow fell during the month. Sunshine was deficient. Lightning was observed at Loughborough on the evening of the 4th, and a lunar halo on the 21st.

Wm. Berridge, F. R. Met. Soc.

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Natural History Note.

The Older Palæozoic Rocks in North-East Warwickshire.— Hearing that a shaft was being sunk in search of water half way between Chilvers Coton and Burton Hastings, by the Hinckley Local Board, I visited the place. The exact spot is a quarter of a mile south of the W in "The White Stone" on the Ordnance Map. The ground may be roughly estimated at about 325ft. above O. D. The shaft is stated to be 80ft. deep. The upper 60ft. or thereabouts is through red marls and white sandstones, apparently Triassic Water-stones; the lower 20ft. is in hard mottled blue and purple slaty shales.

They much resemble the well-known Cambrian shales of Griff Hollow and Stockingford, and possibly belong to the same formation. At the bottom of the shaft a bore hole is being made, which was already between 40ft. and 50ft. deeper in the same shales. The shaft is a mile and a half beyond the eastern edge of the Warwickshire Coal Field. The River Anker flows at about 50ft. or 60ft. lower level at a short distance to the north, and if its valley were carefully searched it is perhaps possible that outcrops of these ancient rocks might be found on the surface.—W. ANDREWS, Coventry.

ERRATUM.—I regret that, owing to a slip of the pen, the names of the fungi in my note on p. 25 are wrongly given, *myces* being used for *ascus*. The two species should be *Gymnoascus ruber* and *G. Reesii*, and the group Gymnoasceæ.—W. B. GROVE, B.A.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY—GENERAL MEETING, Dec. 1. Mr. T. Bolton exhibited the plasmodium of a myxomycete, in which the rhythmic movements of the granules and protoplasm were explained by Professor W. Hillhouse, M.A. Mr. W. B. Grove, B.A., read his paper on "New or Noteworthy Fungi," Part 3. The paper described about twenty species of Fungi found in this neighbourhood, many of them new to science, and all new or rare in Great Britain. It was illustrated by specimens, and portions of some of them, under the microscopes, also by carefully executed drawings showing their structure, &c.: among them were the following: *Mortierella polycephala*, a fungus on sphagnum; *Septocylindrium Chætospira*, *Helminthosporium Anglicum*, and *Catenularia simplex*, on dead wood, all new to Great Britain. MICROSCOPICAL GENERAL MEETING, Jan. 19.—Mr. R. W. Chase exhibited and described photographs of the two white-tailed eagles lately shot in Kent, which have been falsely represented in the newspapers as golden eagles. Mr. C. T. Parsons exhibited thirty-three specimens of fossil gums, from Africa, containing beautifully preserved insects: the specimens included animi, copal, and kowri. Mr. Clarke exhibited mounted specimens of *Holopedium gibberum*, from Grasmere. Mr. J. Morley exhibited a submarine hemipterous insect, of a new genus, *Æpophilus Bonnairei*, from the Channel Islands. Mr. W. B. Grove, B.A., exhibited *Lentomita ampullasca* (Cooke), a rare sphæriaceous fungus, and *Pachnocybe subulata*, on bark of sycamore, from Sutton; *Rhizomorpha subcorticalis*, between bark and wood of sycamore, from Sutton; and on a specimen of the same species, *Arthrobotryum stilboideum*, from Yorkshire, collected by Mr. Soppitt; also *Phoma complanata*, *Torula hysterioides*, from Sutton: and *Lophiotrema angustilabra*, from Middleton. Mr. T. Bolton exhibited a new arrangement for adapting the electric light to the microscope; also Messrs. Beck's cheap cardboard slide case, to hold 288 slides, for 8s. 9d.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 21st. Mr. Deakin exhibited specimens of scales teeth, and other fish remains, in carboniferous shale, from Pouk Hill Mr. Madison, specimens of *Sphærium ovale* from near Manchester Mr. Evans, a hermit crab, *Suberites domuncula*, in a case of silica

—January 4th. Mr. Tylar exhibited a specimen of gold ore from Los Angelos, California. Under the microscope, Mr. Hawkes showed a series of slides illustrative of the structure of the mistletoe.—January 11th. Subject, "Structural Botany." Under the microscope, Mr. Collins showed an anther lobe of mignonette; Mr. J. W. Neville, various moss fruits; Mr. Hawkes, aborted stamens of *Parnassia palustris*, pointing out their resemblance to the glandular hairs of the sundew. The former is said by Dr. Muller to be a plant that is giving up, or has given up, insectivorous habits.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, January 20th; attendance, thirteen (four ladies). The Chairman reported that a flock of siskins (*Carduelis spinus*) had been seen about Christmas time between Swithland and Cropstone, many of which had been captured by the bird-catchers with limed twigs, as they breed with canaries and make good singing mules. It is rather a rare bird in this county. The following objects were exhibited, viz., by Miss Grundy, a branch of butcher's-broom (*Ruscus aculeatus*), showing flower buds, from the New Forest, where it is called "Knee-holm," holm signifying holly, and knee, according to Prior, being derived through corruption and confusion from the Latin *cneorum*, which has no real connection with this plant; by Mr. W. A. Vice, several minute fungi on bark and dung; by the chairman, a piece of bark from the decayed bough of an elm tree, showing the radiating and sinuous tunnels of the larvæ of *Scolytus destructor* and the holes through which the perfect beetles escape. A very instructive and interesting address was delivered by Dr. Tomkins, officer of health to the borough, on "Microscopic Organisms in their Relation to Disease," describing the leading characters of the four principal forms Micrococcus, Bacterium, Bacillus, and Spirillum, and illustrated on the blackboard and by a series of admirable microscopic slides.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—December 31st. BOTANICAL SECTION.—Chairman, Mr. J. W. Bodger. Five members present.—Mr. J. W. Bodger continued his address upon the tissues of plants, dealing more especially with wood structure, fibres, and vessels; exhibiting microscopically specimens of pitted, annular, scalariform, and laticiferous vessels; wood and bast fibres; together with transverse and vertical sections of various plants, to show the arrangement of the vessels, &c.—January 7th. GEOLOGICAL SECTION.—Chairman, Mr. E. Wheeler. Subject discussed—"Denudation" (Chap. VI., "Lyell's Student's Elements"). The various statements given in the chapter were considered, and the President illustrated the effects of what Lyell terms "Subaerial denudation," by the way in which rocking stones, &c., have been formed. It was thought a careful section of the Nene valley, in the neighbourhood of Peterborough, might show a somewhat similar section to the ideal one given on page 73, Fig. 81.—January 14th. BOTANICAL SECTION.—Chairman, Mr. J. W. Bodger. Nine persons present. The Chairman gave an address on the "Epidermis and its appendages;" explaining the formation and mode of growth of the endophlœum, mesophlœum, and epiphlœum, the stomata, glands (internal), lenticels, hairs, prickles, papillæ, glandular hairs, stings, nectaries, and vittæ, illustrating the same with from fifty to sixty drawings and specimen plants, and by means of the blackboard.

A POSSIBLE ORIGIN OF ORGANIC LIFE.*

BY F. T. MOTT, F.R.G.S.

I have lately been reading a volume entitled "Natural Law in the Spiritual World," by H. Drummond. It would be difficult to find a richer mine of false analogies, and the argument is vitiated by them throughout; but the book is powerfully and brightly written, and is very suggestive.

The writer endeavours to show that as the inorganic cannot by any force inherent in itself rise to the level of the organic, nor the animal to the level of man, without a creative miracle at each step, so the natural man cannot become the spiritual man without a similar miracle. In analysing this argument one is struck by the fact that one step in the scale is omitted. It is not asserted that any miracle is required to lift a plant to the level of an animal, probably because the real genesis of the animal is almost within the vision of science at this present day. We find that the animal is not suddenly lifted above the plant by any miraculous intervention, but that the dog and the tree are the latest terms in two diverging series which converge, not as the animal and the human series do upon one distant point, but upon a line drawn from the upper regions of the far Past to the lower regions of the actual Present.

The conditions necessary for the existence of organisms which lie on the border land between the plant and the animal have continued from very early times and still remain, and there is sufficient evidence to make it probable that there was a time when all organic life was of this kind, and that the plant world and the animal world as we know them at this day have slowly developed from those germs in two distinct directions. A true analogy would suggest that the organic and the inorganic have arisen as two distinct kingdoms of Nature by a similar process—that the diamond and the tree are as truly the latest terms in two diverging series as the tree and the dog. But we cannot find in this case the point of convergence. If it ever existed, the conditions which made it possible seem to have passed away. We know of nothing of which it cannot be determined whether

* Read before Section D of the Leicester Literary and Philosophical Society, March 18th, 1885.

its place is in the organic or the inorganic series. Can we discover among the past epochs of which science reads the histories any one in which these two lines could probably have converged? What special characteristics must we look for in such an epoch?

In order to answer this question, we must consider, What is the fundamental difference between the organic and the inorganic? What is required to make the organic diverge from the inorganic? Their most fundamental difference lies in the fact that in an organism energy is more concentrated than it is in a crystal. In some sense the organic is to the inorganic as electricity to magnetism. The energy is more intense, the action more rapid and violent. When heat is communicated to an iron rod the molecules begin to move in a comparatively slow and feeble manner. As more of the heat-energy is concentrated in the iron some of these movements become more rapid. The iron glows with a red light. Then, as a larger number of the more rapid vibrations are set up, these mix with the slower ones and produce yellow light, and as still swifter and more violent vibrations are added by the concentrating energy the yellow gives place to white. If now this mixture of vibration-waves is analysed by the prism, the violet and the red diverge from a common point, and at a short distance the two rays are as far apart and as distinct in character as the organic and the inorganic kingdoms, and a mind which could recognise their differences without knowing anything of their origin might very well doubt whether one could have arisen from the other without a miracle. Yet these differences are due simply to the more concentrated condition of the energy in the one than in the other.

Now if we trace the creation of this world according to the very probable nebular hypothesis, we see that as the nebulous matter condensed, energy became more concentrated. This process continued until the ring became detached from the central mass, and until the ring itself became agglomerated into one glowing sphere. There was a period when the concentration of the energy reached a maximum, and a later period when dissipation became more rapid than concentration, and the active energy began to decline. Is it not possible that at the epoch of maximum energy such form was given to some material molecules, as differentiated their groupings and internal motions as much from the groupings and internal motions of others, as the violet ray is differentiated from the red? That a force-wave was established which has rolled on through the ages since, whose climax is perhaps not yet reached, but whose material expression we recognise as the organic kingdom of Nature?

The epoch which gave it birth has long since passed away. No such conditions, nor anything like them, now exist within our cognizance. The change from inorganic to organic is therefore to us impossible. But we still find that the germs of life, those minutest organisms which have perhaps continued to reproduce their race with but slow and slight changes from those far distant periods, are capable of existing under what seem to us now very extraordinary conditions. They may lie dormant for long periods, perhaps for centuries resisting time and frost and drought. No heat short of the boiling point will injure them. We do not know what temperature would be required to kill them all, and we may well understand that if indeed their ancestors were born among the fires of this seething globe, when there was neither earth nor water, no heat which we can now apply would have affected them. It is indeed doubted whether protoplasm can in any case endure a degree of heat beyond the boiling point if once the hard cellulose of its protecting wall be penetrated. And it is an accepted doctrine that the cellulose cannot come into existence except as a secretion from pre-existing protoplasm, but we do not know that the heat which protoplasm will endure has *always been* limited to 212° Fahr. Its power of endurance seems greatly varied now. Many creatures are killed by heat of much less intensity than 212°. This limit may be a comparatively recent adaptation, the original protoplasmic germs having been adapted to absorb water not in its liquid, but in its gaseous form.

The progress of science reveals to us more closely at every step the continuity of the universe. The more we interrogate Nature the more loudly she answers that there are no gaps, no breaks, no miracles; that nothing is created; that everything *grows*; and that growth is the unfolding of hidden potentialities, the swelling of the waves of force which rise and fall and rise again in new combinations, each growing out of what went before; that organic life is only crystalline life under a new and more concentrated aspect, giving rise to more complex phenomena; that human life is the same in kind but on a higher level of concentration and complexity with self-consciousness as one of its special and most remarkable phenomena; that there are no doubt higher levels still to which concentrated force may attain, and that the self-conscious units may very possibly rise to the next plane by some increase of concentration, without losing that special attribute of conscious personality.

This is not a materialistic or an atheistic doctrine. The unfolding of potentialities implies that those potentialities already exist, and they are functions not of matter but of the immaterial force. The potentialities hidden in an acorn will mould its development into an oak, but nothing like that oak exists in the matter of the acorn. The moulding power is in the force-wave, of which the acorn represents the potential, and the oak the kinetic phase. And these force-waves can only be ripples of the one great central and eternal force-wave in which must co-exist all capacities and powers exhibited in the universe, including conscious mind and all which that implies.

ON THE OCCURRENCE OF FOSSILIFEROUS HÆMATITE NODULES IN THE PERMIAN BRECCIAS IN LEICESTERSHIRE,

TOGETHER WITH SOME ACCOUNT OF THEIR ECONOMIC VALUE, &c.

BY W. S. GRESLEY, F.G.S.

(Continued from page 37.)

Theory No. 2.—This requires far less appeal to the imagination than does No. 1. If we examine a typical series of the hæmatites side by side with a like set of nodules of clay ironstone (siderite or carbonate of iron), taken from the shales and clay beds of the coal measures, it will be seen that a great similarity exists in the two series. This resemblance is most marked in the external forms, dimensions, surface, and internal hollows, cracks, organic markings, and, in the case of a few, in colour, sp. gr. hardness, &c. It is in their structure, colour, lustre, and especially in their *weight* and *hardness*, that the greatest difference is to be observed. Specimens occur in the superficial deposits of the district whose derivation may, I consider, have either been the Permian beds or direct from the coal measures, they are so little altered. The colour of the surfaces, however, of these doubtful samples is some shade of red or brown. Why, then, may not these heavy, hard, steel-coloured, organised nodules and bits of ore be *altered coal-measure ferrous carbonates?* The only original thing about them is their shape (in the case of *whole* nodules). The mineral iron and the enclosed fossils have also of course been in them from the first. We look upon them, in fact, as Pseudomorphs.*

Here are analyses of the two kinds of iron ore :—

Clay Ironstone.†		Hæmatite.‡	
Protoxide of iron	46·14	Ferric oxide............	95·77
,, manganese	1·40	Manganous oxide ...	·03
Alumina	3·53	Sulphur	·072
Lime	3·43	Silica	3·35
Magnesia	2·13	Loss on ignition, consisting of water and carbonic dioxide ...	·56
Carbonic acid............	32·04		
Silica	8·63		
Water, &c.	3·04		
	100·34		99·782
Metallic iron......	35·95%	Metallic iron......	67·036%

The specific gravity of clay ironstone = 3·75

The specific gravity of the hæmatite = 4·62

The hæmatite was slightly polaric.

Granting that these stones were originally nodules and parts of beds or "measures" of coal-strata carbonates, their high sp. gr. shows that something has since entered into their composition; and the variety of structures, densities, colours, magnetism, and so on, points to changes they have undergone—changes of great importance.

Perhaps if the stones are looked upon as the result of *chemical change* we shall be correctly describing them. At all events they may be termed *pseudomorphous*. "Paramorphous" § or pseudomorphs by paramorphism, is, I think, the best word to apply to them.

That the *change* or *alteration* above mentioned has taken place either in the breccia or before the nodules commenced their travels or were washed out of the coal-measure débris is evident. It does not seem possible that it could have been brought about during the removal and prior to the deposition of the stones in the Permians; though we know nothing of the conditions they may have gone through, or of the length of time they passed through in a state of unrest. This, however, matters little, though further on I shall endeavour to

* Pseudomorph = *false form*. In mineralogy, "a mineral which has replaced another and has assumed the external form of the mineral so replaced." (Geikie.)

† A South Staffordshire ironstone.

‡ Analysis of Permian breccia pebbles by G. E. Harrison, Birmingham.

§ Paramorphs are certain pseudomorphs in which a change of molecular structure has taken place without alteration of external form.

show *when* this change probably did take place. The question is rather, *how* or in *what manner* did it take place? Water no doubt played the chief part. This, supposing it were charged with carbonate of iron or possibly with perchloride of iron, would percolate the Permian strata by occupying any crevices, joints, or other openings, staining the rocks red by precipitating or depositing iron all around. As hæmatite is found pseudomorphous after ferrous carbonate, the latter, in the shape of the clay-ironstone nodules, &c., would naturally combine with ferric oxide. Now this kind of process, or segregation, seems to have continued until all the original carbonate of iron had become changed into hæmatite; in fact, each individual nodule seems to have been a kind of centre of segregation, and taken up considerably more mineral matter than it originally contained, as evidenced by a comparison of their relative weights. The ferrous carbonates would, therefore, appear to have possessed, as it were, the power of attracting and absorbing or combining with the oxide of iron without increasing in bulk. But the most difficult point for explanation seems to be this:—What has become of the siliceous and aluminous materials of the original ore? The foregoing analysis shows that they hardly exist in the pure ore; and if, as I have supposed, the stones were once clay-ironstone, these earthy ingredients must have disappeared. The "Spotted Vein" clay-ironstone of Dowlais, Glamorganshire, is about the purest clay-ironstone I have heard of, if we may judge from the analysis given of it;* and even supposing that the Permian nodules were originally composed of an ore as free from insoluble matter as this Glamorganshire ironstone is, there still remains the difficulty of solving the problem. Now, I understand that as yet chemists have not been able to account fully or satisfactorily for the way in which the removal of the silicates of alumina, &c., can be effected from a clay-ironstone. In a paper read before the Royal Geological Society of Ireland, May 14th, 1873, by Mr. E. T.

* Silica and alumina	14·17
Peroxide of iron	76·61
Red oxide of manganese	1·21
Lime	3·13
Magnesia	3·96
Phosphoric acid	0·57
Potash	0·87
Sulphur	0·06
	100·58

See "Iron Ores of Great Britain," Part iii., p. 209.

Hardman (see "Geol. Magazine," Vol. x., p. 395), descriptive of some peculiar siliceous nodular brown hæmatite in the Carboniferous rocks in Co. Tyrone, an attempt is made, and some chemical formulæ are given, to show how by a complicated series of re-actions and so forth, it is perhaps *theoretically possible* to replace the siliceous and clayey materials by iron oxides, as he maintains the Tyrone nodules have been the result of some such chemical process. That rich red hæmatite has by natural chemical re-actions been produced, directly or *in situ*, from clay-ironstone is, however, a fact notwithstanding, as will be shown further on.

The various kinds of structure noticed would probably be due to change of molecular structure, though we must admit that one or two of them (stalactitic, columnar, and some of the agate forms) are difficult to account for. The agate-like markings are occasionally met with in certain kinds of dense hæmatites, and in these instances they probably do not represent original structures of the carbonates. What most puzzles me is the occurrence of magnetite (polarity) and the manner in which the magnetic iron exists in the nodules. The presence of some Fe O is probably connected with this peculiar property. The writer has not been able to learn that iron ore of this particular character has been found or noticed to possess polarity before. *How* and *when* this property was given them I must ask our electrical and philosophical friends to enlighten us if they can and will kindly do so.

I have yet to explain (under this second theory) how the intermediate or half-and-half forms of hæmatite and gritty sandstones, &c., were probably formed. And here it should be stated that the more closely these associated rock fragments are examined the less able are we to draw a line between the hæmatites and them. The same process that caused the conversion of the clay ironstones into iron oxide, viz., long-continued chemical action, I take it, produced these semi-hæmatitic specimens. They seem to show that the chemical change has not gone quite so far with them, quartz probably being less easily acted upon or replaced than clay ironstone.

In order to show that I uphold theory No. 2 in preference to theory No. 1, I will state a few additional facts and opinions having important bearing upon the questions involved.

We have been considering these nodules, &c., as pseudomorphous. During what geological period or periods the transformation took place I will now proceed to discuss. The fact of the stones being now obtained, or being derived from the Permian breccia, does not prove that this change was effected during the Permian era; they might possibly have been converted into hæmatite in coal measure times, or during the continuance of one or more of the secondary periods—in fact, the gradual replacement may have gone on ever since the deposition of the breccias until these beds were denuded, and their contents scattered over the country. We shall be better enabled to fix the age or rather the beds in which this metamorphism took place, when we consider that the agate or peculiar concretionary markings are not solely confined to the fragments of hæmatite, but that they show themselves on the surface, within, and in joints of other pebbles and fragments of rocks of older date than the coal measures. In all these cases these concretionary markings seem to be the result of segregation of ferric oxide, produced through the action of water. The hæmatitic matter (red staining, coating, and replacing), not being wholly confined to the ironstone, but being present in greater or less quantity in other and older rock fragments, seems to show that the bulk of the ferric oxide present in each and all of these stones, both in and derived from the breccia of the locality, found its way into them during, or certainly not previous to, the Permian epoch.

Now this iron must have come from below, or from above, or along with the water and sediment, by whose agency the breccias were deposited, and in a great measure formed. That it did not come from below is evident; at all events I have no evidence whatever to support such a theory. That it came from above is by no means so uncertain. Water permeates downwards, and in so doing would part with its irony solution to rocks it passed over or through, thereby staining them. But although it is not perfectly clear that rocks of later date, containing iron that could be, or was, by water, dissolved out of and carried down into the Permians, ever existed all over the breccias containing the hæmatite, a study of the geology of the district leads to the conclusion that they did once overlie the whole of the breccias. These newer rocks are the Triassic series, whose well-known red colour is due to oxide of iron. Numbers of instances occur in this country of coal measures so thoroughly altered in colour by staining from superimposed Permian or Triassic strata as sometimes to puzzle greatly mining men and even geologists. In considering, then, whether the iron originated along with the breccia and was not derived from the Trias, we must look for Permians of the same red-stained character, which we can show were never at any time buried beneath strata, as the Triassic, for instance, or where beds intervened between the red Permian and the red Trias, whose contents do not exhibit iron staining, and which we naturally suppose would have been so stained had such conditions obtained as those we have just been considering. In the lower divisions of the Bunter (the conglomerates and sandstones of the Leicestershire areas), we find comparatively little iron staining, and therefore I have come to the conclusion that the hæmatites, &c., have been formed from iron *from the first* in the Permians themselves. I have supposed that the waters of this remarkable geological period were deeply charged with iron in solution—carbonate of iron. (I refer to the Permian area of the Midland counties only.*) It might, however, be said in explanation of the way in which the iron became so abundant in the breccias, that as the coal measures lying immediately beneath them would, by reason of their argillaceous character, be practically impervious to water, and that thus arrested in its descent through the Triassic beds which are pervious, the carbonate of iron in solution would be carried down through, and probably out of those beds, and coming to rest upon the coal strata would there gradually be changed into an oxide of iron and act upon the breccias in such a way as during long ages would ultimately so alter the original character of its rock fragments as to make it very difficult for us to explain their previous history.

This question, viz., During what geological period did the alteration of the nodules take place? is, of course, a speculative one, and a point extremely difficult to prove, and until similar ironstones have been found *in situ* in the coal measures, the solution of this problem must, I think, remain *in statu quo*.

(To be continued.)

NOTES ON THE ANKER VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

(Continued from page 58.)

One of the striking features connected with the flora of the Anker is the rarity or absence of heath-loving plants. And this because there is abundant evidence of the district having in former times been to a great extent moor or heath

* "Contributions to the Physical History of the British Isles," by E. Hull, M.A., F.R.S., &c., 1882, p. 91, and Plate VIII.

land, a continuation of that vast moorland stretching across the country through Fazeley, Middleton, Sutton Coldfield, to Cannock Chase and still further north. Mining, tillage, drainage, and other industrial operations seem to have completely changed the character of the country and its flora. But at Bentley, Baxterley, and Baddesley we have still remains of the old heath lands. Even here, however, as well as elsewhere in the district, plants usually common to such soils are either rare or absent; such plants as the Wood Betony, *Stachys Betonica*; the Bilberry, *Vaccinium myrtillus*; the Lousewort, *Pedicularis sylvatica*; the Sheep's-bit, *Jasione montana*; the Hawkbits, *Leontodon hirtus* and *L. hispidus*; Eyebright, *Euphrasia officinalis*; Sneezewort, *Achillea ptarmica*; Saw-wort, *Serratula tinctoria*; Thyme, *Thymus serpyllum*; Hawkweed, *Hieracium umbellatum*; Red Bartsia, *Bartsia odontites*; Sheep's Fescue Grass, *Festuca ovina*; Green-ribbed Sedge, *Carex binervis*, are most of them rare, and in some cases confined to limited spots in one locality. I have searched in vain for the Star-headed Sedge, *Carex stellulata*; Pill-headed Sedge, *Carex pilulifera*; the Cross-leaved Heath, *Erica tetralix*; the Cudweeds, *Filago germanica* and *F. minima; Myosotis versicolor*, and the Sun-dew, *Drosera rotundifolia.*

As a rule the cultivated lands of this district are remarkably free from weeds, and the plants which Mr. Hewett C. Watson designated "Colonists" are absent over large areas. Such plants as the Corn Cockle, *Lychnis Githago*; the field Crow-foot, *Ranunculus arvensis*; Shepherd's Needle, *Scandix Pecten-Veneris*; Dwarf Spurge, *Euphorbia exigua*, I have only found in one or two localities; the Stink Mayweed, *Anthemis cotula*, usually abundant in Warwickshire, I have only seen as an isolated plant near Shuttington; and the Knawell, *Scleranthus annuus*, in a field near Hartshill; *Chrysanthemum inodorum* and *C. Matricaria* are usually absent from the fields but occur in abundance on the adjacent footways and waste places. Poppies are noticeable for their rarity in the corn-fields; and the Corn Marigold, *Chrysanthemum segetum*; the Corn Bottle, *Centaurea cyanus*, are apparently absent from the district; the Oat Grass, *Avena fatua*; the White Goose-foot, *Chenopodium album*; the Slender Fox-tail Grass, *Alopecurus agrestis*, are usually rare; whilst the Bent Grass, *Agrostis nigra*, is in some of the fields too abundant.

No marshes of any extent occur in the district, but there are marshy places about Baddesley, Shuttington, Atherstone, and Wolvey, and the predominating plants in these places are the Lady's-smock, *Cardamine pratensis*, the Fleabane, *Inula* *dysenterica*, Marsh Cross-wort, *Galium palustre*, Bog Stitchwort, *Stellaria uliginosa*, and the Toad Rush, *Juncus bufonius*. The Marsh Violet, *Viola palustris*, occurs sparingly in a marshy bit near Atherstone; Marsh Valerian, *Valeriana dioica*, near Burton Hastings; the Impatient Lady's-smock, *Cardamine impatiens*, Hartshill; Water Dropwort, *Œnanthe fistulosa*, in about three localities; the Bitter Lady's-smock, *Cardamine amara*, Shuttington, Mancetter, and Burton Hastings. Grass of Parnassus, *Parnassia palustris*, Cinquefoil, *Comarum palustre*, the Bog Pimpernel, *Anagallis tenella*, the Penny-rot, *Hydrocotyle vulgaris*, the Butterwort, *Pinguicula vulgaris*, are not, so far as I have seen, to be found in the district. Blinks, *Montia fontana* is fairly frequent, and the Great Chickweed, *Stellaria aquatica*, is more frequent than in any other Warwickshire district.

Of plants usually found on hedge banks, waysides, and waste places, I find many that are noteworthy. The White Bryony, *Bryonia dioica*; Black Bryony, *Tamus communis*; the Dogwood, *Cornus sanguinea*; and the Privet, *Ligustrum vulgare*, are all widely spread through the district. The Buckthorn, *Rhamnus catharticus*, and Barberry, *Berberis vulgaris*, are both rare; the Alder Buckthorn, *Rhamnus Frangula*, and Spindle Tree, *Euonymus Europæus*, both appear to be absent; and the Guelder Rose, *Viburnum Opulus*, though rare in hedges, occurs in many of the woods.

The Hemlock, *Conium maculatum*, is abundant in two localities near Warton and Caldecote; the Teasel, *Dipsacus sylvestris*; Pepper saxifrage, *Silaus pratensis*; Rest Harrow, *Ononis campestris*, occur over wide areas; but the Goutweed, *Ægopodium Podagraria*, and Greater Celandine, *Chelidonium majus*, both usually abundant near our Warwickshire villages, are remarkably rare. The Hairy St. John's Wort, *Hypericum hirsutum*, and Bastard Stone Parsley, *Sison Amomum*, are both local; and the Greater Burnet Saxifrage, *Pimpinella magna*; Meadow Rue, *Thalictrum flavum*; Wild Basil, *Calamintha Clinopodium*; Meadow Geranium, *Geranium pratense*; Bladder Campion, *Silene inflata*; Tuberose Pea, *Orobus tuberosus*, are among the most rare plants of the district. And the following, all of which occur in the valley of the Sence, are absent from that of the Anker proper:—*Inula Conyza*, *Galium Mollugo*, *Chærophyllum Anthriscus*, *Pyrus communis*, and *Prunus Cerasus*. I also find *Arctium majus*, *A. minus*, and *A. intermedius* at wide intervals.

Ferns, with the exception of the Bracken, *Pteris aquilina*, which occurs throughout the district, are often absent over wide areas, and are usually represented by the male fern, *Lastrea filix-mas*. The common Polypody, *Polypodium vulgare*, usually abundant on hedge banks in Warwickshire, I have only seen as a single plant near Weddington. The Maiden-hair Spleenwort, *Asplenium Trichomanes*; the Wall Rue, *Asplenium Ruta-muraria*; Mountain Shield Fern, *Lastrea Oreopteris*, all occur near Atherstone; the Prickly Shield Fern, *Aspidium aculeatum*, at Hartshill and Gulley Common; and in the woods at Bentley, Hartshill, and Arbury I find both forms of the Ladyfern, *Athyrium filix-fœmina*, *Lastrea dilatata*, *L. spinulosa*, and the noble-looking *L. Borreri*.

But however wanting the district may be with regard to rare plants, the student who pursues that most thorny and intricate study, the Brambles, will here find material enough and to spare, for in these plants the district is rich indeed, giving not only abundance of individuals but also wonderful variety; it is, in fact, the richest bramble district in Warwickshire. Fifty-one species and varieties have been observed by myself, and two, viz., *Rubus Grabowski* and *R. rubicolor*, are recorded by Mr. Bloxam, which I have not yet found.

Rubus Bloxamii, originally found in Hartshill Hayes by Mr. Bloxam, occurs not only in that wood but is also the prevailing bramble of the Hartshill quarries and lanes. *R. foliosus* is abundant on Ansley coalfield, in Hartshill quarries, and near Mancetter. *R. Bellardi*, *R. infestus*, *R. Guntheri*, *R. Lejeunii*, and *R. mucronulatus* are abundant in Hartshill Hayes, Parley Park, and Bentley Woods. A form intermediate between *R. ramosus* and *R. Lindleianus* prevails in the Hartshill quarries, in lanes near Wolvey, and near Anker bridge. Mr. Archer Briggs also finds this form, in Devonshire, abundantly. The true *R. ramosus* occurs somewhat abundantly near Shuttington. *R. rosaceus*, *R. villicaulis*, are abundant in Bentley Park and Gulley Gap; and in the district about Anker bridge and Burton Hastings *R. concinnus* and *R. pilosus* are the prevailing brambles. Beside these and many others I find in great abundance and at wide intervals a bramble which Coleman named *R. Bloxamiana*, a very noticeable plant, midway, I think, between *R. scaber* and *R. fusco-ater*, but at present undescribed in our English floras. In fact, any industrious student of these plants would find in this district most of the acknowledged species and varieties, and more than one not at present described in our text-books.

Of the genus Rosa I find *R. micrantha*, two forms of *R. tomentosa*, and twenty-four varieties of *R. canina*, but as a rule both *R. tomentosa* and *R. micrantha* are very rare. Of the *Canina* group *R. surculosa* and *R. senticosa* are well represented. *R. Borreri*, *R. Reuteri*, *R. implexa*, *R. Watsoni*, and *R. dumetorum* occur in various parts of the district. A form, which Dr. Christ named *R. concinna*, occurs as a single bush near Birch Coppice, *R. Bakeri*, near Shilton, but just in the Anker district, and *R. bibracteata*, in Gulley Gap; but the prevailing Rose is *R. arvensis*. *R. spinosissima*, *R. Sabini*, *R. rubiginosa*, and *R. mollissima*, all recorded from the Sence Valley, I have not found in the Anker district. Among the plants of the meadow lands the Ladies' Mantle, *Alchemilla vulgaris*, and the Meadow Barley, *Hordeum pratense*, are both rare; but *Orchis morio*, *Colchicum officinale*, *Bromus racemosus*, *B. commutatus*, *Ophioglossum vulgatum*, and *Botrychium lunaria*, I have not observed. These are all recorded from the Sence Valley.

None of our Warwickshire rivers can surpass the Anker in the abundance of plant inhabitants, and we see on every side the beautiful purple Loose-strife, *Lythrum salicaria*; forest-like growths of the Reed, *Phragmites communis*; the Bulrush, *Scirpus lacustris*; and the Reed Grass, *Glyceria aquatica*; now and again the Arrow Head, *Sagittaria sagittifolia*; the beautiful flowering Rush, *Butomus umbellatus*; and the Water Betony, *Stachys palustris*; the Yellow Cress, *Nasturtium amphibium*; the Horned Pondweed, *Zannichellia palustris*; and streaming masses of the Floating Crowfoot, *Ranunculus fluitans*. But the most noticeable, because most rare, in North Warwick is the Floating Œnanthe, *Œnanthe fluviatilis*; this plant is evidently brought into this river by the small stream which rises near Market Drayton, as it does not occur anywhere in the river until we get a little above where that stream enters the Anker. Here it suddenly becomes abundant and continues at intervals on to Tamworth. In streams near Bole Hall, I find the opposite-leaved Pondweed, *Potamogeton densus*, a plant not before noticed in North Warwick, and near Anker bridge the neglected Bur-reed, *Sparganium neglectum*, and an abundant growth of the Starwort, *Callitriche obtusangula*; in the canals and other waters I also get *Chara fragilis*, *C. Hedwigii*, *Potamogeton mucronulatus*, *P. zosterifolius*, *P. pusillus*, *Typha angustifolia*, and very rarely *T. latifolia*. *Carex pendula* and *C. Pseudo-cyperus*, occur in various parts of the district, but the conspicuous Hemp Agrimony, *Eupatorium cannabinum*, is, so far as I have observed, absent from the district.

The foregoing will give some slight idea of the peculiarities noticeable in the flora of this district.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART I.

(Continued from page 43.)

During the boring for water at GAYTON, some three years ago, several of the Middle Lias beds were passed through, indeed all that are developed in this neighbourhood. For the section given below I am indebted to Mr. H. J. Eunson, F.G.S.

SECTION AT GAYTON BORING.

	Feet	In.
1.—Surface soil	1	0
2.—Alluvial clay	7	0
3.—Shale, with the limestone of *Fish* and *Insect-bed* ...	0	4
4. B.—Limestone rock, with *Rhynchonella tetrahedra*...	2	8
5.—Clay	2	8
6.—Limestone rock, with *Protocardium truncatum* ...	4	4
7.—Clay, containing *Gresslya seebachii*	7	0
8. L.—Rock. A hard mottled stone, in which a good quantity of water was obtained. The boring actually commenced in this bed	2	3
9.—Blue sandy clay, very micaceous, with *Ammonites margaritatus*	6	6
10.—Rock	0	9
11.—Clay	2	0

The boring was continued to a total depth of 994 feet, but through beds with which we are not here concerned.

I have only personally examined beds 8 and 9 from the above section, hence it is perhaps advisable not to attempt to identify the beds 5, 6, and 7, which intervene between B and L. One thing is pretty evident: the Middle Lias beds here are not so fully developed as they are further westward, and this is confirmed by a section at MILTON, about two miles east of the locality of Gayton boring. A well was being sunk at the brewery, and the proprietor, Mr. East, very kindly gave Mr. W. D. Crick and myself every facility for examining the beds passed through.

SECTION OF WELL AT MILTON.

	Feet	In.
1.—Soil and clay	3	0
COMMUNIS-BEDS.		
2.—Light blue clay, numerous small *ammonites*, chiefly *A. communis*	6	0

SERPENTINUS-BEDS.

3.—Yellowish or red sandy clay, with a few nodules, the representative of Lower Cephalopoda-bed ... ...1ft. to 1 6

4.—Dark blue clay, scarcely any fossils 4 6

FISH AND INSECT-BEDS.

5.—Paper-shale, 6in.
Fish-bed ... 6in.
Paper-shale, 6in. } Fish remains abundant in all these beds 1 6

TRANSITION-BED.

A. 6.—This bed only indifferently represented, and where present it is hard and the fossils poor. *Ammonites acutus.* ... ...

ROCK-BED.

B. 7.—Hard stone, very black in fissures, blue hearted, *pebbles* and *concretions* rather plentiful. *Pecten dentatus*, *Terebratulæ*, &c. About 2ft.

D. ?. { Very ferruginous bed, highly fossiliferous, fossils obtained best from top. *Modiola*, &c. About 1ft.
Light coloured and soft rock, quite oolitic in places, containing:—*Cardium truncatum*, *Pecten liasinus*, *Pholadomya*, *&c.* About 1ft.

} 4 0

I. 8.—Dark blue micaceous clay, getting more sandy
J. towards the bottom ... ...
K. A band of highly-fossiliferous nodules about 1ft. from top, containing:—*A. margaritatus.* Other fossils, chiefly from clay:—*Ostrea sportella*, *Ostrea cymbium*, *Pecten æquivalvis*, *Plicatula spinosa*, *Avicula inæqualvis*, *Cardinia antiqua*, *Pleuromya costata* ... ...

} 10 0

L. 9.—Hard bed, seems to be made up of highly-fossiliferous nodules. This bed yielded a good supply of water under pressure, and so was only just broken into. From the single nodule obtained, the following fossils were extracted:—*Turbo cyclostoma*, *Pecten æquivalvis*, *Pecten liasinus* (very large), *Limea acuticosta*, *Plicatula spinosa*, *Avicula inæquivalvis*, *Cardinia lævis*, *Cardinia antiqua*, *Protocardium truncatum.*

The matrix resembles that of Bed "L" at Gayton and elsewhere.

The Upper-beds have a dip of ten degrees W.S.W. Here again I have only been able to identify with certainty "A," "B," and "L," though I have little doubt that 8 is the representative of "I," "J," "K," and that 7 includes more than the Rock-bed. I think it was the presence of Terebratula (punctata?) in the lower part that induced me to put the fossils obtained from there under "D."

Two other sections may be found between Milton and Northampton, one to the right and the other to the left of the road. The one nearest Milton—right hand side going towards Northampton—is almost obscured now, though the Rock-bed itself may be seen around the field under the hedge. The *Paper shales* and *Fish and Insect limestone* are not quite so well developed here as in the village, but the Lower Cephalopoda-bed and Transition-bed much better. The latter has yielded:—*Ammonites acutus*, *Ammonites Holandrei*, *Ammonites communis*, *Eucyclus concinnus*, *Cucullæa Münsteri*, *Lima punctata*, *Astarte voltzi*, *Rhynchonella tetrahedra*, *Waldheimia resupinata*, *&c.*

Several things from here require identification, and one or two may be new.

In a field a little way from the road, on the left-hand side, and not far from the section just referred to, the Rock-bed may be seen, with traces of the Transition and Fish-bed at the top. The stone is mostly of a rubbly character, and used for road mending. The Rock-bed at this place presents only its normal characters; there is nothing like the three-fold division of bed No. 7 in the Milton section, although less than a mile away.

The only other section I now have to refer to is one at Northampton. In a boring for water made on the Kettering Road some few years ago, the whole of the Upper, Middle, and Lower Lias was passed through, and the following is the sequence of beds from near the bottom of the Upper Lias to about the top of the Lower Lias. It is the account given by the miners who sank the first shaft, before the boring actually commenced, and was given to me by Mr. H. J. Eunson, F.G.S.:—

Section at the Kettering Road Well and Bore Hole.

	Feet	In.
1.—Surface clay and marl	4	0
2.—Blue clay	147	0
3.—Green rock (fossils)	4	0
4.—Binds* (fossils)	1	0

* Binds. A miner's term for tough shales or clays, but not very precise in its meaning.

	Feet	In.
5.—Green rock	6	0
6.—Rock binds	2	0
7.—Hard green rock (fossils)	7	6
8.—Strong rock binds (fossils)	2	6
9.—Hard binds	3	6
10.—Binds (fossils)	8	0
11.—Hard grey rock	2	6
12.—Rock binds	3	6
13.—Light coloured rock	1	6
Clay, with bands of ironstone, cement stones, shell bands, &c. Twenty-three hard beds ...	545	0
Bottom of Lower Lias clay	738	0

Of course from the above description it would be impossible to identify the various beds except by analogy in the sequence, and using this method, I should consider the various beds to be as follows:—(3) Cephalopoda-bed, (5) Lower Cephalopoda-bed or Fish-bed, (7) Rock-bed B, (11) Bed L. Comparing beds 7 to 11 in the above section with beds 4 to 8 in the Gayton one, a remarkable resemblance will be noticed in the thickness. If I have correctly indicated the beds 3 and 5, I cannot help thinking that their thicknesses are greatly exaggerated, and the intervening clay beds proportionately decreased. My chief reason for accepting the sequence of beds and doubting the figures, rests on the fact that, by permission of Mr. J. Eunson, C.E., F.G.S., I myself measured what I considered to be the same beds within a mile of the Kettering Road section, at the old Water-works well on the Billing Road, Northampton, and I found the beds to be as follows:—

	Feet	In.
1.—Hard bed, containing very many *ammonites*, large *nautili*, *&c.*	0	9
2.—Clay, containing *A. communis*, &c....	2	6
3.—Limestone, splits into slabs, with *A. communis*, *&c.* Did not certainly identify as Fish-bed ...	5 or 6in.	
4.—Clay	2	8
5.—Marlstone Rock-bed...		

With regard to the character of the Middle Lias eastward of Northampton we know at present very little. There is distinct evidence of the occurrence of the Rock-bed seventeen miles to the N.E. of Northampton, and equally clear evidence of the total absence of the Middle Lias near to Peterborough.

(To be continued.)

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 53.)

BAGINTON.—*Sir Wm. Bagot,* 1407, *with arms on jupon, and wf. Margt. (Whatton), in mantle (head restored), both with SS. collars, large. Haines.*

These fine effigies, which have been relaid and re-enamelled, and are now fixed upon the south wall of the chancel, are nearly 4ft. 10in. long. The knight, who is clad in mixed armour of mail and plate, wears upon his head a sharp-pointed helmet called a *bascinet*, the border of which is chased with a scroll-pattern. The sides of the head and neck are defended by the *camail* of chain mail, which was fastened by laces to the helmet, and had an opening for the face. Round the knight's neck is the collar of SS., of which little is known beyond the fact that it is a badge of the house of Lancaster, first granted by Henry IV. The body-armour is a *habergeon*, or short hauberk of chain-mail, the edge of which is seen below the *jupon*, which is a short, sleeveless garment fitting close to the body, escalloped at the lower edge, and made of velvet or silk. In the present instance the jupon is embroidered with the arms of Bagot: arg. a chev., gu., between three martlets sa.; a crescent for difference. The shoulders are covered with *epaulières* of five or six plates; the upper arms with *brassarts*, which are fastened by two straps; the elbows with *coutes*, and the forearms with *vambraces*. Upon his hands, which are upraised, the knight has gauntlets, the knuckles of which are armed with pointed projections called *gadlings*, used sometimes for offence. The thighs, knees, and legs of the effigy are encased respectively in plate armour, called *cuisses*, *genouillières* with plates below them, and *jambs* (which are fastened with straps). Gussets of mail are seen at the knees and insteps. Upon his feet, which rest upon a lion, the knight has pointed *sollerets* and rowelled spurs. An ornamental transverse belt surrounds his hips, and supports at his left side his sword, with its straight cross-guard, and at his right an *anelace*, *misericorde*, or dagger. The scabbards and hilts of these weapons are richly engraved.

At the knight's right side is his wife. Her head rests upon two cushions, the lower of which is plain, the upper being richly ornamented and tasselled, and set diamond-wise. The lady's hair is dressed in two large plaits which are kept in place, one on each side the face, by a narrow ornamented band, presumably of metal. Round her neck is a collar of SS. Her fur-lined mantle with its *fermailes*, the sideless dress and kirtle, are very similar to those of the lady at Astley (see above). In the present example, however, there is an ornamented belt encircling the kirtle. At the lady's feet are two lap-dogs with collars of bells.

An engraving of the brass with a mutilated inscription, and shields bearing the arms of the knight and lady, is given by Dugdale, who states that Sir Wm. Bagot was a knight of the shire in several of Richard II.'s Parliaments. At Bolingbroke's rebellion he remained faithful to Richard, with whom he was a favourite, and in consequence was imprisoned by the usurper, who, however, eventually set him at liberty and restored his lands, and, it would seem, decorated him with the collar of SS. It is said that Henry Bolingbroke slept at the castle of the Bagots at Baginton the night before his meeting with Thomas Mowbray, Duke of Norfolk, in the lists at Coventry. Readers of Shakespeare's "Richard II." will remember that Bagot is one of the characters in the play, and that the interrupted duel forms one of the chief scenes.

BARTON.—*Edm. Bury,* 1558, *and wife Elizabeth (Underhill)* . . . 1608, *(eff. lost) and* 3 *children. Haines.*

This brass has been sadly interfered with. The effigy of the lady is lost, and the plates which are left have been relaid in a new stone, without any regard to ordinary usage.

The remaining effigy is 1ft. 10in. high, and represents a civilian with closely cropped hair, moustache, and pointed beard. Round his neck is a ruff, and he wears a gown open in front and reaching to the feet. The sleeves of the gown reach nearly to the knees, but are mere strips depending from the shoulders. Beneath the gown is a short doublet buttoned to the chin and belted; its sleeves are moderately tight and have no cuffs. Trunk-hose, hose, and low shoes complete the costume. The figure is well drawn and in good preservation.

Opposite the effigy is a shield, 6½in. long, bearing the arms of Bury: Arg., on a chev., sa., three squirrels cracking nuts, ppr. [Kittermaster, Warw. Arms and Lineages, p. 16, puts the chev. between the squirrels]. Below this, to the left, is a plate 7½in. sq., engraved with the figures of two boys and a girl, the former dressed like the father; the latter has her hair brushed back under a Paris hood, and wears a ruff, and a dress with pointed stomacher, tight sleeves puffed at the shoulders, and a plain skirt projecting from the hips.

Beneath these plates is another, 2ft. 2in. by 1ft. 2in., bearing this inscription in Roman capitals:—

VNDER THIS STONE ARE BVRIED THE BODIES OF EDMVND BVRY AND | ELIZABETH HIS WIFE WHICH ELIZ: WAS THE 7 DAVGHTER OF ED | WARD VNDERHILL OF NEATHER ETINGTON IN THE COVNTIE OF | WARWICK ESQ: THE SAIDE EDMVND DECEASED THE 22 OF JANVARY | 1558. BVT THE SAIDE ELIZ: SVRVIVINGE THE SAIDE EDM: TOOKE TO | HIR SECONDE HVSBAND THOMAS TAWYER OF RAVNDIS IN THE COV̄ | TIE OF NORTHAMP: GENT. WHOM SHE ALSO OVERLIVED & THEN RE | TVRNINGE INTO WARWICKS: HIR NATIVE COVNTRIE & DESIRINGE AF | TER THIS LIFE ENDID TO HAVE HIR BODY LAIDE IN THE CHAN | CELL OF THE P̄ISH CHVRCH OF BARTON ON THE HEATH IN THE COVN | TIE OF WARW: AFORESAIDE W^TH^ THE BODY OF THE SAIDE EMVND (*sic*) HIR | FIRST HVSBAND CAVSED THIS STONE TO BE PREPARED ANO DN̄I | 1608 FOR A MEMORIAL OF THE SAIDE ELIZABETH. WILLIAM. | JOHN. MARGARET. | WHEN CHRIST WHICH IS OVR LIFE SHALL APPEARE THEN SHALL WE ALSO APPEARE W^TH^ HIM IN GLORY. COLL. 3. 4 |

William, John, and Margaret are the names of the three children represented above. As the brass was put down fifty years later than Edmund Bury's death, we may fairly presume that the costume represented is not *quite* that worn in 1558. (Compare Compton Verney, III.) To the right of the inscription is a shield 6½in. long, bearing the arms of UNDERHILL: Arg., a chev., sa., between three trefoils slipped, vert.

In the fourth line the engraver by mistake put Edward for Edmund, and has imperfectly corrected his error. There seems also to have been an erasure after the name Margaret. Dugdale in quoting this inscription gives "Sawyer" for Tawyer, and inserts "Edmund" in the fourth line from the end.

CHADSHUNT. I.—*William Askell, civilian*, 1613. *Mural. Nave.*

This brass is not mentioned by Haines. It consists of two plates set in a mural tablet 1ft. 9in. square, with a moulded border, and is over a pew on the south side of the nave. The upper plate is 1ft. 4in. by 5in., and bears this inscription:—

HERE LYETH THE BODY OF WILLIAM
ASKELL OF GEYDON GENT: WHO DE-
CEASED THE VI OF FEBRVARIE ANNO
DNI 1613. ÆTATIS SVÆ XLVIII.

Beneath this is a plate about 1ft. by 11½in., having its upper corners moulded off. Upon it is engraved the figure of a civilian, very similar to that at Barton described above. In the present instance the hair is longer, the sleeves of the gown a little shorter, and those of the doublet have cuffs. William Askell is kneeling on a tiled floor, his knees resting upon a tasselled cushion. Before him is a prayer desk or small table covered with a fringed cloth, upon which rests a book-desk bearing an open book. The present writer is indebted to the Rev. C. Francis, Rector of Tysoe, for information of the existence of this brass, a further account of which will be found in the "Midland Antiquary" of April, 1885.

II.—On the north side of the aisle, upon the floor, is a plate of brass, 1ft. 7½in. by 4½in., bearing this inscription:—

HEARE LYETH BVRYED THE BODY OF
THEOPHILVS WILKINS LATE OF GEADON
WHO DIED ON THE FIRST DAY OF AVGVST. 1613.

CHARLECOTE.—There were two brasses in this church, one in memory of John Marskre, chaplain, circ. 1500, the other to Edm. Wykham, gent., of the same date. I am informed by the Vicar of Charlecote that both these memorials disappeared at the rebuilding of the church in 1851, and that a search for them was unrewarded.

COLESHILL. I.—*Wm. Abell, Vicar,* 1500, *with chalice, small, chancel. Haines.*

This effigy is 13in. long; the plate bearing the inscr. is about 13in. × 3in. Wm. Abell is tonsured and clad in some of the Eucharistic vestments. These are:—(1) The *Amice,* an oblong piece of linen having an ornamental lappet, called an *apparel,* sewn on one of its long edges. It was worn round the neck and fastened by strings crossed upon the chest, and resembled a deep embroidered collar. (2) The *Chasuble,* an oval vestment with an aperture in the centre through which the head passed, the vestment falling over the shoulders before and behind. In the present instance the chasuble is plain, but it was not unfrequently ornamented back and front with a

Y-shaped orphrey. It was made of various materials and varied in colour with the festival or season of the Christian year. (3) The *Albe*, a white linen vestment like a cassock, but fuller, reaching to the feet, and with close-fitting sleeves. It was girded at the waist and generally ornamented with apparels on the upper side of the cuffs, and at the edge of the skirt in front. In the present instance it is plain. In addition to these vestments the celebrant at mass wore the *stole*, which resembles a long narrow scarf generally embroidered and fringed at the ends, and the *maniple*, which may be described as a miniature stole worn upon the left wrist. The chasuble, stole, and maniple would always be of the same colour. Wm. Abell is without the two last (compare the brass at Whitnash), and Haines considers this a mark of provincial production.

The priest holds a large chalice, over which is a wafer with the letters **ihs**.

The following is the inscription :—

> **Hic jacet dn̄s willm' abell quōdm vicari' isti' ecclie qui quidē dn̄s willm' obiit xviii° die mēs maye. āno dn̄i m d cui' aīe ppiciet' de' amē.**

Translation :—

Here lieth Sir William Abell formerly vicar of this church, which Sir William died the 18th day of the month of May, A.D. 1500; whose soul God pardon. Amen.

In inscriptions clergy who were non-graduates are called *dominus*; graduates are called *magister* (see Fuller, Church Hist., vi., 5, 10). This distinction will in future papers be suggested by translating *dominus* ' sir,' and *magister* ' master.'

There is an engraving of this effigy in the Imperial Dictionary, under the word " brasses."

II.—*Alice, dau. of Simon Digby, and w. of Robt. Clifton. Esq.*, 1506, *C. Haines.*

This figure is about 2ft. long, and is considered by Haines to be the work of a provincial artist. The lady wears the kennel-shaped head-dress, with long lappets; her dress is high in the neck, and has sleeves reaching to the knuckles. Round the waist is a loose belt, terminating in two rosette-like ornaments, probably of metal. From the belt depends a chain, to which is fastened a highly ornamental pendant of open metal-work, representing either a *pomander* to hold scent or preservatives against infection, or a receptacle for a heated metal ball for warming the hands. Dugdale gives an illustration of this brass, and supplies the following imperfect

inscription, which still runs round the edge of the tomb:—
"Of your charitie pray for the soule of | Alice Clifton late the wyffe of Robert Clifton, Esq. and daughter of Simon Digby Esq., wh: Alice | . . . | and the year of our Lord God MCCCCCVI. on whose soules Jhu have mercy. Amen."

From Dugdale we learn that Simon Digby, the father of Alice Clifton, first supported the House of York in the Wars of the Roses, and received considerable benefits in consequence. He afterwards "fought stoutly" for the House of Lancaster at Bosworth, and reaped a rich reward. He was Constable of the Tower in the reign of Henry VII., and acquired the Manor of Coleshill in that king's reign, after the execution of Sir Baldwyn Mountfort, the previous holder, who assisted Perkin Warbeck.

III.—*Sir John Fenton, L.B., Vicar, Official of Coventry,* 1566. *C. Haines.*

The influence of the Reformation will be noticed in the altered dress of this cleric, who is vested in a long Genevan preaching-gown with high collar and wide sleeves, beneath which the collar and cuffs of his cassock are visible. The priest wears long hair, and is not tonsured. He points with his right forefinger to a closed book inscribed with the words **verbū dei**, which he holds in his left hand.

At his feet is a plate 1ft. 5in. by 4½in. bearing this inscription:—

Here lieth the body of Syr John Fenton prest Bachelar of law sumtyme vicar of this church and Offishall of Coventree. Who deceassed the xvii daye of Maye 1566. Whose soule Jesus pardon. Amen

The title "Syr" should be noticed as an exception to Fuller's rule quoted above. The post-Reformation prayer for the dead will also be noticed.

In Latham's Dictionary this passage is quoted: "*Official* is that person to whom the cognizance of causes is committed by such as have ecclesiastical jurisdiction.—*Ayliffe, Parergon Juris Canonici.*"

The three brasses described above have been restored by Messrs. Waller.

IV.—*Inscription. Mary Milward,* 1651. C.

This inscription is not recorded by Haines. It is in very refined Gothic characters, and is engraved on strips of brass 4½in. wide set round a large flat stone.

Here lyeth the body of Mary Milward late wife to John Milward of Bradlnash in the county of Darby Esqr. who lived at Colshill Hall with the Right Honble the Lady Offaly of whom she was much regarded and died there Aug. 17. 1651.

V.—*Arms and Inscription. Richd. Beresford*, 1651. N.

Two plates, the upper one 1ft. 2in. by 11½in., bears the arms and crest of BERESFORD.

The lower plate, 1ft. 11in. by 10in., bears this inscr.:—

HERE LYETH INTERRED THE BODY OF RICHARD BERESFORD GENT. WHO TOOKE TO WIFE ALICE THE DAVGHTER OF THOMAS WILINGTON GENT. THEY WERE MARRIED 19 YEARES, AND HAD ISSVE 4 SONNES AND 4 DAVGHTERS. HE DEPARTED THIS LIFE THE 4TH OF SEPTEMBER 1651. AGED 87 YEARES.

(To be continued.)

Review.

British Zoophytes: An Introduction to the Hydroida, Actinozoa, and Polyzoa found in Great Britain, Ireland, and the Channel Islands. By ARTHUR S. PENNINGTON, F.L.S., F.R.M.S. London: L. Reeve and Co.

IN this book Mr. Pennington has produced a work intermediate between the monographs of such specialists as Hincks or the Hertwigs and the popular writings of the Rev. P. H. Gosse. On the other hand, whilst preserving the scientific accuracy of the former authors, and giving in a condensed form the latest and best results of modern research, he has also been able to invest technical details with some of the fascination of the latter. The book commences with a very interesting history of the investigations that have been made into the subject, from those of Ferranto Imperato in the year 1599, down to Dr. André's recent work, and then follows the general classification and distribution of species. Here it is gratifying to find that it is not external characteristics merely which have been described, but that the requirements of modern zoological science have been met by a good account of the typical internal anatomy, and even histology, of each of the three groups mentioned in the title. The classification followed is that of the well-known naturalist, the Rev. Thomas Hincks, but that of Professor Allman is also added. All known British species are described, and their various synonyms and habitats given; but, in addition, many interesting passages from the works of Gosse, Johnston, Ellis and others enliven what would otherwise be mere enumeration of dry facts. Thus we are told that Dr. Landsborough sent Dr. Johnston a specimen of *Lytocarpus myriophyllum* which "was got by a fisherman, adhering to his long lines, off Whiting Bay, Arran, who, being struck with its beauty, like a kindhearted man, took it home as a present to his wife, and she, being a person of similar taste, admired it as much as her husband had done. With all due care, therefore, she planted it in an old teapot filled with earth, and, watering it with fresh water every morning, she had the satisfaction of thinking that it grew a little larger under her judicious management!" The following anecdote, told by the author himself, is so delicious we must extract it. A Filey fisherman, seeing him take a specimen of *Antennularia ramosa* out of the dredge, observed that he "had had one of that kind, which stuck to his lines, growing in a plant pot out of doors, and that it had stood the winter very well!" There are twenty-four plates of illustrations which are of unequal merit. Those diagrammatic of the internal anatomy of the groups are as far as they go, clear and accurate, but many are on so small a scale as to afford but little aid in the identification of the species they represent. A good bibliography of the subject is given, and also a glossary of the technical terms used and indices of the popular and scientific names. The last contains "all the synonyms whose identity with present nomenclature has been established," and is full, and, as far as we have tested, accurate. With the exception mentioned as to some of the illustrations the book is exceedingly good, and well worthy of recommendation. A. B. B.

METEOROLOGICAL NOTES.—January, 1886.

Atmospheric pressure was very unsteady, and its changes both numerous and rapid. The highest point reached by the mercurial column was 30·149 inches, on the 12th, which is much below the maximum usually attained in January. The lowest reading was 28·988 inches, on the 18th. With the exception of the first three days the weather was generally cold, but not severe. Frost and thaw alternated in quick succession. The highest maxima, which occurred on the 1st, 2nd, or 3rd, were 55·0° at Henley-in-Arden, 51·3° at Hodsock, 51·0° at Loughborough, 50·0° at Coston Rectory, and 49·9° at Strelley. The lowest minima were 16·0° at Henley-in-Arden, on the 8th; 16·5° at Hodsock, 18·2° at Coston Rectory, 20·8° at Strelley, and 23·9° at Loughborough, on the 19th. On the grass, 10·9° at Hodsock, on the 25th; 13·5° at Strelley, on the 9th; and 19·6° at Loughborough, on the 7th. In the rays of the sun, 90·9° was recorded at Hodsock, on the 31st; 81·4° at Strelley, on the 2nd; and 79·2 at Loughborough, on the 30th. Snow, or rain, fell on 22 or 23 days, and the totals were generally in excess of the average for the month. The values were—at Henley-in-Arden, 3·50 inches; at Strelley, 3·41 inches; at Hodsock, 3·24 inches; at Loughborough, 2·80 inches; and at Coston Rectory, 2·63 inches. The total fall in the 24 hours did not, in any instance, reach half an inch. The wind freshened to a moderate gale, from S.S.W., on the evening of the 16th. Sunshine was rather above the average.

Wm. Berridge, F. R. Met. Soc.
12, Victoria Street, Loughborough.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—On February 2nd the ANNUAL MEETING was held at Mason College. The annual report showed that a small decrease had taken place in the number of members, which is now about 240; but that the work of the year had been carried on by the members in a very satisfactory manner. The treasurer's report showed an adverse balance of about £37, or, including a few outstanding debts, about the same position as at the last report. Mr. R. W. Chase was re-elected president; Professor W. Hillhouse and Mr. W. B. Grove vice-presidents; of the ex-presidents, Messrs. Hughes, Levick, Marshall, and Waller were also elected vice-presidents; Mr. C. Pumphrey, treasurer; Mr. W. B. Grove, librarian; Messrs. G. M. Iliff and H. Miller, curators; Messrs. J. Morley and W. H. Wilkinson, hon. secretaries; Messrs. Bagnall, Browett, France, Goode, Rabone, and Udall were elected as the committee. The meeting was then adjourned to receive the retiring president's address at a future date.— BIOLOGICAL SECTION.—February 9th. Mr. W. P. Marshall in the chair. Mr. W. P. Marshall was elected president and Mr. J. E. Bagnall secretary of the section for the ensuing session. Mr. W. H. Wilkinson exhibited a moss, *Neckera crispa*, from Italy. Mr. J. E. Bagnall, a series of brambles, from the United States and for Mr. J. B. Stone, J.P., a large collection of plants, from the Pacific Slopes and Vermont, U.S., giving also notes on the physical features of the country, and the geographical distribution of the various species. These represented the natural orders: Ranunculaceæ, Berberidaceæ, Papaveraceæ, and Fumariaceæ.—GENERAL MEETING, February 16th. Prof. W. Hillhouse, M.A., in the chair.—The Chairman exhibited the following high power objectives: one-twelfth oil immersion lens, by Leitz, of Wetzlar; one-sixteenth glycerine immersion lens, by Parkes and Son, Birmingham; one-twentieth glycerine immersion lens, by Parkes and Son, Birmingham; illustrating their powers by various test objects. Mr. W. R. Hughes, F.L.S., exhibited on behalf of Mr. F. W. Sharpus, of London, slides of *Platessa flesus*, the common plaice; *Cyclopterus lumpus*, the lump sucker; *Pycnogonum littorale*, *Palinurus quadricornis*, *Hyas araneus*, and Odontophore of *Littorina littorea*. These specimens were all mounted in Canada balsam, the delicate staining of the two first showing the internal structure most exquisitely. Mr. Hughes pointed out that *Platessa* and *Cyclopterus* among the fishes, and *Palinurus* among the crustacea, exhibit most interesting phases of embryological development. Mr. T. Bolton exhibited *Floscularia calva*, a new floscule discovered the year before last at Dundee, and now found by Mr. Bolton, near Kingswood. Mr. T. Bolton then read his paper on the "Enumeration of specimens of organic life, both animal and vegetable, found in a swampy ditch in Sutton Park." The list included a number of species never found before in Great Britain. The paper will be printed in the "Midland Naturalist."—SOCIOLOGICAL SECTION. Thursday evening, W. H. France read the XI. Chapter of Mr. Herbert Spencer's "Study of Sociology" on "The Political Bias." Mr. W. R. Hughes, F.L.S., President of the Section, Mr. F. I. Cullis, Mr. A. Browett, Hon. Sec., and others taking part in the discussion which ensued.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—January 18th. Mr. J. Madison exhibited a small collection of marine shells; Mr. Tylar, a series of photographic negatives of microscopic objects; Mr. Hawkes the following fungi:—*Polyporus versicolor*, *Nectria coccinea*, *Stereum purpureum*, and *Nectria cinnabarina*. Under the microscope, Mr. Hawkes exhibited some preparations of the latter fungus, and described, with the aid of highly magnified drawings of the conidia and sporidia, its two modes of fruiting, one of which was formerly believed to be a different fungus and was known as *Tubercularia vulgaris*. Mr. Rodgers read a paper on "The Star Sirius," in which he described its enormous magnitude when compared with our sun, and that it usually gave a white light, though frequently appearing coloured. The ideas of the ancients respecting it were considered, and the frequency of its mention in their myths. Modern researches show that Sirius is not the nearest star, as was at one time thought. The writer also described the annual displacement of this star, its spectrum, its motion through space, circling around another orb, the search for and supposed finding of this orb, shining with a faint light, and concluded by saying that Sirius, from its size and rank, well merited the title of the "Giant Sun."—January 25th. A lime-light exhibition was given by Mr. C. Pumphrey, of a large number of photographic views of Canadian and American scenery taken by himself during a recent visit to those countries. The views were of a varied kind, and comprised many of a most interesting character of the Yellowstone Park, with its hot springs and geysers and the peculiar rocky deposits formed by them, and also of the Yellowstone River, that showed the same rocks in section. At the conclusion a hearty vote of thanks was accorded to Mr. Pumphrey for his kindness.—February 1st. Mr. Hawkes exhibited a geometric slide for the magic lantern, and explained the principle by which various designs could be drawn, also a lichen, *Cenomyces deformis*; Mr. Dunn, a number of insects from Calcutta. Under the microscope, Mr. Hawkes showed a series of slides of sections of buds from various trees, some through the immature flowers, and drawings and specimens illustrating the same. Mr. P. T. Deakin read a paper on "Oology as a study," describing the period of the nidification of birds as a most interesting one. A collection of eggs should not be large, two of each species being amply sufficient, with a few varieties. Several classes of birds were referred to where the eggs bore a strong family likeness, but local differences were sometimes found difficult to account for. The paper dealt with the colour of eggs and gave reasons for them, and concluded by referring to the ancient ancestry of birds, their embryology, and some ways in which evolution had favoured them. A collection of eggs was exhibited.—February 8th. The President, Mr. C. Beale, C.E., delivered a lecture on "What is around us." The extensive view from the summit of Sedgley Beacon was described, and the fossils of its lower beds passed in brief review. The surface layers resting on the topmost members of the Silurian caused us to ask "Where is the carboniferous limestone?" The absent beds were described at some length, as being of enormous extent, amounting in all to 19,000 feet between our local development of the Silurian and Carboniferous systems. The fossils of each were referred to as indexes of climate and the upward march of organisms. The true coal was mostly laid down in fresh water. The vast accumulation of vegetable matter composing our 10 yard seam was computed to have taken not less than 250,000 years. The lecturer concluded by describing the intrusive rocks of the district, and how the everlasting see-saw of land and water had left, and was still leaving, its marks upon the earth.—February 15th. Mr. Hawkes exhibited, under the microscope, Gemmæ and Protonema of moss, *Aulacomnion androgynum*. Mr. J. W. Neville, section of cement-stein from Isle of Fur, Denmark, showing *Trinacria excavata* and other diatoms in *situ*. Mr. Tylar, gemmules of *Spongilla fluviatilis*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. Section D, Zoology and Botany. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, February 17th. Attendance twelve (three ladies.) The following objects were exhibited, viz.:—By Miss Shenton, coloured drawings of Leicestershire fungi, *Morchella*, *Clavaria*, *Geoglossum*, &c., very delicately executed; and a collection of dried plants from the Black Forest. By Mr. W. A. Vice, fresh specimens of Leicestershire fungi, *Daedalea*, *Sphæria*, &c. By Mr. F. Bates, the first number of the new work by Dr. Hudson, on "The Rotifera," with coloured plates, to be completed in six numbers, at 10s. 6d. each. Mr. E. F. Cooper, F.L.S., called attention to a recent article in the *Daily News*, referring to the possibility of driving out an injurious Bacterium from the human body by the introduction of an innocuous and more vigorous one. Dr. Tomkins said in reply that there was not at present sufficient evidence of the truth of the statements contained in the *Daily News*. Several microscopes were set up fitted with cameras of different forms, and experiments were made in microscopic drawing. Dr. Tomkins remarked that photography was now superseding hand-drawing of microscopic objects. Photographic apparatus for the purpose could be bought for about 30s., exclusive of developing apparatus.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—January 22nd. Geological Section.—Chairman, Mr. E. Wheeler. Six members present.—Chap. VII. of Lyell's "Student's Elements" was read and considered. The Chairman read a portion of Darwin's theory of Atoll formations from the "Voyage of the Beagle"—the remaining part to be read at the next meeting.—January 29th. Botanical Section.—Chairman, Mr. J. W. Bodger. Nine persons present.—The Chairman gave an address on "The Root or descending axis of Plants," dividing it into true or primary and adventitious or secondary, explaining and illustrating the terms pileorhiza, coleorhiza, exorhizal, endorhizal, and heterohizal; the mode of growth of the chief kinds of roots, giving illustrations of fibrous, coralline, tuberculated, palmate, fasciculated, nodulose, annular, moniliform; and the modifications of taproots, as conical, fusiform, napiform, placentiform, contorted, and premorse.—February 5th. Geological Section.—Chairman, Mr. E. Wheeler. Six persons present. —The Chairman concluded a reading from Darwin's "Voyage of the Beagle," relating to the formation of coral islands.—February 12th. Botanical Section.—Chairman, Mr. J. W. Bodger. Nine persons present.—The Chairman gave an address on "The Stem or ascending axis of Plants," explaining and illustrating the structure of exogenous, endogenous, and acrogenous stems, the terms nodes, internodes, cicatrix, &c.; adventitious shoots, exhibiting ferns with young plants growing upon older fronds, as examples of the latter; also bulbils in the axils of the leaves of a begonia, and in the inflorescence of *Allium vineale*, and various forms of stems, together with species of Labiates with decussate leaves and quadrangular stems.

NOTES ON THE ANKER VALLEY AND ITS FLORA.

BY JAMES E. BAGNALL, A.L.S.

(Concluded from page 73.)

In the Anker Valley proper there are 661 flowering plants and twenty-two ferns and fern allies. In the Sence Valley, which forms part of the catchment basin of the Anker, Mr. F. T. Mott records 650 species, of which 120 have not at present been recorded from the Anker Valley proper, so that the total flora of the Anker basin will be 803 flowering plants, ferns, and fern allies.

CLASSES OF CITIZENSHIP.—These have been very ably defined by Mr. Hewett C. Watson in the "Compendium of the Cybele Britannica." *Native.* "Apparently an aboriginal British species, there being little or no reason for supposing it to have been first introduced into this island by human agency," as examples, *Corylus*, *Calluna*, *Bellis*, *Butomus*. *Denizen.* "Apparently wild, but liable to suspicion of having been introduced by human agency, whether by design or by accident," as examples, *Chelidonium*, *Vinca*, *Ægopodium*. *Colonist.* "A weed of cultivated land, or by roadsides, and seldom found except where cultivation exists," as *Ranunculus arvensis*, *Anthemis Cotula*, *Alopecurus agrestis*. *Alien* species are those certainly or very probably of foreign origin, as *Acer Pseudo-platanus*, *Sedum reflexum*, *Populus nigra*. *Casual* species are chance stragglers from cultivation, such as are found on waste heaps, railway embankments, and sometimes in cultivated fields, as *Trifolium hybridum*, *Medicago sativa*, *Melilotus arvensis*.

The 803 plants are divided as follows :—

Natives	724
Denizens	37
Colonists	25
Aliens or Casuals	17
	803

TYPES OF DISTRIBUTION.—In making out the types of distribution of the plants found in the Anker Valley, I have again had recourse to Mr. Watson's able work, in which he gives six leading types of distribution, which may be briefly shown thus :—

1. British type.—Species widely spread through S. M. N. Britain.
2. English type.—Species chiefly seen in S. or S.M. Britain.
3. Scottish type.—Species chiefly seen in N. or N.M. Britain.

Intermediate type.—Species chiefly seen in Mid Britain.

4. Highland type.—Species chiefly seen about mountains.
5. Germanic type.—Species chiefly seen in East Britain.
6. Atlantic type.—Species chiefly seen in West Britain.

Of these only four of the types are represented in the district, and as it will better illustrate the nature of the Anker flora, I shall give both the flora of that valley and that of the 120 Sence Valley plants separately. They will be as follows :—

	British.	English.	Scottish.	Intermediate.	Germanic.	Total.
Anker..	423	165	4	1	4	597
Sence..	50	53	1	0	2	106
	473	218	5	1	6	703

The remaining 100 are either varieties, aliens, or casuals not classified by Watson.

It may be interesting to compare the flora of the Anker with that of another Warwickshire River, the Blythe, and with that of Britain as a whole.

The Blythe, which rises near Earlswood, on the Worcestershire side of the county, is for a considerable part of its course an insignificant stream, and its course from its source to its confluence with the Tame, near Hams Hall, is about twenty-three miles. The district drained by it is strictly agricultural. The woods are usually small but fairly abundant, and the district as a whole is flat, but having many minor streams is well watered. The prevailing rocks are those of the New Red Sandstone. In this district I find 825 flowering plants and ferns, or about 142 more than in the Warwickshire portion of the Anker basin, and twenty-three more than in that of the Anker basin as a whole.

The following table will show the distribution of native plants throughout Great Britain, and the relative distribution in the valleys of the Anker and Blythe :—

Types.	Britain.	Anker.	Blythe.
British	532	423	510
English	409	165	194
Germanic	127	4	6
Atlantic	70	0	2
Scottish	81	4	9
Highland	120	0	0
Intermediate	37	1	3
Local	49	0	0
	1425	597	724

So that it will be seen that whilst the Blythe basin yields one half the British native flora, that of the Anker only yields a little more than one-third the British flora; and I find that there are 180 species occurring in the Blythe basin that have not as yet been given for that of the Anker, and thirty-nine species occurring in the Anker not yet found in the Blythe.

The moss flora of the Anker basin is not so rich as I had anticipated, my total records being 162 species representing forty-four genera. Still there are many noticeable mosses in the district; such for instance as *Scleropodium cæspitosum*, *Tortula latifolia*, and *Leskea polycarpa*, which are usually rare in North Warwickshire, but are abundant in the Anker district, more especially near Shuttington and Mancetter. *Bryum murale* and *Encalypta streptocarpa* occur in solitary stations near Caldecote. *Didymodon flexifolius*, which I had not previously seen in the county, occurs in abundance on a hilly heath near Atherstone, and *D. luridus*, also new as a record for the county, near Weddington and Grendon. *Fontinalis antipyretica* was abundantly in fruit in a most unlikely-looking pool near Weddington Wood. This is usually a local moss with us, and had not before been found in the fruiting condition in Warwickshire. The influence of the smoky atmosphere seems to make itself manifest in the absence or rarity of tree-loving mosses, such as the *Orthotrichums*, so that one has to walk a distance from the coal district before one spots any trees having such tenants; near Wolvey, however, *Orthotrichum affine* and *O. diaphanum* occur in slight quantity; *O. Lyellii*, *Leucodon sciuroides*, *Zygodon viridissimus*, and *Tortula lævipila* very rarely, and in single stations near Wolvey and Anker Bridge. *Dicranum montanum* and *Ulota intermedia*, in Bentley Park; and on marly banks in Bentley Park *Dicranum majus*, in the barren condition. Stone walls and fences are abundant in the district, but in the smoky parts the mosses are poor and depauperised examples, usually blackened tufts of *Grimmia pulvinata*, *Tortula muralis*, *Bryum cæspiticium*, and the ubiquitous *Ceratodon purpureus*. Marsh-loving mosses, such as the *Sphagnums*, *Aulacomnion*, and the *aduncum* group of *Hypnum* are poorly represented. *Sphagnum fimbriatum*, *S. cymbifolium*, *S. auriculatum*, and *S. contortum* are thinly represented in Bentley Park and on Baddesley Common; *S. acutifolium* and *S. squarrosum*, in a pool near Seckington; *Aulacomnion palustre* and *Hypnum aduncum* on Baddesley Common; but *Leucobryum glaucum*, which I expected to find abundantly, is apparently absent from the district. The most noticeable of the mosses from this district, however, is *Eurhynchium Teesdalii*, of which I found a solitary patch on a stone in the little stream that runs through Bentley Park. The most prevalent moss of all the watery situations is *Hypnum cuspidatum*, which seems to prevail everywhere, and would, I believe, grow in Styx itself.

In conclusion I may say that although the district has a less rich flora than I had anticipated, I do not regret having given it so much attention, for if the investigation has given me little I did not before possess, it has afforded me many pleasant rambles and many happy hours.

Erratum.—In the "Midland Naturalist" for February, page 57, line 6, for "Austrey" read "Ansley."

ON THE OCCURRENCE OF FOSSILIFEROUS HÆMATITE NODULES IN THE PERMIAN BRECCIAS IN LEICESTERSHIRE,

TOGETHER WITH SOME ACCOUNT OF THEIR ECONOMIC VALUE, &c.

BY W. S. GRESLEY, F.G.S.

(Continued from page 69.)

Whilst preparing this notice, the author had occasion to examine some fire-clay workings in the neighbourhood (at Swadlincote), where the clay beds and overlying strata are well exposed in an open-cast working in the side of a hill. The lower part of the "baring" (the strata overlying the clay beds in an open-hole working of this kind) consists of argillaceous shale of the coal measures (usually of a blue-grey colour at other places where the same clays are worked in the district), of a blotched, variegated, or mottled appearance; the colour of the blotches and bands being purple and red. Now this shale contains very numerous nodules of red hæmatite of a rather soft and jointy nature; round, oblong, disc, and kidney-shaped; and they peel off very much on the outside. On removing several of these nodules from their beds, I observed that the red stains on the surrounding shale lay very much more closely together than further away from the nodules, and that a regular banded or series of concentric zones or contours of red lines were often seen to run round or exist in proximity to the hæmatite. These nodules are chiefly septarian in structure, are thus nearly solid, and often furnish compact steel-like ore, displaying parallel zones of concretionary structure. Some of them exhibit many varieties of stages between clay ironstone, limonite, and red hæmatite, in layers around a central nucleus. Fibrous ore is sometimes seen lining small cavities in the nodules, and as we should expect, "box-stone," "eyed" and other concretionary forms are present. The red beds above this shale undoubtedly furnished the colouring matter in the latter, and has so far affected the nodules of ironstones in it as to change them into a kind of hæmatite. I maintain that the process of variegating the shale and forming this hæmatite affords us an interesting case of pseudomorphism or replacement which has taken place *in situ*, in the very manner I think that they must have done in the Permian breccias (though the conditions then were different) and in the very neighbourhood of the hæmatites; in fact, specimens of this Permian ore occur in the breccia of this Swadlincote section.

VERTICAL SECTION OF ROCKS AT SWADLINCOTE, NEAR BURTON-ON-TRENT.

		Feet	In
	Surface soil and clay	3	0
	Sand, sandstone, and pebbles	2	6
Permian.	Light yellow sandstone	2	3
	Breccia—in two beds—containing fragments of hæmatite, &c.	4	0
	Red marl	4	0
	Yellow sandstone	3	0
Coal measures.	Mottled marl or "bind" crowded with nodules and thin bands of red hæmatite (often septarian)	8	0
	Dark "bind" with nodules of hæmatite towards top	7	0
	Coal	1	0
	Fire-clay, called "marl"	3	6
	Do. best quality	4	6
	"Bottle" clay (fire-clay)	7	0
	Coal	2	0
	Fire-clay	2	6
	About ...	54	3

The Permian series rest unconformably upon the Coal-measures.

I have obtained fossils (*Terebratulæ*, *Natica*, *Orthis*, &c.) in the red nodules above referred to, but I have not found any of these Swadlincote nodules to possess polarity; but that the clay-band ironstones of the coal measures do sometimes display this property is certain, from the fact that the author in 1874 picked from a large heap of "stone" on one of the pit-heaps at Hanley, Staffordshire, called the "New Mine" ironstone, a specimen, containing a beautiful bit of a *lepidodendron*, which he subsequently found to possess poles, sufficiently strongly magnetic to cause the specimen to point north and south when freely suspended and clear of attraction by iron.

In attempting to account for the extreme hardness and compactness of the ore, it would appear that the original carbonates were capable of combining with or taking up a very large quantity of ferric oxide without any increase in size, that this chemical change was accompanied by a re-arrangement of the particles, and I may suggest that possibly electricity had something to do with it, though I am very sceptical on this point. It seems difficult to resist the conclusion, that in the case of the hæmatite nodules of nearly chemical purity, the carbonates from which they have been derived must have been themselves of great purity. The coarser stones,—those presenting a gritty, flinty, and porphyritic appearance—I look upon as probably the only remaining fragments, other than the hæmatite, of the denuded coal measures contributing to form the breccias. The rest of the strata—the coals, clays, shales, and softer beds,—only exist in the Permians in the shape of coarse gravelly sediment, mud, and perhaps a few broken lumps which may have escaped destruction.

It may be said by some that if the pseudomorphic process in clay-ironstones can be proved to have taken place *in situ* in the coal-measures, as in the above-mentioned instance, why may not these hæmatite nodules have been formed in those rocks long before they became turned out and re-deposited in the Permians? My answer is that we know of no rocks from which the iron could produce the pseudomorphic action in the underlying coal measures ever having been formed in the upper coal series, or before the Permian period set in. I believe our British coal-beds, where found of a red colour (known as "red rocks"), are held to have become this colour by iron-staining from newer rocks.* This reddening or blotching is due no doubt to the oxidation of the iron in the rocks, and the colouring is naturally most intense in rocks like clay-ironstone, which contain a large amount of iron.

It is evident that the above-described features and properties possessed by the hæmatite nodules are facts which harmonise singularly well with the theory of pseudomorphism, while they are much less reconcilable with that of sublimation or the cave or fissure-formed deposits. This conclusion, namely, that the ore is of Permian age, is supported by the fact that many of the largest and richest

* The instance of the Froghall hæmatite deposits in the lower coal-series is of course an exception.

deposits of hæmatite in the British Isles have been shown by geologists in all probability to belong to that age:—for instance, the Cumberland and North Lancashire ores, deposits at Llantrissant, &c., in Glamorganshire, &c. With regard to the determination of the locality whence the hæmatite was derived, I believe it is generally supposed that the boulders, &c., in the Permian rocks of the district in question came from the west.

It is right to mention that specimens of hard, compact hæmatite are now and then to be met with along with the nodules from the breccia, which have all the appearance of veinstone, such as might very well be derived from the Carboniferous or Mountain Limestone—the commonest home of hæmatite. But specimens of this or of any other limestone in the breccia are conspicuous by their absence, and I myself am not inclined to think that veinstone ore really exists in this formation. I look upon such specimens as merely angular fragments of compact sedimentary nodules, whose smooth rounded outline does not appear in the fragments, as they are broken out of the interior of them.

Having endeavoured to show why I consider the pseudomorphic theory to be the correct reading of these stones,* I pass on to notice very briefly

5.—The uses in the arts and manufactures to which the hæmatite is put; its value; and how obtained.

As burnishers (bloodstone burnishers) these particular stones are principally if not solely employed. Those that are of any real value are the fragments and nodules the most compact, the toughest, and those of a bluish tint. The very best burnishers are made from the "red-barked" specimens (see Figs. 2 and 6, plate I.), or those coated with a thin layer of bright red powdery ore (anhydrous sesqui-oxide of iron). To prepare them for use they are cut and roughly polished up into a variety of shapes according to the purpose for which they are wanted, and fitted into short handles. Quantities of them are used by porcelain manufacturers to burnish the gold after the ware comes from the kiln. Bookbinders, gilders, metal-plate-workers and the like employ them for

* Since writing this article I have thought that it is *possible*, I do not say *probable*, that the formation of the hæmatite may be accounted for in a third way, namely:—That the clay-ironstone nodules and their associated rock-fragments were subjected to *a heated chemical solution within an open fissure or fissures*, into which they had been drifted or thrown, which was sufficiently prolonged to render the alteration of the mineral matters more or less complete.—W. S. G.

getting their things up bright; though I understand that the grey agates and burnishers of steel have in late years taken the place of the hæmatite ones, owing to the former being less expensive; still, for certain purposes, the latter are found to be indispensable.

Whether any "ironstone jewellery" is made from these particular hæmatites I cannot say. English ores, I believe, are shipped to Germany, where they are cut by water-power, and sent back to England and sold by our jewellers under this name. At any rate this nodular ore is equal in quality and brilliancy to that which I have seen in the shops in Hamburg, London, and elsewhere. The ore is made up into lockets, seals, scarf-pins, ear-rings, and so forth. The value of the stones described in this notice depends of course upon size and soundness; a faultless lump weighing say from 12 to 15 ounces is worth from 15s. to 20s., but such as these are exceedingly rare; 2 ounce pieces are about the average, and are worth from 9d. to 1s. 6d. wholesale price.

With reference to the production of burnishers in the rough, years ago they were obtained in large quantities by systematic working—by underground mining and in open-casts. These workings were chiefly, if not entirely, carried on at Measham, in Derbyshire, which village is built upon the Permian beds. The *modus operandi* was somewhat as follows:—The site for the pits, &c., having been fixed, the ground was first marked out in plots of one hundred square yards each, for which a rent or royalty of £10 was paid to the landlord—equal to £484 per acre. Shallow pits, termed "wallow pits," were sunk to the burnisher-bearing bed. This occurred at from 10ft. to 20ft. deep, and usually about 12in. in thickness. The ground was then "pottered out" (excavated) all round the pit, the hæmatite being carefully picked out and the debris cast aside. One pit being exhausted of burnishers, another was put down beside it, the old one being filled up, and so on until the entire area was cleared. The stones were also obtained in the open-working system, and often occurred in patches or clusters rather than spread evenly through the mass. I cannot state what the yield per acre was, but that the business at one time was a very paying one is a fact. The selling price would be at the rate of between £100 and £200 per ton, but the stones were sold according to size and quality rather than by weight. Numbers of them have been picked from the beds of the streams in Measham, Packington, and Willesley. Also some valuable ones were formerly obtained clandestinely by men who went and grubbed them out of the ditches, &c., by night, with the aid of candles, &c. The burnisher-miner, or rather hunter, carried a small hand-hammer about with him with which he tested every ore pebble for soundness as he proceeded with his work. The grinding and getting-up of the stones for the trade was and is still carried on at Measham; the process being for many years kept very secret, a single individual having the monopoly of the business. At the Great Exhibition of 1851 this man obtained a prize for bloodstone burnishers.

6.—In concluding this paper I wish to draw the reader's particular attention to the following points above referred to, as I think they deserve in some respects a closer investigation than it has been possible for me to give them:—

1st.—It must be from a carefully conducted examination of the hæmatite, and especially of the associated rock fragments in the Permian breccia, that the locality or localities whence they were derived can be fixed. This is an important question for solution.*

2nd.—Our enquiries result in showing that a metallic mineral of very high qualities and of great purity is not necessarily devoid of fossils, or conversely that coal-measure fossils do not necessarily occur only in rocks composing those measures.

3rd.—That the coal measures have indirectly furnished us with a class of ore, the peculiar properties of which make it of special commercial value.

4th.—That external appearances in regard to these nodules, as in many other things, goes for very little, the water-worn aspect of them being very deceptive.

5th.—These stones afford an almost unique example of the process of pseudomorphism, or of the extent to which chemical action has gone on within a rock bed or a contained rock fragment, an instance, I take it, of actual movement of inorganic matter having taken place within a stratum or rock mass at rest, an instance also of the growth of a mineral in weight and in density though not in bulk. The whole series of stones afford us a very instructive example of the way in which a mineral, or rather a combination of minerals, pass by imperceptible gradations from the most earthy stage to a metallic mineral of nearly chemical purity.

* Since this article was written the author has been engaged in the collection of a series of these rock-fragments, a microscopic examination of which has been kindly made by Prof. Bonney, F.R.S., and he reports to me that he has detected fragments of rocks in them which he believes do not occur above ground anywhere in the country. We are still working at these most interesting fragments.—W. S. G.

6th.—The agate-like specimens are a study in themselves, and afford one of the most interesting examples it is possible to have of the delicately beautiful processes of mineralogical construction.

7th.—The magnetic properties displayed are not unworthy of investigation.

8th.—The author having had the good fortune to discover in these hæmatite fragments the remains of some exceedingly rare organic fossil remains (Arthropoda) hitherto almost unknown* in the district, it should stimulate us to still further work amongst them.

9th.—Certain of these specimens probably possess as interesting a history, and would furnish enquiring minds with subjects for almost endless investigation as valuable in a mineralogical point of view as any it would almost anywhere be possible to obtain. In other words, I maintain that the number of points or characteristics possessed by the "pebbles," viz.:—Origin,—removal at close of the Carboniferous period,—treatment in Permian times,—re-deposition,—chemical change,—magnetic properties,—concretionary agate-like and other structure,—striæ, and other super-induced features,—organic remains,—variety of structure, fracture, colour, &c.,—occurrence in the alluvium,—value,—and so on,—is probably as great and as varied as it would be the lot of few to study in any other geological specimens.

Lastly.—The author is indebted to several geologists and others who have kindly furnished him with ideas and information, enabling him to work out, so far as has been possible, the probable history of these burnishing pebbles.

A List of the Fossil Plant, &c., Remains Discovered in the Hæmatite Nodules of the Permian Breccia of Leicestershire.

Flora :—

Neuropteris subfalcata ?
N. gigantea.
N. tenuifolia ?
N. (possibly of three other species).
Pecopteris.
Asterophyllites foliosa ?
A. equisetiformis ?
Lepidodendron obovatum (leaf-scar of).
L. clypeatum ? (leaf-scars of).
L. (a third variety of leaf-scar).

* See Hull's "Leicestershire Coal Field," p. 26; and Molyneux' "Burton-on-Trent," p. 263.

Lepidophyllum ?
Lepidostrobus (macrospores of).
Sphenophyllum ?
Rhacophyllum ?
Trigonocarpum olivæforme ?
Sphenopteris ?
Cordiates.
Pseudopecopteris nervosa ?
Calamites cannæformis ?
Halonia ? (a tubercle of ?)
Odontopteris.
Tree-fern stalks ?
Seed-vessels ? (a group of).
Lycopodites vanuxemii ? Dawson.
Rootlet of Stigmaria ficoides ?
Fungus ? (two species).

Fauna :—

Anthracosia æquilinus ?
A. (another species).
Anthracoptera ?
Lingula ?
Rhynchonella ? R. Etheridge.
Entomostraca ?
Arthropoda (leg of an insect), H. Woodward.
A. (probably parts of two legs of a small scorpion-like form).
Fish bones ?
Worm castings of various dimensions.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Exposition of Part III. Chapter V.

BY DR. WILLIAM L. HIEPE.

The first remarkable fact that arrests our attention in the study of embryology is expressed by Von Baer in the following words:—"In its earliest stage every organism has the greatest number of characters in common with all other organisms in their earliest stages; at a stage somewhat later its structure is like the structures displayed at corresponding phases by a less extensive multitude of organisms; at each subsequent stage traits are acquired which successively distinguish the developing embryo from groups of embryos that it previously resembled, thus step by step diminishing the class of embryos which it still resembles; and thus the class of similar forms is finally narrowed to the species of which it is a member." But these resemblances are only general, and not special; for example, it would be wrong to say that the human embryo at any stage specially resembled a fish, but certainly it passes through certain stages during which it possesses more general characters which are also possessed by fishes and which it loses during its advance towards maturity. Examples of passing general resemblances to other classes could be easily found. But in many cases there are irregularities, and the embryo, instead of advancing to a likeness of a higher type, seems to be stationary, or even retrograding. But if we assume this development through stages to have some connection with the stages through which the ancestral races of the species have passed, we see clearly that it must be so, as the modification of organic forms is irregular and does not always imply a progress to higher forms. As we found that from the relations of languages we derived some good illustration of the facts of classification, it appeared to me interesting to try if the facts of embryology could be supported by ethnological facts. The development of an embryo is evidently analogous to the development of speech in an infant. Now it struck me as remarkable that in nearly all European languages the first words which an infant learns, those expressive of the names of the parents, "Papa," and "Mamma," are very much alike, even if the words for father and mother are different. And besides this we find that when children first learn to speak they do not form their sentences grammatically, but put the words together without any inflections. We find the same mere combining of words now in some Eastern languages, and it may have been the characteristic of some common ancestral language.

The next fact which we have to consider is the substitution and suppression of organs. In some cases the embryo, during some period of its development, possesses organs which the mature form does not possess; they are either reabsorbed, or their function is changed so that they discharge a different function in the mature stage. Sometimes they are only partly absorbed, and then form, in the mature animal, rudimentary organs. As an example, Mr. Spencer quotes the case of the development of an allantois in the mammalian embryo. This allantois is homologous to the breathing apparatus of birds and reptiles during their last embryonic stage. But in the embryo of the mammal it serves no such purpose; it is either reabsorbed, as in the implacental mammals, or it becomes placental—that is, it serves as a connection between the embryo and the parent animal for the admission of nutritive matter.

The development by different stages is called indirect development. But in some cases the germ forms itself almost directly into the form of the mature organism; such development is called direct. Direct development is found among the spiders, some gastropods, and most of the lowest classes of animals, while the indirect development characterises the higher classes. On the theory of evolution the development of each organ must be a sort of condensed repetition of the development of that organ in the ancestral races, and must therefore be indirect originally. The direct method must therefore have been substituted for the indirect one wherever it occurs. To find the reason of this substitution, Mr. Spencer compares the embryonic development with the formation of social agencies. He shows that now such agencies as colonies, towns, mercantile associations, &c., are formed directly, while formerly they were formed indirectly and by degrees. The reason is that such agencies having been long established or being very prevalent, people's ideas have become changed, and they at once arrange themselves according to a finished plan instead of going through all the stages of development. In like manner we can explain the substitution of direct for indirect development; as each organism consists of physiological units, these must be altered by external forces acting on and modifying the whole organism.

If these external forces cease to act, no modifications will take place, and a complete harmony between the action and re-action of the organism and its units will be established in time—that is, the units will be so modified as to shape themselves at once into the form of the organ or organism, and we have direct development; but continued action of external forces will prevent this harmony being established, and each modification of the organism, causing a modification in the units, will be inherited and reproduced during the development of the individual. From this we conclude that we ought to find development direct where the conditions have been most constant, and indirect where the modifications through which an organism has passed during its evolution from its ancestors have been numerous and great. This is what we find, as the low types which possess direct development show by their inferiority that since their first production they have not undergone many changes. We have here also an explanation of the fact that the heart and other internal organs are more directly developed than the external organs, which are most exposed to the modifying actions of external forces. Thus all the remarkable facts of embryology are brought into harmony with the principles of the theory of evolution.

Chapter VI.

If we turn from the organisms in the stage of development to those which have already arrived at the stage of maturity, we find that sub-groups belonging to the same group as a rule are similar in their structure. Let us take the vertebrate animals as an example; there are the mammals, the birds, reptiles, fishes, and amphibia, all with the same structure of the vertebral column, ribs, and four limbs. The latter are not always directly recognisable, and in some cases are entirely wanting, but as a rule we can trace their rudiments or homologous structures. In the class insecta, which Mr. Spencer quotes, there is the uniform structure of twenty segments, which is also present in the crustaceans. Here the case is still more remarkable, as the number is always the same. Although sometimes they are difficult to make out, several segments having apparently united to form one, their presence can always be demonstrated. There are numerous similar examples in the animal and vegetable kingdoms.

Now, it is evidently absurd to suppose that such facts are the result of design of the Creator, or of chance, or of necessity; but if we assume that the present organic forms have arisen by modification and divergence from common ancestral stocks, we at once understand these similarities and analogies as a sort of heirloom, or as characters belonging originally to the typical ancestors. We see thus that these facts not only offer no difficulty of explanation by the theory of evolution, but actually follow as a necessary consequence. The very exceptions seem to strengthen our argument. If there are such animals as the spiders, which have not twenty segments as they ought to have, it is easy to see that although the typical character of the progenitors has been retained by most of the descendants, in cases of exceptional modification even that may have undergone a change; but a theory of design or necessity is at once made impossible.

There is more evidence of the same class in the similarity of structure between different organs of the same individual. Compare the structure of the human leg and arm, of the bird's leg and wing, of the finger and the toe, and it seems surprising that organs of such difference externally, and of such different uses, should be constructed on so similar a plan. Look at the vertebral column of a man. One part, the sacrum, in which great strength is required, consists of five vertebræ consolidated to one piece, but still showing the divisions. The number of these divisions varies in different orders and even in the same order.

Can we suppose such structures to be the result of a design, or chance, or necessity? No. Here, as before, evolution is the only agency by which such a state could have been brought about.

In the last chapter we saw that during development an organism often requires organs which later on disappear, are absorbed, or replaced by other organs; but often they are retained and form then what are called rudimentary organs.

The examples of these are numerous; some snakes have rudimentary legs under the skin; smooth-skinned amphibia sometimes have rudimentary scales under the skin. In some birds the feathers are rudimentary and are reduced to simple shafts or even hairlike forms. Our own fine hairs covering the whole of the body are the rudimentary covering homologous to the hair of mammals.

There are numerous cases of rudimentary wings in insects, or wings uselessly hidden under firmly closed wing-cases. In the productions of artificial selection we often find such cases; rudiments of tails in tailless breeds, rudimentary ears or horns in breeds which are without these organs.

In all these cases an assumption of design would evidently be absurd, as likewise that of necessity, and we arrive again at the conclusion that they represent the signs of a kinship between the organisms which must be traced back to their common ancestors.

We have thus three points in which all theories but that of evolution fail: First, the unity of type in forms of great difference belonging to the same group; second, the similarity of structure in different organs of the same organism; third, the presence of rudimentary and useless organs; but all can easily be explained by the theory of evolution and follow as a necessary consequence of it.

Chapter VII.

In considering the facts of distribution as arguments for or against evolution we must treat separately distribution in space and distribution in time; further we have to distinguish, when investigating distribution in space, between that over different areas in the same medium, and that over different media. The facts of distribution over different areas in the same medium are chiefly the following:—The fauna of a peculiar area is determined less by its fitness for certain types than by the possibility of its being populated from neighbouring areas. This is to say, we often find areas very much alike in climate, soil, and physical condition, but inhabited by quite different types, while on the other hand the same types are often found on areas differing very much in those respects. Now these facts at once contradict any theory of design.

If we consider the latent tendency of all organisms to extend their sphere of existence we shall be able to understand these facts better. Supposing an organism inhabits a small area and has arrived at a complete harmony with its surroundings. Then it will surely begin to spread over the neighbouring areas, where, in the struggle for existence with already established forms, modifications must be produced, and the result is that there are two closely allied forms of the same type inhabiting adjacent areas. And that is, in fact, exactly what we find in Nature. This spreading of organisms over new areas is very well illustrated by the spreading of European animals and plants in New Zealand, where they overrun the country to the extinction, in frequent cases, of the native types.

In the last case we assumed that there was no barrier to the spread of the organism. If there are such, the present state of the fauna and flora will entirely depend on the length of time these barriers have existed. If they had been in existence for a long time, we should expect that although before their appearance the faunas were closely allied, they will not be so now, as ample time has elapsed for their modification. The modifications will be the more important the longer the time that has passed since the last connection. We find very striking illustrations of these facts in the study of the fauna and flora of islands; such as the Azores have only a small number of different types, and all are allied to those of the nearest continents. In fact, the organic forms are only derived from chance arrivals from the shores of Africa and Europe. They are nearly all such forms as have special means of spreading or migrating, or, like birds and insects, are winged animals, which may be carried away by the wind. Some types are much modified, and they must be the descendants of continental forms which arrived there at a very remote time. Others are very little modified, and do not trace their pedigree quite so far back. Others, again, are identical with continental species, and these are found among the regular arrivals from the continent during storms, and as the new arrivals mix with the natives they thus prevent modifications.

But if we take the fauna and flora of St. Helena, for example, we find that there are only very few species identical with continental ones; a greater part are allied forms, and the greatest proportion are entirely peculiar forms found nowhere else. The reason is that St. Helena is farther from any continent, and has never been in connection with one; while the Azores are at a smaller distance, and although perhaps they have never been in direct communication with the continent, it is possible that the distance at a remote period was smaller still, and broken by intervening islands.

From the principles of the theory of evolution we should also expect that those areas which have been isolated for the longest time possess the lowest types; and that is actually the case, as is shown by the peculiar fauna of Australia, almost the only country where the marsupials, the lowest type of mammals, are preserved.

There is also no difficulty in explaining the distribution of organisms over different media. As we find the lowest organisms in water, we must suppose that the beginning of life occurred in that medium, and we must explain how it was possible for organic forms to spread from water to land. The first beginning of a change in that direction might have been caused by agencies like the tide. Along the shores of the sea there is a large number of animals which regularly spend part of their life in water and part in air. There are fishes which fly through the air or climb trees; birds which dive. There are animals living in mud pools which during the dry season have to live without water. There are the amphibia, most of which can live in either medium, but some only inhabit one, although they are able to live in the other. We have thus a perfect gradation from animals entirely confined to water through such as can live in either to those which can only live in air; and that is just what we should expect, what is a necessity from the principles of evolution.

When we consider the distribution in time we find that the evidence is very scanty, but such as it is, it is entirely on the side of evolution. The fact that the difference in fossil remains is proportional to the difference in the time of their existence; the fact that species, genera, and entire types are extinct; the fact that the length of existence of a species does not necessarily imply a large amount of modification; all those facts are in harmony with the evolution theory.

Still more we recognise this harmony when we compare living types with types extinct. The types of the uppermost strata show the most resemblance to now living forms, and are often identical. The lower we go the greater is the difference between the then existing forms and the present fauna; the cases of identity become rarer, and the types become lower and less specialised; in some cases we can trace the whole pedigree of a now existing animal to the remotest ages. We also find that the fossil forms of one area correspond most closely to the living forms of the same area; while in many cases these living forms can be proved not to be specially fitted for that area, as is the case with the fauna of Australia for example, which disappears rapidly before the better fitted European fauna.

We come thus to the conclusion that the theory of evolution better than any other theory explains the remarkable facts of the distribution of animals and plants in space and time.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 84.)

COMPTON VERNEY. I.—*Anne, dau. of Rich. Verney, Esq., and wife of Master Edw. Odyngsale, of Long Itchington.* 1523. *Haines.*

This effigy is 1ft. 10¾in. long, and represents a lady in the usual prayerful attitude. Upon her head is a kerchief, beneath which is a *wimple*, drawn closely under the chin, and covering the neck and sides of the face. A loose outer gown, with wide sleeves, is so draped at the left side (cf. the Aston brass) as to disclose a *kirtle*. Above the effigy is a small shield, 5½in. long, bearing part of the VERNEY arms: ar., three crosses moline gu., apparently quartering GREEN: three bucks trippant.

On a mutilated plate, 1ft. 8in. by 3in., below the figure is this inscription:—

Off yeor charyte pray for the sole off Anne Odyngsa . . .
off mayster Edwarde Odyngsale off Longe yggyngeton . .
dogter of M Rychарde Verney Esquyer y^e^ whyche deptyde
y^e^ yere of o lorde m°cccccxxiii o whose sole Jhū have mcy

There were originally four evangelistic symbols, of which only one, that of S. Mark, is left, at the right hand top corner. Dugdale gives a fair illustration of this brass, but with different armorial bearings.

II.—*Richard Verney, Esq.*, 1536–7, *and w. Anne, with 9 sons and 5 daus. Haines.*

The effigies are about 1ft. 10in. high.

The husband, who is bare-headed and wears his hair long, is represented in armour rather different from any yet described. The *pauldrons*, or shoulder-pieces, are composed of plates arranged in ridges. The cuirass has a central ridge called a *tapul*, and a skirt of oblong plates, from which depend three *tuilles*, one at each side and one in front. Under these is a hawberk. The hands are encased in gauntlets of plate, which leave the fingers exposed. The sword is fastened to a belt hanging diagonally across the body. The *genouillières* have plates above and below them, and ornamental appendages at the sides. The greaves are prolonged over the ankles; the feet are covered by broad *sabbatons*, to which spurs are attached.

The lady wears the kennel-shaped cap, and an outer dress with tight sleeves, and wide-frilled cuffs. This dress, being cut low and square upon the chest, shows an under garment fastened at the neck with a button. The outer dress has a wide border, and is confined by a waistband with a rosette in front; it is gracefully caught up at the left side, showing an under skirt.

Above these figures is a shield, 8in. long, with Verney and Green quartered, six quarterings being now vacant. Below the figures are two groups of children. The daughters are dressed like their mother; the sons wear short dresses or kilts reaching to the knee, hose, and square-toed shoes. One of the boys wears a gypcière, and another has something like a Scotch *sporran* hanging in front of his kilt.

At the corners of the tombstone were evangelical symbols, only three of which are left. On narrow strips of brass round the edges of the stone is this mutilated inscription:—

Off your Charyte Praye for the soulles of
. . . . depted out of this psent worlde the xxviiith daye
of the monethe of September
in the yere of our Lord God m°ccccc. . . . . .

Dugdale gives an illustration of this brass, with a different coat of arms, and says Richard Verney "was in that esteem with King Henry VIII. that, being informed of some infirmity in his head, he afforded him a speciall licence . . that he should wear his bonnet at all times and in all places, as well in the king's presence as elsewhere."

III.—*Geo. Verney, Esq.*, 1574. *Haines.*

This is a figure 1ft. 10in. high, representing a man in armour of the seventeenth century; indeed, the effigy might be a portrait of one of Charles the First's cavaliers. His hair is long and curled; he wears a deep falling collar and trunk-hose. The most noticeable features of the armour are the pointed breast-plate, the large *tassets* over the thighs, the escalloped border of the lining of the *pauldrons*, and the numerous rivets with which the plates are fastened together. The sword-belt is arranged diagonally across the body, the sword has the modern guard, and the dagger is at the back of the figure. Apparently the knight wears jack-boots (which meet the *genouillières*), with spurs and spur leathers. The brass was evidently, as Haines says, engraved about 1630, *i.e.*, sixty years after Geo. Verney's death. (Compare the brass at Barton.)

Above the effigy is a fine shield, 8in. long, well engraved, with the quarterings of VERNEY, LOVELL, LUCY, GREEN, BEAUCHAMP, and others.

There is also this inscription on a plate, 8in. by 11in.:—

HERE LIES GEORGE VERNEY | OF COMPTON ESQ: SONNE OF SR | RICHARD VERNEY KNIGHT AND | HVSBAND OF JANE THE DAVGHTER | OF WILLIAM LVCY OF CHARLCOT | ESQ. BY WHOME HEE HAD ONE | SONNE AND FOWER DAVGH | TERS. HEE DIED THE EIGHT | DAY OF APRILL ANNO DNI 1574.

Dugdale gives a fair representation of this brass, but with different armorial bearings.

There are several tombs in the church, with brass shields bearing the Verney arms.

Haines considers Nos. I. and II. the work of Warwickshire artists, and No. III. by the same artist as the brasses at St. Columb, Cornwall.

COUGHTON. I.—*Sir Geo. Throkmorton and w. Kath.* c. 1500. *Haines.*

Two effigies 3ft. high, of decidedly provincial workmanship. The knight's head rests upon his tilting-helmet, under which is a cushion. The helmet bears the crest an elephant's head sa., eared or. The epaulières have ridges called passguards to protect the neck, and upon the breast-plate is fixed a lance-rest. The coutes are heart-shaped and ornamented, the two tuilles are fastened by straps to the cuirass and are scored to represent separate plates. The genouillières are absurdly large and have cuspidate edges.

The lady wears the kennel-shaped head-dress, a mantle fastened with a band across the chest, an under-dress with ornamental collar, and a loose twisted waistband with circular clasp and pendant ornament.

Above the knight's head is a shield bearing the arms of THROKMORTON: Gu., on a chevron arg., three bars gemel, sa. Above the lady's head is a shield with THROKMORTON impaling VAUX.

Beneath the knight are the effigies of 8 sons, and beneath the lady those of 11 daughters. Below the sons is a shield of four quarterings: 1 THROKMORTON, 2 OLNEY, 3 SPINEY, 4 ——. Upon the lady's side is a shield, THROKMORTON impaling ABERBURY.

Upon the sides of the tomb were four shields, two of which are lost, the two remaining bear the quarterings of all the families mentioned except VAUX.

The following is the inscription:

Of youre Charite praye for the Soule of syr George Throkmerton knyght, And dame Katheryn hys wyfe, one of the Daughters of syr Nycolas Vause | Knyght (Lord Harroden) Whyche syr George deceased the . . . day of | . . . In the yere of the incarnacyon of our lord god A mccccc . . . and dame Katyn dyed the . . . day Of . . . Ano mvc . . . on whose soule ihu have mcy amen.

Dugdale, who gives an illustration of this brass, states that the tomb was prepared in the knight's lifetime, which accounts for the omission of the dates.

II.—*Inscr. Dame Elizabeth Throkmorton last abbess of Denye.* 1547. *Haines.*

Upon a plate 20in. by 4½in. between four evangelical symbols is this inscription:

Off youre charite pray for the soule of Dame Elizabeth Throkmerton | the last Abbas of Denye, and aunte to syr George Throkmerton | knight, who decessyd the xiiith day of Januarye, In the yere of our | lord god a mcccccxlvii, who lyeth here tumilate in thys tombe | on whoes soule and all chrysten soules Jhesu have mcy amē | ☞ vivit post funera vtus.

Above and below the inscription is a lozenge-shaped plate with the arms of Throkmorton. The brass has been restored.

III.—*Inscr.* *Sir John Throkmorton*, 1580.

A plate, about 21in. by 10in., upon the south wall of the chancel. It is not mentioned by Haines.

The inscription is in black letter, the letters being in relief, and runs:—

Here lieth interred ye bodie of Sir John Throkmorton knight of | Feckenham, the fiveth sonne of Sir George Throkmorton knight of | Covghton, somtime Master of ye Requests unto queene Marie of hap- | pie memorie, who in respecte of his faithful service bestowed upon | him ye office of Justice of Chester and of hir Covnsaile in ye marches of | Wales in wch rome he continewed xxiii yeares & supplied wth in ye | same time ye place of vice president ye space of iv years, he had to | wife Margerie puttenham Daughter of Robert puttehā Esquier | by whom he had Issue v sonnes & iiii daughters, he departed | this life ye 22 of May Ao 1580. his wife survivinge who lived | and died his widoe ye . . . and is here also interred.

Above this is a shield with the Throkmorton arms.

No. II. is upon an Altar-tomb at the north side of the chancel. Upon the same tomb is a brass cross and inscription to Sir C. Throkmorton. d. 1840, and an inscription to Dame Elizabeth Throkmorton, d. 1850.

(To be continued.)

Reviews.

Illustrations of British Fungi. Part XXXIX. M. C. Cooke. 8s. 0d. Williams and Norgate.

This part completes Vol. IV. of this very valuable work, and affords a favourable opportunity for calling attention to the great advance which has been made in the study of the fungi of late years, more especially since the publication of the "Handbook" in 1871. In that work, up to the point now reached in the "Illustrations," 433 species of the Agaricini are described and recorded as British species, and this was an advance, since the publication of Berkeley's "Outlines," of 90 species. The number now reached in the index of the "Illustrations" is 794, or nearly double the number of species recorded in 1871, and of these all but 54 are figured in this work. The four volumes before us contain 622 plates, upon which are given coloured figures of 740 species and varieties of the Agaricini. Of these, 24 are entirely new species or varieties, and at least 100 are species or varieties that have never been figured before. The true value of this work will be better understood by a comparison with the previous illustrated works on the fungi.

The species of the Agaricini figured by our most prominent British authors were Bolton, 108; Sowerby, 165; Hussey, 80; Berkeley, 93; Badham, 20; Saunders and Smith, 60; Price, 67; a total of 583. But many of these figures are merely repetitious, the same figure appearing over and over again in the various works. And whilst acknowledging our great indebtedness to these earlier authors for their valuable work, we cannot but feel how great an advantage it is to have, within the compass of one work, and that work costing less than such a work as that of Sowerby, illustrations far greater in number than are to be found in the works of all our previous authors combined. Then again these older works are not only costly but also rarely to be met with, and hence only few students could avail themselves of the valuable aid they afforded. The importance of illustrations in such a study as that of the fungi can only be appreciated by those who have given attention to the plants, so that this work of Dr. Cooke's may be said to have commenced a new era in this study. The great help afforded by this has encouraged our younger students to take up a study which before seemed to be surrounded by insurmountable difficulties. Hence, instead of mycologists being as heretofore a small and select band, we have now few field clubs in the kingdom in which there are not one or more of the members who devote themselves to this most intricate but pleasing study. A work which has brought about so great a result should surely be supported by every true lover of botanical science. From an announcement in "Grevillea" for March, we learn "that Part 40 of this work will commence with illustrations of the remaining genera of the Agaricini, and that about two more volumes will complete the present series." We can only express a hope that the talented author may have health and length of days to finish his great undertaking.

J. E. BAGNALL.

The Birds of Lancashire. By F. S. MITCHELL, Member of the British Ornithological Union. London: John Van Voorst.

MR. MITCHELL aptly describes his book as "a chapter on geographical distribution." The author, however, does not merely record all the birds found in Lancashire, but also adds a large amount of information about their habits, time of breeding, migration, &c., so that in this respect the book is of more than local interest and may be consulted with advantage by all who are interested in the "Natural History" side of ornithology. In the case of the rarer species, localities and habitats are given, and the references to books and periodicals where their appearances are recorded range from Camden's "Britannia," 1507, to the "Birds of Europe," Dresser, 1883. In addition there are lists of local names, a good map of the county, some illustrations of birds and duck decoys, and last but not least, a reliable index. It is to be hoped that similar works for the other counties, written by competent naturalists, will soon appear.—A. B. B.

Lecture Notes on Physical Geography and Geology. By J. V. ELSDEN, B.Sc., and W. B. LOWE, M.A., F.C.S.; large 8vo., 106 pp., plates. Published by A. Percy Smith, Rugby, price 10/6.

THIS is without doubt the best resumé of that broad subject called Physiography with which we are acquainted. The first part of the book deals with the Earth as a planet; the Atmosphere; the Ocean; the Land; and the Classification and Distribution of Life. The second part is divided into Physical Geology, Structural Geology, and Palæontology.

The mass of matter relating to the subjects treated of is very large; it is skilfully arranged, and is at once compact and brief, yet intelligent and interesting. The authors have "sat at the feet" of Professor Judd at the Royal School of Mines, and Professor Bonney at Cambridge, and have evidently laid under contribution the lecture notes of these high authorities. One side of each leaf is left blank, so that the reader may add notes from his general reading, or from lectures which he may attend. As a guide to examination work in Physiography, &c., this is certainly an excellent book, but it is not the less valuable to the general reader for guidance or reference on the subjects to which it refers. W. J. H.

METEOROLOGICAL NOTES.—February, 1886.

The barometer was low on the 1st of the month (29·194 inches), but rose rapidly, with two slight checks, until the 9th, when the reading was 30·684 inches, thus covering a range of 1·490 inches in eight days. From this point a fall took place to the 14th, after which it gradually rose, and continued high until the end of the month. The mean temperature, 34·5°, is the lowest in February during the past eight years, and is about six degrees below the average. The maximum temperatures have been unusually low, the highest recorded being 50·1° at Loughborough, 49·0° at Henley-in-Arden, 48·8° at Hodsock, 48·6° at Coston Rectory, and 47·3° at Strelley, all on the 13th. In the rays of the sun, 93·9° at Hodsock on the 26th, 88·3° at Loughborough on the 27th, and 81·4° at Strelley on the 1st. The lowest readings were 19·5° at Coston Rectory on the 27th, 20·7° at Hodsock on the 7th and 27th, 21·9° at Loughborough on the 15th, 22·0° at Henley-in-Arden on the 7th and 24th, and 22·1° at Strelley on the 7th. On the grass, 13·0° at Hodsock, 18·9° at Strelley on the 27th, and 19·7° at Loughborough on the 15th. The number of nights below 32°, in the air and on the grass, were respectively—Strelley, 23° and 26°; Hodsock, 19° and 25°; Loughborough, 18° and 25°. The rainfall was very slight, the total values of rain or melted snow being—1·19 inches at Henley-in-Arden, 0·39 at Hodsock, 0·38 at Strelley, 0·32 at Loughborough, and 0·25 at Coston Rectory. These amounts are less than in any February of the last ten years. Sunshine was deficient.

Wm. Berridge, F. R. Met. Soc.
12, Victoria Street, Loughborough.

EARTH TEMPERATURES AND WEATHER IN SOUTH AUSTRALIA.

BY CLEMENT L. WRAGGE, F.R.G.S., F. R. MET. SOC.

At my Torrens Observatory, situated on the plains two miles north-east from Adelaide, I give special attention to the matter of earth temperatures, and have records from depths greater than at other observatories in Australia as far as I am aware. The following statistics will be of interest to my meteorological friends, and prove by the rise at the lower depths the abnormal force of the heat-waves recently experienced on the Adelaide Plains. The earth temperatures are taken, as soon as practicable, after the ordinary 9 a.m. observations:—

	February 1st, 1885.	February 1st, 1886.
At 1 foot	80·4	76·0
At 2 feet	79·3	78·1
At 4 feet	75·5	76·2
At 6 feet	71·5	73·5
At 8 feet	69·0	71·9
At 10 feet	68·1	71·2
At 12 feet	66·5	68·2

During January, 1885, the air maxima ran over 95°, but 100·0 was not reached. During January, 1886, maxima of 100·6, 105·2, and 111·6 were registered in my enlarged Stevenson's screen; the latter value occurring on the 4th. At 3 p.m. on that day the dry bulb read 109·7, wet 75·9, giving the enormous difference of 33·8; and a relative humidity or fraction of saturation of only 15 by Guyot's formula. At 3 a.m. on the 3rd inst. my electric hygrometer read—dry bulb 49·6, wet 48·6, giving 93 as a percentage of humidity. Can we have a better instance of the extraordinary vicissitudes of the South Australian climate? Nothing like it have I experienced during all my recent wanderings in Queensland.

Adelaide, February 8th, 1886.

Natural History Notes.

New Aquatic Moss.—Prof. J. B. Schnetzler describes a Moss attached to pieces of limestone found by fishermen in their nets, when fishing at a depth of 200m., at a particular spot in the Lake of Geneva. No fructification has yet been found on it, but the author considers it as probably allied to *Hypnum* (Thamnium) *alopecurum*, which it resembles in its mode of branching, and in the form of its cells. It is multiplied by green shoots, and the leaves contain abundance of chlorophyll and starch. Assimilation and the formation of chlorophyll therefore take place at a depth which marks the extreme limit of the sun's rays.—*Jour. of Mic. Soc.*, Feb., 1886, from *Bot. Centralbl.*

Meteors.—A meteor shower, radiating from the constellation *Andromeda*, may always be observed more or less during the last week of November. The *Leonids* appear about the 13th of November, and the *Andromedes* from a week to a fortnight afterwards. These latter are supposed to be connected with Biela's comet. They are often seen in small numbers for several nights in succession, but on the night of the 27th of November this year they came out with most unusual splendour. From about six to eight p.m. there was a perfect rain of meteors all round the heavens, the radiating point being almost exactly in the zenith. Between eight and nine the sky became cloudy, but I am told that it cleared up after midnight, and that the shower was still proceeding. It was not equal in grandeur to the display of the *Leonids* in 1866, but was, nevertheless, a very striking and beautiful phenomenon.—F. T. Mott, Birstal Hill, Leicester, November 28th.

STYLES OF INDIAN CORN FOR EXAMINING MOVEMENT OF PROTOPLASM.—Prof. C. E. Bessey recommends the long styles of Indian corn for the study of the movements of protoplasm. By taking a young style from an ear which has been kept in a warm place for an hour or so, clipping off a piece a couple of inches in length and carefully mounting it in water under a large cover-glass, there will be no difficulty in seeing a great deal of activity in the protoplasm. Care must of course be taken to have the style lie flat, remembering that it is not cylindrical, but somewhat ribbon-shaped. The cells are much elongated, and the walls are so transparent that with careful focussing their contents may be seen, even in the interior parts of the style. The protoplasm is sufficiently granular to be easily seen. It moves along the side of the cell in a strong steady stream, occasionally heaping up a great mass, which is eventually pushed onward by the current. As an easily obtained and instructive example of protoplasmic activity, the Professor knows of nothing which is superior to such a specimen.—*American Naturalist*, 1885, *p.* 888.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION, March 9th.—Mr. W. P. Marshall in the chair. Mr. W. B. Grove, B.A., exhibited a microscopical preparation of *Peziza nivea*, a fungus collected at Shirley by Mr. J. Morley; Mr. Charles Pumphrey, photographs on glass of an abnormal foxglove recently exhibited by Mr. W. H. Wilkinson; Mr. J. E. Bagnall, A.L.S., mosses, *Hypnum sericeum*, *H. cupressiforme*, var. *filiforme*, and *Racomitrium lanuginosum*, from Dartmoor; also a fine collection of plants from the Western and Eastern States, U.S., and Norway, representing the natural order Cruciferæ, from the herbarium of Mr. J. B. Stone, J.P., F.G.S., giving also notes on their generic distinctions and their geographical distribution. Professor Hillhouse, M.A., exhibited six microscopic slides illustrating the mechanical structure of the mid-rib of *Scolopendrium vulgare*, the Hart's-tongue fern. These were sections taken from the mid-rib and stalk of the frond, at intervals of 1½in., and illustrated beautifully the gradual development of the mechanical structure. Professor Hillhouse gave an interesting and lucid description of the structure, illustrating his remarks with black-board diagrams.—MICROSCOPICAL AND GENERAL MEETING, March 16th.—Mr. R. W. Chase read a paper on the "Petrels and Shearwaters," describing the habits of the birds, so far as they are known, and the breeding stations in Great Britain of the different species; he exhibited the following specimens in illustration of his paper:—*Procellaria pelagica*, also egg, stormy petrel; *Procellaria leucorrhoa*, Leach's petrel; *Puffinus anglorum*, also egg, Manx shearwater; *Fulmarus glacialis*, Fulmar. Mr. J. Levick exhibited, in illustration of pond life, *Brachionus urceolaris*, *Melicerta ringens*, *Hydra vulgaris*, Floscules, Entomostraca, &c. Mr. J. Morley made some remarks on the fact that rotifers have the power of retaining their vitality even when dried for months, or of being heated to 200° Fahr., and discussed the theory of their being sealed by the gelatinous mass which surrounds them. In support of the theory which is now generally accepted, he exhibited some specimens of *Philodina roseola*, which had been dried on paper and sent to him per post by Rev. E. J. Holloway, of Clehanger, and some of which being revived by placing in water could be seen under the microscope in the full vigour of life. Mr. T. Bolton exhibited *Cordylophora lacustris*, also various freshwater diatoms, including some fine *Nitzschia sigmoidea*.—SOCIOLOGICAL SECTION, March 18th.—Mr. F. J. Cullis discoursed on Part IV. of the second volume of Mr. Herbert Spencer's "Principles of Biology" on "Morphological Development," passing in rapid review the opening chapters on "Morphological Composition of Plants and Animals," dwelling at length on the later chapters on "Morphological Differentiation," and expounding exhaustively the thirteenth chapter on "Morphological Differentiation in Animals." His most interesting and lucid address, of an hour-and-a-half's duration, was listened to with close attention by the members of the section present. In illustration of the modification and differentiation produced by environment, Mr. W. R. Hughes, F.L.S., president of the section, exhibited under the microscopes specimens of *Palæmon serratus*, the common prawn, and of *Bopyrus squillarum*, its parasite, both of which it is assumed have originated from a common progenitor.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 22nd. Mr. Moore showed the following land and freshwater shells from America:—*Helix albolabris*, *H. alteriata*, *H. manselen*, and *Limnophysa reflexa*; Mr. C. Neville, specimens of tufa and fossil wood from Portland; Mr. Evans, transverse section of the jaws of an ichthyosaurus, the intermediate space being filled with iron pyrites. A paper was read by Mr. Hutchinson on "Yeast fungi and their functions," which reviewed the history of observations on this subject, showing that although the minute cells of the yeast plant were known in the seventeenth century, really accurate knowledge could only be gained after great improvements in the microscope. The paper described the yeast of commerce as mainly a Continental product. The various forms and sizes of cells were spoken of as being largely dependent on the suitableness of the fluid they lived in; the small oval cells were said to be most valuable for bread making. The paper was illustrated by experiments and specimens of the plant under the microscope.—March 1st. Mr. J. E. Bagnall presented to the society a copy of his "Handbook of Mosses." Under the microscope Mr. Hawkes showed *Ræstelia cornuta*, on mountain ash leaf, from Scotland; Mr. J. W. Neville, gizzard of mole cricket, *Gryllotalpa vulgaris*.—March 8th. A paper was read by Mr. Evans on "Volcanoes and volcanic action," describing the many erroneous ideas respecting them that had come down to us from olden times. A volcano was simply a fissure in the earth's crust where a molten interior found a vent. The phenomena of an eruption were described, Stromboli (which was said to be a pocket edition of a volcano) being given as a type. Volcanoes were either active, quiet, or extinct; the number of the first was computed at about 320. The paper reviewed the different theories of volcanic action as coming within the province of the astronomer, chemist, and geologist, and concluded by showing that evidences of eruptions were as old as the world, and that these furious outbursts were only specks in the universe on which all mankind depends. The paper was illustrated with diagrams, minerals, &c. A discussion closed the meeting.—March 15th. Mr. Collins exhibited a collection of minerals, including specimens of opal, chalcedony, amethyst, &c.; Mr. A. T. Evans, an ammonite showing nacre of shell; Mr. H. Hawkes, a collection of seaweeds and zoophytes; Mr. C. F. Beale, specimens of trilobites from the American Silurians, probably species of Calymene. Under the microscope Mr. Moore showed a series of preparations of the larva and imago of *Dytiscus marginalis*; Mr. H. Hawkes, slides of *Sporendonema muscæ* on the house fly, and *Achlya prolifera* on larva of *Corethra plumicornis*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. SECTION D, ZOOLOGY AND BOTANY.—Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, March 17th. Atttendance, eleven (two ladies.) The Chairman urged the members to make notes of their observations of plants and animals, and to send such notes to the "Midland Naturalist" for publication. Dr. Finch undertook to try the experiment of keeping a daily diary for the record of observations in the various branches of natural history, to be presented to the Section at its monthly meetings. Mr. F. Bates suggested that objects brought for exhibition should be accompanied by written notices of them, some of which would be acceptable to the "Midland Naturalist," and he illustrated his excellent suggestion by exhibiting specimens of *Nostoc*, and reading a short description of this interesting alga. Mr. Bates also exhibited specimens of diatomaceous earth from eight different localities in North America, some of which was distributed among members who desired it. The Chairman read a paper on "Scale Insects," illustrated by drawings of a *Coccus* infesting the White Abutilon, in the various stages of its life. He pointed out that the *Coccidæ* had been very little studied in this country, that there was no English work upon them, that the standard authority was the French monograph by Signoret, and that there was here a wide field for original research. Mr. W. A. Vice exhibited several species of *Coccus* on twigs of vine, peach, and apple,

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PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—February 18th. GEOLOGICAL SECTION.— Chairman, Mr. E. Wheeler. Portion studied, Lyell's "Student's Elements," chap. viii.—February 25th. BOTANICAL SECTION.—Address by the Chairman, Mr. J. W. Bodger, "On the different forms of stems, aerial and subterranean," illustrated with the runner or flagellum of the strawberry, the offset of houseleek, the stolon or stole of carnation, the sucker in rose and mint, the rhizomes of iris, and of Solomon's seal, the latter showing scars; various forms of pseudobulb of orchids and cacti, also procumbent, decumbent, ascending, scandent, and twining stems; the sobole in *Carex arenaria*, tubers of potato and artichoke; scaly bulbs of lily and tunicated of onion; corm of *Colchicum autumnale*; also cirrhi or tendrils of vine and passion-flower, leafy thorns of sloe, phyllodes of Ruscus and of *Acacia heterophylla*, the latter terminating with a bipinnate lamina.—March 4th. GEOLOGICAL SECTION.—Chairman, Mr. E. Wheeler. Lyell's "Elements of Geology," chap. ix., read and discussed.—March 11th. BOTANICAL SECTION.—Address by the Chairman, Mr. J. W. Bodger, "On the form of the mature leaf, stipules, ligules, and venation, illustrated with specimens of *Tilia Europæa*, *Dactylis glomerata*, *Heracleum sphondylium*, *Juncus conglomeratus*, *J. effusus*, *Plantago major*, *Astragalus glycyphyllos*, *Vicia hirsuta*, *V. sepium*, *Stachys palustris*, *Orchis pyramidalis*, and other plants; also specimens of *Anemone pulsatilla*.

A HALF-DAY'S RAMBLE IN THE ARROW DISTRICT.

BY JAMES E. BAGNALL, A.L.S.

One of my first rambles for the present year was in the Arrow district, from Studley, through Spernal, Morton Bagot, Mapleborough Green, and Ipsley, to Redditch; a beautiful district, enclosed on the east and south-east by the high lands of the Alne Hills, Spernal Park, and the woodlands about Morton Bagot. These are in part the watershed of the Arrow, which was at the time of my visit a turbid, rapid stream. My desire was to work more fully the moss flora of this district, to note its boundaries, and to get some general idea of its physical features. My work began as soon as I left the railway station at Studley, the footways and banks being verdant with mosses. The first to be noticed were *Funaria hygrometrica* and *Ceratodon*, intermingled with the straggling stems of *Plagiochila bidentata;* on the banks, the fisherman's favourite, *Hypnum purum;* flattened patches of *H. denticulatum*, velvety patches of *H. velutinum*, straggling masses of *H. rutabulum*, silky tufts of *Dicranella heteromalla*, and here and there closer search revealed the beautiful fern-like *Fissidens bryoides*, whilst in the drains its more robust congener, *F. taxifolius*, was abundant, but rarely fruiting. Near Spernal Ash I noticed some patches of a dark, shining, green moss, with peculiar incurved branches, which I afterwards found to be *Scleropodium illecebrum*. This I had never seen in the county before; it is a moss more often found in maritime situations than in inland districts. In the lane leading to Spernal I noticed the polypody, *Polypodium vulgare*, very abundant, and its frequent companion, *Arum maculatum*, and on reaching the Arrow, which runs through this village, I found the trees on the river side well clad with the mosses more usual in such places, such as *Leskea polycarpa*, in abundant fruit; *Tortula mucronata*, *Scleropodium cæspitosum*, both very local mosses; *Tortula lævipila*, and *Orthotrichum affine;* higher up the river at Washford, I found *Tortula papillosa* in scanty patches, *T. subulata* growing in abundance in the mud left by the stream on tree roots; with this an abundant growth of *Didymodon rubellus*, with old capsules; large tufts of *Tortula insulana* and *Homalia trichomanoides*. I also noticed at Spernal that form of *Orthotrichum affine* which more nearly approaches the rarer *O. rivulare* in size and habit; *O. Lyellii* in abundance, and the leaves richly clad with the articulated bodies (*Conferva orthotrichi*) by which it is usually propagated; and its frequent companion, *O. diaphanum*. On the wooden bridge over the river were minute tufts of *Weissia cirrhata*, and on the river bank, *Hypnum ruscifolium*. From Spernal I went past Spernal Park to Greenhill Green, gathering on my way *Bryum murale*, and noticing large tufts of *B. capillare* and small tufts of *B. cæspiticium*, and in the wood by Spernal Park the beautiful flowers of the primrose and anemone, always welcome as harbingers of spring. Here also I noticed fine masses of *Hypnum splendens*, as proliferous a moss as is *Thuidium tamariscinum*, which was also in abundance. On some of the footways *Hypnum squarrosum* was the only moss to be found, but the banks were rich in variety; among others *Atrichum undulatum* and *Weissia viridula* were noticeable. In the wood I found an abundance of the common scale-moss, *Plagiochila heterophylla*, *Polytrichum commune*, *Dicranum palustre*, and *Mnium hornum*. The trees about Greenhill Green were not only well clothed with lichens, such as *Parmelia saxatilis*, *Evernia furfuracea*, *Ramalina farinacea*, and *R. fraxinea*, but were also the habitats of the squirrel tail moss, *Leucodon sciuroides*, *Tortula ruralis*, and the beautiful *Zygodon viridissimus*, which is quite abundant in the district. At Greenhill Green there is some elevated land which appears to be the remains of an old heath; it has been at one time marshy, I think, judging by the mosses I noticed there. These were *Hypnum cuspidatum*, quite a prevailing moss; *H. molluscum*, with its pretty shell-like foliage; *H. stellatum*, a few isolated patches of *H. falcatum* and *H. filicinum*, and dark brownish-green tufts of *Tortula fallax* and *T. spadicea*. In a wood near Spernal Park I came across a splendid crop of *Helleborus viridis*, apparently thoroughly naturalised; this is a very rare plant in the county, and I considered it my best find, and searching the wood more thoroughly I found masses of the tree-like *Thamnium alopecurum*, and a most unusual moss in woodlands in this county, *Grimmia apocarpa*. The trees were well clad with such mosses as *Isothecium myurum* in good fruit, *Hyp. cupressiforme*, and its close ally *H. resupinatum*, and the very noticeable *Dicranum fuscescens*, this being new as a record for the Avon basin. I also gathered a fine patch of *Fissidens incurvus*, and saw an abundant growth of *Hypnum triquetrum*, a moss much used in Christmas decorations; its natural colour, the red stem showing so beautifully through the golden leaves, appears so appropriate that it seems a sad perversion of taste to dye this moss the unnatural colours one sees, often deep blue, and who can imagine a blue moss? On the trees in the lanes about Morton Bagot I gathered *Hypnum serpens*, *H. confertum*, *Tortula unguiculata*, and saw the pale green masses of that peculiar hepatic, *Metzgeria* *furcata*, isolated tufts of *Radula complanata*, and the purple patches of *Frullania dilatata*, and now and again, but more rarely, *F. tamarisci*. Making my way over Out Hill and by Lower Skilts to Ipsley, I found in a tuft of *Hyp. Swartzii* a few isolated plants of *Fossombronia pusilla*, a very local hepatic in this county, and on the bridge over the Arrow at Ipsley *Tortula revoluta*, *T. muralis*, and *Grimmia pulvinata*. I might probably have added still more to my list, for the district is evidently a rich one, but the light began to wane and the mosses were unrecognisable, and though I could have wished for a longer spell of light, I felt I had done fairly well, and had been so well occupied that time had fled more rapidly than I had thought. To those who look with contempt on these studies, it may seem that I had taken a great deal of trouble for very little good, but to such I would reply, in the words of Southey, "Do not depreciate any pursuit which leads men to contemplate the works of their Creator! The Linnæan traveller who, when you look over the pages of his journal, seems to you a mere botanist, has, in his pursuit, as you have in yours, an object that occupies his time and fills his mind, and satisfies his heart. It is as innocent as yours, and as disinterested, perhaps more so, because it is not so ambitious. Nor is the pleasure he partakes in investigating the structure of a plant less pure or less worthy than what you derive from perusing the noblest productions of human genius."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART II.

Palæontology.

(Continued from page 77.)

In dealing with the stratigraphy of the Middle Lias of Northamptonshire, as will have been observed, I have endeavoured to trace, not only the zones, but the separate beds over a rather large area. My success has not been equal to my wishes; nevertheless, it has added considerably to the interest of the work, and may be of some use to future observers. It is not usual to be so particular in giving lists of fossils from the separate beds as I have been, so a few remarks as to the reason for it seems called for.

In studying the lower beds of the Upper Lias in Northamptonshire and some other districts, I have been led to the conclusion that the hard beds have a peculiar significance—that in fact they form the boundaries of distinct palæontological zones. Thus, at the base of the Upper Lias we have a paper shale in which *fish remains* are common, and at or near the top of this deposit occurs a limestone band in which they are exceedingly abundant. The hard bed is called the Fish and Insect-bed, or with us, insect remains being rare, simply the Fish-bed, and although for a few inches above fish fragments may still be met with, the limestone band practically forms the upward limit of the Fish and Insect Zone. Next we have in Northamptonshire a clay, with very few fossils, capped by another limestone band containing "*falcifer*" *ammonites* in enormous numbers. This bed, locally named the Lower Cephalopoda-bed, forms the upper boundary of the "Serpentinus-beds." Above this again is a clay containing great numbers of small ammonites, chiefly *A. communis* and *A. Holandrei*, with another limestone band at the top, in which they are, in places, still more abundant. This latter bed, which we call the Upper Cephalopoda-bed, forms the upper boundary of the "Communis-beds"; above it there is scarcely a fossil to be found for a considerable thickness.

There is no progressive increase noticeable in the number of ammonites and other fossils as we approach the limestone bands from below; hence it seems necessary to assume a scarcity of sedimentary matter during their formation, the shells of marine animals, chiefly ammonites, themselves constituting, in many cases, the greater portion of the bed.

The question as to whether the change in the fauna which took place at the end of each period was brought about during the cessation of deposit, or when the fresh sediment was introduced, can be fairly well decided in favour of the latter view, because there is a noticeable lingering of certain forms of fossils just above two of the hard beds, though only for a few inches.

It seemed to me probable that the hard beds of the Middle Lias might have a similar significance, and I think they have, though to a less noticeable extent. There certainly is a large increase in the number of fossils in the hard beds as compared with the soft ones below them respectively, and each one forms the upper boundary of one or more fossils, and the place of maximum development of perhaps several others for this neighbourhood, though of course out of this district they may be found higher or lower according to the direction in which migration took place.

It is important to notice that the lower beds of the Upper Lias were formed whilst the area was sinking, whereas the land was pretty certainly rising during the latter portion of the Middle Lias period. In the former case, therefore, fossils from remote districts would successively be introduced; in the latter the area of deposit would become more and more restricted, and so the introduction of new forms more difficult. This seems at first entirely opposed to the fact that there are a good many *characteristic* fossils in the Rock-bed and Transition-bed. Two suggestions may be made to account for them. One is that these fossils were present in the Middle Lias before, though scarce, and that their large numerical increase was a result of restricted migration; the relative abundance of species of Brachiopods in the Rock-bed and Gasteropods in the Transition-bed being a result of altered though not necessarily unsuitable conditions. The second explanation I would suggest is that the land was sinking during the period marked by the deposition of the sandy micaceous beds of the "*Margaritatus*" *Zone*, reaching its greatest, though never very great depth, when the impervious clays just below the Rock-bed were deposited, and that this was the time when the Brachiopods and other fossils were introduced, after which the land commenced and continued to rise to near the end of the Middle Lias period. The similarity of the "*Margaritatus*" *Zone* to the lower part of the Upper Lias in the frequent alternation of hard and soft beds, and in the distribution of fossils in them, seems to favour this latter view.

Of course if the theory of palæontological zones being bounded by hard stone beds, which I have sketched out here, has any truth in it, the bed which I have placed at the base of the Middle Lias could scarcely be the commencement of a zone, though it might be the termination of one. I must confess the belief is growing with me that the "*Margaritatus*" *Zone* must include the clay bed immediately below "L." This would alter the boundary between the Middle and Lower Lias, as drawn by the Geological Survey, so I hesitate to make this change without some better reason than that of a theory only imperfectly worked out.

There are certain well-marked palæontological differences between the three zones of the Middle Lias we are concerned with. The "*Margaritatus*" *Zone* is characterised by Lamellibranchs; the "*Spinatus*" *Zone* by Brachiopods; and the "*Transition-bed*" by Gasteropods. These differences are much more evident to those practically acquainted with the beds than to those simply studying the list of fossils from them, owing to the abundance of individual specimens of common forms rather than distinct species.

So far as my own observations go, bed "L" is the highest in which *Avicula cygnipes* and the very large specimens of *Pecten liasinus* occur. *Limea acuticosta* reaches its maximum development in the beds "I," "J," "K," and then rather rapidly declines in numbers; the same remark applies to *Unicardium globosum*. *Pholadomyas* are met with in greatest abundance in bed "H," but above this they are comparatively rare. Bed "F" seems a very decided boundary for a number of fossils. *Ammonites margaritatus*, *Pleuromya costata*, *Cardinia antiqua*, *Cardinia lævis*, *Goniomya heteropleura*, and *Arcomyas* practically finish in it, only stragglers of any of them being found above. "D" is the highest bed in which I have found *Pholadomya ambigua* and *Cardita multicosta*, and the lowest for *Pecten textorius*.

The Rock-bed "B" contains a good number of things not yet found in any of the lower beds—*Ammonites spinatus*. *Hinnites*, *Pectens*, *Limas*, *Spiriferinas*, and enormous numbers of *Brachiopods* of the classes *Terebratula* and *Rhynchonella*, of which I have not found even the genera in the "*Margaritatus*" *Zone* of Northampton.

I need not here enumerate the fossils peculiar to the Transition-bed "A," because they are numerous, and the table of fossils to follow will sufficiently show them. Whether we regard the Transition-bed as a separate bed or only a modification of the Rock-bed, there is certainly as much difference between it and the true Rock-bed—palæontologically—as between any of the Middle Lias beds.

The following fossils have a considerable vertical range, passing through all or nearly all the beds:—*Ostrea cymbium*, *Pecten liasinus*, *Pecten æquivalvis*, *Limea acuticosta*, *Plicatula spinosa*, *Avicula inæquivalvis*, *Astarte striato-sulcata*, and *Protocardium truncatum*.

(To be continued.)

Colours of Flowers.—The shades of red and brown in the leaves of zonal pelargoniums are due to the same colouring matters as are found in the flowers of those plants. Hence when the flowers are picked off, which is a common practice with gardeners, the tints of the leaves become more brilliant, because they then monopolise the whole supply.—H.

Dressing for Insects.—Mix nine parts of benzole with one part of carbolic acid. This may be lightly brushed over the insects with a camel-hair brush. Beetles, &c., may be dipped in bodily, and the excess fluid removed with the brush.—H.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 110.)

COVENTRY, St. Michael's. I.—*Maria Hinton, 1594, with four infants. Haines.*

The plate containing the figures is 8½in. by 11in.; that with the inscription 1ft. 4½in. by 11in.

The lady is represented as kneeling at a prayer-desk, upon which is an open book. She wears a high-crowned hat with curled brim, and ruffs at the neck and wrists (?). Her over-gown has a wide turned-back collar and plain skirt, and is confined at the waist by a belt. It is sleeveless, and allows the striped sleeves of the under dress to be seen.

Upon a tiled floor near the prayer-desk lie four infant children in *chrysoms* and swaddling clothes. The chrysom was a "white cloth with which children were invested" at their baptism. If the child died before it was a month old the chrysom became its shroud. Swathing-bands were wrapped round the under clothes, giving the child the appearance of a mummy. These children all died in their infancy. The inscription is:—

MARIAE HINTON FAEMINAE LECTISSIMAE
VXORI DILECTAE PROBAE ET PIÆ MARITVS
AMORIS HOC SVI MONVMENTVM POSVIT.

Quæ pietatis eras, quæ relligionis amore,
Et matronali cunctis gravitate probata,
Vivens et moriens constans exemplar amicis
Vivendi in vita, moriendi in morte relinquis.
Sic tibi, sic vivit vitae bona fama peractae;
Sic tibi, sic vitae constat spes viva perennis.

OBIIT ANNUM AGENS TRICESSIMUM
APRILIS 27°, 1594.

Translation:—To Maria Hinton, a woman of a thousand, a wife beloved, righteous, and dutiful, her husband has set up this memorial of his affection.

Approved by all for holiness of life
And love, and all that can adorn a wife,
Alive or dying thou dost ever give
A pattern how to die and how to live.
Thus lives thy good report of life well passed,
And certain hope of life that aye shall last.

She died in her 30th year, April 27th, 1594.

Maria Hinton was the wife of Dr. William Hinton, Vicar of St. Michael's and Archdeacon of Coventry. (Sharp's Antiquities of Coventry, p. 12, and Poole's Antiquities, pp. 138-9, where an illustration of this brass is given.)

II.—*Ann, w. of Wm. Sewell, Vintner*, 1609. *Haines.*

Like the above, this brass consists of two plates; the upper being 11in. by 8½in., the lower 1ft. 4½in. by 8½in. The lady kneels upon a tiled floor before a prayer-desk. She wears a high broad-brimmed hat, wreathed round the crown. This is worn over the "Paris head," "a kind of close linen cap projecting forward at each side of the face, often with . . . a lappet dependent behind" (Haines). Round the lady's neck is a large ruff; her dress has tight sleeves, a plaited stomacher, and plain skirt.

To her memory is the following inscription :—

HER ZEALOVS CARE TO SERVE HER GOD
HER CONSTANT LOVE TO HVSBAND DEARE
HER HARMELES HARTE TO EVERIE ONE
DOTH LIVE ALTHOVGH HER CORPS LYE HERE
GOD GRAVNTE VS ALL WHILE GLASS DOTH RV
TO LIVE IN CHRIST AS SHE HATH DONE.

ANN SEWELL Y^E^ WIFE OF WILLM SEWE^LL^ OF THIS CYTTY VINT
NER DEPTED THIS LIFE Y^E^ 20^TH^ OF DECEM : 1609 OF THE AGE OF
46 YEARS: AN HVMBLE FOLLOWER OF HER SAVIOVR CHRIST
AND A WORTHY STIRROR VP OF OTHERS TO ALL HOLY VERTVES.

Illustrations of the brass will be found in Bloxham's Mon. Arch., p. 254, and Poole's Antiquities of Coventry, p. 138.

III.—*Inscription. Captain Gervase Scrope*, 1705. *Mural.*

This memorial, not mentioned by Haines, is upon a large plate, 2ft. 2in. by 1ft. 10in., within a moulded stone border. At the top is a small shield, with the arms of Scrope, az., a bend or., and the legend, *non haec, sed me.* Then follows :—

Here lyes the Body of Capt^{n}. GERVASE SCROPE of the Family
of the SCROPES of Bolton in the County of York who
departed this life the 26th day of Aug^{t}. Anno Dni 1705
Aged 66

AN EPITAPH Written by Himfelf in the Agony and
Doloro^{v}s Paines of the Gout, and dyed soon after.

Here lyes an Old Tofsed TENNIS BALL,
Was Racketted from Spring to Fall
With so much heat and so much haft,
Time's arm for shame grew tyr'd at laft.

Four kings in CAMPS he truly seru'd
And from his Loyalty ne'er sweru'd.
FATHER ruin'd, the SON slighted,
And from the CROWN ne'er requited,
Loſs of ESTATE, RELATIONS, BLOOD,
Was too well known but did no good.
With long CAMPAIGNS and paines o' th' GOVT
He cou'd no longer hold it out.
Always a reſtleſs life he led,
Never at quiet till quite dead.
He marry'd in his latter dayes
ONE who exceeds the common praise ;
But wanting breath still to make known
Her true AFFECTION and his OWN,
Death kindly came, all wants supply'd,
By giving REST which life deny'd.

An illustration of this brass is given in Poole's Antiq. of Coventry, p. 140.

In addition to these there are several other inscriptions on brass plates, the most noteworthy being :—

"Here lyeth Mr. Thomas Bond, Draper, sometime mayor of this cittie, and founder of the hospitall of Bablake, who gave divers lands and tenements for the maintenance of ten poore men so long as the world shall endure, and a woman to looke to them, with many other good gifts; and died the xviii. day of March in the year of our Lord God MDVI." Lisle Cave, Esq., 1622. Mrs. Mary Vavasour, 1631. John Wightwick, of Pembroke Coll., Oxford, 1637; fourteen Latin elegiacs, with punning allusion to the Holy Trinity; Abraham Astley, M.D., 1662 ; a Greek motto and twelve Latin elegiacs. The Honble. Caroline Hood, 1858.

Poole quotes the following from Sir John Harrington (temp. James I) :—"The pavement of Coventry Church is almost all tombstones, and some very ancient; but there came in a zealous fellow with a counterfeit commission, that for avoiding superstition, hath not left one pennyworth nor penny-breadth of brass upon all the tombs of all the inscriptions, which had been many and costly." (Poole, p. 141.)

Holy Trinity Church. *John Whithead, mayor, and ws., circ.* 1600. *Haines.*

This brass is wrongly assigned by Haines to S. Michael's. It is 2ft. 4½in. by 18in., and is inlaid in a mural tablet with moulded border. The mayor wears a ruff and his official fur-edged gown. His hair is brushed back from the forehead, and he wears a moustache and pointed beard. At the ends of a prayer-desk, before which he stands, kneel his wives. The one upon his right hand wears a high-crowned hat with narrow curled brim, over a "Paris head;" a ruff, an outer gown open down the front and confined by a sash, and an under dress. The wife on the left side is similarly dressed, but without the hat. Her French hood is depressed in the centre.

Below the former wife kneel three girls and a boy; under the latter, three boys and two girls, a prayer-desk separating the groups. The girls are dressed like the lady last described; the boys wear short doublets, knee-breeches, hose, and shoes. At the mayor's right hand are the arms of Coventry, at his left those of Whithead.

There is the following somewhat fanciful inscription:—

CARMEN IN OBITVM VIRI CHARISSIMI JOHANNIS WHITHEAD QUONDĀ PRAETORIS HUIUS CIVITATIS DIGNISSIMI.

ROMA NVMĀ JACTAT DECORAT LACEDAEMONA PRISCĀ
JVSTA THERAPNAEVS JVRA LYCVRGVS AGENS.
NON MINOR EST NOBIS PRAECISO STAMINE VITAE,
QVI JACET HIC CLAVSVS LVMINE CASSVS HVMO.
VIRTVTIS CVRSV CONSTANS ATHLETA JEHOVAE,
O QVAM LONGE ABERAT SVBDOLA GRAECA FIDES.
MORTVVS ANTE DIEM PROH, SAEVO FVNERE RAPTVS
TEMPORE PRAETVRAE, MORTVVS ANTE DIEM.
TEMPORE PRAETVRAE, TRIBVS ET PLUS PARTIBVS ANNI
OFFICIO FVNCTVS, SCANDIT IN ASTRA POLI.

In English thus:—Epitaph upon the death of the well-beloved John Whithead, sometime most worshipful mayor of this city.

Rome boasts of Numa: ancient Sparta's famed
For equal laws by her Lycurgus framed.
As great our chief who, in death's gloom profound,
His life-thread snapt, here rests beneath the ground.
God's steadfast champion in virtue's race,
No subtle Grecian guile might him disgrace.
Ere his day, dead, to cruel fate a prey,
He died in harness, ah! died ere his day.
He died in harness, scarce a year was given
In which to rule, ere he was called to heaven.

For an illustration of this brass see Poole, p. 140.

Mention should here be made of an ancient brass tablet, dated 1568, now in St. Mary's Hall, on which are engraved the conditions of the lease of Cheylesmore Park, granted by the Duke of Northumberland to the Mayor, Bailiffs, and Commonalty of Coventry.

(To be continued.)

FUNGUS-HUNTING IN SPRING.

BY W. B. GROVE, B.A.

Away to the woods! Away! The Spring is come. The longest, dreariest Winter of our time is gone; *abiit, evasit, erupit*, and, as our Warwickshire folk express it, "Joy go with him;" though why Joy should be expected to go with a guest whose departure is welcome I confess I never could understand. I would prefer she stay, and truly while fungi abound so thickly as they do, and eyes and microscope hold out to view them, there is little doubt she will.

It seems but a fortnight since we wandered disconsolate by icebound brooks and dreary hedgerows, and now on this brilliant day in early April the sun is shining in an almost cloudless sky, and the wind is scarcely chill. The hawthorns are leaping into leaf, the horse-chestnuts are bursting their huge buds, the catkins are hanging from the hazel, the flower-buds of the elm have decked each twig with two geometrical rows of rich brown globes.

In our sad brumal climate it is remarkable how speedy a change clear skies and the sun's unfettered rays work in us. Our blood courses quicker in our veins. Old and staid as we are, we vault the stiles and fences with a lively glee. But stay; as we place our hands for this purpose on a pole which forms the upper rail of a fence our eyes are attracted by a myriad black round tiny specks bursting through the bark which had not been removed from the rail. Behold a fungus.

"Thanks, thanks to thee, my worthy friend," thou unknown farming man, unwitting benefactor of thy kind, whose hand hath placed this pole to rot and grow rich in saprophytic life. A blessing in corduroy art thou to the mycologist; for the sticks thou plantest in the earth to make thy sham hedges, the chips and cuttings thou leavest in the woods and ditches, the stumps and logs thou lettest decay in winter instead of burning them to warm thy shivering limbs —all these are his happy hunting grounds, and of the smaller fungi yield him richest treasures.

Glancing again at the pole, our first thought is to determine the species of tree to which it belongs. This gives us pause. The pole is straight, about 8ft. long, and 5in. thick at the lower end; the bark is smooth, shining, and greyish, here and there brownish-white. It cannot be birch, for it is not white enough; nor beech, for it is too shining. The wood is not the pure white of the holly. The bark resembles that of young hawthorn, and has in parts somewhat of the rich tawny sheen of the hazel; but the pole is too large for these. It has not the purple undertone of the laburnum, and the trunk is too straight; for the laburnum loves to grow in undulating curves, wherefore when young it lends itself readily (note this, ye suburban gardeners) to the tying of fantastic knots and loops, which in their old age will be a sight curious to behold. The wood shows that it is not young oak, though the bark is similar to that of a sapling "monarch of the forest." At last, I have it. It is a mountain ash!

Of course I am merely putting into words the thoughts which passed swiftly through my mind, while gazing at the pole. Further comparison and the judgment of a friend "weel acquent wi' trees" confirmed my conclusion; but a more decisive, because impartial, confirmation was still to come. Examined at home, the black specks of our prize resolve themselves into irregular globes, called perithecia, whose interior is filled with colourless spindle-shaped spores. This, combined with the habitat on the branch of a tree, shows that we must look for our fungus among the species of the genus Rhabdospora.

The first step towards its nearer determination was to make out the form and size of the perithecia, and here an unexpected difficulty presented itself; no two perithecia were alike; some round, some oblong; at one time single, at another crowded; now obtuse at the summit, now acute; here opening by a small round pore, there splitting with a long and gaping slit. These are the very points which we find in general to be helps in determining a species, but here everything is irregular. Then I look at the spores (or sporules), which by careful measurement are found to be about sixteen or seventeen thousandths of a millimetre long.

It remains but to turn to that monument of Herculean labour, the "Sylloge Fungorum Omnium" of Professor Saccardo. This great Italian mycologist, the professor of botany at the University of Padua, who stands head and shoulders above all the other mycologists of the age, has conferred upon his fellow-students a boon for which they can never be too thankful. In his Sylloge, he is collecting (for the work is not yet half finished) the descriptions of all known fungi, and our fungus fortunately belongs to one of the groups of which he has already treated. The perithecia, enclosing free spores, point it out as belonging to the Sphæropsideæ, a distinct and well-marked class which is swallowed up, under the old Friesian system, by that *olla podrida*, the Coniomycetes.

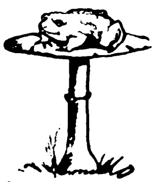
In the genus Rhabdospora, Saccardo enumerates only eighty-six species, and in a rapid glance down the pages the attention is at once arrested by *Rhabdospora inæqualis*, a name that seems exactly suited to describe the varying forms of the perithecia which were so puzzling. On looking below we find, in fact, that this very variation is given as characteristic of the species. The size of the spores is the same, the other points of the description are not inconsistent, and, most conclusive of all, the habitat is given as "on smooth bark of *Sorbus aucuparia*."

But we have not quite exhausted the resources of civilisation. This species was erected by Professor Saccardo himself in his "Reliquiæ Libertianæ," *i.e.*, the descriptions of part of the vast collection of fungi left behind by the late famous mycologistess (excuse the word) of Malmédy, the indefatigable Madame Libert. Now it is well known that Saccardo, with that care and perfection of method which have raised him to his present fame, generally illustrates by figures the new species which he describes, and, on turning to the part (Series iv.) of the Reliquiæ in which this species is contained, we find a figure which to our great delight proves to be an excellent representation of the one we have been examining.

"Now my task is smoothly done." No link in the chain is wanting. We have determined our fungus with a degree of certainty which cannot always be attained, and are still further rewarded by finding that it is a species new to Britain. Nor was this the only spoil brought back from that first spring walk, but time would fail to tell of all the others.

ON THE WEAPONS OF ANIMALS.*

BY F. T. MOTT, F.R.G.S.



In the vegetable world the struggle for existence is carried on not by active warfare but by the process of starving out. It is not a question of weapons but of vegetative vigour. In the animal world, however, with the capacity for locomotion comes war in its most violent and terrible aspects, and the provision of weapons for both offence and defence becomes one of the prime necessities of life.

* Transactions of Section D of the Leicester Literary and Philosophical Society. Read February 18th, 1885.

Plants as a rule do not feed upon one another, and obtain only an indirect advantage by the smothering of their competitors. But while one half of the animal kingdom feeds upon plants, the other half devours the flesh which is thus manufactured. The struggle for life is therefore much more complex, depending partly upon vegetative vigour, partly upon muscular development, but largely also upon the excellence of the weapons, and upon intellectual cunning.

The weapons are furnished either by the adaptation of various organs, or by the growth of additional organs for that especial purpose, and there is an extraordinary variety both in their structure and their uses. There is scarcely a single external organ which has not, in some species of animal, been adapted as a weapon of war. Teeth, tongue, lips, nose, eyes, ears, arms, legs, hands, feet, tail, hair, skin, and even the body itself are all made available as fighting weapons, besides a number of special growths taking the forms of horns, spurs, spines, tentacles, stings, javelins, stink-bags, and electric batteries.

Carnivorous habits are almost necessarily associated with fighting weapons, and as there are carnivorous species in every great division of the animal world, there are found in every one also organs of attack and defence, from the infusoria to the highest vertebrates.

The following table shows the various organs and special growths, with indications of the families and species by which they are used as weapons:—

MODIFIED ORGANS.	
Teeth..................	Most mammals, reptiles, and fishes, and some invertebrates.
Tongue	Ant-eater, chameleon, frog, echidna.
Mandibles	Birds, tortoises, insects.
Palpi	Scorpion, chelifer.
Nose	Elephant.
Eyes	Snakes, for fascination.
Ears	Horse and donkey, as fly-flaps.
Claws...................	Carnivorous mammals and birds.
Hoofs..................	Ungulate mammals, for striking and trampling.
Fore limbs...........	Deer, swan and other large birds, for striking. Lobster, and other crustaceans.
Hind limbs..........	Horse, donkey, giraffe, cattle, &c., for kicking.
Tail	Whale, kangaroo, crocodile, and most land mammals, for defence.

Hair, as spines......	Hedgehog, porcupine, echidna.
Tentacles.............	Octopus, hydra.
Body..................	Boas and pythons.
Skin..................	Toads and medusæ, by poison glands.
Voice.................	Many mammals, for paralysing by fear.
SPECIAL GROWTHS.	
Horns.................	Ruminant mammals, rhinoceros.
Spurs.................	Gallinaceous and some other birds. Ornithorhyncus.
Stings.................	Hymenopterous insects, scorpions.
Poison fangs.........	Snakes, spiders.
Javelin hairs.........	Hydra.
Electric apparatus..	Torpedo, electric eels.
Stink-bag.............	Skunk, bombardier beetle.
Ink-bag...............	Sepia.

To these natural weapons the apes and monkeys add the artificial ones of sticks, stones, and hard fruit, and in man the natural weapons are altogether subordinate, his higher intelligence enabling him to manufacture his fighting implements, thereby releasing all his natural organs for the multitudinous offices which he requires them to serve.

From the foregoing table several curious facts may be deduced.

It appears that the use of poison as a weapon is confined to the lower orders of animals. No creature higher than a reptile possesses poison glands of any kind.

Stings are confined to the invertebrates; and among insects to the hymenoptera, the ants, bees, and wasps, which for intelligence and capacity stand at the head of the insect world. The sting of the scorpion is rather an abdominal fang than a true sting, having some resemblance to the fangs of spiders, with which family the scorpion is nearly allied.

Horns and antlers in all their wonderful variety are developed only by the ruminant mammals, with the one peculiar exception of the rhinoceros. Horns which are hollow but permanent are characteristic of all cattle, sheep, goats, and antelopes; while antlers, which are solid but deciduous, being shed and reproduced annually, are peculiar to the deer family.

Probably there is some connection between the growth of horns in these ruminants and the fact that as feeders upon grass chiefly they graze with their heads close to the ground, so that weapons on the forehead are ready for instant use.

But the horse, donkey, and zebra are also grazing animals, yet they have no horns.

The most formidably armed of all animals are the cats. No weapon can be more powerful or terrific in its action at close quarters than the retractile claw wielded by such muscular limbs as those of the lion and the tiger, and when to this terrible claw is added the no less terrible canine tooth, the creature so armed may well become the tyrant of his jungle.

Perhaps the most remarkable of all animal weapons is the electric battery possessed by two families of fishes—the torpedoes and the electric eels. These batteries consist of plates of bone and cartilage arranged in a sort of honey-comb fashion, the interstices being filled with gelatinous liquid and the whole apparatus supplied with innumerable nerves. The torpedoes are flat fish, and have two batteries, one on each side of the head. The electric eels have each four batteries. That these are reservoirs of energy is proved by the fact that when exhausted by repeated discharges they only become recharged after long rest and an abundant supply of food. They afford strong evidence that nerve force is a form of the same energy which is exhibited in the physical world as heat, light, and motion.

Throughout the whole vertebrate section of the animal world *teeth* form one of the principal weapons, except among the birds. No bird has yet been seen with anything like true teeth. Birds form a highly specialised and almost abnormal class, evidently evolved by long selection from some old reptilian type; and in the chelonian or tortoise group of modern reptiles occurs the same suppression of teeth and hardening of the lips into horny mandibles, which is so strongly characteristic of birds. The reason for this modification of the mouth in birds may, perhaps, be found in the same necessity for diminished weight which has modified their bones and limbs. The arched hook of the eagle's beak is as strong, though composed only of light horn, as any tooth could be of solid and heavy ivory. In the birds of prey there is the same combination of armed feet and mouth as in the mammalian cats. The talons of the eagle are not actually retractile, but the action of the free-spreading toes gives them a similarly piercing grip.

A considerable number of the weapons enumerated in the table are of rare occurrence, confined to small groups or single genera.

The palpi of the invertebrate mouth, which in most cases are soft and harmless organs, are converted, in the scorpions and chelifers, into weapons armed with jointed claws, like those of the lobster.

The nose becomes a formidable weapon only in the elephants.

The eyes can scarcely be reckoned among weapons at all, unless it be true that some snakes fascinate and paralyse their victims by their glassy and unwinking stare.

The ears of the horse, donkey, and some other animals are defensive only; but they are truly defensive weapons against the attacks of the gadfly and the tse-tse.

The use of a stink-bag, ejecting a pungent and disgusting liquid against pursuing enemies, is confined apparently to the skunk among mammals, and to two or three beetles among insects; and the ink-bag, rendering the water opaque so as to conceal the line of escape, to a few cephalopodous mollusks.

Nothing perhaps more distinctly marks off the human race from all lower animals than the entire absence of natural weapons. Man, inhabiting every region of the globe, is exposed to the attacks of every carnivorous beast and every poisonous insect; and he captures and eats a greater variety of prey than any other creature, yet he is naturally unarmed and defenceless. Brain power manifests in him its infinite superiority to brute force, and its development continually widens the gulf between him and his ancient ancestry, and opens to him the gateway of a new life.

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Chapters VIII., IX., X., "The Evolution of Life."

BY W. H. FRANCE.

"How is Organic Evolution Caused?"

The title of this chapter is a question which the chapter itself does not attempt to answer, except in a negative sense, and that only to a very limited extent; but sufficiently so to show that to further pursue the subject on such lines would be a waste of time and thought. To minds free from bias, principles which are erroneous soon show themselves as such, and, when recognised, the sooner they are abandoned the better.

* Transactions of the Birmingham Natural History and Microscopical Society.

Mr. Spencer has, in the chapter now under notice, referred to attempts on the part of De Maillet and others, including Dr. Erasmus Darwin (father of Charles Darwin), and also Lamarck, to explain organic evolution by the assumption that each form of life is imbued with an inherent disposition to develop new and improve existing organs, with also the tendency to transmit to their progeny such organs more or less developed, with increased desires for greater complexity of organisation.

Now, without any desire to ignore the facts of hereditary transmission of organs, whether rudimentary, developed, or even potential, it is only necessary to bear in mind the infinite variety of forms of life to perceive at once that such influences are but factors in the problem, and important as they undoubtedly are, they are quite insufficient for our acceptance as an explanation of the resultant effects. Where the conditions of life are stationary, forms of life are stationary also. Progress in organic development, either of kind or function, is not essential to vitality.

There are many kinds of plants and animals which, under existing conditions, are doomed to that extinction which, in every direction, has overtaken forms of life which, like individual lives, can never reappear, but under the improbable, if not impossible, recurrence of exactly the same conditions under which they were developed and maintained. I have yet to learn that individual lives of apparently expiring forms of life show any decadence of vitality. The facilities for the extension of any form of life over a larger area, or an increase of numbers on a given area, may be increased or lessened without any consequent individual loss of vitality, such as would be indicated by shortened lives. There is a plant, well known to us all by the name of groundsel—I abstain from the use of botanical terms as I am too ignorant to inflict them upon you—which, because it gives us trouble, we call a weed; and which I believe is doomed to extinction on account of its propensity to fertilise itself with its own pollen. However much that propensity may hasten the time when from its rarity the said plant may, for its beauty, be deemed a flower and treated as such, individual plants flourish without any apparent or recorded diminution of vitality.

The florist takes in hand an insignificant plant, and by skilful manipulation produces from it endless varieties of form and colour, none of which would have been produced but for the florist.

By similar processes of selection, the flockmaster suppresses in the sheep that of which he disapproves, and developes that which he desires as dictated by fashion or requirement.

Subjected as every department of nature now is to the scrutiny of modern science, the fact of universal evolution could not much longer have remained undiscovered.

Voltaire was once by all—and still is by some—theologians charged with atheism. Yet it was he who wisely asserted that were there no Creator, it would be necessary—in order to account for facts around us—"to invent one!"

In the same way, had we not in our vocabulary a word of sufficient expansiveness to cover the universe of mind as well as of matter, we should have to invent one. But as men's minds, searching after truth, saw in every direction, not only in existing, but in geologic records of successive forms of life, change without disruption, it became more and more necessary to frame a formula which should express the order which reigns where previously it was thought that accident and chaos might be held accountable for all that happened.

Thus the word "Evolution" has been raised to a dignity rivalling that of "Creator" in its universality. The application of the word "evolution" is, even by many students, limited to only a part of its full significance. An organ, by disuse, first loses its function, then the organ itself will in part or entirely disappear, according to its value in the general economy of the life of the animal or plant of which it forms a part. The partial or entire suppression of organs no longer required, or which are less necessary than previously, is clearly as much a part of evolution as is the development of entirely new organs either in substitution for or addition to existing organs. Further, what we call degradation even to extinction is still evolution. Death itself is necessary for the maintenance of life. So then the theory that high and complex forms of life are due to an innate desire on the part of low and simple forms to attain to something higher and more complex as presumably better is in no way substantiated by facts. Under prolonged domestication animals lose simultaneously or successively those organs which in a state of perfect freedom and self-dependence are necessary for attack or defence against other animals or climatic rigour.

The Shetland ponies wear more shaggy coats on their home hills than in this and other milder climes to which they are transported. Those animals which are reared in variable climates change their natural covering to suit the changed external temperature. So also do plants. The sheep in a wild state grows horns for combative purposes and conditions which do not exist under domestication. The hair-like wool of the wild sheep is better adapted to keep its body uniformly dry than is the absorptive covering which has been developed by agricultural selection and treatment. Coarse hair-like wool and horns are both objected to by the careful flock-master, who is constantly striving to suppress the tendency to reversion to those and other features prominent in wild sheep, and even in those which are in a semi-wild state on our mountains. I therefore suggest as an answer to the question conveyed in this chapter, that organs are produced or suppressed, not by an inherent tendency to produce or suppress, but solely by a prolonged and increasing necessity for such changes, such necessity being caused by modifications of environment due to climatic variations, which again are caused partly by terrestrial disturbance but mainly by changes in the form of our path round the sun.

The foregoing remarks are intended to refer to Chapters VIII., IX., and X., but were intentionally written before reading the two last mentioned, for the reason that I preferred thinking out for myself an answer to the first to acting simply as an echo, even to Mr. Herbert Spencer. By reading to you a few extracts from Chapters IX. and X. you will be well able to decide to what extent, in dealing with the question propounded in Chapter VIII., I have taken lines of thought parallel to those of Mr. Spencer.

DR. T. SPENCER COBBOLD, F.R.S., F.L.S.

It is with sincere regret we record that this distinguished Naturalist and Helminthologist passed over to the great majority on Saturday, the 20th of March last, at the comparatively early age of 58. Dr. Cobbold came of an old Suffolk family, his father being the Rev. Richard Cobbold, of Wortham, in that county, who was possessed of considerable literary ability. Dr. Cobbold was born in the year 1828, and was educated at the Charterhouse in London. After serving a three years' apprenticeship with Mr. Crosse, an eminent surgeon of Norwich, he proceeded, in 1847, to the University of Edinburgh, where he matriculated. His early talent was soon recognised, even as a student, in dissecting, in the preparation of specimens, and also as a draughtsman, and he was honoured by Professor John Goodsir with the appointment of Prosector. Under the influence of this great anatomist, and of the genial and accomplished Professor Edward Forbes, it was only natural that he should be attracted from his profession of medicine to the more absorbing study of animal morphology, and he soon after received a gold medal from the Medical Faculty for an essay in original research, on the "Canal of Petit." Many important papers followed, notably one "On the Anatomy of *Actinia*," in the Annals of Natural History for February, 1853, and the article "Ruminantia" in the Cyclopædia of Anatomy and Physiology, 1856. Honours also rapidly succeeded; he became President of the Royal Medical Society, and Curator of the Anatomical Museum.

Dr. Cobbold left his *alma mater* in 1856, and removed to London, where he devoted himself to the then neglected and somewhat repulsive study of animal parasites. In this he soon became famous, and his *opus magnum* on "Entozoa," published in 1864, and its supplement in 1869, and subsequent writings will take rank with the great works of Van Beneden, Von Siebold, Kuchenmeister, and Leuchart. From a sanitary point of view it is scarcely possible to estimate the value of the researches of these distinguised Helminthologists, who have educated the people to an appreciation of their science in its practical bearing, and thus greatly added to human life and happiness.

Dr. Cobbold was elected F.R.S. in 1864, and he held several professorships in London; one of the most important being that of Swiney Professor of Geology, under the Trustees of the British Museum, and he had also been President of the Quekitt Microscopical Club.

His memory will be long held in respect, both by the Members of the Birmingham Natural History and Microscopical Society, and by the Members of the Midland Union. He was an honorary Vice-President of the Society, and he was among the early founders of the Union, in both of which he took great interest. His long and valuable series of Papers on the "Parasites of Man," which appeared in the early numbers of the "Midland Naturalist," have been again and again recognised not only in England, but also on the Continent, and in America.

In private life Dr. Cobbold had many attractions irrespective of his scientific abilities. His brightness and true-heartedness, his desire for others rather than himself, his intellectual companionship, and his ready willingness whenever his services were sought in the offices of friendship, are qualities that ennoble the man beyond even his fame as a scientist.

Dr. Cobbold succumbed after a few hours' illness from a long-standing cardiac affection, in perfect consciousness and thoughtfulness, and he leaves a widow and several sons and daughters to mourn his loss. His place in the science that he followed cannot readily be filled. W. R. H.

FAULTS IN THE DRIFT.

BY W. J. HARRISON.

At Kibworth, about eight miles south-east of Leicester, I examined some extensive sand pits in 1875. The sand and gravel is false-bedded, very flinty, with the black streaks which seem everywhere to characterise these drift-sands. The gravel is worked to a depth of from 30 to 40 feet, below which the presence of water stops the working. In some of the pits the sand is distinctly faulted, the faults being of small throw, not exceeding a few feet. The existence of faults in the drift has been strongly denied, yet here the beds are undoubtedly displaced. I do not, however, think that the faulting extends to the lias beneath. Probably it is due to a "settling" of the sands, owing to some change at their base. In the pit which lies 200 yards north-east of the railway station the lower part shows some remarkable contortions; a bed of clay, which looks like reconstructed lias, being pushed up into long tongues, which penetrate the gravel. A block of lias limestone here, full of *Gryphæa incurva*, had one side as finely polished as could have been done by hand. We have here unmistakable evidence of the presence of ice, either as a berg or a glacier. The surface of these pits is about 376 feet above sea level. From one of these pits a workman gave me some fragments of encrinite stems—"sharks' backbones" he called them.

ANNUAL MEETING OF THE MIDLAND UNION OF NATURAL HISTORY AND SCIENTIFIC SOCIETIES,

To be held at Shrewsbury, June 22nd and 23rd.

The Reception Rooms will be at the Music Hall in the Market Square, where also the Council Meeting, at 12 noon, and the General Meeting, at 3 P.M., will be held on Tuesday, June 22nd.

After the Meeting there will be a visit round the Churches and other objects of Antiquarian interest of the town.

The Conversazione will be held at the Music Hall at 7.30. Members of the Associated Societies willing to contribute specimens and objects of interest for the Conversazione will kindly communicate with W. Phillips, Esq., 37, High Street, Shrewsbury.

On the 23rd of June there will be Three Excursions, of which the objects will be mainly Geological, Botanical, and Archæological respectively.

GEOLOGICAL EXCURSION.

The party will leave Shrewsbury by the 10.35 train for Craven Arms Station. On their arrival they will proceed along the Corvedale Road, passing on their way quarries of Aymestry Limestone, to Norton Farm House, where a good exposure of the famous Ludlow Bone Bed may be seen, as well as sections of the Upper Ludlow and Downton Sandstone containing characteristic fossils. From Norton they will ascend to the edge of the Bluff, called Norton Camp, a good specimen of British or, in the opinion of some, of Saxon entrenchment. A fine and instructive view is afforded at various points of the route of the succession of strata up to the Carboniferous towards the East, and down to the Llandeilo on the West. From the Camp a descent may be made to Stokesay Castle, a fortified mansion of the age of Edward I., not far from which is a quarry replete with Lower Ludlow forms. The entire distance of the walk and back to the station is five miles.

A Meat Tea will be provided at the Craven Arms Hotel, close to the Station, at 5 P.M. The Return Train arrives at Shrewsbury at 7.35. The Excursion will be conducted by the Rev. J. D. La Touche, President of the Union, who will point out the various objects of interest from time to time along the route.

BOTANICAL EXCURSION.

The party will drive to Colemere Village and from thence walk by Colemere Mere and Kettlemere to Ellesmere. If time permit they will also visit Whitemere. A Meat Tea will be provided at Ellesmere, and the party will drive back to Shrewsbury in the evening.

ARCHÆOLOGICAL EXCURSION.

Carriages will take up the party in the Market Square at 9 30 A.M. The drive will be over the English Bridge, and by the Abbey Foregate, Lord Hill's Column and Atcham Bridge, to Wroxeter, where a halt will be made for the inspection of the "Old Wall" and other remains of the Ancient Roman city of Uriconium. The work of excavation has laid bare the foundations of walls, pillars and other remains of Hypocausts, tesselated pavements, &c., and some of these may still be seen. A large collection of objects of interest found during the work of excavation may be seen in the Museum of the Free Library, at Shrewsbury; and in Part III., Vol. II. of the Transactions of the Shropshire Archæological and Natural History Society is an article on "Roman Shropshire," by Mr. W. T. Watkin, in which much interesting information relating to Uriconium is given. The church at Wroxeter will be next visited. The tombs of the Newports in the interior are worthy of an inspection. From Wroxeter the drive will be continued, leaving Eaton Constantine on the left, through Leighton to Buildwas, where time will be given for a visit to the finely situated ruins of the Abbey. Hence a short drive will bring the party to Much Wenlock, where the ruins of the Priory, the Church, and other objects of interest will be visited. After a Meat Tea, at 4.30, the return drive to Shrewsbury will be by Harley and Cressage, Shrewsbury being reached about 7 P.M. The scenery passed through in this drive is of great beauty.

The very attractive character both of the ancient town of Shrewsbury and of the surrounding country makes it probable that this Meeting of the Union will be of unusual interest. Three such Excursions could probably be offered by but few localities within the boundaries of the Midland Union, and the archæology of Shrewsbury itself will furnish abundant interest to those whose tastes lie more particularly in that direction.

It only remains for the Members to attend the Meeting in such numbers as to repay the labour that the Local Committee have given to make the Meeting a great success.

Review.

Synopsis of the Natural Orders of British Flowering Plants. By JOSEPH W. OLIVER.—London: Simpkin, Marshall, and Co.

THIS very handy little book is compiled for the use of students preparing for the Science and Art and other examinations in Botany. It contains within the compass of eighteen pages the general characters of each British natural order of flowering plants; together with the number of genera and species found throughout the world, the number of genera and species found in Great Britain, and the scientific names of the leading British genera. To the overtaxed student it will be a great boon, giving him, in small space and at little cost, information only to be found in much more costly books. If the advice given by the compiler be strictly followed, the knowledge gained will be of the greatest service in the examinations. The arrangement is mainly that of Bentham's Handbook, and the diagnosis of the natural orders that given in the Student's Flora. The type is small but clear, and the book a very convenient size for the pocket. J.E.B.

METEOROLOGICAL NOTES.—MARCH, 1886.

Pressure was unsteady till the 6th, when the mercury rose rapidly, reaching 30·500 inches, its highest point, on the 11th; thence it fluctuated downwards to the end of the month. The mean temperature was about one degree below the average. The first eighteen days were decidedly cold, the maximum being below forty degrees on eleven days. From the 18th to the end of the month more genial weather was experienced. The highest maxima were 64·9° at Loughborough and 64·0° at Henley-in-Arden on the 24th; 63·2° at Hodsock on the 21st; and 61·0° at Strelley and Coston Rectory on the 24th. In the rays of the sun, 126·6° at Hodsock on the 6th; 116·8° at Loughborough, and 107·2° at Strelley on the 25th. The lowest minima were 6·5° at Coston Rectory, 8·4° at Hodsock, 13·3° at Strelley, 13·5° at Henley-in-Arden, and 16·1° at Loughborough, all occurring on the 7th. The thermometer on the grass registered 5·4° below zero at Hodsock on the 7th, 10·5° at Strelley on the 6th, and 14·6° at Loughborough on the 7th. Rainfall was above the average, the total values of rain or melted snow being 3·15 inches at Strelley, 2·70 inches at Loughborough, 2·58 inches at Coston Rectory, 2·35 inches at Hodsock, and 2·21 inches at Henley-in-Arden. Heavy rain fell in some districts on the 30th, when 1·23 inches were collected at Strelley, and 0·82 inches at Loughborough. The number of "rainy days" varied from fourteen to twenty.

The amount and frequency of snow storms were unusual for March. A slight thunderstorm visited Loughborough on the 29th, and thunder was heard at Coston Rectory on the same day. Sunshine was deficient.

12, Victoria Street, Loughborough. WM. BERRIDGE, F. R. Met. Soc.

Natural History Notes.

COMPOSITION OF THE EARTH.—The following estimate of the proportion of the various elements in the crust of the globe is by the Italian geologist, Prof. A. Stoppani :—

	Parts in 1000
Oxygen	500
Silicon	250
Aluminium, Magnesium, Calcium, Potassium, Sodium, Iron	227
Carbon, Sulphur, Hydrogen, Chlorine, Nitrogen	23

Of the remaining elements, about 57 in number, the aggregate mass is too small to be noticeable.—H.

BOULDER-CLAYS.—The finely laminated clays which occur irregularly in the drift I have always found to be unfossiliferous. They appear to have been formed by rapid streams issuing from the termination of the melted ice and carrying along the finely-divided particles which are formed by the crushing of the rock-fragments along the bed of a glacier.—H.

TREES.—At the outside there are only about fifty common forest trees in Great Britain ; not more than twice as many as the letters of the alphabet. Yet how many know the alphabet of trees? How many people can name even the trees they see in a single walk? Loudon's book, now out of print, is still the best general guide to a knowledge of trees and shrubs.—H.

REPTILES — ROMAN COINS. — Will any reader of the "Midland Naturalist" kindly inform me if "Reptiles" exist at the present time in Ireland; and, if so, what species, and in what localities? Also the best work from which to name and tabulate "Roman Coins," together with price and name of publisher.—J. W. BODGER, 18, Cowgate, Peterborough.

Reports of Societies.

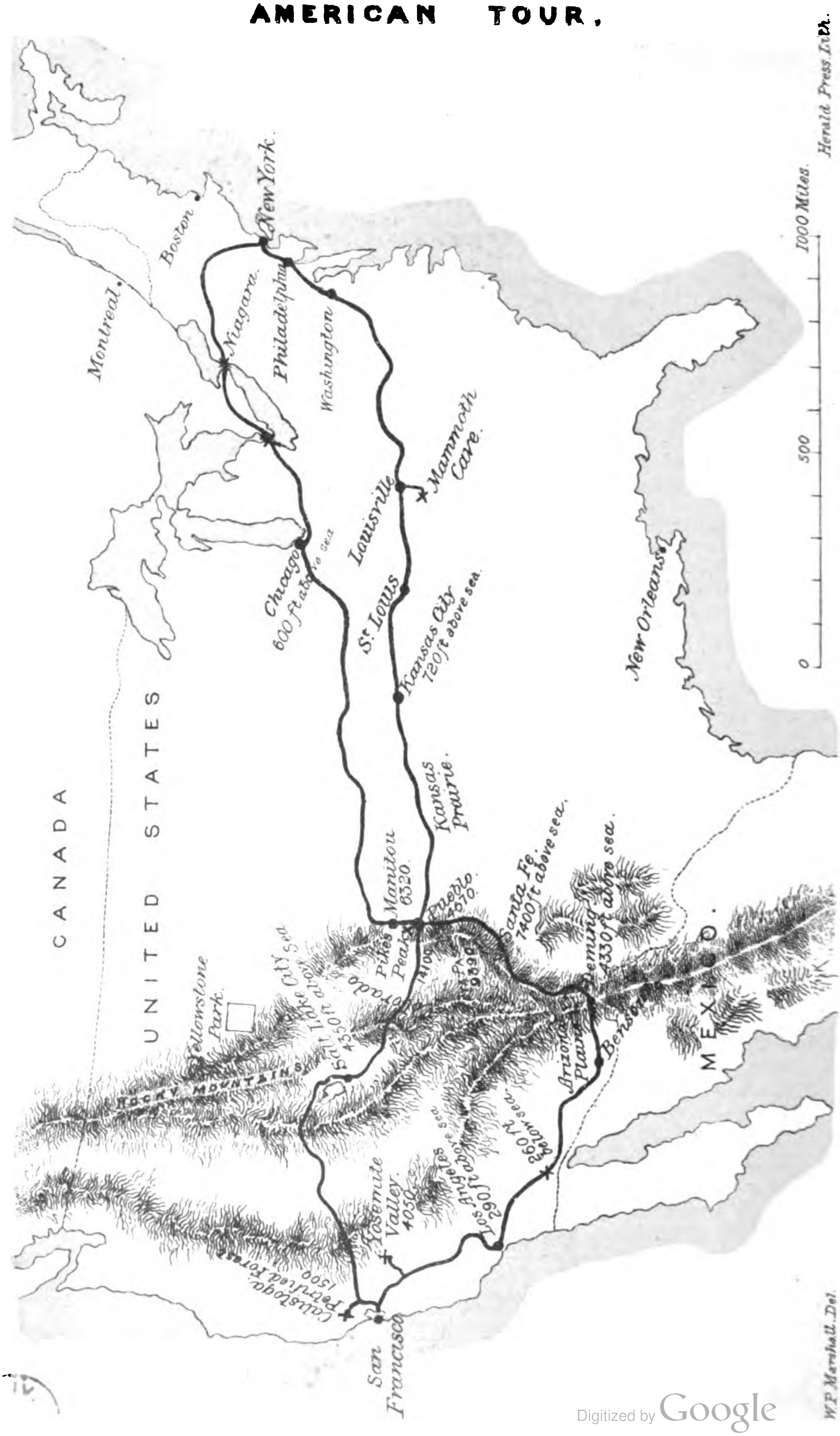
BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, March 2nd.—Dr. Crosskey delivered an address on "The Physical History of Great Britain from the Glacial Epoch to the Present Day." Dr. Crosskey chiefly occupied himself with the discrimination between the established facts and the problems yet to be solved. A rise in the level of the land accompanied the coming in of Arctic conditions. The exact height reached is uncertain, but the existence of large river beds beneath ice-made clays; the changes in water courses necessary for the existence of many caves; the evidently altered courses of some of our present rivers, prove the alteration of level. Which of our local Midland glacial beds, if any, belong to this period of extreme cold and elevation is a point to be examined. Was there a great ice sheet obliterating hills, valleys, and plains, or simply an Alpine condition of the country? Subsidence followed. What was its depth? Certainly 1,400ft., probably 2,000ft. The local shell only proves a depression of 500ft. or 600ft. Dr. Crosskey found marine foraminifera near Wolverhampton 519ft. above the sea level. Elevation and subsidence, however, must have gone on irregularly, and have been effected to a greater and less extent in various localities. The surface of the land did not go up *en masse* and sink down *en masse* in two consecutive movements without any break any more than the climate became colder and colder and then hotter and hotter without fluctuation. The evidence there is of these fluctuations was noted. In the *Archipelago* condition of what is now Great Britain icebergs must have floated in the seas. *Some* of our boulders must have been dropped as they melted. But the question remains open for study whether the great and extraordinary accumulations of boulders mark the trail of the land ice or could have been deposited by icebergs. The land on its re-elevation attained a slightly greater height than at present. The work of ice in the valleys during modified Arctic conditions has to be distinguished from the older ice work. During this period a slightly warmer climate prevailed in Great Britain and forests flourished at heights and in latitudes in which they cannot now grow. Among the evidences of local land ice Dr. Crosskey noted the distribution of the Charnwood Forest and also the Rowley Rag boulders.—General Meeting, March 30.—The President, Mr. R. W. Chase, in the chair. Mr. Charles Pumphrey exhibited the section of a log of macassar ebony, perforated, as he supposed, by pholas; also two shells, apparently marine. Mr. W. P. Marshall, M.I.C.E., then read his paper, entitled "Notes on a Tour in America," which will appear in a future number of the "Midland Naturalist."—General Meeting, April 6th.—The President (Mr. R. W. Chase) in the chair; nearly sixty members and friends being present. Mr. J. Edmonds read a paper, "Hints on Photo-micrography," which he illustrated by exhibiting a series of negatives and positives, which he had taken on glass from various microscopic specimens, including insects whole and portions of some more magnified; sections of plants, and a few sections of rocks. He then exhibited a photo of the apparatus he had used, and gave a lucid description of it, remarking, for the encouragement of beginners, that with the recent improvements the process was easy, and need not be at all expensive. Mr. C. Pumphrey showed the pictures by the aid of the oxyhydrogen lantern; and afterwards he exhibited a number of views he had taken, showing the very interesting manner in which the cliffs of Bournemouth are weatherworn. He then rapidly showed a series of photos he had taken of flowers (mostly Alpine), animals, and snow scenes taken during some of the recent snowstorms. Mr. Pumphrey afterwards threw upon the screen some photos taken by Mr. T. H. Waller, B.A., of various rock sections, and also some photos of diatoms, &c., taken by Mr. Iliff.—Microscopical General Meeting, April 20th, the President (Mr. R. W. Chase) in the chair.—The news was received with deep regret of the death of two eminent scientists, T. Spencer Cobbold, M.D., F.R.S., whose papers and specimens have frequently been sent to this Society, and of the Rev. W. W. Newbould, M.A., whose labours in the Botany of this district have rendered more complete Mr. Bagnall's Flora of Warwickshire. Mr. J. E. Bagnall, F.L.S., read an account of a visit to the Arrow district, and exhibited a series of mosses, lichens, and plants which he found there, including *Helleborus viridis* (Green Hellebore), *Dicranum fuscescens*, *Scleropodium illecebrum*, &c. Mr. W. B. Grove, B.A., exhibited sterile form of *Corticium sangu·neum*, staining the wood scarlet, and green oak wood stained by the mycelium of an *Helotium;* also wood (? alder) stained orange by the sap. Mr. W. H. Wilkinson exhibited *Agaricus ostreatus*, the oyster fungus, from a poplar tree; an edible species. Mr. T. Bolton exhibited a small but interesting myriapod, *Polyxenus lagurus*, from King's Norton. Professor W. Hillhouse, M.A., then gave a minute description of the structure of a fern, and exhibited two living plants, *Osmunda palustris* and *O. regalis*, of which he showed sections to illustrate his remarks. After referring to the height to which the latter plant sometimes attains, 8ft. to 10ft., the Professor described the erect under-ground stem and its anatomy; then the leaf-stalk and the barren and spore-bearing leaves or fronds; and next described the curved lines of the vascular system, affording the most perfect mechanical arrangement for the requirements of the plant; and concluded by describing the alteration of the leaflet into the spore capsule, each nominally containing thirty-two spores. The beautiful sections under the microscopes, the diagrams, and the black-board sketches added very much to the interest of the lecture. After remarks by Messrs. Chase, Bagnall, Browett, and Morley, a hearty vote of thanks was passed to Professor Hillhouse.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 22nd. Mr. Hopkins exhibited specimens of Stag Beetle, *Lucanus cervus;* Mr. Corbet saurian remains from the Greensand, Cambridgeshire. Mr. Hopkins then read a paper on "A Day's Shell Collecting in Hampshire." The object of the journey was to procure specimens of *Helix obvoluta*, said to be found there. The paper described the visit as a successful one, the day's collecting yielding thirty-four species of land shells, including specimens of the one wished for. March 29th. Mr. Insley presented, on behalf of Mr. J. E. Bagnall, a number of diatomaceous earths from the United States. Mr. A. T. Evans exhibited a fossil coral from Ohio; Mr. Dunn, specimens of a fruit from India, the juice of which is used by the natives as a marking ink. Under the microscope Mr. J. Moore showed eggs of *Planorbis corneus;* Mr. Hawkes, a fungus, *Torula herbarum;* Mr. Tylar, sections of chalk, from Antrim, and pitchstone, from Arran.—April 5th. Mr. J. Madison exhibited specimens of *Actinocrinus* and *Productus punctata*, from Clitheroe; Mr. A. T. Evans, shark's teeth, from greensand; Mr. C. F. Beale, *Lima gigantea*, from Lower Lias, Barrow-on-Soar, and a group of *Gryphea incurva*, from Kilby Bridge; Mr. C. P. Neville, beetles, from Brazil; Mr. Mulliss, larva of gadfly, *Tabanus autumnalis*. A paper was then read by Mr. H. Insley on "The Past and Future of Geology." The writer stated that Geology, as a science, had not a history of great antiquity, though ideas regarding the origin of the earth were probably as old as mankind. The rise and progress of the science from early times was traced, and the work done by ardent enquirers summed up. A brief resumé of the effect of geological thought upon current Theology brought the paper to a close.—April 12th. Mr. J. Madison exhibited *Planorbis corneus*, densely clothed with an alga; Mr. Moore, specimens of *Unio tumidus* and *U. pictorum*. Under the microscope Mr. J. W. Neville showed the antenna comb of honey bee.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, April 21st. Attendance twelve (two ladies). The Chairman read the draft of the annual report of the Section to be presented to the Council of the Society, which was approved and adopted. Exhibits:—A leaf of chrysanthemum on the under-side of which were several minute cocoons of some very small insect, by Mr. E. F. Cooper, F.L.S. Mr. Vice undertook to keep these cocoons and report the nature of the insect which should emerge. Specimens of *Ricciocarpus natans*, a floating hepatic new to the county, recently discovered in a pond near Thurcaston, by the Chairman. Dr. Finch read a paper on *Colchicum autumnale*, commonly called the autumn crocus, which abounds in a meadow near Keyham, and has the unusual habit of producing its leaves in spring, its seed-vessels in summer, and its flowers in the autumn. The seed-vessels are of course those which result from the flowers of the previous year, but it was believed by early writers to be an anomalous plant which produced its seeds before its flowers. The poisonous and medical properties of the several parts of the plant were pointed out, and the paper was illustrated by an excellent series of fresh and dried specimens, in various stages of growth. Mr. Thos. Carter, LL.B., read a letter from Mr. L. Fosbrooke, jun., of Ravenstone, describing the recent capture of a badger in that neighbourhood.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—March 18th. GEOLOGICAL SECTION. —Chairman, Mr. E. Wheeler. The subjects considered were the Danish peat and shell mounds, Crannoges and the lake dwellings of Switzerland.—March 25th. BOTANICAL SECTION.—Chairman, Mr. J. W. Bodger. An informal address was given by the chairman on the plants brought by the members, viz.: *Draba verna*, *Tussilago farfara*, *Lamium purpureum* and *L. album*, *Mercurialis perennis*, *Arum maculatum*, *Senecio vulgaris*, *Capsella Bursa-pastoris*, *Ranunculus Ficaria*, *Viola odorata*, *Stellaria media*, *Cerastium semidecandrum*, *Corylus Avellana* (showing both male and female flowers), and *Bellis perennis*. The various forms of leaves and parts of the flowers were considered, and the chief characteristics of the plants pointed out.—April 2nd. GEOLOGICAL SECTION.—Chairman, Mr. E. Wheeler. Subject considered: "The Alluvial Deposits of the Palæolithic Age."—April 8th. BOTANICAL SECTION.—The chairman gave an address on "Phyllotaxis, or the Arrangement of the Leaves," illustrating the terms orthostichy, cycle, and genetic spiral by means of diagrams; showing also plants of *N. O. Labiatæ* and *Caryophyllaceæ* having a divergence of $\frac{1}{2}$, also Sedges with $\frac{1}{3}$ divergence, and giving instances of divergences of $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, and $\frac{13}{34}$. Miss Lilley exhibited in flower *Lamium album*, *Cerastium viscosum*, *Cardamine hirsuta*, *Corydalis solida*, *Capsella Bursa-pastoris*, *Narcissus Pseudo-narcissus*, and other plants.—April 15th. GEOLOGICAL SECTION.—Chairman, Mr. E. Wheeler. Portions of Lyell's "Students' Elements," pages 126—143, were read and discussed, reference being made by Mr. J. W. Bodger to the skull of the ox found in the Cambridgeshire Fens with a flint celt partially imbedded in the bone immediately between the horns; and by whom bones and teeth of *Elephas primigenius*, *Equus caballus*, *Cervus alces*, and of other animals from the Pleistocene gravels in the neighbourhood of Peterborough were exhibited.

AMERICAN TOUR.



NOTES OF AN AMERICAN TOUR.*

BY W. P. MARSHALL, M.I.C.E.

In this tour, which was taken last spring, the special objects aimed at were to see the great Yosemite Valley in California, within 150 miles of the Pacific Coast; the Pike's Peak District of the Rocky Mountains in Colorado; the Mammoth Cave of Kentucky; and to visit again the wonderful Niagara Falls that I had seen the year before on the occasion of the British Association Meeting at Montreal in Canada. The route taken extended across the continent, from New York to San Francisco, going on the way down to the Mexican frontier in the South, and returning by a different route up to the Canadian frontier in the North on the way to New York, as shown on the map, plate II.

The time of this trip was the two months of May and June, and that time of the year seems specially favourable for a visit to the North American continent, being clear of the winter snows, with the advantage of the recently melted snow for filling the waterfalls, and also clear of the great heat of summer, which is very oppressive in the greater portion of the continent, going up to a temperature of 100 degrees and upwards in New York. That city is in the same latitude as Naples, about 40 degrees latitude; and the most southern point visited on the Mexican frontier is in the same latitude as Alexandria in Egypt. The northern boundary between the United States and Canada is in the latitude of Paris, and the dotted line of 50 degrees latitude shown through the southern portion of Canada is the same as the south of Devonshire.

The most striking feature that claimed notice was the immense size of the country, which is nearly as far across from New York to San Francisco as the whole length of the voyage from England to New York (each about 3,000 miles), and on arriving at San Francisco you find yourself one-third way round the world, and your watch has to be altered eight hours from English time, or one-third of the whole twenty-four hours.

On the return to New York, at the end of this American tour, I found that I had travelled more than 8,000 miles without going out of the United States or going over any of the ground

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twice; and this distance is equal to the diameter of the earth, so that if there had been a passage through the centre of the earth to the other side that would not have been a longer journey. A most striking impression was received of the vast extent of the United States, which are seen to be really a compound of many widely different countries—the older Eastern States each about the size of England on the average, and the newer Western States several times larger. The contrast is very striking in going from New York State, with its energetic restless Yankee activity, to Virginian take-it-easy indolence of habit; and the contrast in the scenery from the extensive wooded hills and valleys of New York and Vermont to the barren prairies and wild deserts of Kansas and Arizona. The changes in the people too are very marked in going West, where they speak like English without the peculiar Yankee twang of the Eastern States; which is probably simply a survival of the old Puritan style of speaking established by the first settlers, the Puritan Fathers, and has since become greatly mixed and diluted in the Western States by the enormous subsequent immigrations.

New York is pre-eminently the capital of the United States, as London is of Great Britain; being equal in population to the whole of the ten next largest cities of the country, and as large as one-half the population of London, including with New York, Brooklyn and New Jersey, which are on the opposite banks of the two rivers.

New York itself is in a very unique position, and occupies the whole of an island ten miles in length and two miles in width, with the great Hudson River on one side, and on the other side the narrow extremity of the arm of the sea that separates Long Island from the main land. Brooklyn is situated on Long Island, and is as large as one-third the size of New York; New Jersey is on the main land, one-quarter the size of Brooklyn. The island on which New York stands, called Manhattan Island, is filled up completely with houses, excepting a small portion at the North end that is not yet built upon, and excepting the large Central Park that is reserved in the centre, about two and a-half miles in length and half a mile in width, which is beautifully laid out as ornamental pleasure grounds and forms a charming breathing place in the middle of the great city.

The streets are all at right angles and in straight lines, excepting the old portion of the city towards the southern point, which is irregularly built, and excepting the most important street, the celebrated "Broadway," which crosses the other streets obliquely for a great portion of its length.

The elevated railways are a special unique feature, and extend for eight miles in length from the southern extremity of the city; they are a very great convenience for quick and ready access to widely distant parts; fivepence (ten cents) fare anywhere by trains running every two or three minutes, with frequent stations.

The southern extremity of the city ending with Battery Point is the special business portion, containing the celebrated Wall Street great Stock Exchange and the wharfs from which the English steamers start. The approach from the sea is by the fine large harbour of New York, four miles wide, which is a remarkable sight with its throng of vessels of all kinds, including the numerous great ferry boats passing incessantly in all directions. The entrance to the harbour is at the outer bar of Sandy Hook, eighteen miles from New York, beyond which all the large steamers have to be piloted on departure and arrival, causing often a considerable delay; and the passage time of the steamers is consequently reckoned to and from Sandy Hook as a definite measure for the speed of passage. Some gigantic submarine blasting operations have been many years in progress for the removal of rock obstructions in the approach to New York from the opposite direction by the sea passage between Long Island and the main land, which will lead to the distance from England being shortened, and avoid the delay caused by Sandy Hook bar.

The railways to the North and East come into New York to the Central Station near Central Park; but those to the West and South, including by far the largest portion of the whole traffic, have to stop in New Jersey, on the opposite side of Hudson River, and the passengers are conveyed across to and from each train in very large ferry boats, which are like floating stations, and carry over horses and carriages with the passengers. As the river is too large for a bridge, a tunnel has been attempted for removing this great drawback, and bringing the railways direct into New York; but the work of the tunnel was stopped when only about one-quarter made, from the serious difficulties met with of sand beds under the river, and this work is still in abeyance. There is now, however, a bridge on the other side of the city over to Brooklyn, the celebrated Suspension Bridge, which has the largest span of any bridge yet constructed, and forms a very fine object in the view on approaching by the harbour.

Coney Island Elephant should be mentioned as a conspicuous object in the approach from sea to New York Harbour; it is a wooden seaside refreshment house, built in the form of a gigantic elephant, 130ft. length in the body, and 170ft. height to the top of the howdah canopy. It is entered by a spiral staircase up one of the legs, and stands in a tea garden on the shore (a truly American notion).

We now start from New York for the far West in the Philadelphia express, the quickest train in America, running the ninety miles from New York to Philadelphia in two hours, with one stoppage; and although this may not appear at first any very special speed, the case is materially altered when it is noticed that for some miles at each end of the journey the train has to travel along the streets of the two cities, getting along as well as it can, just like a steam tramcar in our streets. It is a strange sight to see a big express locomotive with a large train of the very long bogie carriages wandering along the public streets as if it had lost its way; its approach heralded by the clanging of a great bell on the engine, which is kept going incessantly whilst running through a town as a warning for clearing the way. The engine whistle is never used in towns because of its frightening horses, but they take no notice of the bell. The general speed of American trains is only about two-thirds that of English railways, and on the longest of the railway journeys, the one direct across the continent from New York to San Francisco, the average speed throughout, including all stoppages, is only twenty-two miles an hour.

The remarkable feature in the American railways is the extraordinary length of the lines; there are five separate railway companies working each of them more than 4,000 miles length of line, and one of these as much as 6,000 miles length; and a striking illustration is given by a comparison of the American monthly "Bradshaw," which takes the place of our sixpenny Bradshaw, giving the trains of 19,000 miles of railway in England, Scotland, and Ireland; and the American one is a two-shilling book, with the trains of no less than 148,000 miles of railway in the United States, Canada, and Mexico, and actually amounting to about one half of the total railway mileage of the world.

The line from New York and Philadelphia runs mainly over level agricultural country, and approaching Philadelphia the striking novelty is seen of peach orchards filled with peach trees, standing alone, much like apple trees in appearance, and bearing abundance of capital fruit. This fruit is served plentifully at the stations and also in the trains by lads who are frequently passing through the carriages whilst travelling, walking through the whole length of the train with baskets of fruit of various kinds, also varieties of sweetmeats of which the Americans take a good deal, and supplies of railway bookstall literature. The ease of travelling the very long distances that are required on American railways is greatly added to by the comfort and convenience of the American Pullman cars, in which you can walk about from one carriage to another, and enjoy fresh air on the open platforms between the carriages. This gives a comfort and ease in travelling that we have no idea of in this country, and it has been found a necessary provision for the very long journeys and continuous day and night travelling that are necessary in getting about the vast continent of America, where, from New York to New Orleans, 1,370 miles, is a two days and nights' journey; and from New York to San Francisco, 3,270 miles, is a six days and nights' journey. The comfort and convenience of the carriages is so great that you do not feel any more fatigue from a couple of days and nights' travelling than from a few hours' travelling in our carriages; on three occasions I travelled two days and nights continuously, and got out of the carriage at the end of the journey as fresh and ready for sight-seeing as if just stepping out of an hotel. The carriages are indeed really travelling hotels, for in parts of the thinly populated West, where refreshment stations are not to be met with, the meals are served and cooked in the train, and are thoroughly well managed.

Entering Philadelphia, the first bridge over the railway is seen; a long bridge, carrying a public road across many lines of railway. As a rule, there are not any bridges over the American railways, and they cross all roads and streets on the level, but the use of bridges is now getting introduced for the safety and convenience of thronged road traffic, and Philadelphia has taken a lead in this matter. Another novelty at Philadelphia Station was hansom cabs at reduced fares; the regular American four-wheel cabs are, in most cities, at the exorbitant fare of four shillings per mile (a dollar per mile).

Philadelphia is the next largest city to New York, having more than 800,000 population, and it contains one of the finest buildings in America, the new City Hall, a very large building of white marble, with four fronts of fine design, standing in the middle of a square in the centre of the city. Also, Fairmount Park, which is celebrated as the largest city park in the world, extending more than a dozen miles along both sides of the river.

Washington was next visited, with its grand Capitol, the Parliament House of the country, which stands on an eminence forming the terminus of a number of very wide, long lines of streets, that are laid out radially from the Capitol in all directions. The Capitol is a very large, noble building, surmounted by a fine dome that is nearly as large and high as that of St. Peter's at Rome, and would contain inside it the dome of our St. Paul's in London.

There has been recently completed at Washington the great Washington Monument, a gigantic obelisk, the tallest structure in the world, and actually 550ft. high from the ground; the highest structure previously being Strasburg Cathedral spire, 470ft. high. Washington city is laid out upon a very ambitious and grand scale, and has very fine lines of streets of great width, but these are at present only imperfectly built up, and the population is only about 150,000.

A day and night travelling then brought us to Louisville, and a further journey southwards to the great Mammoth Cave of Kentucky, which is reached by a drive of eight miles from the nearest station, over a very rough and hilly road. This wonderful cave is a series of limestone caverns and tortuous passages, which are entered from the side of the hill, and extend eight miles in direct distance from the entrance. There has been as much as 100 miles total length of these passages explored, and more still exist; and there are some of the chambers of enormous dimensions, one rotunda that we visited being 175ft. by 100ft., and 100ft. high; and one chamber was 500ft. long and 65ft. high. Five hours were spent in the cave, and a specimen was brought away of the celebrated blind crayfish, and one of the cave crickets caught running over a rock in the depth of the cave.

(To be continued.)

NOTES ON THE RIVER REA AND THE FLORA OF THE REA VALLEY.*

BY HENRY BOYDEN, B.A.

In turning over the pages of a fine old copy of Dugdale's "Warwickshire," in an old Warwickshire vicarage, a few weeks ago, I happened to light on a passage which indicates

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the author's view of the derivation of the name which our river bears. Under the head of "Edgbaston," he writes, "The Tame is enlarged by a brook called Rhea, from the British word Rhe, rheawdr, or rheag, as I conceive, which signifies to run or flow, and seemeth to have its origin from the Greek word ῥέω, *fluo*; which torrent hath its rise from the foot of the Lickey Hills in Worcestershire, whence, passing on with a swift course, it enters this county here at Edgbaston, whereof I am next to take notice." With regard to the name of the river, my conjecture is that the old orthography was that which Dugdale here employs, viz., Rhea, and that gradually the "h" was dropt in the spelling, as it was almost sure to be in the pronunciation, till about a century ago, when it was fixed in its present form. On the copy of a very old map, which I saw in the Edgbaston Estate Office, the name is spelt in both ways, which may indicate a transition period.

Adverting to Dugdale's description of the river, we notice that if he seems in one place to write contemptuously of it as "a brook," he makes ample amends further on by calling it "a torrent." And both terms in the description are accurately applied, for the Rea is a mere brook in dimensions through its general course, and it does roll down as a torrent in time of flood. The swiftness of its course is also correctly described, and may be accounted for by the fact of its descent from the Lickey and Frankley Hills, which are elevated about 800 feet above the sea.

From careful investigation of the locality, and personal enquiries among old residents, I came to the conclusion that the Rea has its highest source in a spring which rises midway on one of the Lickey hills, popularly called "The Shoulder of Mutton Hill," approached by a narrow footpath through the cultivated fields of Wetty Farm. The water from the spring trickles down by the side of a hedge, disappears underground, accumulates by field drainage, emerges in its descent towards Rubery, flowing through the village parallel with the Bromsgrove Road, and then round by the Lunatic Asylum, till it is joined midway between Rubery and Long Bridge by a babbling tributary. This takes its rise at the foot of a field descending from Frankley Beeches, flowing through a deep, narrow, shrub-entangled dingle; receiving on its right bank the waters discharged from a drain-pipe, passing in a tortuous course through woods, and then by the railway, till it joins the Rea. After this junction the Rea flows on as a conspicuous stream beneath Long Bridge, through Northfield, King's Norton, and Lifford, receiving at the Pebble Mill, Pershore Road, the tributary stream of Bournbrook, and passing there out of the county of Worcester into Warwickshire. From thence it flows by Cannon Hill and Calthorpe Park, where it enters on its town conditions, unfavourable to the botanist, and passes through the older part of Birmingham across Deritend, to join the Tame in the neighbourhood of Aston. The Tame, thus augmented, flows into the Trent beyond Tamworth, near to Croxall, and this finds its way into the estuary of the Humber, and so into the North Sea. In tracing the course of the Rea from the Lickey Hills to the German Ocean, the thought was suggested to me whether it would not be well, in addition to the county floras which we have, but the limits of which are artificial, to work out the flora of large natural geographical areas. The ornithologists of Scotland are working on this plan, as I saw by the maps of Mr. Harvey-Brown, during a recent visit. The great natural divisions of that country are more distinctly marked by its mountain systems than our own; but our larger rivers, with their affluents, would form, I think, botanical areas of an instructive character. Thus the Trent Valley might be taken as a large district, and, in connection with it, the sub-districts of the Tame and Anker, which have been so exhaustively worked out by Mr. Bagnall, and the Rea, which I am attempting.

I said that the Rea enters on its town conditions where it leaves Calthorpe Park, and this reminds me of the rapid growth of the town in this direction; for I can remember when the river was crossed by stepping stones where the Gooch Street Bridge now stands; when Barford Street was barred by gates, beyond which were Dester's fields, where I gathered my first wild-flowers, now the populous parish under my ministerial charge; when snipe were shot in the marshy places that became Bishop Street; and when the Rea ran betwixt smiling meadows till it reached the old Apollo Gardens of Moseley Street. But if we consult maps dated 1781, copies of which we can see in Dr. Langford's "Century of Birmingham Life," we shall find that the Rea was a country river through nearly the whole of its course, the main street of Deritend being the only strip of town that intervened; we shall see meadows by Deritend Chapel, divided by hedgerows, diversified by trees, rendered picturesque by an occasional homestead and a windmill, and personally interesting by the couples who stroll on the banks of the Rea in the summer gloaming.

Having traced the course of the river, I will add a few words on the geology of the valley through which it flows.

The whole stretch of valley from Calthorpe Park to the Lickey Hills, a distance of seven or eight miles, seems to be uniformly composed of the Keuper Red Marl of the Triassic system; not presenting, therefore, that variety of formation which is conducive to a richly diversified flora. In the Lickey Hills themselves we have a combination of Llandovery Rocks and Quartzite, which Professor Lapworth describes as "resting upon ashy-looking rocks of Pre-Cambrian age;" but it is only with a portion of the Lickey Hills the Rea Valley is connected. The geographical features of the Rea Valley are also, in some respects, unfavourable to an extensive flora. There is an absence of such primeval bogs as those of Sutton Park, Coleshill, and Hartlebury, with their rare marsh plants and bog mosses, the sphagnums, which are wanting in my collection. Marshy places there are of some, though of less value. Neither have I found extensive woods, though there are some coppices, and, towards Frankley, small woods and dingles, which invite inspection. The valley for the most part is open, and consists of meadows, cultivated fields, and narrow lanes. The principal botanical stations are the Pebble Mill Pool and Pebble Mill Fields, Stock's Wood and canal banks at Selly Wick, and the Dog Pool Lane, Lifford, King's Norton, Northfield, Frankley Beeches, and Rubery. Travelling through the Rea Valley, as now indicated, I will mention some of the principal plants I have found there. The two parks, Calthorpe and Cannon Hill, being modern, furnish little to record, unless it be *Myriophyllum alterniflorum*, in flower, which abounds in Cannon Hill Pool, with the American weed, *Elodea canadensis*. The Pebble Mill Pool is a station that is doomed to pass away, as it is being gradually filled up—a loss to the botanist, but a gain to society, as the scene of some suicides, and pregnant with malaria. If thoroughly searched its yield, I think, would be good. I have obtained there *Nymphæa alba*, though not in flower; *Nasturtium amphibium*, of luxuriant growth; *Lychnis Githago*, a colonist; *Artemisia vulgaris*; *Iris Pseudacorus*, the Yellow Flag; *Carex riparia*; and of grasses, *Digraphis arundinacea* and *Phalaris canariensis*. From the neighbourhood of Selly Wick, including canal banks and Stock's Wood, I have obtained *Polygala vulgaris*, *Genista tinctoria*, *Vicia angustifolia*, *Prunus Avium*, *Rubus Idæus*, *Hieracium vulgatum*, *Lemna trisulca*, the Ivy-leaved Duckweed, and *Carex remota*. The Dog Pool Lane and adjoining fields have supplied me, among other plants, with *Orobus tuberosus*, *Prunus domestica*, *Adoxa Moschatellina*, *Dipsacus pilosus*, the Shepherd's Teazle, *Petasites vulgaris*, frequent along the sandy banks of the Rea; and *Colchicum* *autumnale*, the Meadow Saffron, interesting from its peculiarity in putting forth its leaves, flowers, and fruit, and as being in bloom when most of the other flowers are faded and gone. One of my best stations is Lifford, with its combination of canal banks, canals, pools, and marshes. Among the best plants obtained there I would mention *Nasturtium palustre*, in abundance on the muddy shore of Capon's Pool; *Reseda Luteola*, *Viola odorata* (white variety), *Epilobium roseum*, *Sium angustifolium*, a rather rare plant; *Silaus pratensis*, *Senecio erucifolius*, *Stachys palustris*, *Rumex Hydrolapathum*, *Sparganium simplex*, and *Sparganium ramosum*, the branched Burweed; *Potamogeton pectinatus*, *Sagittaria sagittifolia*, *Alisma Plantago*, var. *lanceolatum*, *Scirpus setaceus*, rare; and *Carex vulpina*. King's Norton, perhaps through want of more accurate search, has furnished nothing worthy of special note, but Northfield has proved a more fertile locality. Among many plants obtained there I select for mention *Ranunculus aquatilis*, *R. sceleratus*, and *R. arvensis*, *Cardamine amara*, a good local plant; *Chelidonium majus*, *Lychnis vespertina*, common, but rare in the Rea Valley; *Malva moschata*, *Pyrus malus*, *Circæa lutetiana*, *Sedum acre*, *Centaurea Cyanus*, a colonist; *Achillea Ptarmica*, *Hieracium umbellatum*, rare; *Campanula latifolia*, the Giant Bell Flower, abundant and luxuriant on the railway bank; *Convolvulus sepium*, *Orchis maculata*, *Listera ovata*, and *Narcissus Pseudo-narcissus*, the latter a common plant which deserves special mention here as giving a name to a locality,—the Daffodil Fields—meadows on either side of the Rea, made golden by a profusion of these glorious wild flowers, these early gleams of a returning spring. Of the grasses of this district I would name *Aira cæspitosa*, *Melica uniflora*, *Triticum caninum*, and *T. repens*. Several members of the Society also report the Snowdrop for this locality. Proceeding from Northfield to Frankley Beeches along the lanes, I cull *Epilobium angustifolium*, rare in the Rea Valley; *Bryonia dioica*, *Tamus communis*, *Asperula odorata*, *Primula vulgaris*, strangely rare in the Rea district; *Epipactis latifolia*, abundant in the copse of Frankley Beeches; and *Epipactis media*, nearer Rubery. Rubery, with its neighbouring hills, the watershed of the Rea, I have not yet worked out, but I would mention *Corydalis claviculata* and *Geum rivale*, the Water Avens, as good plants, also *Salix pentandra* and *Typha latifolia*; and from the "Shoulder of Mutton Hill" *Lycopodium clavatum*, never previously recorded as part of the flora of the Lickey Hills. The Rev. J. H. Thompson also records, for the first time, *Melampyrum montanum*, from Rednal Hill, in the year 1884.

The Rea Valley, so far as I have been able to discover, is not rich in the cryptogamic flora. Of the ferns I have to mention seven species, viz., *Pteris aquilina*, *Lomaria spicant*, *Asplenium Ruta-muraria*, found by Mr. R. Moore, on Moseley Park wall, since pulled down; *Aspidiun aculeatum*, *Nephrodium filix-mas*, *N. spinulosum*, and *Polypodium vulgare*. Of the horsetails I have to mention six species—*Equisetum arvense*, *E. sylvaticum*, *E. palustre*, *E. limosum*, and two taken from Mr. W. Mathew's list, *E. maximum* and *E. hyemale*.

The mosses of my district are not so numerous as I expected, or else my eye is not sufficiently acute to detect them. I have to record forty-five species, most of them being such as might be expected to grow in a marly district like the Rea.

All my critical flowering plants have been submitted to the Rev. J. H. Thompson, and Mr. W. Mathews, who have kindly examined them; and all the mosses have been seen, and for the most part named, by the kindness of Mr. James E. Bagnall.

All the plants obtained in the Rea Valley I have catalogued, adding some from Mr. Mathew's excellent little book, "The Flora of the Clent and Lickey Hills," as belonging to my district. Counting up my gains, with this list before me, I find that my plants represent sixty-seven out of the ninety-three natural orders named in the London Catalogue; and 326 species out of the 1,665, exclusive of the mosses. I hope very largely to increase my list by further search, and publish it later on in the year.

I will not further trespass on your patience except to speak a word in behalf of our little Birmingham river, to which I am bound in attachment by the pleasant memories of many years. No poet that I know of has sung its praises, but on the contrary, the mention of its name is the signal for mirth on all occasions. The Archbishop of Canterbury, in his Presidential address at the Midland Institute, provoked much laughter by his allusion to "the silvery and sportive Rea." That it was silvery in good weather in early times I am sure, and sportive also, as its present windings and eddies testify. As a river it may be despicable, but the valley through which it passes is by no means to be despised. It can boast, in near neighbourhood to the town, two parks—the people's pleasure grounds, Calthorpe Park, attractive to the lovers of athletic exercise; and Cannon Hill, which should, by reason of its beauty, be attractive to everybody, and which by a moderate outlay, as suggested in the public prints, might be made very useful for botanical studies.* The Pebble Mill Fields are very pretty and inviting when aglow with the buttercups and daisies of early summer, and as flanked with the wooded uplands of King's Heath and Moseley; and the landscape is improved when the valley widens out towards Northfield, with a distant view of the Lickey Hills, from which the Rea descends, fringed with briars, willows, alders, and hazels, haunted by the Water Voles, and here and there made resplendent by the swift flight of the Kingfisher.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(*Continued from page 126.*)

EXHALL, near Alcester.—*John Walsingham, Esq.*, 1566, *and w. Elenor. Haines.*

One of the most pleasing brasses in the county, the style and drawing being admirable. The man is 1ft. 11in. high, the woman 1ft. 10in. The former has close-cropped hair, moustache, and beard. Round his neck is a ruff, which fits closely upon a narrow gorget of plate. The *pauldrons* are large, and have a lining with escalloped border; they are fastened by staples and spring-pins. The *coutes* are small and elegant, and the hinges of the *vambraces* are plainly shown. The hands, which are well drawn, are bare. The breast-plate is ridged, and to it are fastened, by hinges, two large *tassets*, which are kept in their place by straps passing round the thighs. The *genouillières* are similarly fastened. The sword-belt does not go round the body, but is fastened to a ring at the right side of the breast-plate; the sword has the modern guard. This armour belongs to a period about fifteen years later than 1566, so that we seem to have here another instance of a brass put up some time after the decease of the person it represents. (See Compton Verney III.)

* The suggestion as to the utilising of Cannon Hill Park for the purpose of Botanical Science came first from Mr. Oliver, and I have recently learned that he is laying out a portion of the park in a series of beds to show specimen plants of the European natural orders. The smaller pools might be economised for the growth of aquatic plants, and botanical knowledge would be imparted if the names, Latin and English, of the less familiar trees and shrubs were conspicuously attached to them.

The lady has a French hood, a ruff, and a loose outer gown thrown open from the neck downwards, except where it is confined by a sash at the waist. A richly-embroidered bodice and petticoat are thus disclosed, the former having striped sleeves with cuffs. Above the effigies are two shields, each 6in. long. One, part of which is lost, bears the arms of WALSINGHAM: Quarterly, 1 and 4, paly of six, arg. and sa., over all a fess gu.; 2 and 3, gules, a cross coupeè compony arg. and az., bet. 16 bezants. The other shield is for ASHEFIELD. arg. a trefoil slipped sa., bet. 3 mullets, gu.

The inscription is upon a plate 1ft. 7½in. by 4½in.

Here lieth buried the bodies of John Walsingham late of Exhall in ye | County of War' Esquire and Elenor his wyfe one of the daugh= | ters of Humfrey Asheffeld late of Heythropp in the countye of | Oxford Esquire. The same John decessed the xxth day of January | 1566. And ye said Elenor decessed the

The wife was probably buried elsewhere. (Compare the Aston brass.)

There is no monumental brass at HALFORD, as stated by Haines. In the chancel, however, is a stone incised with the figures of a cross and chalice.

HAMPTON-IN-ARDEN.—*A civilian, c.* 1500. *Haines.*

In the nave of the church lies an effigy, 14in. high, of a man in civil costume. The tombstone in which it is inlaid has matrices for a woman's effigy and an inscription, both of which are lost.

The man has long hair, and wears a gown with wide sleeves, edged with minever at the neck and cuffs. The collar and sleeves of an under garment are visible. From the left side of the civilian's girdle hangs a *gypcière* or pouch, and from the right a rosary.

It is doubtful whom the brass represents. Dugdale records a brass to "Ricardus Brokes balinus de Hampton in Ardene et Isota uxor ejus." Haines refers to the "Gentleman's Magazine," 1795, Part II., p. 988, where the following inscription is printed:—

Mon yt behoves the off to have i mynd
yt yo delyst wt yn hand yt shalt yo fynde
Childyr bene sclothil & wiffys ben unky'd
Excekutiors covetose & kepe at yt yyr y fynd
Hic jacent Ricardus Stokys Salter de hampton in Ardenie
Et Isota uxor eius quor' aiabus p' picietur deus amen.

Dugdale gives the same verses, modernised; they were common on gravestones at the end of the fifteenth century, and a longer version will be found in Weever's "Ancient Funeral Monuments." Whether our brass is in memory of Richard Brokes, bailiff, or Richard Stokys, salter, it is impossible to decide. Perhaps there were once two brasses, and the inscription has been misplaced. Too much weight, however, must not be given to the statement in the "Gentleman's Magazine," which is evidently inaccurate in describing the brass as that of a "*woman* holding a rosary and purse." The words "yyr y" in the fourth line of the inscription may be a misreading of "yey," *i.e.*, "they."

An illustration of the brass will be found in the Transactions of the Archæological Section of the Birmingham and Midland Institute, 1878-9, p. 8.

HARBURY. I.—*Alice Wagstaff*, 1563. *Haines.*

This brass is now at the west end of the nave. It consists of several plates, one of which, 21in. by 5in., placed at the head of the tombstone, contains this inscription:—

Ales Wagstaff sometyme Savage wife, heare sleapeth in the duste | Whose Image shoes whereof we be, and where unto wee must | Her life well spent, a deathe did brynge, agreable to the same | Whose vertues in the boke of liefe, recorded hath her name | God graunt all those that present be, or shall heareafter pas | Suche gift of grace, suche perfett liefe, as in that matron was. |

A plate, 3in. by 1in., is lost from its position below and adjoining this larger plate. Possibly it contained the word "Amen." Beneath this is a space enclosed by three strips of brass, with the following inscription; on a fourth, loose in the Rector's study, the words are illegible:—

✠ Beholde the ende my children all, and marke yt well or ye begynne | To deathe are ye subject and thrall, take hede therefor and flie from synne |

(Third line illegible)

And liefe agayne shall springe and growee, where deathe hath reapt and also mowen

Within this enclosed space were the effigies of Alice Wagstaff and her children. The lady's figure and a group of children are lost; one girl only is left, dressed in French hood, ruff, and gown with falling collar and tight sleeves puffed at the shoulders and frilled at the wrists. There are two plates, 8in. by 4in., near the head of the principal figure. That on the right enumerates

[The parent of this Alys]
Thomas ffurnor the sonne
of Willm̄ ffurnor & Alys
ffurnor the daughter of
Willm̄ Tyrrold.

The left hand plate details

Her bretherne & systers
William ffurnor and John
ffurnor Anne ffurnor
and Jone ffurnor

At the bottom of the tombstone is a plate 20¼in. by 4in., inscribed thus:—

This Counscell good this mother deare, unto her children gave | In lieffe to learne, souche deathe to dye, a better lieffe to have | By coursse of kynde her liefe sursesd, the twenty-fourth of Maye | for whose swete soule amonge the rest, I do most humbly pray | Anno dn̄i | 1563.

There has been an attempt, probably by a Puritan, to erease the word "pray" in the last line of this post-Reformation prayer for the dead.

II.—*Anne Wagstaff*, 1624. *Haines.*

A small plate, 1ft. by 5in., in a moulded tablet upon the south wall of the chancel, bears this inscription:—

ANNE WAGSTAF DAVGHT' TO IO' HANSLEPP
OF STONITHORPE HEARE DOTH LYE
WHOSE VERTVOVS LIFE DID WELL DESERVE
ETERNAL MEMORYE. QVE OBIIT
AN° DOMINI 1624.

III.—*James Wright, Gent.*, 1685. *Haines.*

Like No. I., this brass has been placed at the west end of the nave. It consists of two plates; the upper one, which is 2ft. square and placed diamond-wise, bears the crest, a dragon's head ppr. issuing out of a ducal coronet or., and the arms of WRIGHT:—az., two bars arg., in chief three leopards' heads or., impaling WAGSTAFF arg., two bends engr., sa., the under one couped at the top, in chief an escallop of the second.

The lower plate, 2ft. 9in. by 10in., is inscribed :—

HAC IACET SVB VRNA CORPVS IACOBI WRIGHT GENEROSI
QVI OBIIT DVODECIMO DIE SEPTEMBRIS ANŌ CHRISTI
MILLIMO SEXCENTESIMO & OCTOGESIMO QVINTO
ÆTATIS SVÆ 61, CVIVS ANIMA REQVIESCAT IN PACE

Hac bene qui meruit tumulatur Regis in urna
Et patriae uiuens uerus amator erat
Optima prima fere manibus Rapiuntur auaris
Implentur muneris deteriora suis.

Translation :—

Under this tomb lieth the body of James Wright, gentleman, who died on the 12th of September, 1685. May his soul rest in peace.

Beneath this tomb is buried one who deserved well of the king, and who in life was a true lover of his country. The best things are generally the first to be snatched from our greedy hands, the worse things are filled with their full numbers, *i.e.*, are undiminished.

In order to make any sense of the last line, "numeris" has been conjectured for "muneris," which will neither scan nor give sense. There seems to have been an attempt to change "tumulatur," in line 1, into tumulator, which means nothing. Regis is curious Latin. The seventeenth century prayer for the dead is remarkable.

(To be continued.)

THE LATE REV. W. W. NEWBOULD, M.A., F.L.S.

A FEW PERSONAL REMINISCENCES

BY J. E. BAGNALL, A.L.S., AND W. HILLHOUSE, M.A., F.L.S.,

COMMUNICATED BY THE LATTER.

The breadth and depth of the feeling which the news of the death of Mr. Newbould will have called forth, especially in the Midland Counties, appears to demand, in the pages of the "Midland Naturalist," something more than the brief reference to it in the last number (p. 142). To those who had come across him—and who in the ranks of active local botanists had not?—his loss will seem rather that of a dear personal friend than of a mere working colleague ; of a companion in arms, rather than of a fellow-soldier. And, indeed, Mr. Newbould was no mere working colleague. The very incarnation of self-abnegation, nothing was to him a source of greater happiness than to place his time, his brains, his critical experience freely at the disposal of some younger man who seemed in need of them. This he did ungrudgingly. He asked no return. Notoriety he sought not. To see his name in print brought to him not the smallest quickening of the pulse, unless, indeed, from a feeling of abashed humility. And yet, for all this, few men have done so much work, patient hard work, in connection with local floras, as he has.

It was my lot in the years 1875, '76, and '77, and to a lesser degree in the two following years, to devote my whole spare time to the compilation of materials for a reissue of the Flora of Bedfordshire. It was in this connection that I, as so many others have done, first became acquainted with Mr. Newbould. This was in June, 1876. I had sent to him a copy of my "Plant List for 1875" (Trans. Beds. Nat. Hist. Soc., Vol. I., p. 65), and received in acknowledgment a letter full of kindly sympathy and encouragement—a letter such as, in my experience of critical botanists, only he and the late Hewitt Cottrell Watson could write. It so happened, however, that just then another tie between us had arisen in a way which to me was a grateful surprise. I was at the time just beginning life, botanically speaking, in another sense, in that I had just commenced a course of lectures on Elementary Botany to a class of about 100 boys from the lower forms of the Grammar School at Bedford—boys varying between nine and eleven years of age. Amongst these were two of Mr. Newbould's own boys, who were being educated at that School. No one could feel so much as I could myself how desperately hard this task was to a beginner. Years have only accentuated the feeling of failure which I had at the time. How grateful to a young beginner, full of a love for his subject, but fuller still of a sense of inability to teach it properly, to be told at this beginning of the work, "I was very glad to learn a few weeks ago that one of my boys had come under your tuition. If you can but teach him any one thing *well and accurately* I should not much mind what he does not learn. All the rest will be only a mere question of time" (June 17, 1876); and again a few months later (Aug. 7, 1876), "You have contrived to get a monstrous quantity of botany into my lads, and they have much improved in other ways. Many thanks to you for this." Only those who know and have felt the sickening sense of failure can realise what precious balm this was to me, and how it spurred me on to try and do indeed what the kindly heart of Mr. Newbould had prompted him to attribute to me.

I am fully aware that this is very personal, and to most will be very trivial, but it is to the full characteristic of the heart and disposition of the man, and as such I mention it. This, then, was the beginning of Mr. Newbould's direct assistance in my work on the Bedfordshire Flora—work which the local society is still actively pushing on.

In one of my botanical rambles with him in South Beds (August 9th, 1876), a curious incident occurred, illustrating in a remarkable way the restricted nature of vision. We came across a little bare patch in the corner of a field, shortly after we had sat down and marked off nearly 200 plants as seen. Pointing to the ground, Mr. Newbould said, "There's a new plant for to-day." I stooped and picked up the fruiting stage of *Carum bulbocastanum*, which at once caught my eye. To my surprise, he said he had not seen that plant, and picked up *Fumaria densiflora*, which grew side by side with it. It seemed impossible not to have seen the two at once; perhaps, though, it was not surprising that my less trained eyes should have fixed upon the more conspicuous plant, but it was very remarkable that he himself had not seen the *Carum*. I need hardly say the tenour of our conversation for some minutes was turned to things non-botanical.

Perhaps the most interesting hours, botanically speaking, I remember, were spent with Mr. Newbould and the late Mr. R. A. Pryor, B.A., of Hatfield, a botanist of well-known critical ability, in the critical examination of the Herbarium of Abbott, the author of "Flora Bedfordiensis," which, by kind permission of its owner (the late Mr. Chas. Longuet Higgins, M.A., of Turvey Abbey, Bedfordshire), was passed over into my possession for a few weeks. I had carefully examined this from beginning to end, and made copious notes; then we three worked through it together. For a long time the results were used mainly for my own purposes, but at length Mr. Pryor compiled them anew, with some literary additions, and they were published by him in the "Journal of Botany" for 1881, pp. 40 and 67. One of Mr. Pryor's last journeys before his too early death (February 18th, 1881), was to see me at Cambridge in connection with this matter. I know what a shock his death was to Mr. Newbould, though not altogether unanticipated by him; and several times he expressed surprise why a feeble old man like himself, who could do so little, should be spared, while one comparatively young, and of brilliant promise, should be taken away. This again illustrates Mr. Newbould's characteristic and genuine humility.

Mr. Bagnall's first note from Mr. Newbould was dated August 17th, 1880. Mr. Newbould was then temporarily residing at Honington Hall, near Shipston-on-Stour, and his letter spontaneously offered Mr. Bagnall assistance in his "Flora of Warwickshire," as far as the Stour district was concerned, in which he ultimately recorded about 420 plants. Mr. Bagnall, about ten days later, had a day excursion with him, and describes him as "one of the most interesting companions I had ever met." During this visit Mr. Newbould seems to have persuaded Mr. Bagnall to adopt river basins as his basis for county divisions, instead of the main roads he had originally intended to take. I well remember that some of my most animated discussions with Mr. Newbould were on this same point in connection with the Beds Flora, as I resolved (most presumptuously I knew) to take a geological division of the county, primarily into chalk, gault, greensand, and oolitic clays (Beds. Nat. Hist. Soc. Trans., March 9th, 1876). Just as with myself, Mr. Newbould made Mr. Bagnall the recipient of every atom of information about Warwickshire Flora he could scrape together, and as for years he had spent his winters almost wholly in the Reading Room and Herbarium of the British Museum, his collections of literary notes were peculiarly extensive and valuable. It may further illustrate the way in which he placed his time at the disposal of those whom he sought to help, that on his return to London he specially searched through the British Herbarium at Kew and the British Museum, for all information as to Warwickshire plants, giving transcripts of all notes of other botanists on the labels, and subsequently did the same thing with Professor Babington's Herbarium at Cambridge. All this material he freely handed over to Mr. Bagnall.

I have thus far trespassed on the space of the "Naturalist" to illustrate a character, alas! comparatively rare. A man in whose thoughts and actions self comes really last, is worthy of more than a passing thought. I can but wish that my dull labouring pen were more capable of worthily disclosing the pure refined gold of one of the brightest characters within the sphere of whose influence it has been my lot to come.

FUNGUS-HUNTING IN SPRING.—II.

BY W. B. GROVE, B.A.

One of the most fascinating pursuits of the embryo mycologist is that of searching for leaf-fungi, for these are easy to find if one but goes the right way about it, and when found are, in general, easily determined. The distinctions of the genera are not difficult to comprehend, and the species of the host-plant is, in nine cases out of ten, an infallible guide to the name of the parasite. And then one has, in Cooke's "Microscopic Fungi," a convenient and ready helper in the study.

To the mycologist it is one of the delights of spring that with its return there returns also the opportunity of finding these devourers of the tender leaves. This is the way for the beginner to commence his work. Having first obtained the indispensable book just mentioned, let him look therein for a species which is described as common, or, at least, as not rare, and which occurs in spring. *Uredo confluens*, which grows in May and June on the Dog's Mercury (*Mercurialis perennis*), is a good example of what I mean. In this district the host-plant is extremely abundant. One can walk for miles along the country lanes and find large patches of it every hundred yards or oftener. Moreover, coming so early as it does, before the hedge-rows are in leaf and before other and taller plants are advanced enough to overshadow it, this plant is easily detected and examined.

Now although all the leaf-fungi do not produce conspicuous markings upon the leaves on which they grow, yet the majority of them, including the one in question, do. Hence all that is necessary for the discovery of *Uredo confluens*, if it occurs in the district, is to walk a certain number of miles in country lanes, and patiently but superficially glance over every patch of *Mercurialis* one's eyes may fall upon. If it is there, before long the eyes will be rewarded with a sight of a brilliant yellow blotch on a leaf or on a stem, and on closer examination the flat erumpent pustles of the *Uredo* will be seen, crowded together (on the leaves at least) in a more or less concentric form.

The same process will be equally effective in finding the *Puccinia* on Anemone, and the Cluster-cups on Viola and on Ranunculus, always supposing that they occur at all in the district examined. I speak from personal experience when I say that this method of starting with a definite object, with the intention of finding a particular fungus which one has ascertained previously from books to grow upon a certain host-plant is far more like to be successful than an indiscriminate search for whatever may turn up. Of course it is only fully applicable to those which grow upon common plants, and if the fungus is not there we shall never discover it. But it must not be forgotten that the species of leaf-fungi are not equally abundant every year, and if we do not succeed one year we may the next.

It was by this process that I at last succeeded, three years ago, in discovering *Triphragmium ulmariæ* on the Meadow Sweet. But this is an autumn fungus, and my present purpose is to enumerate those species of the group which have been found in this neighbourhood in spring—let us say before the fourth week in May. I shall mention none but those which I have seen myself; a few of them have been gathered and sent to me by Mr. H. Hawkes and Mr. W. H. Wilkinson.

To begin with the Cluster-cups. The commonest species, at this early date, is *Œcidium ficariæ*, which is found in April and May on both *Ranunculus repens* and *R. ficaria*, most abundantly on the former. I have specimens from King's Heath, King's Norton, Northfield, Alvechurch, Kingswood, Temple Balsall, Hampton, Fillongley, Shustoke, Water Orton, Langley, and Hunnington. *Œ. lapsanæ* is the earliest I have found; it occurred on *Lapsana communis*, at Blackwell, before the end of March. *Œ. urticæ*, on *Urtica dioica*, from Alvechurch, Fillongley, and Shustoke; *Œ. violæ*, on *Viola Riviniana*, from Kingswood, Packington, and Sutton; and *Œ. depauperans*, on cultivated Violas, at Perry Barr and Sutton, all in May. Mr. Hawkes has sent me *Œ. tragopogonis*, from near Great Barr, on Goat's Beard.

Of the Puccinias, *P. adoxæ* is the earliest, having occurred on *Adoxa moschatellina*, near Blackwell, before the end of March; *P. anemones*, at Middleton and Northfield, in April; *P. ægopodii*, from Shustoke and Erdington, in May. Mr. Hawkes has also sent it me from Northfield. I once found *P. malvacearum*, at Alvechurch, on *Malva sylvestris*, in the first week of May; it does not become abundant till June. *P. coronata* has occurred on sheaths of a species of Aira as early as the middle of February, but these specimens were, of course, those of the preceding year. The *Uredo* spores of *P. graminis* can also be occasionally met with before the middle of May; and Mr. Wilkinson has sent me those of *P. luzulæ*, from Gnosall, in April.

The curious jelly-like fungus, *Podisoma juniperi*, has occurred on Juniper trees at King's Norton, and was sent to me by Mr. C. Pumphrey.

Of the Phragmidia, one can occasionally find the teleutospores of *P. violaceum* on leaves of *Rubus fruticosus* which have stood the winter. The uredo-stage (*Uredo potentillarum*), and I believe the œcidium-stage too, of *P. obtusum* are common wherever *Potentilla fragariastrum* grows; and the teleutospores of the previous year also frequently linger on the dead leaves which still remain attached to the root-stock of this plant. Mr. Wilkinson once sent me the uredo of *P. mucronatum*, on young Rose leaves, from Gnosall, in April.

The only one of the unattached Uredos that I have found is *U. confluens*, already mentioned. I have specimens from King's Heath, Northfield, Temple Balsall, Hampton, Packington, Maxtoke, Shustoke, and Hunnington. It is unusually abundant this year.

Uromyces ficariæ is tolerably common on leaves and stems of *Ranunculus ficaria* throughout the whole of April and May. I have specimens before me from King's Norton, King's Heath, Temple Balsall, Marston Green, Fillongley, Sutton, and Middleton. *U. rumicis*, the *Uredo bifrons* of the "Handbook," has occurred on *Rumex acetosa* at Marston Green about the middle of May; and Mr. Hawkes has sent me *Uromyces concentrica*, on leaves of *Scilla nutans*, from Northfield, about the same time.

Among the Ustilagineæ of spring I have specimens of *Urocystis pompholygodes* on leaves of *Anemone nemorosa* from Barnt Green, Kingswood, and Maxtoke. This fungus is probably widely distributed. Mr. Hawkes has sent me an imperfectly developed specimen of *U. violæ* from Penns. I find *Entyloma ficariæ*, Fisch. von Wald., rather common on leaves of *Ranunculus ficaria*, on which it produces small angular whitish spots, which have a mealy appearance on the under side. It has occurred at Northfield, Coleshill, Packington, Maxtoke, and Shustoke, and can no doubt be found everywhere by searching for it in the early part of May.

Peronospora ficariæ is another fungus which afflicts this long-suffering phanerogam. I have not found it myself on *R. Ficaria*, but on *R. repens* and *R. acris*, at Water Orton and Sutton, in May. *P. parasitica* grew on *Alliaria* at Northfield, and on some other *Crucifer* at Sutton; *P. nivea* on *Angelica* and *Anthriscus sylvestris*, at Water Orton and Sutton; and *P. gangliiformis* on Groundsel, also from Sutton, all in May. I mention these because some persons include under the head of Leaf-fungi the species of *Peronospora*, which, however, are not allied to the Leaf-fungi proper.

This concludes the list of all the species of Leaf-fungi of which I have seen specimens from this neighbourhood in spring. It is obvious that there are several other early species which may be expected to occur about here, and these will no doubt turn up in future years. I shall be glad to receive specimens of these from any members of the Birmingham Societies who may be fortunate enough to meet with them and kind enough to help me in completing this branch of the Fungus Flora of the district.

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

EXPOSITION OF CHAPTERS XI. AND XII., "DIRECT EQUILIBRATION" AND "INDIRECT EQUILIBRATION."†

BY CONSTANCE C. W. NADEN.

By Mr. Spencer's expression "a moving equilibrium," we are to understand a mechanism the parts of which are in a state of constant activity, and yet preserve equilibrium with regard to each other and to external forces. The mechanism may be organic or inorganic, its component parts may be atoms, heavenly bodies, or the organs of the human frame, but their movements, of whatever kind, must always be rhythmic. The Solar System is a moving equilibrium—so is a watch—so too is a plant or animal.

Now if any fresh incident force affects the mechanism it will either destroy the rhythmic motions altogether, as when I wind my watch too far and break its mainspring; or it will go on modifying the motions till a new equilibrium is established, as when I move the regulator of my watch from slow to fast.

Every plant and animal is daily receiving from without fresh energy, in the place of that which it daily expends. Its food supplies it with heat, which is converted into various modes of motion. But the resulting equilibrium may be disturbed by a lack of food, by altered climate, by the introduction of hostile or helpful organisms, by increased or diminished power of assimilation, or by other natural causes. A change of state will gradually be brought about; the primary disturbance originating secondary and tertiary dis-

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* Transactions of the Birmingham Natural History and Microscopical Society—Sociological Section.

† Miss Naden's paper on Part III. of Mr. Herbert Spencer's *Principles of Biology*, Chap. I., "Preliminary;" Chap. II., "The Special Creation Hypothesis;" and Chap. III., "The Evolution Hypothesis," has been published in a separate form.

turbances, and so on until the whole organism is modified and equilibrium restored. Or it may be that the disturbance has been too great and the organism dies.

Equilibration may be *direct* or *indirect*.

It is direct when the new force calls forth the counteracting force, indirect when it is balanced by a change which it has no share in producing.

Direct equilibration is usually spoken of as *adaptation*. It occurs when the force operates on individuals continuously or frequently, not inflicting vital injuries. In this manner light and heat act on the stems and leaves of plants, and the skin of animals; the effects of use and disuse of organs also must be classed under this head.

Indirect equilibration is a result of the process known as Natural Selection. Many beneficial modifications cannot be directly produced by the environment. The propensity of cattle to browse on a plant would not tend to clothe it with thorns or stinging hairs; nor would the tastes of pollen-carrying bee or butterfly help to develop honey in a flower.

The individuals of a species become unlike by the transmitted effect of the joint variations of the parents; a complex train of new variations being set up in the offspring. If any change occurs in the environment some of these individuals will be better able than others to accommodate themselves to it, and will have a better chance of surviving and producing offspring to which their peculiarities will be transmitted. Thus a type will gradually be formed in harmony with the new conditions. Even where there is no alteration in external forces, a more delicate adjustment to existing conditions may still be possible. and those individuals which show this adjustment are likely to survive their less fortunate fellows.

A *species* may thus be regarded as a moving equilibrium, yielding in the direction of least resistance and regaining its balance by a compensating reaction.

Leafing of Oak and Ash.—During the first and second weeks of May I had several opportunities of observing the progress of foliation in these trees over a great part of North Warwickshire. Although individual exceptions were numerous, yet it was obvious that by far the great majority of the oaks were about a week or ten days in advance of the ashes. If the proverb were true this would presage a warm and dry summer. The exceptions are due to the constitutional differences of individuals. We are familiar with such variations in the different kinds of garden peas and strawberries, &c.; and I am acquainted with a horse-chestnut, in Edgbaston, which now for many (perhaps eight) years I have observed to be in full leaf more than a week before all others in its vicinity.—W. B. Grove.

METEOROLOGICAL NOTES.—April, 1886.

Atmospheric pressure underwent several variations during the month, the highest point being 30·301in. on the 15th, the lowest 29·182in. on the 8th. The mean temperature was about one degree below the average. The earlier part of the month was decidedly cold, the maximum not reaching 60° until the 19th. From the 23rd to the 27th the weather was more seasonable. The highest readings occurred on the 27th, when maxima of 71·0° were recorded at Loughborough and at Henley-in-Arden (also on the 24th), 66·7° at Hodsock, and 65·8° at Strelley and at Coston Rectory. In the rays of the sun, 123·1° at Hodsock on the 25th, and 117·9° at Loughborough and 115·2° at Strelley on the 27th. The lowest readings were 27·0° at Hodsock on the 30th, 28·0° at Coston Rectory on the 12th, and at Henley-in-Arden on the 11th and 30th, 29·0° at Strelley and 29·2° at Loughborough on the 11th. On the grass, 17·2° at Strelley, 19·8° at Hodsock, and 24·6° at Loughborough on the 12th. The minimum readings were not unusually low; the deficiency in the mean temperature is attributable to the low maxima. Rainfall was slightly above the average, the frequency of the falls contributing to this result rather than their amounts. The totals were: 1·88ins. at Henley-in-Arden, 1·77ins. at Loughborough, 1·66ins. at Hodsock, 1·59ins. at Strelley, 1·47ins. at Coston Rectory. The number of days on which rain or snow fell varied from fifteen to eighteen. Snow fell at Loughborough on the 9th, 10th, and 11th. Thunderstorms visited Strelley and Loughborough on the 10th. Sunshine was about the average. The wind was strong during the earlier portion of the month, chiefly from south-westward. A solar halo was observed at Loughborough on the morning of the 7th, and a lunar halo on the 11th.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, May 4th. Mr. J. Rabone and Mr. W. B. Grove, B.A., gave a report on the excursion to Chirk on Easter Monday; Mr. T. Bolton exhibited *Lynceus macrourus*, a rare entromostracon and Mr. J. Edmonds exhibited photo-micrographs of the same; Mr. T Bolton also exhibited *Physa fontinalis*, variety *inflata*, with its curious fringed mantle; Mr. J. E. Bagnall, A.L.S., exhibited *Hypnum brevirostre*, new to the district; *Orthotrichum stramineum*, new to the district; *Primula intermedia*, *Viola hirta*, and other plants, from the Arrow district; he also exhibited, on behalf of J. B. Stone, Esq., *Hypnum brevirostre*, from Dartmoor; and on behalf of Mrs. S. C. Beck, *Peziza venosa*, from Crowell Rectory, Oxon. Mr. W. B. Grove, B.A., exhibited *Didymium globosum*, on dead leaves; *Phoma leucostigma*, *Trochila craterium*, *Coniothyrium Hederæ*, on ivy leaves; *Œcidium ficariæ*, on *Ranunculus repens*, and *Rhytisma acerinum*, on sycamore leaves, all from Chirk. *Œcidium ficariæ*, from Hunnington and King's Norton; *Uromyces ficariæ*, from King's Norton; *Entyloma ficariæ*, from Northfield, all on *Ranunculus ficaria*; *Uredo confluens* from Halesowen, on *Mercurialis perennis*; *Puccinia anemones*, from Northfield, on *Anemone nemorosa*; *Colpoma quercinum*, on young oak twigs, from

Temple Balsall; and several other fungi. Mr. T. Clarke exhibited *Lynceus macrourus*, showing young; *Argulus foliaceus*, in the larval state; and the larva of the Water Feather, *Oeyethira coltalis*. —BIOLOGICAL SECTION, May 11th. Professor W. Hillhouse, M.A., in the chair. Prof. Hillhouse exhibited, on behalf of Miss Taunton, the Rose of Jericho, *Anastatica hierochuntia*, and gave an interesting account of its hygroscopic properties, and related some of the legends pertaining to it. This exhibition led to an interesting discussion, in which the President and Messrs. J. Morley, W. H. France, and J. E. Bagnall took part. Mr. W. B. Grove, B.A., exhibited *Ranunculus auricomus* from Kingswood; and fungi, *Lepiota cepæstipes*, growing on cocoa nut fibre in a hothouse at Sutton; *Œcidium ficariæ* on *Ranunculus ficaria*, *Uredo confluens* on *Mercurialis* from Temple Balsall, *Œcidium violæ* on *Viola Riviniana*, *Uredo fragariæ* on *Potentilla fragariastrum*, *Urocystis pompholygodes* on *Anemone nemorosa*, all from Kingswood, and *Diatrype verrucæformis* on hazel from Packington; on behalf of W. H. Wilkinson, *Œcidium adoxæ* from Loch Lomond. Mr. J. E. Bagnall, A.L.S., *Primula polyanthus* with foliaceous sepals, a case of reversion—*Barbarea intermedia*, *Prunus cerasus*, *P. insititia* from Coughton, male and female plants of *Fontinalis antipyretica* from Weddington, with microscopical preparation to show male flowers, also a series of mosses and hepatics from the Arrow district. For Mr. Alderman J. B. Stone, J.P., *Eucalyptus*, with notes on its peculiarities of growth, &c., and a collection of mosses and hepatics from the Riviera, Dartmoor, &c. For Mr. W. Mathews, M.A., *Barbarea stricta*, *Cicuta virosa*, and other flowering plants. For Mr. R. M. Christy, a beautiful double variety of the lady's smock, *Cardamine pratensis, plena*, from a field belonging to Mr. Frederick Impey, at Longbridge, near Northfield, very abundant; the variation in the flower Mr. Impey believed to be due to liberal manuring. Mr. J. Morley exhibited on behalf of Mr. T. Clark *Holopedium gibberum* from Grasmere.—GENERAL MEETING, May 18th. Professor Ernst Haeckel, of the University of Jena, and Professor Edwin Ray Lankester, M.A. (Oxon), of the University College, London, by the recommendation of the Committee, were elected Honorary Vice-Presidents. Mr. T. Bolton exhibited *Dinocharis pocillum*, the skeleton wheel animalcule. Mr. C. Pumphrey exhibited *Podisoma juniperi*, a fungus from a tree in his garden. Mr. J. E. Bagnall, A.L.S., exhibited *Equisetum maximum*, horsetail; *Convallaria majalis*, lily of the valley; *Orchis mascula*, the male orchis; and *Rhamnus catharticus*, the buck thorn, from the Arrow district. Mr. W. B. Grove, B.A., exhibited *Peziza vesiculosa*, from Water Orton; *Œcidium violæ*, *Uredo confluens*, *Urocystis pompholygodes*, from Packington; *Puccinia ægopodii*, from Shustoke; *Piggotia astroidea*, from Hampton-in-Arden; and *Rhytisma acerinum*, in the perfect state, from co. Antrim, Ireland. He also made some interesting remarks on the different stages in the life history of *Aspergillus glaucus*, the green mould, illustrated by specimens and drawings. After the remarks a discussion followed, in which most of the members present took part.—GEOLOGICAL SECTION, May 25. T. H. Waller, Esq., B.A., B.Sc., in the chair. A paper was read by Mr. A. T. Evans on "The Quartzite Pebbles of the Drift." Mr. Evans exhibited many beautiful specimens of fossils obtained from the Drift pebbles. Mr. Horace Pearce, of Stourbridge, exhibited fine specimens of rocks from granite quarries of Aberdeen and Peterhead, also from Aberdeen Beach. These specimens were interesting, as showing the component minerals of granite, separated out in large quantities. Mr. Walliker exhibited *Menyanthes trifoliates* (busk-bean). A vote of thanks was given to Mr. A. T. Evans and Mr. Horace Pearce.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—April 19th. Mr. C. F. Beale exhibited two ancient bronze celts from a gravel bed at Abingdon. They were of different kinds, one was of the winged form, the other socketed and looped; also sections of a coral from the greensand. Under the microscope Mr. Hawkes showed a fungus, *Venturia myrtilli;* Mr. J. W. Neville, specimens of *Polyxenes lagurus.* Mr. Delicate then read a paper on "Staining Vegetable Tissues." The writer described the cutting, bleaching, and washing of sections ready for staining. The following aniline dyes were recommended as very suitable—magenta, mauve, green, and blue. When the tissues are sufficiently stained the colours are fixed with acetic acid. The process of single and double staining was shown, and the objects exhibited during the evening.—May 3rd. Mr. J. Moore exhibited specimens of *Physa gyrinea*, *P. arnillina*, *Limnæa elodes*, and other freshwater shells from America; Mr. Madison, specimens of *Vertigo minutissima*, from Sheffield; Mr. Hawkes, *Empetrum nigrum* and *Vaccinium vitis-idæa*, from Sutton Park; Mr. Baker, a wren's nest built in an old hat that was used to scare away birds; also a wasp's nest built in a currant tree.—Saturday, May 8th. The members and friends visited the Lye Cross Colliery, near Dudley. The shaft, passing through 76 yards of basalt, reaches the heathen coal at a depth of 233 yards. The party was conducted through the workings by the president, Mr. C. Beale, and Mr. Latham, who pointed out various places in which the coal was charred and burnt by contact with the intrusive rocks. A portion of the workings was lighted up with coloured fire. A hearty vote of thanks to Mr. Latham and Mr. Beale brought the afternoon to a close.—May 10th. Mr. Hawkes exhibited several fungi, including *Trichobasis scillarum* and *Puccinia anemones;* Mr. A. T. Evans, pebbles from the drift, containing fossils of *Orthis Budleighensis*, and other shells. Under the microscope, Mr. Wagstaff showed *Melicerta tubicolaria*, a rare rotifer; Mr. Rodgers, sporangia of *Asplenium viride;* Mr. Mulliss, proboscis of honey bee. A paper was then read by Mr. Hawkes on "Buds, their contents and development." The writer described the various kinds of leaf and flower buds, and the manner in which they aided the fall of the leaf. The large number of aborted buds was noticed, and their effect on the form of the tree, and the appearance of the grain of the wood. The structure and contents of buds were dealt with at some length, the mode in which leaves and flowers were stowed away, the early development of the male organs, the simplicity of bud corollas, the special development of some buds, as the horse-chestnut, to suit this climate, and the large number of flower buds that never reach maturity, were remarked upon. The paper was illustrated by diagrams and a large number of sections under the microscope.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, May 19th. Attendance thirteen (two ladies). Mr. Mott was re-elected chairman and Dr. Cooper secretary. Mr. Vice reported that the occupants of the small cocoons on the chrysanthemum leaf, which Mr. E. F. Cooper brought to the Section last month, had come out, and proved to be dipterous flies, about $\frac{1}{8}$in. long; probably a species of *Phytomyza.* The following objects were exhibited, viz.: by Mr. E. F. Cooper, F.L.S., a spadix of *Arum maculatum.* The Rev. T. A. Preston, M.A., described the arrangements in this remarkable flower for catching and detaining small insects, in order to convey the pollen to the stigmas. Upon this a discussion arose as to the need of such an arrangement merely to secure self-fertilisation, which must almost certainly take place automatically, seeing that the anthers are just above the stigmas. Yet the reflexed hairs on the abortive flowers above the anthers seem to prevent the insects from escaping to carry the pollen to other flowers. It was suggested that the members should investigate the process individually, and report their observations. By Miss Noble, a flowering specimen of *Geum rivale*, from Burbage Wood. By the Chairman—fertile fronds of *Onoclea (Struthiopteris) germanica*, full of ripe spores, from Belvoir Castle, portions of which were distributed for cultivation, as this fine hardy fern is said to do well in gardens; also, fragments of a nodule of iron pyrites, brought to him as part of a meteorite, which was certainly a mistake. A discussion took place as to the depth to which meteorites would penetrate if they ever really struck the earth. Dr. Tomkins, as a member of the Volunteer Artillery, pointed out that the kinetic energy of such objects must be greater than that of cannon shot, and that they must bury themselves to a depth which would render a small meteorite practically irrecoverable. The Chairman suggested that the resistance of the atmosphere, especially the denser portion near the surface, would counteract and extinguish a large part of the initial velocity, and that though the accelerated velocity of a body falling from a height of say forty miles could be theoretically calculated, the formula was only correct *in vacuo*. No experiment from such a height had ever been made, and the atmospheric resistance in such a case would become a very important factor. Subjects for discussion:—1. Carnivorous plants. Mr. J. T. Thorpe exhibited a beautiful living specimen of *Pinguicula vulgaris*, in flower, in a pot, which he had had in his possession for several years. The leaves were observed to be covered with glandular papillæ, and about their incurved edges were seen the remains of several captured flies. Mr. Thorpe stated that from his own observations he found that the edges were rolled over in about twenty-four hours after the capture of an insect, and that they unrolled themselves and became flattened out again in from thirty to forty hours more. Inquiry was made as to how many British plants were known to be carnivorous. The list, as at present known, is a small one—viz., *Pinguicula vulgaris*, *Drosera* (three species), *Utricularia vulgaris*, and probably *minor* and *intermedia*; perhaps also two or three species of *Saxifraga* should be included, and further investigations may add other genera. Many plants exude viscid secretions, by which insects are caught and killed without being utilised as food by those plants. 2. Natural history diaries and note books. Rev. T. A. Preston described "The Practical Naturalist's Diary," published by Swan Sonnenschein and Co., price 2s. 6d. Several other forms of diaries and note books were also exhibited, and their merits discussed.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—April 26th. Excursion to Helpstone Heath.—April 27th. The Marchioness Dowager of Huntly threw open the grounds at Orton Hall to the members of the society. The rock and alpine plants, which were flowering in great beauty, attracted considerable attention.—April 29th. GEOLOGICAL SECTION.—President, Mr. E. Wheeler. Visit made to the Spital Cutting (Cornbrash section), but owing to the lateness of the hour no rare fossils were obtained, and arrangements were made to work the same section on May 13th.

MICRO-ORGANISMS IN A SWAMPY DITCH IN SUTTON PARK.*

BY T. BOLTON, F.R.M.S.

In a swampy ditch in Sutton Park, not more than thirty yards long and one yard wide, in which a quantity of sphagnum was growing, I have found in the course of the last six months a great variety of interesting organisms, more than a hundred in number, and including several new species.

For the identification of the desmids and diatoms I have had the assistance of Dr. Anthony and another correspondent. Dr. Hudson and Mr. Gosse have helped me as to the rotifers, and the finding in this ditch of *Notommata spicata* (described by Dr. Hudson before the Royal Microscopical Society in May last) led me to make a more systematic examination of its contents. Mr. Gosse has identified from the same source a great number of free-swimming rotifers, several being new, and others so rare that he had not seen them before.

Diatoms.

Nitzschia sigmoidea.
,, *Tænia.*
Pinnularia nobilis.
,, *major.*
,, *lata.*
,, *gibba.*
Navicula ovalis.
Stauroneis Phœnicenteron.
,, *gracilis.*
Surirella bifrons.

On the diatoms from this locality I have occasionally seen the growth of numerous filaments resembling those described by Mr. Badcock in the "Journal of the Royal Micr. Soc.," 1884, p. 352, figs. 49, 50. I believe them to be of an algoid or fungoid nature.

Desmids.

Hyalotheca dissiliens.
,, *dubia.*
Micrasterias denticulata.
,, *rotata.*
,, *ovata.*
Euastrum oblongum.
,, *crassum.*
,, *Didelta.*
,, *ansatum.*
Closterium lanceolatum.
,, *turgidum.*
,, *Ehrenbergii.*
,, *moniliferum.*
,, *Dianæ.*
,, *didymotocum.*
,, *lineatum.*
,, *striolatum.*
,, *Cornu.*

* Transactions of the Birmingham Natural History and Microscopical Society. Read February 16th, 1886.

Tetmemorus Brebissonii.	*Closterium acuminatum.*
,, *granulatus.*	,, *gracile.*
Penium margaritaceum.	,, *parvulum.*
Closterium lunula.	*Spirotænia condensata.*
,, *acerosum.*	

Among the desmids *Closterium lunula* was very abundant and fine. I called Dr. Anthony's attention to the remarkably strong manifestation in this species of the circulation of the granules in the protoplasm, and we examined them together under his $\frac{1}{25}$th-inch objective. We could see two rapid currents of granules coursing down the edge of the frustules in opposite directions in very definite channels. Such rapidity and definiteness of the circulation in desmids neither of us had ever seen before. I have often seen the swarming of the desmids from this locality, especially in Micrasterias, when the whole protoplasmic contents seem to be in a boiling state. It is remarkable that no biologist has yet been able to explain satisfactorily either the circulation or the swarming.

An interesting occurrence of abnormal growth in *Closterium lunula* found in this locality is worthy of note. A very similar growth is figured by Mr. Archer in the "Quarterly Journal of Microscopical Science," 1860, pl. XI., fig. 5. I believe it is the result of a parasitical fungus, Olpidium.*

Of the other algæ I have only identified the pretty spherical *Eremosphæra viridis*, figured in Plate I. of Cooke's "British Freshwater Algæ." The different species of Oscillatoria and Spirogyra and some other filamentous algæ, often present, I have as yet not identified sufficiently to distinguish the species.

Rhizopoda.

Amœba Proteus.	*Centropyxis (Arcella) aculeata.*
,, *verrucosa.*	*Actinophrys sol.*
,, *radiosa.*	*Actinosphærium Eichhornii.*
Difflugia pyriformis.	*Acanthocystis chætophora.*
,, *acuminata.*	*Biomyxa vagans.*
,, *spiralis.*	*Euglypha sp.* (empty case only).
,, *urceolata.*	*Cyphoderia ampulla.*
,, *corona.*	
Nebela coronis (or *D. lobostoma*?)	
Arcella vulgaris.	

Of the Rhizopoda, the *Amœba Proteus* was remarkably large and fairly abundant. I would call attention to the peculiar markings on the Difflugiæ, corresponding well with

* Figured in Cooke's "British Freshwater Algæ," pl. 81, fig. 2.

the beautiful drawings in Dr. Leidy's splendid Monograph of Freshwater Rhizopods of North America. They afford very good examples for studying the question raised by Dr. Wallich in his critique on this work in the "Annals and Magazine of Natural History," Vol. XVI., 1885, as to the source of these markings, some of which are evidently dependent on the appropriation of the empty cases of diatoms; but such markings as those shown by Dr. Leidy in *Difflugia spiralis* (often present in this locality) are to me inexplicable. It is most wonderful that a minute mass of formless jelly, such as these animals apparently consist of, should have the power of building up these definitely-shaped and elaborately-adorned dwellings.

The specimens of *Acanthocystis chætophora* with its bristling bifurcate-spine-covered spheres and brilliant green contents were numerous, but of *Biomyxa vagans* I have only found two specimens, both on the same slide.

Infusoria.

Astasia trichophora.
Dinobryon sertularia.
Urella virescens.
Hemidinium nasutum.
Euglena viridis.
Spirostomum ambiguum.
Stentor sp. (*Mülleri ?*).
Vorticella campanula.
Ringed groups of Flagellate Monads.

Of the Infusoria, the ringed groups of flagellate monads form, I think, a new species. I have seen them only in this locality. They look like a ring of choano-flagellate monads; I have not been able to submit them to a power sufficient to make certain of the flagella or collars, but their active motion as they swim about, revolving on the axis of the ring, gives a fair presumption of their flagellate character. The diameter of the ring is $\frac{1}{800}$ of an inch.

Rotifers.

Rotifera :—
Floscularia ornata.
Ptygura melicerta.
Philodina aculeata.
,, *citrina.*
**Notommata spicata.*
*Two other allied species.
Furcularia forficula.
,, *gracilis.*
,, *cæca.*

* Described in Hudson and Gosse as *Copeus spicatus*, *Copeus labiatus*, and *Copeus pachyurus*. Mr. Gosse considers the first to be the largest known rotifer.

Rotifer vulgaris.
,, *tardus.*
,, *macroceros.*
,, *macrurus.*
Callidina elegans,
Polyarthra platyptera.
Pleurotrocha constricta.
Notommata forcipata.
,, *saccigera.*
,, *collaris.*
,, *decipiens.*
,, *felis.*
*Two other species.
Eosphora aurita.
Mastigocerca carinata.
Euchlanis luna.
Dinocharis tetractis.
Colurus caudatus.
,, *deflexus.*
And a new *Anuræa.*
Chætonotidæ :—
Chætonotus larus.
,, *hystrix.*

The great variety of rotifers is very remarkable. They have all been seen and identified by Mr. Gosse except *Ptygura melicerta*, which Dr. Hudson has seen. Of the new ones, *Notommata spicata* was named by Dr. Hudson; of the others, *N. pachyura*, *N. labiata*, *Furcularia micropus*, and *F. Boltoni*, I give the names which Mr. Gosse has proposed for them, and I look with interest to see his descriptions of them in their Monograph of the Rotifera, which is now being published. Two other species, *N. saccigera* and *N. felis*, had not been previously seen by Mr. Gosse.

Tardigrada or Water-bears.

Occasionally I found some specimens of this group, which I think must be *Macrobiotus Hufelandii*, but I am not quite certain of the species. The most complete account of this group that I know of is given by M. Doyère in the "Annales des Sciences Naturelles," 1840. A translation of this memoir, with reprints of the figures, would be very welcome to pond-hunters.

Naidina.

Chætogaster diaphanus.
Nais proboscidea.
,, *hamata.*
Slavina appendiculata.
,, *lurida.*
Æolosoma quaternarium.

Professor Ray Lankester identified for me *Nais hamata*: I have not heard of its having been found elsewhere in England. It is figured and described in my "Portfolio," No. II.

There were a few entomostraca, such as Cyclops, Cypris, and Lynceus, but I have not identified the different species.

* *Ibid.* *Furcularia Boltoni* and *Furcularia micropus.* Mr. Gosse records another new one, *Pedetes saltator*, allied to *Triarthra*, but with only two styles instead of three.

NOTES OF AN AMERICAN TOUR.

BY W. P. MARSHALL, M.I.C.E.

(Continued from page 150.)

In St. Louis city, visited next, a singular sight was witnessed, illustrating the primitive nature of the original construction of the town; the principal street was under repair for repaving and lowering a portion to make it level, and get a good foundation. Half the width of the roadway was closed for the purpose, and there was a two-horse plough at work ploughing up that portion and turning up original field soil; the original ground having been simply covered with rough concrete for laying stone blocks, and just laid on the surface of the field in making the primitive road of the young settlement.

Then came a long railway ride of two days and nights continuously across Kansas State into the heart of the Rocky Mountains in Colorado. The railway crossing the open prairie of Kansas is an extraordinary sight, a nearly level plain of grass to the extreme horizon, like a view at sea, without a single object in sight sometimes, not a fence nor a hedge or tree, nor any trace of animal life except stray skeletons and horned skulls. The railway is carried straight across the prairie, on the surface of the ground, without any fence or ditch, and only a row of telegraph poles to be seen running alongside. The prairie on fire was seen one night, a grand sight; the fire was a long way off, near the horizon, but there was a grand effect of flame and smoke.

Breakfast was served next morning in the train, served just as at an American hotel, at a number of little tables for four persons each, ranged down both sides of a Pullman dining car. The dining car was shunted at the next station to another train going back in the opposite direction, for giving the passengers breakfast in that train also, there being no refreshment station within half a day's distance.

The comical little prairie dogs (a kind of marmot) were seen in quantities scampering about alongside the railway, often standing up like rabbits squatting on their hind legs on the top of their hillocks in amusing attitudes, and then suddenly plunging head foremost into their burrows. They are something like small light-brown rabbits, but give a sharp little bark like a dog, and on that account have the name of prairie dogs.

An adventure at one station in this part gave an amusing picture of American travelling in this thinly populated prairie country. A carriage was seen driving across the open prairie towards the station at which the train had stopped, but still at a great distance; and some passengers in the train told the conductor they were sure it was someone known to them who was wanting to catch the train (it must be remembered there is only one through passenger train per day on the line). The train was actually kept a quarter of an hour stopping for the purpose, when up drove a carriage and pair of horses, and out jumped a gentleman and lady and caught the train before it was started; they told us they had driven twenty-five miles in 2¼ hours across the open prairie to catch the train, and were going on to California. There was hardly anyone else to get in or out of the train at the station, and the town consisted of little more than a dozen houses or huts, without an object in view but some cattle, to the extreme horizon, except some very distant mountain outlines with snow caps.

The first sight of snow mountains was Pikes Peak, which is 14,000 feet high, and was seen from Las Animas Station, at about 150 miles distance. The clearness of the air was wonderful; the mountains looked only twenty or thirty miles distant, so bright and clearly defined with the snow seen lying upon them, and the light and shade of the cliffs. Such lovely perfection of atmosphere and weather, glorious bright warm sunshine, and light summer clouds with beautiful effects of brilliant light and colour, and the whole tempered by soft cool breezes from the great elevation of the prairie, which is 5,000 to 6,000 feet above sea level. Then getting into the Rocky Mountain district, at Alamosa, the level is 7,000 feet above sea, and there the railway is carried over the great La Veta Pass 9,000 feet above the sea, and afterwards passed near the grand snow-capped mountains, "Spanish Peaks," which are 13,000 feet high (as much as the Jungfrau and its neighbours); lovely objects they were, two grand peaks of dazzling whiteness with their snow caps standing out in the clear atmosphere, so that the cliffs and ravines could be plainly distinguished, though about twenty miles distant. This atmosphere is the great charm of the country, so exhilarating and free; it seems another sensation of life altogether.

The La Veta Pass through one range of the Rocky Mountains is a remarkable work with long sharp curves, that double on themselves in the zigzag ascent up the steep side of the valley, and pass so near in each course that a stone could almost be thrown from one to another of three trains on lines one above another, and more than four miles of line are run over to make an advance of only half a mile. There is a continuous ascent of fourteen miles at a gradient generally as steep as one in twenty-five, and then a similar descent of as great length on the other side of the pass. This railway through the Rocky Mountain district is the narrow gauge of three feet.

Manitou, a valley in the Rocky Mountains in Colorado, is a favourite place for visiting from all parts of the States, and was stayed at for several days; it is at the foot of Pikes Peak, and is itself 6,000 feet above the sea, and the grand Pikes Peak towering above with its lovely snow cap, at 14,000 feet height (within 1,000 feet of the height of Mont Blanc). In the neighbourhood of Manitou are the Garden of the Gods and Monument Park, two very interesting and remarkable collections of strange fantastic rocks that are quite fascinating from their extraordinary forms and picturesque variety of colour, and of great extent. These rocks are sandstone of different degrees of hardness, and varying in colour from light grey to dark red; the caps are portions of a harder stratum above the softer one below, which has consequently worn away faster, but the difference in hardness is only little, and both are in a friable condition. There are also in the Garden of the Gods great irregular masses of sandstone rock, standing up on edge, and reaching to more than 300 feet height.

The ascent of Pikes Peak from Manitou was a grand adventure, taking eleven hours, and gave charming views of the other distant snow peaks of the Rocky Mountains, and the immense extent of distant plains; and the view, on descending in the evening sunlight, of the strange picturesque rocks in the Garden of the Gods at the foot of the mountain was most fascinating, from the brilliant colours shown by the different rocks in the bright sunshine. There was a complete garden of flowers extending through the valley and far up the mountain.

Pueblo was then visited, an old Mexican town at about the latitude of Algiers, giving a very interesting and picturesque effect in the brilliant sunshine. Many of the houses are built of sun-dried bricks made of mud and straw, called "adobés," which is the native building material. Adobé houses, as they are called, are scattered about over a large tract of the country; the bricks are about eighteen inches long, nine inches wide, and three and a half inches thick, and are stuck together with mud for mortar, and plastered over with smooth mud, and the flat roofs are made with poles laid flat across the top of the walls and plastered over with mud. Many modern houses of this make are built with regular wood-framed doors and windows, and they are universally preferred by the native population of mixed Mexican breed. A number of Indians were seen swarming about the train at the stations in the open country, bringing curiosities for sale.

Then we stopped at Santa Fé, in New Mexico, the oldest town in the United States, where a fine collection was seen of interesting and unique Mexican relics, including an agate spearhead as large as 6¼ inches long and 4¼ inches wide, said to be the largest known, and stone axe-heads with three grooves round them for the binding on the handle, considered to be unique. The place was most delightful from the soft clear air and brilliant sunshine, at an elevation of 7,000 feet above the sea.

From there the journey was all day across a great level plain, bounded by lovely blue mountains on each side at twenty to fifty miles distance, the plain being 4,000 feet high above the sea, in some parts green with shrubs and dwarf trees, but more generally bearing nothing but isolated cactus plants and tufts of the sharp-pointed "Mexican dagger plant," a kind of aloe *(Yucca angustifolia)*, the root of which is used as soap in the district.

One long portion of the country was an absolute desert of sand, without any object visible but the distant mountains, and we saw there, in passing, a real desert *mirage;* the blue hills about fifty miles off at the extreme horizon appeared lifted up in the air, with an inverted reflection of them below and a narrow streak of apparent water in front. This had the exact appearance of a great lake, with the reflection of the hills in the water; the whole so perfectly natural when examined with an opera glass, that it seemed impossible for it not to be real. The scene remained visible without alteration for a long time whilst passing in the train. The sun was blazing hot, with an almost cloudless sky, but there was a delightful soft cool fresh air that made the weather perfectly delicious.

Benson, in Arizona, on the Mexican frontier, was the most southerly point visited (about the latitude of Alexandria). The great charm of the country was the "desert garden;"

the whole plain, as far as the eye could reach, was covered with gigantic plants of cactus, yuccas, and aloes, grand yuccas with splendid spikes of flowers standing 20 feet high or more, and enormous dead stems 30 feet high and 1 foot to 1½ feet diameter, presenting most strange and uncouth shapes. Cactus plants in great numbers, some globular, as large as a small barrel, just bursting into bud all over, others flat-leaved, in patches as large as a dining table, with leaves as big as small plates; and cactus trees standing up like weird giants, one 10 feet high and 19 inches diameter, bursting into bud (in the garden of a station open to the platform), and another as high with a bunch of lovely white flowers at the top, each as large as a wine glass. Still larger plants were seen afterwards on the plain in passing by the train, with great vertical side branches. Large quantities of beautiful flowers were seen, and while stopping at stations we just stepped off the carriage platform to pick escholtzias and gallardias and others of our favourite garden flowers growing wild in abundance and in rich flower. The train, approaching Los Angeles on the Pacific coast, gradually descends from the high table land to the sea level, and at one point, at 150 miles from the coast, actually drops 260 feet below sea level on passing across a great depressed sandy track, probably an old lake bottom now dried up; for sixty miles length the line is below sea level. Eighty miles before Los Angeles in South California we passed through a remarkably fertile corn-growing valley; a fine wheatfield, 1½ miles long and more than half-a-mile wide, continuous without a single fence or break, and joining on to continuous barley crops at each end, extending altogether as long as half-a-dozen miles. Large tracks of the barley were cut and being carried (at the end of May), and the wheat was nearly ready for cutting. Barley is grown very extensively in Western America as horse food, instead of oats, which are little used; barley is found the more suitable food for the sturdy half Mexican horses that are used in the mountainous districts for coach traffic, where the time of each run is very long on account of the very hilly roads, although the distances are not great.

The new American reaping machine was seen at work, by which the corn is not only reaped, but is also threshed, winnowed, and sacked, all continuously in the same machine, avoiding the extra labour and the loss arising from subsequent handling of the grain. The corn is cut close below the ear, and the straw left on the ground The machine is followed in the field by waggons, which are loaded with the sacks of grain that are delivered by the reaping machine ready filled, weighed, and tied. Such a process is, of course, only possible in a very dry country, where the grain is ready for threshing when cut.

Los Angeles, near the Pacific coast, and within 300 feet of sea level, is in a real southern climate, with only about 12° variation in average monthly temperature throughout the year, 55° average for January, and 67° average for July. It is the special orange country, and a charming drive to Sierra Madre, fifteen miles out, was mostly through orange orchards, with the trees loaded with fruit, lemon and lime orchards, and miles of grape vineyards (dwarf plants like the Rhine vineyards). Oranges picked up off the ground like dropped apples, and orange orchards open to the road like apple orchards; and a beautiful display of wild flowers all the way, including many of our favourite Californian garden plants growing wild in abundance and in luxuriant bloom.

There are a number of large private houses with beautiful gardens extending several miles round Los Angeles, which is a favourite place for residence; and a great treat is the sight of the luxuriant semi-tropical plants and shrubs and rich masses of flowers, rich creepers over the houses covered with blossom, banana trees in fruit, and pomegranate and pepper trees grown as ornamental shrubs, the pomegranate covered with magnificent deep crimson flowers, and the pepper trees with elegant bunches of bright red berries, that turn black when the pepper is ripe. A great aloe was seen in full bud, thirty feet high, with a flower panicle twelve feet long, and the bottom leaves six feet long and seven inches wide.

A curious circumstance noticed from having travelled so far south was that instead of the days getting longer with the advance of summer they stood still or actually got shorter as the journey proceeded. The sun was set by seven o'clock at the end of May, and if we had gone as far as the Equator we should have seen him setting and rising at six o'clock, the same all the year round. The sun was so nearly vertical over head that the south could not be ascertained from his position, and the only way was to turn round until the shadow of your head when standing upright fell just between your toes, and then you knew that you were facing the north.

(To be continued.)

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 160.)

HASELEY.—*Clement Throkmorton, Esq.*, 1573, *and w. Kath., with* 6 *sons and* 7 *daus. Haines.*

Upon an altar-tomb in the chancel is this interesting memorial, part of which is palimpsest. This word is more properly applied to a M.S. in which the first writing has been defaced to make room for later matter; but the term palimpsest is also applied to (1) brasses engraved anew upon the reverse side of the original; (2) those altered to suit another name and date; (3) unaltered effigies with new inscriptions. The present brass is an example of the first kind; part of the inscription has lines of drapery on its reverse side; and the group of sons is upon a plate bearing some beautiful architectural details. These portions have lately been fitted with hinges, so that both sides may be examined.

The effigies of the knight and his lady are 2ft. 3in. and 2ft. 1in. long respectively. The former is recumbent, his head resting upon a tilting-helmet; but his feet are inconsistently represented as standing amongst grass and flowers. His armour is chiefly of plate, but he wears a hauberk of mail; and there are ruffs round his neck and wrists. There is no need to describe the armour in detail, but reference may be made to the two *tuilles* over the thighs, the broad *sabbatons* on the feet, and the rivets which fasten the plates together. The lady, who is at the knight's left side (armorially speaking, her proper position), wears a Paris hood, and a gown with out-standing collar, and tight sleeves puffed at the shoulders. Beneath this is another dress, with profusely embroidered skirt. Ruffs are seen at the neck and wrists; and from the waist-band, attached to a long ribbon, hangs a book with two clasps. Below the knight are six sons, in long gowns and doublets; and opposite to them are seven daughters, dressed like their mother. Above the parents are two shields and a lozenge. The centre shield bears THROKMORTON, with quarterings of ABERBURY, OLNEY, SPINEY, ——, and WIKE. The lozenge, which has been relaid upside down, of course bears the lady's arms, NEVELL, and the shield on the left shows the husband's arms (already described) impaling the wife's. At the bottom of the tombstone are two shields like those already described.

The inscription is :—

✠ **Here lieth the bodye of Clement Throkmorton Esquier the thirde | Sonne of Sr George Throkmorton Knight, and Katherin Nevell his wyffe the ffirste and eldeste Daughter of Sr Edward Nevell Knight, of whom he begate syxe sonnes and seven | Daugters, he departed this world the sondaye beinge the xiiiith of | December in the yere of our lorde God MCCCCC seventye and three and in the syxtene yere of the raigne of our most Gracious and sufferaigne ladye quene Elizabeth.**

The Sir George Throkmorton referred to is the knight whose effigy is at Coughton (see above). Dugdale gives an illustration of this brass.

HILLMORTON.—*A lady, circ.* 1410. *Haines.*

This fine effigy, 4ft. 6in. long, is very similar to the brass at Merevale. It is underneath the floor of a pew in the south aisle of the church, and is in fairly good preservation. The lady is clad in a close-fitting kirtle, with sleeves reaching to the knuckles. Over the kirtle is a mantle drawn together by a cord. The head-dress is that known as the *crespine* (see Merevale), with which is worn a graceful kerchief. At the lady's feet are two small lap-dogs. From her hands proceeds a scroll, part of which, containing the angel's salutation to S. Mary the Virgin, is lost. The following words are left :—

Ave . . . . fruct' ventris tui. Jhū fili dei miserere mei.

That is in English :—

Hail . . . . fruit of thy womb. Jesu son of God have mercy on me.

There is no other inscription left; on either side of the effigy is the matrix of a small shield.

Dugdale records "two gravestones of marble having small portraictures in brass," a description which does not suit this example.

IPSLEY.—There are no brasses at Ipsley, as Haines states, but two incised slabs.

ITCHINGTON, LONG.—*John Bosworth, yeoman,* 1674, *and ws. Haines.*

A large plate, about 2ft. 2in. square, set in a stone tablet with pillars, mouldings, &c. At the top of the plate is the figure of a man in a long belted doublet, kneeling upon a cushion. The letters I B are engraved near his head. Upon his right side is depicted a lady kneeling upon a cushion and holding a book. She wears a cap with acutely pointed sides, a bodice, skirt, and apron. The name ELLINOR is inscribed near her. On the opposite side kneels a similar figure, with the name ISABELLA. At the bottom of the brass on the left is a skull and cross-bones, and on the right an hour-glass and cross-bones. The drawing is poor, and the spirit and style of the whole composition is debased. The following inscription is beneath the figures:—

BEHOLD THE CHARITY OF JOHN BOSWORTH OF YARDLEY IN THE COVNTY | OF WORCESTER YEOMAN HE DEPARTED THIS LIFE THE XTH OF MARCH 167$\frac{4}{5}$ | IN THE LXXXII^{D} YEARE OF HIS AGE HE GAVE BY HIS LAST WILL AND TESTAMENT | VNTO DIVERS TRVSTEES FOR THE VSE AND BENEFIT OF THE POORE OF | THE PARISH OF LONG ITCHINGTON IN THE COVNTY OF WARWICK AND | THEYR SVCCESSORS THE SVMME OF XV^{L} IIII^{S} YEARLY EOR EVER TO BE | PAYD AND ISSVED OVT OF ONE MESSVAGE CALLED BY THE NAME OF | BROWNE SCITVATE LYING IN BICNILL ALIAS BICKINHVLL IN THE COVNTY | OF WARWICK AND ALSOE ONE CLOSE OF LAND IN V PARTS COMMONLY | KNOWNE BY THE NAME OF WADDICE AND ALSOE ONE LITTLE CRAFT | CALLED BROAD CRAFT AND ALLSOE IIII RVDGES OF ARRABLE LAND IN | A COMMON FEILD CALLED EWETREE FEILD LYING IN YARDLEY IN THE | COVNTY OF WORCESTER VIZ V^{L} IIII^{S} TO BE BESTOWED IN XII TWOPENNY | WHEATEN LOAVES EVERY SABBATH OR LORDS DAY TO BE SETT ON THE | COMMVNION TABLE AND TO BE DISTRIBVTED BY THE CHVRCHWARDENS | AND OVERSEERS OF THE POORE VNTO XII OF THE POOREST OF THIS PARISH | VIZ THE OTHER X^{L} TO BE BESTOWED FOR THE MAINTAYNANCE OF A GOOD & | ABLE SCHOOLMASTER TO TEACH THE POORE OF THIS PARISH SONNES AND | DAVGHTERS TO READ THE GRAMMER & OTHER LITERATVRE & ALLSOE TO WRITE | & CAST ACCOMPT AS IN MY WILL IS MORE AT LARGE EXPRESSED |

ALL YOV THAT PASSE MEE BY
AS YOV ARE NOW SOE ONCE WAS I
AS I AM NOW SOE SHALL YOV BEE
REMEMBER THE POORE & IMITATE MEE

MEREVALE.—*Robt. Lord Ferrers of Chartley* 1412(?), *and w. Margt.* [*Spencer.*] *Haines.*

These magnificent effigies lie upon the floor of the chancel. The knight is 5ft. 2in. high, and is clad in the plate-armour of the early part of the fifteenth century, viz.: bascinet, gorget (instead of the mail camail), epaulières, brassarts fastened with straps, coutes, vambraces, gauntlets showing the finger-tips and armed with gadlings, cuisses, genouillières, jambs, sollerets, and rowelled spurs. At the armpits are circular plates called *roundels*, which served to cover the joints of the harness. The breast-plate has a skirt of seven overlapping *taces*, to the lowermost of which at its centre are fastened three smaller plates forming the *baguette*. Below this skirt is a row of rings, every third ring having another depending from it. This edging of mail may be part of a mail shirt, but is probably merely a survival in the shape of a fringe. The knight's sword has a straight cross-guard (part of which is lost) and is fastened to an ornamental belt, arranged diagonally across the hips. Part of a dagger remains at the left side, and the scabbards of this and the sword are ornamented with the usual rows of *guttès* or drops. The knight's head rested upon a tilting-helmet, which is lost; the *panache* of peacock's feathers which adorn it is, however, in good preservation. At the feet of the effigy is an animal resembling a bear. The lady's effigy measures 5ft., and is at the knight's left hand, the head resting on two cushions. She wears the *crespine* head-dress, which confined the hair in a net, and formed two small bunches over the ears, the whole being kept in place by a band encircling the head. Over this is thrown a kerchief. The rest of the costume is a long mantle fastened across the chest by a cord, and a tightly-fitting kirtle, with tight sleeves reaching to the knuckles and buttoned beneath the forearm with eighteen buttons. A small dog, with a collar of bells, is at the lady's feet.

There is neither inscription nor canopy, and as the brasses, both of which have been broken, have been relaid in a new stone, there are no matrices. Haines refers to illustrations of this brass in Gresley's Forest of Arden, and Boutell's Series. Gresley seems to suppose that the knight's effigy represents Robert Earl Ferrers, who founded the Abbey of Merevale in 1148, and was there buried in an ox-hide, a most improbable supposition.

MERIDEN. *Elizth. Rotton*, 1638, *with anagram. Haines.*

An effigy, 2ft. 4in. long, representing a young lady of very comely appearance. She wears a cap with escalloped edges, beneath which her hair hangs in graceful curls. Her bodice, which is tied at the waist with a ribbon, has a double falling-collar and double cuffs, both with escalloped edges. The upper parts of the sleeves have lappets caught up above the elbow and tied with a bow. The skirt of the dress is plain, and short enough to reveal a pair of high-heeled shoes with rosettes in front.

On a plate, 2ft. 4in. by 1ft. 4in., below the figure is this inscription, with an anagram upon the lady's name, *i.e.*, a re-arrangement of the letters of her name in the form of a motto:—

Memoriae Sacrum
SVB ISTO LAPIDE MARMOREO PLACIDE RECVMBIT ELIZABETHA ROTTON, SINGVLARIS FORMÆ AC VIRTVTIS VIRGO FILIA ET HÆRES THOMÆ ROTTON GENEROSI, ET MARGARETÆ VXORIS EIVS, QVÆ IN FLORIDA (HEV) IVUENTVTE EX HAC VITA MIGRAVIT 14° DIE DECEMBRIS A° ÆTATIS SVÆ 20 ET SALVTIS NRÆ 1638
The Text at her Funerall.
Math. 9, 24. The maide is not dead but sleepeth.
Anagr. { Elizabeth Rotton / I to A blest Throne. }

FREINDS WEEPE NOE MORE: WHEN THIS NIGHTS SLEEPE IS GONE I SHALL A RISE, AND GOE TO A BLEST THRONE.

Translation of the Latin:—

Sacred to memory.

Beneath this marble stone peacefully rests Elizabeth Rotton, a maid of rare beauty and virtue. the daughter and heiress of Thomas Rotton, gent., and of Margaret his wife; who in the bloom (alas) of her youth departed out of this life on the 14th of December in the 20th year of her age, and in that of our salvation 1638.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

PART III., "THE EVOLUTION OF LIFE."

BY C. H. ALLISON.

CHAPTER XIII., "THE CO-OPERATION OF THE FACTORS."

To more fully show that the truths of animal and vegetal development are expressible as manifestations of the abstract truths postulated in *First Principles*, the processes separately described in the four preceding chapters are in this chapter contemplated in their *ensemble*.

* Transactions of the Birmingham Natural History and Microscopical Society. Read June 25th, 1885.

We find that change of structure is always due to change of incident forces, and that for organic evolution there is sufficient cause in the continual changes in environments; and further that, conforming to the law of "the instability of the homogeneous," there has been continual differentiation among individuals and aggregates of individuals, of which those only whose internal actions have been but slightly incongruous with external actions have survived. But survival through changes of conditions implies adjustment to the new conditions, and this is inductively verified, for adaptation is expressible in mechanical terms as direct equilibration, and natural selection is similarly expressible as indirect equilibration.

In the earliest times, changes in external inorganic forces were the only causes of the successive modifications of organisms; but whilst these must always continue to operate, the actions of organisms on each other have become ever increasing sources of such modifications, until in man they are the chief factors.

As regards the internal processes of change entailed by these external causes, there always has been and will be a survival of the fittest; but whilst natural selection (indirect equilibration) has been and remains the only process among lower organisms, there grows with the evolution of organisms—having some activity—a direct equilibration or adaptation which plays an increasingly important part, until finally, among civilised human races, it becomes the main factor, social arrangements even tending to prevent the survival of the fittest.

Chapter XIV., "The Convergence of the Evidences."

For the doctrine of "The Evolution of Life," three classes of evidence have been assigned, of which the *à priori* were partly negative and partly positive.

The Special-Creation-Hypothesis was found to be worthless, but the more the Evolution-Hypothesis was considered the clearer its truth became, and this grew even more indubitable when the two hypotheses were confronted with the general truths established by naturalists. These inductive evidences occupied four chapters, embracing the arguments from Classification, Embryology, Morphology, and Distribution (in space and time), each of which groups contained arguments pointing to the same conclusion, and, moreover, the conclusion to be inferred from the arguments of any one group is the same as that to be inferred from the arguments of all the other groups, thus giving to the induction a very high degree of probability.

But deduction brings us to a conclusion in harmony with that inductively reached, for all organisms are continually passing into new environments, which, if they (the organisms) are to survive, must be met, as individuals, by re-adjusted balance of functions and correlative adaptation of structure, and as species by natural selection or survival of the fittest.

Thus we see that organic evolution conforms to the universal laws of the redistribution of matter and motion conformed to by evolution in general.

Yet, strong as is the evidence presented by the organic world as a whole of the evolution of organisms, we shall see it is greatly strengthened when we come to consider "the *ensemble* of vital phenomena presented by each organism."

Appendix to Vol. I.

The Appendix consists of a letter written in 1868 for publication in *The North American Review*, but declined by the editor in pursuance of a general rule. The subject matter is of such vast importance, as elucidating some of the most recondite portions of *The Principles of Biology*, as replying to certain serious and able criticisms, and as demonstrating that the evolution of the organic from the inorganic is a necessary deduction from *First Principles*, that it is deeply to be regretted that the necessary limitation of space renders an adequate exposition of it impossible. In the preface to the system it was explained that on account of the largeness of the projected work, the author decided to omit the two chapters on Inorganic Evolution which would otherwise have preceded *The Principles of Biology*, and this necessary though regrettable hiatus appears to have led some critics to suppose that Mr. Spencer believed in spontaneous generation instead of in generation by evolution. The way in which this latter process has operated in accordance with the great fundamental laws of the instability of the homogeneous and of the persistence of force, by the continual compounding and re-compounding of the elementary atoms, and then of the resulting Complex Molecules, until after the lapse of vast periods of time such a substance as protein comes into existence, from which still further modifications upon modifications at length evolved the lowest living forms, which at first without organs afterwards attain these attributes, is explained with an amplitude of scientific illustration and minuteness of detail requiring for its due comprehension the most careful study. It is here only possible to thus briefly indicate the nature of the propositions and the lines of argument followed in their demonstration.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

NINTH ANNUAL MEETING, SHREWSBURY, 1886.

The Ninth Annual Meeting was held in the Music Hall, Shrewsbury, on Tuesday, June 22, 1886. The Rev. J. D. La Touche (President of the Union) occupied the chair, and among those present were—Rev. O. M. Feilden and the Rev. T. Auden (local secretaries), the Rev. Canon Butler, Rev. C. H. Drinkwater, Rev. N. Cooper, Rev. W. Houghton, Rev. W. H. Fletcher, Colonel Barnes, and Messrs. W. Phillips, R. W. Ralph, W. Beacall, W. Southam, H. Wilson (Malvern), Egbert de Hamel (Tamworth), F. W. Richards (Birmingham), E. Wheeler (Peterborough), Rev. D. P. Lewis, &c.

The Minutes of the last Meeting held at Birmingham were read by the Rev. T. Auden, who apologised for the unavoidable absence of Mr. T. H. Waller, B.A., B.Sc., Birmingham (Union Secretary).

PRESIDENTIAL ADDRESS.

The President said before reading the address he wished to say a few words of welcome to the delegates of the various towns represented. He was pleased to say that among naturalists there existed a sort of Freemasonry, and they were always glad to meet one another; therefore it did not require many words from him to express the feeling of pleasure entertained by the members of the Shropshire Society towards the visitors belonging to the Union. He wished very much that it had fallen to the lot of some gentleman more able and more eloquent than himself to welcome the delegates. It was a source of great regret to all concerned that some of those gentlemen more intimately acquainted with the town of Shrewsbury, and especially the Mayor of the borough, were not able to be present. He had received a letter from Mr. Southam, who said he was exceedingly sorry that he was unable to attend the gathering, to which he had looked forward as one of the principal events occurring during his term of office; but having been invited to London by the Lord Mayor to attend, in his official capacity, the laying of memorial stones and other ceremonials, he thought it only right that an ancient borough like Shrewsbury should be represented. In welcoming the Union, he (the President) would say that the county of Shropshire was rich in many respects, and especially to geologists, for it was by the geology of Shropshire that the geology of many other parts of the world was deciphered. It was also a country full of interest to the botanist, and therefore those gentlemen who had come from a distance would have ample opportunities for prosecuting their studies; but he was afraid the short time they would spend among the hills and valleys would give them only a very inadequate idea of the treasures concealed beneath. He hoped, however, they would be able to reap some benefit from their visit. The work done by these Field Clubs was very considerable when taken together, but it might be very much more than it was. There was a feeling abroad that the interest in Field Clubs was declining, but if this were so he hoped that that would soon pass away. Certainly on the establishment of clubs of this sort there was a great deal of interest shown; but like all new institutions it gradually diminished, perhaps to rise again with greater energy. He knew there was a great desire among the more eminent scientific men belonging to the British Association, who recognised the work done by Field Clubs, to attend the general meeting of the clubs, and help to stimulate the love for science. He mentioned this because the delegates from a distance might perhaps make an effort to keep up the interest in the different clubs. Before proceeding with his address there was one other subject to which he would allude. He thought on this occasion, when many eminent men, interested in science, from all parts of England are gathered together, they might consider a matter which would be not only an honour to the town of Shrewsbury itself, but the whole county, and that was some greater recognition of Charles Darwin. It was an old saying that a prophet was not so much appreciated in his own country as he was elsewhere. He did not mean to say that the citizens of Shrewsbury were unmindful of the great honour conferred upon them in Darwin being born in the town, and connected with it for many years; but he did think Darwin was not appreciated as he ought to be, and if before the meeting separated the members would give an expression of opinion as to whether they approved of the suggestion he had ventured to throw out, he thought it might be the means of starting a subscription list for the purpose of erecting a statue, or adopting some other mode of recognising the life of the great and illustrious Darwin. The reverend gentleman outlined his presidential address as follows:—I propose, in the address which I have the honour to deliver on this occasion, first to recapitulate briefly the subjects which have occupied the attention of the Naturalist Societies of this Union during the past year; secondly, to enumerate the various points of interest which this county and neighbourhood afford; and lastly, to allude to the labours of Charles Darwin, that illustrious man of whose connection with the town of Shrewsbury, by birth and family, its inhabitants may feel justly proud.

Canon Butler moved that the thanks of the Meeting be given to the President for his admirable address. He announced that he had been asked to express, on behalf of the Mayor and Corporation of the town, their sense of pleasure at the visit of the Union.

Mr. H. Wilson seconded the vote, which was unanimously carried.

The Rev. T. Auden then detailed the proceedings of the Meeting of the Council held that morning and explained their report which was now presented. At that Meeting Mr. E. de Hamel had been re-elected treasurer, and Mr. T. H. Waller, the general secretary, had been asked to again undertake the duties of that office, he having expressed a wish to resign.

Mr. W. Phillips proposed that the proceedings of the Council Meeting be approved and adopted by the General Meeting. Mr. J. Calcott seconded the resolution and it was carried.

Mr. R. W. Ralph moved a vote of thanks to the president and officers for their services during the past year. Mr. Houghton seconded it, and it was carried.

Mr. E. de Hamel proposed on his own behalf, and that of the other visitors, their hearty thanks for the excellence of the arrangements made by the local officers for that meeting. He well knew what trouble had to be taken to get up a two days' entertainment such as that, and he could fully appreciate all that had been done.

Mr. Wheeler seconded the resolution and it was carried.

Mr. H. Wilson proposed a vote of thanks to the president for his valuable services. This was duly seconded and carried unanimously.

The following is the

REPORT OF THE COUNCIL.

Societies in the Union.

During the past year two Societies have withdrawn from the Union, viz., the Bedfordshire Natural History and Field Club and the Nottingham Naturalists' Society. The list of component Societies will therefore now stand as follows:—

Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Evesham Field Naturalists' Club.
Leicester Literary and Philosophical Society.
Northamptonshire Natural History Society.
Nottingham Working Men's Naturalists' Society.
Oswestry and Welshpool Naturalists' Field Club.
Peterborough Natural History and Scientific Society.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.
Tamworth Natural History, Geological, and Antiquarian Society.

The Council views with great concern the continued withdrawal of Societies from the Union, and feels that the apparent failure of the Union to meet the expectations of so many of the original constituent Societies demands very careful attention from the members, in order to determine the causes and to devise means for more efficient mutual help and intercourse. At present the sole function of the Union appears to be that it is the excuse for a pleasant meeting and pic-nic, and with these—as the only result—the expenditure of time and money involved appears decidedly out of due proportion. The Council believes that the time has come when the Societies still remaining in the Union, 16 out of about 30 which have at one time or another belonged to it, should definitely consider whether there is any feasible scheme by which the bond of connection now existing in the Union may be strengthened and still further utilised.

"MIDLAND NATURALIST."

The monthly issue of the "Midland Naturalist" has continued, and the character of the papers contributed has, we believe, been as high as in any former year. We have again to thank the editors, Messrs. W. J. Harrison and E. W. Badger, for their valuable services and the labour and energy they have given to the work; and the Birmingham Natural History Society for the illustrations which have added so much to the interest of several of the articles.

Since the last meeting, the conclusion of the list of the Flora of Warwickshire, by Mr. J. E. Bagnall, A.L.S., has appeared. We feel that the Union is to be congratulated on the completion of this very excellent piece of work, the outcome of the unwearied personal observations of many years, supplemented by diligent research into previous records. Among the principal articles published we may mention:—

Pennatulida and the Mode of Automatic Section Cutting and Mounting, by W. P. Marshall, M.I.C.E.; Leicestershire Forms of Capsella Bursa Pastoris, by F. T. Mott; Geological Structure of the Titterstone Clee Hill, by the Rev. J. D. La Touche; The Ear and Hearing, by W. B. Abel, B.A., F.R.M.S.; The Middle Lias of Northamptonshire, by B. Thompson, F.G.S., F.C.S.; Some Recent Observations on the Structure of Rowley Rag, by Thos. H. Waller, B.A., B.Sc.; On Starch, by Edward Francis, F.C.S.; Niagara and its Physical and Geological Conditions, by W. P. Marshall, M.I.C.E.; Notes on the Flora of America, by W. H. Wilkinson; Anthropology, by Joseph Smith, jun., M.A.I.; Some Inaccuracies upon the Geological Survey Maps and Section of the Leicestershire Coalfield, by W. S. Gresley, F.G.S.; The Occurrence of Fossiliferous Hæmatite Nodules in the Permian Breccias in Leicestershire, by W. S. Gresley, F.G.S.; The Monumental Brasses of Warwickshire, by E. W. Badger, M.A.; Notes on the Anker Valley and its Flora, by J. E. Bagnall, A.L.S.; Notes on the River Rea and the Flora of the Rea Valley, by the Rev. H. Boyden, B.A.; The Precarboniferous Floor of the Midlands, by W. J. Harrison, F.G.S.

DARWIN MEDAL.

The subject of the present year is Zoology, and the following gentlemen kindly undertook the office of Adjudicators, viz.:—Professor T. W. Bridge, Professor A. M. Marshall, Sir Hereward Wake, Bart., and Rev. W. Houghton.

The Council regrets that the Adjudicators have unanimously expressed the judgment that none of the papers or sets of papers were deserving of the distinction of the medal. The Council, therefore, in accordance with the rule, has made no award of the medal for this year.

The Council, at the last meeting, referred the regulations for the medal to the Executive Committee for their consideration, with the view of removing some ambiguities which appeared in the existing rules. The result of the Committee's consideration was the adoption of the modified rules published in the "Midland Naturalist" in December, 1885, by which the whole set of papers, by one author, is to be considered as the competing matter, and not any one individual paper; together with an instruction to the Council to withhold the medal in any year when, as unfortunately in this, the majority of the Adjudicators decide that none of the papers sent in are of sufficient merit to warrant the award of the medal.

The Committee appointed at the Birmingham meeting to bring the appeal as to the destruction of wild plants before the public took considerable pains to do the work entrusted to them effectually. They obtained the insertion of the appeal in many of the leading journals of the country, and articles were also published in several of them, drawing attention to and enforcing the appeal. It was also circulated extensively among the leading Natural History and other Societies of the country, and in many instances promises were sent in reply that these would do all in their power still further to spread the appeal and to carry out the suggestions contained in it.

The Council feels that the Committee deserve the hearty thanks of the Union for the thorough and painstaking way in which they have conducted the work, and hopes that as time goes on we may see the result of their labour in an increased abundance of the rarer plants of our country.

In conclusion, the Council, while regretting the apathy as regards the Union of so many of the members, feels that the circumstances of many of the component Societies are at present exceptionally difficult, and that it is only by the efforts of those who can bring to the task the necessary energy, and can devote to it the necessary time and attention, that the Union can be preserved for better times.

THE CONVERSAZIONE.

The Conversazione was held in the large room of the Music Hall on Tuesday evening, when there was a large company present, including delegates from Birmingham, Malvern, Tamworth, and Peterborough, in addition to representatives from various parts of Shropshire. Principally through the kindness of local ladies and gentlemen, an unusually interesting collection of curiosities was displayed upon tables arranged round the room, whilst upon the walls many objects of interest were exhibited. The chief attraction, however, appeared to centre in the microscopical instruments, the marvellous specimens of life, as seen when magnified, obviously affording an interesting and instructive lesson for the majority of those present. The microscopes and specimens of organisms were kindly lent by Mr. Bolton, of Birmingham, the Rev. W. Houghton, Mr. H. E. Forrest, Mr. W. E. Harding, Mr. W. Beacall, and Mr. F. W. Richards. During the evening a couple of scientific lectures, which were made exceedingly interesting by the respective lecturers, were delivered by Dr. Callaway, of Wellington, and Mr. Luff, of Shrewsbury.

The former gentleman, in the course of his discourse upon the formation of the Wrekin, said that the view first held by the Geological Survey in respect to the formation of this mountain was that it was composed of a mass of intrusive green-stone. The first to throw doubt upon the view was Mr. Allport, of Birmingham, a man who had rendered great service to geological science, and who, by the application of the microscope, had introduced quite a revolution into that science. Mr. Allport applied the microscope to the strata rocks of the Wrekin, and ascertained that they were composed of volcanic rock lavas and volcanic ashes, which had been erupted at the surface like ordinary volcanic rocks. The next step was to ascertain the age of this volcanic series, and it was found that these lavas and ashes were several thousand feet in thickness. He (the lecturer) commenced to study the question at Shineton, where he found a new series of fossils which proved that the Shineton Shales were Upper Cambrian, whilst underlying the Shales he found sandstone with some fossils. He next came to a band of quartzite, and at the base of the quartzite were pebbles derived from the Wrekin series, showing that the Wrekin volcanic series must have been Upper Cambrian; but he found another piece of evidence which demonstrated the matter beyond a doubt, for he discovered that the Longmynd Hills were largely derived from the volcanic rocks of the Wrekin. He found, for instance, in the Wrekin series, certain distinctive lavas, and he found similar lavas undistinguishable under the microscope from the Wrekin series, embedded in this range of hills. He ascertained also that the sandstones of the Longmynd were fragments of the same lava, so that they could conclude that the Longmynd series was derived from the Wrekin series. As to the structure of the Wrekin, it was, in the centre, composed of volcanic rocks, whilst the quartzite rested on either side. These were real strata—not a mass of molten matter forced up from below. The bedding of the rock was oblique to the axis, which was a peculiarity attached to mountains of great antiquity, and he had described this structure as plagioclinal. At the south-west end of the Wrekin there was a little rise known as Primrose Hill, which was formed of metamorphic rock—of a sort of granite—and of ordinary gneiss rocks. Then he found in the Wrekin series a conglomerate, or pudding stone as it was commonly termed, which was made by rounded fragments, and was derived from the metamorphic series of which Primrose Hill was a fragment. He had lately discovered an Archæan formation at Rushton. They were reminded that at this very ancient epoch this region was occupied by volcanoes, and these volcanoes probably extended from North Wales to Charnwood Forest.

Mr. Luff, in describing the geological character of the Clun district, dwelt principally upon the fact that he had discovered on the hill-tops in the neighbourhood large blocks of very hard stone, which were similar to those found at Rhayader. For the stones to have been conveyed by ice from Rhayader to Clun, however, the flow must have travelled in an entirely opposite direction to their invariable course—north to south—and the question therefore arose as to how stones similar to those found in the district of Rhayader got to Clun, unless they were carried by a flow running from west to east, which was very remarkable, should such have been the case. He had sent specimens of the stone to the British Association, and they had been trying to solve the problem, but up to the present their efforts had been futile. His supposition, however, was that the sheet ice and snow by which England was formerly covered gradually melted as the climate became warmer, and left these blocks of stone stranded upon the hill tops in the Clun and Rhayader districts. To add to the variety of the proceedings, Mr. Pumphrey delivered a series of interesting dissolving-view lectures in an adjoining room, whilst Mr. Lea's excellent choir contributed several glees, which were sung with exceeding sweetness and precision.

Mr. John Bennett, Mardol, Shrewsbury, exhibited fine specimens of old Salopian china, a cannon ball found near Castle Hill about 50 years ago, a framed painting of Wenlock Abbey, an engraving of Charles Darwin, and also one of the Hon. T. Kenyon, together with a painted portrait of General Lord Hill. Mr. Henry Shaw kindly sent several cases of stuffed birds of a very beautiful character; whilst Mr. W. Phillips showed a series of diagrams, illustrating the algæ which caused the breaking of the meres; representations of British fungi, skilfully drawn from nature by himself, together with an admirable collection of lichens. Mr. George Luff had suspended on one of the walls a couple of large maps, drawn on linen, by which he illustrated his lecture, illustrating the position of Clun at the extremity of the central transverse range of the Cambrian Mountains and the mountainous nature of the district which the Clun boulders have traversed. Miss Cooper, Claremont Buildings, sent a very handsome piece of ancient Gobelins tapestry, whilst Mr. T. R. Blunt exhibited a series of views of Shrewsbury and sketches of the interior of the Abbey Church by Mr. Henry Blunt, a section of the first Atlantic cable, which possessed peculiar interest, a copy of Buddhist Inferno or Purgatory, together with an interesting model of a lunar crater and other curiosities. Two very skilfully-executed paintings of the interior of St. Julian's Church and Golden Cross Passage, by Mrs. Hay, were lent by Mrs. Auden; whilst on the mantelpiece stood two fine steel-plate engravings of Darwin, exhibited by Mr. W. Beacall, and Mr. Shaw also showed a painting of the great naturalist. A very fine painting of Butcher Row was shown by Mr. J. Laing, together with a new series of etchings of "Ye Olde Town of Shrewsbury," a painting of Stokesay Castle, of the Court in Butcher Row, and the old Welsh Bridge, together with views of other interesting spots in the town. Mr. Acherley exhibited a view of St. Alkmond's Church before the nave was taken down, whilst the Rev. D. Phillips Lewis showed several Egyptian brass trays, which were masterpieces of engraving, and specimens of Chinese fancy work, together with skilfully-inlaid Japanese panels, beautifully executed, the flowers being of coloured ivory. Mr. Morgan exhibited a magnificent collection of moths and butterflies from Berma, whilst Dr. Callaway lent a series of geological specimens showing the partial derivation of the Longmynd series from a pre-existing volcanic group, &c., being obtained principally from Shropshire. Mr. Horace Pearce, F.G.S., Stourbridge, also exhibited specimens of rocks from the granite quarries of Aberdeenshire; and the Rev. William Houghton showed specimens of fossils, rocks, and shells obtained from Egypt, together with an assortment of dried fungi. Mr. Martin J. Hardy, Shrewsbury, exhibited a splendid case of British butterflies; whilst Mr. T. S. Stooke kindly lent a glacier-scratched stone obtained from an excavation 15ft. in depth, at Llyn Slygard, Rheidol, Plynlimmon, together with cores of sandstone from a bore-hole in Leicestershire, obtained by the use of a Diamond Rock Boring Machine. Mr. Walter Southam sent a very fine specimen of the *Polyporus sulphureus*; Mr. W. Phillips also supplied a collection of *Conferva Ægagropila*, and several hedgehogs, or balls of pine needles, found in the mere at Ellesmere, and specimens of the *Polyporus nigrescens* and *Polyporus rufescens*. Mrs. Salt, Council House, exhibited a collection of Sikh armour picked up upon the field after the battle of Chillianwallah by a Shropshire man. Mr. Henry Fenton showed an assortment of fossils of echinus found in Sussex chalk, a giant ammonite found in Somerset, together with a magnificent crystal of carbonate of soda, and a remarkable specimen of potato flint. Major Southam showed a seventeenth century bottle found in White Mere, whilst Mr. J. Gray sent fine specimens of Fijian war clubs, stone hatchets, fishing hook and stone bait, together with a stone bowl found in the Dead Sea. Messrs. J. and B. Blower exhibited a series of very old views of Shrewsbury and neighbourhood, and the Rev. Canon Butler sent an extensive collection of dried plants. The proceedings throughout were of a very agreeable character.

METEOROLOGICAL NOTES.—May, 1886.

The mercurial column was high at the commencement of the month, 30·463ins. on the 5th, but fell steadily till the 13th, when the reading was 29·262ins,, after which it underwent various fluctuations till the end of the month. The range of temperature was remarkably uniform for the first ten days, the mean gradually ascending till the 7th, when a maximum of 75·3° was registered at Loughborough, and 71·8° at Coston Rectory; while at Henley-in-Arden 76·0° was recorded on the 6th. In the rays of the sun, at Loughborough, the highest reading was 132·2° on the 5th. The difference between the maximum readings on the 10th and 11th was 19 degrees. The temperature was generally low for the remainder of the month. The lowest readings occurred on the 1st, and were 26·0° at Coston Rectory; 29·0° at Henley-in-Arden; and 30·3° at Loughborough. The mean temperature was about one degree above the average, the warm weather of the 5th, 6th, and 7th contributing to what would have been otherwise a great deficiency. May is remarkable for its rainfall, for, although the first nine days were dry, the total for the month was three inches above the average. The greatest fall was at Henley on the 12th, 1·75in., at Loughborough 1·39ins., and at Coston Rectory 0·97 of an inch on the 13th. At Loughborough the total value for the 12th and 13th was 2·20ins., and for the whole month 5·16ins., while at Henley the total was 5·66ins., and at Coston Rectory 4·50ins. This is by far the heaviest rainfall in May for the past eight years; and great floods resulted, from which much damage was done to growing crops and other property.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Review.

Hymenomycetes Britannici: British Fungi (Hymenomycetes). By Rev. John Stevenson. Vol. I. Wm. Blackwood and Sons, 1886.

The first volume of this long-looked-for work has now appeared. In regard to the known British Hymenomycetes, the "Handbook" has been for some time very defective; how much so can be seen from the simple statement that there were contained in it 452 species of the genus Agaricus, while the number in the work now published amounts to 782 species of the same genus. Besides Agaricus, the present volume contains the two succeeding genera, Coprinus and Bolbitius; and the second volume, which will comprise the remainder of the Hymenomycetes, is promised at an early date. It is not too much to say that these two volumes will be absolutely indispensable to every student of the gilled Fungi in this country. They form the necessary complement of the "Illustrations," and the two combined will render comparatively easy in the future what has always been the hardest task of a British mycologist, the satisfactory identification of the members of the vast and polymorphous genus, to which the common mushroom belongs. The descriptions, which are founded chiefly on those in Fries's "Monographia Hymenomycetum Sueciæ," are fuller and more comprehensible than have ever been at our command before. Dimensions are given in nearly every case, with the colours of the pileus, the size of the spores, and other means of identification—a most blessed change from that curt Linnæan style in which some of the early mycologists believed. Besides this, all the sub-genera and some of the smaller sub-divisions are illustrated by wood-cuts engraved in his well-known effective style by Mr. Worthington G. Smith. W. B. G.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Biological Section, June 8th. Prof. W. Hillhouse, M.A., in the chair. Mr. J. E. Bagnall, A.L.S., exhibited *Bromus secalinus*, *Arenaria leptoclados*, *Trifolium striatum*, *Pyrus communis* var. *Pyraster*, *Thlaspi arvense*, *Montia fontana*, *Trifolium filiforme*, from the Arrow district, the last three plants being new as records; for Mr. Wm. Mathews, M.A., the very rare *Carex Boenninghauseniana*; and presented on behalf of Mr. Fred. Enock, F.E.S., beautifully prepared slides of the Fairy Fly, *Anagrus incarnatus*, and head of Ground Bee, *Colletes Daviesana*, which were accompanied with carefully executed lithographic drawings and descriptive letterpress also by Mr. Enock. Mr. W. B. Grove, B.A. (for Mr. Hawkes), Fungi, *Œcidium tragopogonis* and *Ustilago receptaculorum* on *Tragopogon minor* from Great Barr.—Microscopical and General Meeting, June 15th. Prof. W. Hillhouse, M.A., gave an interesting account of the growth of the cocoa-nut (*Cocos nucifera*), and exhibited specimens cut in different sections to show the various parts. He referred to the nut being formed from three altered leaves or carpels, as shown by the shape of the husk and the three holes in the shell. After describing its structure and the manner of the growth of the young plant, and the ingenious way in which it escapes from the hard shell, he described the sweet albuminous fluid called "milk," and its use to the plant; and concluded his lucid and instructive lecture by a facetious reference to the juice taken from the flowers, and known as "palm toddy." Mr. J. Edmonds exhibited, under the microscope, living specimens of Polyzoa, Entomostraca, and Crustaceans sent by Mrs. Rabone, from Tenby. Mr. W. H. Wilkinson exhibited *Trientalis europæa*, and a collection of minute plants from the top of a hill in Scotland.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 17th. Mr. J. Moore exhibited specimens of the mason wasp, *Odynerius murarius*, and their nests; also cuckoo flies, *Chrysis ignita*, reared from the same. Under the microscopes: Mr. Wagstaff, two polyzoa, *Alcyonella fungosa* and *Fredericella Sultana*, and a thrips, not yet named, found on the dracænas in the Botanical Gardens; Mr. H. Insley, a section of coal ball through a fern stem and leaf bud; Mr. Hawkes, *Æcidium violæ*.—May 24th. Mr. C. P. Neville exhibited a Silurian coral, *Thecia Swindermana*, from the Wren's Nest; Mr. F. C. Beale, slabs of Madrepore marble from Iowa and Teignmouth. Under the microscope: Mr. Wagstaff, *Euglena viridis* in the red stage, and *Draparnaldia plumosa*. A lecture was then given by Mr. Edmonds on "Photo-micrography," describing the scientific value of photographic pictures of microscopic objects, on account of the accuracy of their detail. The simplicity of the apparatus and mode of manipulation were described. The lecture was illustrated with numerous positive and negative pictures, many being shown by the lantern.—May 31st. Mr. J. Moore showed specimens of the mining bee and nest of the same, also nest of wasp; Mr. Deakin, models of snails and slugs; Messrs. Tylar and Delicate, a series of photographs of the Wren's Nest. Under the microscopes: Mr. Hutchinson, *Puccinia umbelliferarum;* Mr. Insley, transverse sections of fossil fern stems; Mr. Tylar, zoëa of *Palæmon squilla;* Mr. Hawkes, a series of slides and sketches showing the structure of *Arum maculatum;* Mr. J. Madison, clausium from *Clausilia rugosa*.—June 7th. The Photographic Section presented to the Society an album and note book for photographs and remarks on geology, natural history, and general science. Mr. A. T. Evans exhibited fossiliferous pebbles from the drift; Mr. J. Madison, a monstrosity of *Limnæa peregra;* Mr. Rodgers, larva and imago of tiger beetle, *Cicindela campestris*. Under the microscopes: Mr. J. W. Neville showed *Gamasus coleoptratorum* from humble bee; Mr. H. Hawkes, specimens of coccus found on willow twigs. A paper was then read by Mr. J. Collins on "Modifications of Floral Organs." The writer described the wonderful variety of form, colour, and perfume in common wild flowers, and various stages of development from ordinary leaves. After describing the two parts of flowers, the reproductive organs and their envelopes, the subject was considered under three heads—modifications of colour, of the perianth, and of the stamens and pistils. These modifications had generally taken place to secure cross-fertilisation, though some instances were given where self-fertilisation was most advantageous, and the flower had been modified accordingly. The writer concluded by saying that this branch of botany acted as a corrective to the selfish notion that flowers in all their variety were only to please the eye of man. The paper was illustrated by diagrams and specimens.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D, Zoology and Botany. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, June 16th. Attendance twelve (four ladies). The Chairman reported that the Field Day Excursion to Loseby and Tilton Hill last week was attended by eight members, but that not much of special interest was met with beyond a few new localities for some of the less common plants. Mr. E. F. Cooper, F.L.S., read an extract from Grant Allen's paper on *Arum maculatum*, in which he states that cross-fertilisation is secured by insects who escape from the spathes after the "lobster-pot hairs" are shrivelled. The Chairman and Rev. A. Preston both stated that these hairs were not shrivelled in a number of old spathes which they had examined and in which flies were lying dead. The Chairman said he had examined a number of spathes in which there were no traces of flies, but the stigmas were fully fertilised notwithstanding. The pollen seemed to fall naturally upon the stigmas below. The following objects were exhibited, viz.:—By Rev. A. Preston, heads of the fuller's teasel, and a cake of vegetable wax from Ceylon. By Mr. E. F. Cooper, dried plants from Lancashire, including *Andromeda polifolia*, *Myrrhis odorata*, &c., and a curious small green excrescence, abundant in the cracks of the bark of oaks in that district, possibly a gall of some kind. By Dr. Finch, a specimen of the cockchafer (*Melolontha vulgaris*). Rev. A. Preston gave a very interesting description of the extraordinary contrivances for insuring fertilisation in orchids, illustrated by a number of fine coloured diagrams drawn by Mr. Worthington Smith, which gave rise to some discussion as to the real origin and meaning of such apparently unnecessary complications to secure a very simple object.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY. — May 6th. BOTANICAL SECTION.—Chairman, Mr. J. W. Bodger. Address by the Chairman on "Anthotaxis, or the various kinds of Inflorescence." Examples were given of the following, and, where possible, plants exhibited showing the same. Whorled, as in *Hippuris vulgaris*, the spike as in lavender and plantain; the amentum or catkin, as in the willow (both male and female); the locusta or spikelet in various grasses, the spadix in *Arum maculatum*, the cone in firs and branch of the larch (*Larix Europæa*), showing the ripened cones of the previous year and the delicate young fasciculated leaves of the present year; the strobilus, as in hop; the raceme, as in currant and laburnum; the corymb in hawthorn, the thyrsus in vine and lilac, capitulum in coltsfoot and daisy, the hypanthodium in fig, the umbel simple in *Allium ursinum*, compound in fennel, parsley, &c.; the cyme in laurustinus, &c.; the panicled, helicoid, and scorpioid cymes in privet, *Myosotis palustris*, and *Lymphytum officinale;* the glomerule in box, and the verticillaster in *Lamium album*. Several plants were brought by the members, and commented on in the course of the address.—May 20th. Chairman, Mr. J. W. Bodger. Address by the Chairman on the "Perianth," simple and compound, the calyx of the latter only being considered, the various terms relating to the calyx being explained and the following forms illustrated:—Partite in Anagallis, cleft or fissured in *Erythræa centaurium*, toothed in *Lychnis vespertina*, entire, inferior in various plants, superior in gooseberry, etc.; petaloid in crocus and iris, rim in madder, hooded or galeate in *Aconitum napellus*, gibbous or saccate in cheiranthus, calcarate or spurred in tropæolum and *Aquilegia vulgaris*, caducous or fugacious in poppy and Eschscholtzia, the latter being operculate, persistent in gooseberry, etc., marcescent in campanula, deciduous in ranunculus, accrescent in winter cherry (*Physalis Alkekengi*). Mr. Bodger also exhibited several wild flowers from the neighbourhood of Peterborough, and Miss Lilley specimens of *Nepeta glechoma*, *Ranunculus bulbosus*, *Cheiranthus Cheiri*, *Euphorbia peplus*, *Veronica chamædrys*, and *Viburnum lantana*.—June 3rd. Ramble to Thorpe, among plants collected were *Alliaria officinalis*, *Sagina procumbens*, *Stellaria Holostea*, *Geranium molle*, *Geum urbanum*, *Valerianella olitoria*, *Galeobdolon luteum*, *Scandix Pecten-Veneris*, and *Sedum acre*.—June 10th. GEOLOGICAL SECTION.—Geological excursion to Spital Cutting, under the guidance of Mr. E. Wheeler. Fossils found in cornbrash, *Ammonites Herveyi*, *Terebratula ornithocephala*, *Rhynchonella varians*, *Trigonia incurva* (casts), *Ostrea flabelloides*, *Pholadomya ovulum?*, *Lima rigida*, *Pecten demissus*, *Avicula echinata*.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT SHREWSBURY, JUNE 22ND AND 23RD, 1886.

ADDRESS BY THE REV. J. D. LA TOUCHE, PRESIDENT OF THE UNION.

Ladies and Gentlemen,—I propose in the address which I have the honour to deliver on this occasion, first, to recapitulate briefly the subjects which have occupied the attention of the Naturalist Societies of this Union during the past year; secondly, to enumerate the various points of interest which this county and neighbourhood afford; and lastly, to allude to the labours of Charles Darwin, that illustrious man, of whose connection with the town of Shrewsbury by birth and family its inhabitants may feel justly proud.

I.—In reference to the first subject, the difficulty lies in selection. A glance through the pages of the modest but useful monthly periodical which is devoted to the record of the operations of these societies reveals a quite embarrassing number of papers on a multiplicity of subjects connected with science in its varied branches, as well as abundant evidence, from the vast number of specimens and objects of natural history exhibited from time to time at the meetings of the microscopical and literary societies, especially in Birmingham, Leicester, Peterborough, and the occasional notes of field club meetings, that there is no decline in the interest with which natural science is pursued.

Among the most important of the papers which have appeared in the "Midland Naturalist," I notice a series by Mr. Harrison, on the "Pre-carboniferous Floor of the Midlands." That the geological interest of this area is far from being exhausted or fully explored has been proved by the recent and unexpected discovery of rocks of pre-Cambrian age near Atherstone, at Hart's Hill. These had previously been mapped by the Survey as carboniferous; again, the altered rocks near Rowington, in Warwickshire, supposed to be millstone grits, are now decided to be Cambrian; and near Nuneaton sundry purple and other shales, classed as carboniferous, are shown by Professor Lapworth to be Cambrian, and yield Cambrian fossils, such as *Olenus*, *Lingula*, &c. Mr. Thompson has also contributed some valuable papers on "The Lias of Northamptonshire," with some carefully prepared lists of fossils found there. Those interested in physiology will appreciate the papers on "The Ear and Hearing," by Mr.

Abel, in which the subject is treated both popularly and in such a way as to convey much instruction to the general reader. Mr. Bagnall, in his paper on "Flowering Plants and Ferns in the County of Warwick," has been doing a service of much importance to the botanist, and one which well deserves to be imitated in other counties. Of the addresses, too, by the presidents of field clubs, which are occasionally published in this periodical, I may especially mention that by Mr. Waller, which is full of interest, especially in relation to an earthquake of exceptional severity which prevailed over the east and south of England, and which presented some remarkable features. Mr. Waller also draws attention in this address to the change continually going on in the composition of minerals, a subject which must largely engage the attention of the geologists of the future, and modify very considerably the opinions that have hitherto been held as to the origin and nature of rocks which are called metamorphic. I may, perhaps, be pardoned in alluding to a paper of my own in the "Geological Magazine" in the year 1863, upon this subject, in which I suggested the probability that the great strata of limestone, so characteristic of our Silurian rocks, and even beds of coal, owe their origin, in a large degree, to a gradual process of segregation, carried on through countless ages. We are all familiar with the fact that the fossil remains of the strata above and below these deposits are deficient, if not quite destitute, of the substance which preponderates enormously in them. You seldom find a fossil shell with more than a mere vestige of the carbonate of lime of which it was composed; and in the coal measures you see huge trunks of trees and stems of plants which, except the thinnest film on their surface, have parted with all trace of the carbon which at one time made up their entire substance. Its place has been wholly taken by the sandstone or shale in which these remains are found. A process has been quietly going on whereby, without disturbing the most delicate markings on their surface, the fossils have parted with the original matter of which they were constituted; and this, I would suggest, is found accumulated in the strata—in the former case of limestone, in the latter of coal—which is in close proximity to the beds which contain them. Take the entire thickness of the strata throughout which the fossils and other organic remains are distributed; calculate the mass of carbon or of carbonate of lime that must once have entered into their composition, and its equivalent will largely be found in the adjacent strata, which are now entirely composed of those substances. Permanent as we suppose the everlasting hills, changes are incessantly at work in them, breaking up old combinations and forming new ones. As the earth spirit says to Faust :—

> In the currents of life, in action's storm
> I float and I wave
> With billowy motion.
> Birth and the grave
> A limitless ocean.
> A constant weaving
> With changes still rife,
> A restless heaving,
> A glowing life—
> Thus time's whirring loom unceasing I ply,
> And weave the life garment of Deity.

I must say a word on the means by which the societies and field clubs in this Union have endeavoured to turn their time and resources to good account. I see that besides their periodical meetings for the interchange of opinion, the exhibition of specimens and the reading of papers, some, notably the Birmingham and the Peterborough Natural History Societies, have adopted the plan of the members preparing some definite book for discussion. Where members live within a reasonable distance of each other, this is obviously an excellent means of acquiring definite information, and qualifying them for the work of original research. The members of the Caradoc Field Club have for some years past offered prizes to the scholars of elementary schools for collections in botany and geology. I must admit that, although some good collections have thus been made, the scheme has not been widely adopted, owing no doubt to the fact that it involves the constant attention of some one to direct the efforts of the lads, and this requires more time than can usually be spared; otherwise, where the services of such persons are available, they might profitably be expended in promoting habits of observation among the young and the extension of scientific knowledge. The splendid volumes published by the Woolhope Club on the varieties of the apple and pear, now completed, furnish an example of what valuable work our clubs can perform when they apply themselves to some definite object of local interest. It is in this, perhaps, more than in any other way that they have it in their power to promote the objects they have in view.

II.—There are not probably in England many counties which furnish more varied objects of interest to lovers of Nature and of History than Shropshire. Its hills and valleys have furnished the chief materials from which the geologist has been enabled to decipher the successive changes which have throughout the dim and distant ages of the past taken place in the earth's crust; building up from primordial matter the floor, which, itself upheaved, contorted, re-formed, became in after-time the stage on which was to appear the marvellous beauty of Nature as we now behold it, the wealth of vegetation and of animal life, and at last the home of man. I believe that I do not claim more than is just in saying that to the description of the Palæozoic and Archaic rocks of Shropshire by Murchison, Sedgwick, and others, is chiefly due the key which has unlocked these ancient treasures, and solved what had previously been looked upon as a profound mystery. Those who had the privilege of taking a part in the discoveries of some forty or fifty years ago will testify to the enthusiasm which prevailed among the geologists of the time. It was like the exploration of some newly-found continent, where each object is viewed with astonishment and suggests some fresh ideas. Pioneers there had been, men like T. Lewis, of Aymestry, and Dr. Lloyd, of Ludlow, who, by their patient research and careful collection of specimens, as well as by their own intelligent correlation of facts, had paved the way for others, such as Murchison, who, with wider information, and the faculty of describing and writing, were enabled to assimilate and reduce to system the results of their labours. The extraordinary wealth of almost all these strata in fossil remains furnished the clue to their history and arrangement. Founded partly on the evidence which these supply, and partly on the relative position of the strata, which are here very persistent and well marked, the Silurian system was constructed. But like most geologists of his age, Sir R. Murchison was apparently unable to abandon the notion that the fossiliferous strata here explored marked the limits of organic life. He had reached, as he thought, the *Ultima Thule* of organised creation, All beyond was without form and void. Nor could he ever free his mind from the belief in a number of successive and spasmodic acts of creative power, nor entertain the view that, however remote these remains may be, they imply progenitors from whom they have descended. Yet subsequent research has shown that upon these points that eminent observer was in error. The labours of Dr. Hicks have proved that though our Shropshire Cambrians contain only a few obscure impressions of the worms that crawled over their surface when they were soft mud, the very same strata at St. David's Head are stocked with a varied and abundant fauna. And as for the correlation and classification of still older rocks, the researches of Dr. Callaway and his intelligent observation of tracts that previously had either escaped notice altogether or been carelessly included with more recent ones, have within the last few years clearly demonstrated the fact that underlying the Cambrians, unconformable with them, in some places in contact with them, in others with more recent rocks, is what he calls an Archaic formation, consisting of sedimentary and partly of volcanic deposits.

It would manifestly be beyond the limits of this address to enter minutely into a description of this part of the subject. Those who purpose joining the geological excursion to-morrow will have an opportunity of seeing with their own eyes the structure, the framework as it were, of the county. They will observe the ridge of hills called the Longmynd, running N.E. and S.W., which are composed of Cambrian rocks. These have, towards the west, thrown off the Llandeilo or lower Silurian, which rest on them conformably, and, by a huge fault on the east, are brought into contact with the more recent Caradoc or Bala formation, from which a regular succession of the Silurian up to the old red sandstone and on to the carboniferous and coal measures in the Clee Hills can be traced. The evidences of the Archæan, or Pre-Cambrian, to which I have alluded, are more obscure and will not come under your notice, but for those who elect to go on the Wroxeter expedition I would call their attention to a very remarkable exposure of what Dr. Callaway has now proved to be an equivalent of the Tremadoc series, a formation which, underlying the Llandeilo, had been supposed to be entirely absent on the east of the Longmynds. This is well exposed in Shineton Brook, and is replete with fossils, the chief of which is a large trilobite, the *Ogygia Homfrayi*, which is found in a very perfect condition.

In a tract which has been so thoroughly explored for several years past as this has, it is not to be expected that many new forms can now be discovered; nearly every quarry and section has been carefully searched, and we must wait for fresh exposures to add to the list of fossil remains that we now possess. But that this list is far from exhausted is proved by the extraordinary number of entirely new forms, especially of *starfish*, *Pterygoti* and *Ceratiocaris*, which were brought to light a few years ago in a very small area, at a place called Church Hill, near Leintwardine. The fact that the accidental opening of a quarry at any point over so large an area may at any moment reveal so great a number of entirely new genera and species may well impress our minds with the imperfection of the record of the continuity of organic life, which has been so forcibly pointed out and insisted on by Sir C. Lyell and Mr. Darwin. It is often asserted triumphantly, as a crushing answer to the evolution hypothesis, that the absence of the links which unite, *e.g.*, an *orthoceras* of the Palæozoic era with an *ammonite* of the Secondary, is an insuperable objection to the supposition that the latter is the natural outcome of the former. But it has always seemed to me that such objections are extremely feeble. Every new addition to our knowledge may fairly be expected to supply us with missing links; to ask for them at present is unreasonable, considering the very small portion of the surface which has as yet been explored. As an instance of how an organism, though actually existing, may easily escape our most careful research, I would briefly mention certain minute bodies found some years ago in the Downton sandstone, and which were long supposed to be the capsules of a *Lycopodium*. Careful examination, however, of microscopic sections of these bodies shows that they are composed of an alga, closely resembling the modern *Rivularia*, and that this has been invaded, as sometimes still happens, by another, almost, if not quite, identical with the *Œdogonium*, which exists this day in our lakes and rivers. But for the chance blow of a geologist's hammer in an exposure, not three yards square, in one of the shrubberies of Downton Castle, we should never have known of the existence of this link between the present and a remote past. No one can reasonably doubt that, although as yet undetected, this fragile plant never ceased to exist somewhere, through all the mighty changes of which this earth has been the scene, and that it thus furnishes a strong argument in favour of the continuity of life. Another instance of the removal to an earlier date than had previously been known of the existence of an organism is supplied by the discovery of *Lithodomus* borings in the Aymestry limestone by my friend, Professor Corfield. From his acquaintance with the Oolitic formation, in which specimens of these abound, he was struck by the resemblance to them of certain pits or depressions in the surface of the corals which abound at Weo Edge. Sections of the specimens collected by him are now in a case at the Kensington Museum, and figures of these appear in the "Geology of Shropshire" lately published, clearly showing the bivalve lying in the pit which it has burrowed into the coral. And, lastly, the manifold remains found in that most remarkable deposit, called the Ludlow bone-bed, an exposure of which at Norton I hope some of us may visit to-morrow, bear striking testimony to the remark that vast multitudes of animals must have abounded during long periods of time, which have left little or no trace of their existence. Germane to this subject is the discovery within the last year of insects and scorpions in rocks of Silurian age in Scotland, France, Sweden, and America. The first of these consists of a wing of a *Blatta*, or cockroach, from the middle Silurian of Largues, in France, and which has been described by Brongniart; and the second, of specimens of fossil scorpions in the Ludlow beds of Scotland, Gothland, and America. The latter differs from the former in many respects, and attains a length of about 12½ inches. Again, in a coal-pit in Bohemia, a scorpion of the little known order of *Pedopalpi* has been found, which presents a great similarity to present forms, and the same pit has yielded four new spiders, raising the number of Palæozoic *Arachnida* to thirty-four. To an interesting paper by my friend, the Rev. P. B. Brodie, published in the "Naturalist's World," I am indebted for this information. Of more recent geological events, viz., those connected with the ice age, some important discoveries have been made in our county by Mr. Luff in the neighbourhood of Clun. His attention has been for many years attracted to the vast number of travelled blocks scattered about on the picturesque hills which surround that village, and he has with very great industry and care mapped down their position, and tracked them over hill and dale to the source from whence they came. He finds that they vary in size from small fragments to blocks of ten feet long;—that they can be traced over a tract some twenty-three miles in extent to the flanks of Plynlimmon, and to Carrig Gwinnion, by the side of the Wye, two miles from Rhayader—the latter boulders consisting of a grit very marked in character;—that by far the largest blocks are found at the greatest distance from their source;—and that many of them lie at higher elevations than Carrig Gwynnion, pointing to the conclusion that they have been floated from that locality on icebergs.

In concluding this part of my subject, I would refer to some statistics, kindly furnished me by Mr. Watts, as to the number of works bearing more or less on the geology of Shropshire, of which he is compiling a list. They amount, it seems, to no less than about 300, probably more than less. The record begins in 1712 and goes to 1885. The authors' names include Aitkin, Murchison, Conybeare, Prestwich, Lyell, Williamson, Ramsay, Davidson, Salter, Jones, Milne-Edwards, Owen, Lightbody, Roberts, Randall, Morris, Maw, Woodward, Ricketts, Brodie, La Touche, Hall, Mackintosh, Eyton, Davies, Hicks, Hopkinson, Lapworth, Crosskey, Allport, Callaway, Symonds, Salwey, Bonney, Houghton. Nicholson, Etheridge, Duncan, Vine, Flyght, Harrison, and Reade. Such are among the more important contributors. The most active years, in each of which there are over a dozen references, are—1865 (17), 1869 (12), 1870 (14), 1871 (15), 1873 (20), 1877 (12), 1879 (15), 1882 (14).

(To be continued.)

NOTES OF AN AMERICAN TOUR.

BY W. P. MARSHALL, M.I.C.E.

(Continued from page 182.)

The great Yosemité Valley was next visited, going north by train to Madeira Station on the way to San Francisco, and then by ninety miles of coach drive, that took a day and a half, stopping for a night at an hotel that is established on the way, in the midst of the woods. This was a remarkable drive, starting 2,000 feet above the sea, and passing over a ridge 5,500 feet high into the Yosemité Valley, which is 4,000 feet above the sea, with many intervening ascents and descents. The road is mostly either up or down very steep hills, many of great length, crossing many streams with sudden sharp bends, and the road nearly axle deep in dust or in mud, according to the weather. The journey was by a six-horse coach with capital driver and first-rate horses, and was very enjoyable, with the numerous fine views overlooking great wooded valleys that ran down towards the coast; but the ride would have been very different in wet weather. The driver cannot reach the leaders of his team with the whip on account of the road lying so much through forests, and indeed the whip is but little used, and the horses are mainly driven by the voice and a private store of small pebbles kept at the back of the driver's seat to touch up the leaders occasionally.

A fascinating sight of the great Yosemité Valley is obtained, bursting suddenly into view on emerging from the forest at a turn of the road 1,000 feet in height above the valley, that commands a view of two-thirds of the length of the valley. This wonderful valley exceeds all expectation in the reality, formed on each side by extraordinary granite cliffs that are more than half a mile vertical height from the valley, and extending for a length of eight miles. From the floor of the valley you climb up a height as great as Ben Nevis, our highest mountain, to reach the top of the valley sides, and the floor of the valley itself is as high as the top of Ben Nevis above the sea. Most lovely views of the valley are obtained during the ascent, and the clearness and transparency of the air is quite misleading, making the distances appear so much less than they really are.

This Yosemité Valley is situated on the western slope of of the Sierra Nevada range of mountains, and is one of the transverse clefts of these mountains, running from east to west towards the Pacific. The valley is eight miles long, and from one to two miles wide; it has an irregular serpentine outline, and is of a very striking and unique character. The sides are formed by lofty granite cliffs that have nearly vertical faces for the greater part of their height, and only a small proportion of slope formed by débris at the base of the cliffs. These gigantic cliffs are as much as half a mile to three-quarters of a mile in height above the valley, and in one part rise to nearly a mile vertical height (4,870 feet height); but the clearness of the atmosphere is such that this great height is not at all realised until the actual ascent of the cliffs is made, when some hours' climbing is found to be required in getting to the top.

A special feature of the valley is the waterfalls, of which there are several, taking prodigious leaps over the great granite cliffs. The largest of these, the Yosemité Fall, takes a single leap of 1,500 feet (the highest waterfall known), followed by a second leap of 500 feet, and a third of 400 feet, forming with some intermediate shorter leaps a continuous waterfall of 2,600 feet height, as seen from the valley below. One of the waterfalls, called the Bridal Veil Fall, is of singular beauty; the total height of fall is 900 feet, of which the first 600 feet is a clear leap, but the quantity of water, thirty feet width at the top, is not sufficient to make continuous solid water to the bottom, and the result is that the water is mainly dispersed in the air as spray, which is floated about by the wind like a gauze veil.

The River Merced flows through the valley, and this is well wooded throughout, and very fertile in plants, forming a beautiful wild garden of flowers; and the shrubs and flowers extend far up the sides of the valley. There are three hotels in the middle of the valley, where the coach-road from the railway terminates, and many very interesting and charming excursions can be made from there on foot or by ponies, getting up to the top of the cliffs in several directions. The end of Spring and the begining of Summer is the most favourable time for seeing the valley, when the waterfalls are well filled by the melting of the snow that covers up the whole district in Winter, on account of its great elevation above sea level, although in the same latitude as the South of Italy.

The geological features of the Yosemité Valley are very unique, and specially interesting as to the difficulties in attempting to explain its formation. The sides are precipitous granite cliffs of great height, that do not exhibit any signs of erosion by water action. The faces of these cliffs are, indeed, being continually renewed by the weathering action (mainly of frost in winter), which is continually scaling off slabs from the face of the cliffs. The granite presents the appearance of having been laminated vertically from some cause, and undergoing a process of being split off in successive slabs of one inch to a foot or more in thickness. In the course of the ascent by the zig-zag paths up the cliffs there are seen large quantities of these slabs, partially detached from the face of the cliffs, some of very large extent, and looking ready to fall with the frost of another winter. Now, this weathering action is, at the present time, widening the valley surely though slowly; and if carried back long enough a similar action would have sufficed for the excavation of the entire valley from some small commencing fissure; but a difficulty that presents itself to this view is the entire absence of any large accumulation of débris as a result of the excavation of the entire valley, which is from one to two miles in width, and more than half a mile in vertical depth. Also, the river running through the valley is, at the present time, a quiet stream, not capable of carrying away any considerable quantity of débris.

In reference to this it has to be noticed that the material of the cliffs, granite, is already far gone in decomposition by the time it has become sufficiently jointed and loosened to allow of its being detached by the weathering action, and will not require much further decomposition before it becomes completely broken up into the condition of the soil of the valley.

A point of special interest and difficulty in connection with this question is the peculiar condition of the Half Dome, which is at the upper part of the valley, and is the highest point of the surrounding rocks, being nearly one mile vertical height from the floor of the valley. There are several domes around the valley, consisting of hemispherical elevations in the granite of large size, and this Half Dome is the largest of them, being a quarter of a mile in height above the surrounding country and nearly half a mile in diameter; and the special feature of it is that the dome is cleft vertically, and more than one-third of it removed, leaving a vertical face towards the valley, but without any visible trace being left of the missing portion. It has been suggested that the whole valley is the result of volcanic agency, and that this dome was split by some upheaval, and the lost portion swallowed up in a chasm opened by the upheaval. The idea, however, of the weathering action by vertical jointing may also be applied to the formation of the Half Dome, provided that its structure admits of *vertical* jointing; but there is a curious circumstance in one of the other domes that is accessible for examination, the Sentinel Dome, which is *spherically* jointed, and is weathering away in concentric spherical laminations of one to several inches thickness. This dome is situated in the middle of the valley, and is the next highest point to the great Half Dome, being only 700 feet lower. There are reported to be nearly 100 of these domes scattered about the surrounding district.

At thirty miles distance from the Yosemité Valley, on the way back to the railway, is the celebrated Mariposa Grove of Big Trees, the great "Sequoia Gigantea." This grove is situated on the southern slope of a ridge of the Sierra Nevada mountains, at a height of 6,600 feet above the sea, in a sheltered situation a little below the summit of the ridge.

The "Big Trees" grow in a forest of large extent, but they are confined to a small portion of the forest of only a mile or two in extent, and they are limited in total number of trees to only a few hundreds. Some of the finest of the big trees have suffered from former injury by fire from the Indians, but the whole Mariposa Grove (as well as the Yosemité Valley) is now in the care of the State, and set apart for ever for "public use, resort, and recreation."

The largest of the trees reaches the extraordinary height of about 400 feet, and the stem shoots up to as much as 200 feet high from the ground before the first branch occurs, which is itself about six feet in diameter. The stem is more than 100 feet circumference or thirty-three feet diameter at a yard above the ground, and one of the fallen trees has been found to be as much as six feet diameter at a height of 300 feet from its base, and fifteen feet diameter at half that height.

One of the living big trees has an archway cut through the stem at the base, large enough for the coach to drive through, that brings the visitors to the place. The big trees are surrounded by gigantic pines of extraordinary size, reaching to 200 and 250 feet height, which would themselves be objects of great attraction if they were not dwarfed by their giant companions. The bark of the big trees is as much as eighteen inches thickness, and from the number of concentric annual rings seen in the stem the age indicated is as great as 3,000 years. There are three other Groves of Big Trees—Calaveras, Fresno, and Tuolumne—all situated similarly to the Mariposa Grove, and in the same mountain district; and in the Tuolumne Grove are the remains of a fallen tree still larger than those at Mariposa, showing a diameter of as much as forty feet, and a portion of the hollow trunk which is lying on the ground has a road through it large enough for three horses to pass abreast.

(To be continued.)

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(*Continued from page 187.*)

MIDDLETON. I.—*Rich. Byngham, justice of the King's Bench*, 1476, and *widow Margaret. Haines.*

These effigies, which are 3ft. 2in. and 3ft. long respectively, are in good preservation, but have been relaid (at the entrance of the chancel), as there are no matrices for the four shields of arms shown in Dugdale's illustration of the brass. The justice wears a coif or skull-cap, a fur-lined gown, open in front, with high collar and wide sleeves, and a large cloak fastened upon the right shoulder with two buttons. Upon his feet (which rest upon turf, with trefoil and other plants springing from it) are pointed shoes. The lady wears a wimple or *barbe*, the sign of widowhood; a large kerchief, and a long loose cloak, beneath which is a kirtle girded at the waist. Upon her right wrist hangs a rosary of forty beads, four larger beads marking the decades. Attached to the rosary is a tassel.

Upon a plate 2ft. 9in. by 3in. is this inscription :—

Hic jacent dñs Ricardus Byngham miles et Justiciari' de banko dñi regis qui obiit xxiiº | die maii año dñi millᵉo ccccºlxxviº Et dña margareta sui cōsors quor' aĩabs ppicietur deus amē.

In English :—

Here lie Sir Richard Byngham, knight, and justice of our lord the King's Bench, who died the 22nd day of May, A.D. 1476, and Lady Margaret his wife; to whose souls God be merciful. Amen.

There is an illustration of this brass in the Trans. of Arch. Sect. of Birmingham and Mid. Inst., 1874, p. 17.

II.—*Dorothy, w. of Ant. Fitzherbert*, 1507. *Haines.*

Upon the north wall of the chancel, in an arched recess, is a small brass shield with these arms: Arg., a chief vaire, or. and gu., over all a bend sa., for FITZHERBERT impaling WILLOUGHBY or., two bars gu., charged with three water bougets, arg.

Underneath, on a small plate, is this inscription :—

Hic jacet Dorothea filia Herici Wiloughby | militis ac uxor Antonii Fitzherbert qe obiit | quto die nouēbris aº dñi mºccccccº septīo.

Translation :—

Here lieth Dorothy, the daughter of Henry Wiloughby, knt., and wife of Antony Fitzherbert; she died on the 4th day of November, A.D. 1507.

The letters are carved in relief and are beautifully formed; the ground of the plate is coarsely scored, probably to prepare it for the enamel which we may suppose once surrounded the letters. The original gravestone has lately been uncovered during some alterations to the chancel, and this brass, which had been fastened to the wall upside down, has now been relaid in its original position.

Margaret Byngham, commemorated by No. I., was a sister of Sir Baldwin Frevill, and widow of Sir Hugh Wiloughby, of Wollaton, in Nottinghamshire, and great-grand-mother of Dorothy Fitzherbert. Antony Fitzherbert was a justice of King's Bench. Dugdale gives an illustration of this brass.

At Napton-on-the-Hill there is, behind the organ, an incised slab and a stone with matrices, and a brass shield inlaid in it.

PACKINGTON (GREAT).—*John Wright, Vicar,* 1527. *Haines.*

Nothing remains of this memorial save the inscription, upon a plate 1ft. by 4in. There are matrices for the four evangelical symbols, and a small figure of a priest in eucharistic vestments (see the account of a priest at Coleshill). The words of the inscription are—

Hic jacet dñs Johēs Wryght | qndā vicarius istius ecclie q obiit | viiiº diee mēs' marcii anno dñi | mmº cccccº xxviiº cus aīe ppciat' de'.

In English :—

Here lieth Sir John Wright, sometime vicar of this church, who died the 8th day of March, A.D. 1527; to whose soul God be merciful.

PRESTON BAGOT.—*Elizabeth, w. of Wm. Randoll,* "*legis consiliarius,*" 1635. *Haines.*

This effigy, which is now upon the S.W. wall of the chancel, has lost its head. It represents a lady in a bodice, with lappets at the waist, and frilled cuffs. The skirt of her dress is quite plain.

The following inscription is upon a plate 1ft. 7in. by 9in.:

DORMITORIVM ELIZABETHÆ RANDOLL RICH̄I KNIGHTLEY
DE BVRGHE HALL IN CŌM: STAFF: ARMĪG FILIÆ SECVNDÆ
CONIVGIS WILL̄I: RANDOLL LEGIS CONSILIARII, QVÆ PER
BREVES ALIQVOT IN HAC PAROCHIA MENSES DEVOTISSIMA
DEO, AMICISSIMA POPVLO, PRÆCHARISSIMA MARITO SVO
FÆLICITER VIXIT, ET DEIN CVM OPTIMA APVD PIOS MEMO
RIA, NON SINE PLVRIMA LAMENTATIONE, SPIRITVS EIVS
REDIIT DEO ILLIVS DATORI 12° DIE DECEMBRIS A° DN̄I: 1635
CVIVS TAMEN CARO VIVA SVB SPE HIC SECVRE REQVIESCIT
AC PLENA INTEGRÆ P̄ IESVM SVUM REDEMPTIONIS AD
VENTV SVO PROXIMO AD OPTIMAM RESVRRECTIONEM.

Translation:—

The resting-place of Elizabeth Randoll, second daughter of Richard Knightley, of Burgh Hall, in the county of Stafford, Esq., wife of William Randoll, barrister-at-law. For a few brief months she dwelt happily in this parish, most devoted to her God, most friendly to the inhabitants, most especially dear to her husband, and then with blessed memory among the good, and amid very much sorrow, her soul returned to God who gave it, December 12th, 1635. Her flesh, however, living through hope, rests here tranquilly and in full assurance of perfect redemption to a blessed resurrection through her Saviour at His next coming.

RYTON-ON-DUNSMORE. I.—*Rich. Wylmer, farmer*, 1527, *and w. Joan. Haines.*

Unfortunately nothing remains of this brass except a group of six girls, and a plate, 23in. by 3in., bearing this inscription:—

All crysten peplle walkyng alone: be holde the ymages of y^{is} stone: wher lyen | Rychard Wylm^{r} & hys wyffe Johne: the xxiiij day of mey w^{t} good recorde he | dep̄ted owt of y^{e} world y^{e} yere of o^{r} lord a | m v xxvii to whose sollys Jesus geve cōford | farm^{r} of y^{is} towne well knowne was he: of yo^{r} charite say p̄r n̄r and ave.

For the rubbing of this brass I am indebted to a lineal descendant of Rich. Wylmer, Mr. Joseph J. Green, of Stansted Montfichet, Essex, who informs me that he *purchased* the brass of the vicar and churchwardens at a time when it was in danger of being entirely lost. Glad as we may be that the brass is being carefully preserved, we feel bound to protest against the conduct of the vicar and churchwardens of Ryton, and regret the want of an adjective strong enough to characterise them.

II.—*Moses Macham, minister*, 1712, *æt.* 63. *Haines.*

Upon the north wall of the chancel is a plate 15in. by 5in., inscribed as follows :—

Here lyeth the Body of Moses Macham Minister of Ryton | who died June y^e^ 29^th^ 1712. Aged 63 years.

Lo here doth ly a shineing light. wrapped up in the shades of night | the Sheppard is took from his sheep. but o would they his doctrine keep | and practice y^e^ Rules that he did give. so shall y^e^ Pastor and y^e^ People live.

At the bottom right-hand corner is engraved a skeleton underneath a tree ; and near this is a dark lantern standing upon a coffin, the former being the precise length of the latter.

The wife of Moses Macham lies buried in the south-east part of St. Philip's Churchyard, Birmingham.

SOLIHULL. I.—*William Hyll, gent.*, 1549, *ws. Isabell and Agnes, and* 18 *children. Haines.*

The seven plates forming this memorial are now fastened upon an oak tablet which is hung upon the north wall of the tower. The effigies are about 2ft. long. One represents a man with long hair, who is clad in a loose gown edged with fur and having wide sleeves. This garment, which is thrown open at the chest, shows an under-tunic buttoned at the neck. The cuffs of this dress are also visible. Fastened to the left side of the girdle is a gypcière. The ladies wear the kennel-shaped head-dress, small shawls upon their shoulders, and dresses with puffed and banded sleeves. The dresses are gracefully draped at the sides and reveal plain under-skirts. The shoes of all three effigies are broad-toed. The figures are singularly like those at Aston, with which they should be compared. A plate 2ft. by 3½in. bears this inscription :—

Of yo charite pray for the sollys of William Hyll gētilman and for | Isabell and Agnes hys wyffys wich William decessyd the vi day of | december yn the yere of ow lorde god a m^o^ cccccxlix on whose | sole Ihū have marcy amen.

Beneath this are figures of 18 children, not arranged under their respective mothers as is usually the case, but in three groups, viz., four sons, eleven daughters, a son and two daughters. There is an illustration of the brass in Part I. of the "Warwickshire Antiquarian Magazine."

II.—*William Hawes, w. Ursula, and* 8 *chil.*, 1610.

This brass, not mentioned by Haines, is in a tablet with moulded border, at the east end of the north aisle. It is about 2ft. by 19in. William Hawes has close-cropped hair, moustache and beard, ruff, and gown with false sleeves (compare the brasses at Chadshunt and Barton). He kneels upon a cushion at a prayer-desk, upon which is an open book. Opposite to him is his wife in a Paris hood, ruff, and dress with plaited stomacher. Upon the tiled pavement behind the father kneel four sons in cloaks, doublets, and knee-breeches; on the opposite side are four daughters dressed like the mother, but without hoods.

Above the husband's head is a shield with these arms: sa., a chevron arg., betw. three leopards' heads or. for HAWES, and this inscription: 1610 WILLIĀ HAWES ÆTATIS 80. Over the wife's head is this shield: gu., a chevron arg., pellettée, charged with two bars gemel of the field, betw. three lions' heads erased or. for COLLES, and the inscr. 1610 VRSVLA COLLES ÆTATIS 70. Between the shields, within a double-rayed nimbus, are the words "Jehouah GOD." At the bottom of the plate are these lines—

HERE WILLM̄ HAWES AND VRSVLA HIS WIFE
THER BODIES LIE THER SOVLES W^TH CHRIST IN LIFE
WHOSE HOLY SPIRIT DID SO DIRECT THER WAYES
THAT IN HIS FEARE THEY LIVED TO AGED DAYES
IN ENDLES JOYE THEY NOW W^TH CHRIST REMAINE
BY WHOSE BLOOD ALL SALVATION DOE OBTAINE.

Below this monument hangs a tablet of wood, upon which, between two trees, the one bearing hips and the other *haws*, are two epitaphs, one of fifteen verses in Latin, the initial letters spelling "GVLIELMVS HAVVES," the other of thirty verses in English. Both will be found in the "Warwickshire Antiquarian Magazine," Part I., p. 26.

On the wall of the north transept are the following inscriptions upon brass plates:—

III.—HERE LYETH THE BODY OF ANNE AVERELL | WIFE OF GEORGE AVERELL GENT: AGED | 92 YEARES, BVRIED THE 9TH DAY OF | DECEMBER 1633.

IV.—HEERE LYETH THE BODY OF GEORGE | AVERELL GENT AGED 98 YEARES BV | RYED THE XXII DAY OF JVNE 1637 HEE | HAD ISSVE BY ANNE HIS WIFE FOVRE | SONNES AND THREE DAVGHTERS.

V.—HERE LYETH Yᵉ BODY OF HENRY AVERELL | GENT SONNE OF GEORGE AVERELL GENT | WHO LIVED A BATCHELOVR AND DEPARTED | THIS LIFE Yᵉ SEVENTH DAY OF NOVEMB | IN THE YEARE OF OVR LORD 1650. | AND IN THE 73ᴰ YEARE OF HIS AGE.

VI.—This ſtone is not placed here to | perpetuate the memory of the Perſon | interred beneath it, but to preserve | her Aſhes, ſacred from violation.

Therefore
Good Friend, for JESVS ſake forbear
To dig the Dust enclosed here. 1746.

Compare Shakespeare's epitaph at Stratford.

SUTTON COLDFIELD. I.—*Barbara Eliot*, 1606, *and* 2 *chil.* *Haines.*

On the north wall of the chancel is an effigy 19in. high of a lady in a large calash or hood, ruff, and dress with tight sleeves, plain cuffs, stomacher composed of overlapping scales, and plain skirt projecting at the hips, where it is probably extended by a *farthingale* of whalebone. The lady also wears low-heeled shoes tied with a ribbon. Standing upon a tiled floor alongside their mother are a boy, dressed in a gown partially open down the front, like that worn by the boys of Christ's Hospital, and a girl dressed like her mother, but with a Paris hood instead of the immense calash.

This inscription is upon a plate 21in. by 5in.:—

HIC JACET BARBARA ELIOT FILIA RAPHAELIS SIMONDS GE
NEROSI VXOR MAGISTRI ROGERI ELIOT RECTORIS HVIVS
ECCLESIÆ QVÆ OBIIT MENSE SEPT. ANᴼ DNĪ MILLESI. SEX
CENT: SEXTO ANᴼ ÆTATIS SVÆ VICESIM. QVARTO ET HABVIT
EXITV. RAPHAELEM ELIOT ET ELIZABETHĀ ELIOT

In English:

Here lieth Barbara Eliot daughter of Raphael Simonds gent., wife of Master Roger Eliot rector of this church; who died in the month of Sept. A.D. 1606, in the 24th year of her age, and had issue Raphael Eliot and Elizabeth Eliot.

Roger Eliot, mentioned in the inscription, was presented with the living of Sutton in 1595 by a widow lady named Elizabeth Eliot. (See Dugdale, p. 612.)

II.—*Josias Bull, gent.*, 1621, *with* 5 *children.* *Haines.*

Upon the wall facing the last is the effigy of a man, 16in. long, in ruff, civilian's gown reaching to the ankles, doublet, knee breeches and hose; a similar figure to that at Barton. Above his head is a shield, 7in. long, with the arms of BULL impaling BOTLIER. Upon a plate, 19in. by 6in., is this inscription:—

HERE VNDER RESTETH Y[e] BODY OF IOSIAS BVLL LATE OF THIS TOWNE GENT: HE TOOKE TO WIFE KATHERINE WALSHE WIDDOWE DAVGHTER OF WILLM̃ BOTLIER OF TYES IN ESSEX ESQ.
BY WHOM HE HAD ISSVE 4 SONNES AND 1 DAVGHTER: JOSIAS HENRY, GEORGE, JOHN, AND ANN: HE DECEASED THE 29[TH] OF MARCH ANŌ 1621. ABOVT Y[e] AGE OF 50 YEARES

The children are represented upon a small plate beneath the inscription.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

EXPOSITION OF PART IV., CHAPS. I AND II.

BY W. B. GROVE, B.A.*

The first chapter of this part introduces the problems of Morphology, *i.e.*, the discussion of the modes in which the shapes of organisms and of their proximate elements have been produced. It is shown that these problems fall under two heads:—(1) We have to consider the degree of composition of the individual; (2) to investigate the outlines or forms of it and its component parts, and to show in both cases that our results agree with the general theory of Development. The two sets of factors by which Mr. Spencer says this morphological development is caused are the well-known mainstays of Darwinism—Inheritance and Adaptation.

"Evolution implies insensible modifications and gradual transitions." This truth, which has so profoundly modified the idea of a "species" entertained by pre-evolutionary naturalists—though it is but slowly, too slowly, pushing its way into the writings of pure systematists—will now be seen to be applicable to every morphological proposition.

The formation of organic beings commences with the famous "physiological units" which we have previously seen to be necessitated by the phenomena of genesis. These differ from the nitrogenous colloidal molecules of which organic matter is ultimately composed, only in being more complex, and consequently exhibiting greater sensitiveness

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* Transactions of the Birmingham Natural History and Microscopical Society.

to their environment. An aggregation of them, necessarily a minute one at first, would possess still greater mobility, and show the first gleam of what we call "vitality." It would be, in fact, a speck of protoplasm, such as we know to exist (MONERA, *Protomyxa*), manifesting some of the phenomena of life, but as yet possessing no appreciable organisation.

Small as it is, the incident forces must act unequally upon the units of which it is composed. Differentiation begins; some of them take upon themselves the duty of protecting the others, and become modified for that purpose, this being obviously an advantage as the life of the aggregate is thereby rendered more secure. This aggregate we name a *cell*, and we thus arrive at the stage of the unicellular organisms which have been called Protophyta and Protozoa. Of the former Bacteria, Protococcus, and the simpler Diatoms and Desmids are progressively more complex examples.

It will be observed here that no account is taken of the development of the cell-nucleus, and it might be supposed that without this no explanation of the gradual evolution of organisms could be complete. But the fact is that a "cell-nucleus" (however important may be and is the part which it plays in the more highly developed plants) is at first nothing more than a slightly condensed portion of the protoplasm and exerts hardly any influence upon the life of the elementary organisms in which it occurs. We find protoplasm with or without a nucleus, and with or without a cell-wall; thus giving four states of existence. It may be an advantage to restrict the term "cell" to those cases where a wall and a nucleus are both present, but there is at first no distinction of importance between these cells and the "cytodes" which have a wall, but no nucleus; and in higher organisms many structures are loosely called "cells," which neither have nor have had a nucleus. Those nuclei which are now known to perform such promine[illegible] and mysterious functions are but the highest terms [illegible] gradual series of developments.

Let us now pause to check our hypothesis. If the mode indicated in the previous paragraphs be that in which the present organic world began, and if all organisms of higher structure be the descendants of ancestors resembling those just described, the doctrines of Inheritance and Reversion (which, be it remembered, are established by pure observation) will lead us to expect two things:—(1) That cells will play a conspicuous part in the structure of these higher organisms; and (2) that parts of them will be occasionally constructed directly from protoplasm that has not been formed previously into cells. This is just what we do find; moreover, every individual, however complex, if produced by gamogenesis, is at first but a simple cell, and naked protoplasm is sometimes found to enter into the life-history of organisms otherwise highly developed.

A unicellular organism is an aggregate of the first order. These are mostly of small size; but some such, as among Algæ, Codium, Bryopsis and Botrydium,* and among Fungi, Mucor and Peronospora,* reach a considerable size. The first step towards an aggregate of the second order is manifested in the fact that, in some unicellular organisms that multiply by simple fission or budding, the daughter-cells remain for a time attached to each other, or to the parent cell, instead of separating, as others do, at once. The Diatoms furnish an instructive series. Some, such as Bacillaria, simply slide upon one another's longer edge in an irregular fashion; others, as Isthmia, remain attached by the corners only; while some remain permanently connected into more or less tree-like forms. The Desmidieæ furnish a somewhat similar series of more and more perfect aggregation. In Yeast, again, we have an instance where cells continue in contact with one another, although so slight and immaterial is the union that the slightest force suffices to break it. In Sarcina and in most Confervæ we find a greater coherence of the component cells and a greater degree of individuation of the compound. The same type is still further developed and completed under various forms and by various methods in the Lichens, the Mushrooms, and the higher Algæ. A perfect instance of a spherical aggregate of the second order is furnished by Volvox, where the cells are united in a definite form and mass of only one degree of composition, so long as it is not engaged in the process of multiplication.

Thus cells, which are aggregates of the first order, are compounded into fronds or *thalli*, which are aggregates of the second order. Each cell of the thallus has lost its individuality and become merely a part of a whole; that is to say, it is integrated with others, and its life is merged in the life of the compound. But still there is no sudden transition; a complete series can be traced from loose fortuitous aggregations of cells, like those of yeast, up to the final and complete integration which constitutes the frond of a Laminaria. Those branches of the vegetable kingdom which are predominantly of the second order of aggregation are called Thallogens or Thallophyta.

* These are what are called in the text Hydrogastrum and Botrytis respectively. What is now known as Botrytis is not a unicellular fungus.

The transition to aggregates of the third order proceeds in the same unobtrusive manner. The variously formed outgrowths from the sides of a frond of *Rhodymenia palmata* exhibit the beginning of such a tendency, which becomes more marked in *Delesseria sanguinea;* but the sea-weeds, though nearly approaching it, do not present us anywhere with a complete tertiary aggregate. This we shall meet with first among the Jungermanniaceæ, as, for instance, in *J. asplenioides*, and more decided examples are abundant in the ordinary type of Mosses. Take the common *Hypnum triquetrum;* we see a definite erect stem, regularly furnished with foliar expansions each of which presents the characters of a perfect aggregate of the second order, and these by their definite subordination to the stem make the whole a compound individual of the next highest order. The groups in which this is predominant form the classes called Acrogens or Cormophyta.

So far we have considered only the cryptogams. The extension of the theory to the Phænogams, and some important deductions from it, form the subject of the next chapter.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S

PART II.
PALÆONTOLOGY.

(Continued from page 122.)

In drawing up the list of fossils below, I have consulted the following works and papers; and where the record is of a form I have not found myself the authority for it is quoted.

1860.—AVELINE, W. T., and TRENCH, RICHARD. Geology of parts of Northamptonshire. Memoirs of Geological Survey. (Description of quarter sheet, No. 53, S.E.)

1861.—AVELINE, W. T. Geology of parts of Northamptonshire and Warwickshire. Memoirs of Geological Survey. (Sheet, No. 53, N.E.)

1872.—BEESLEY, THOS. A Sketch of the Geology of the neighbourhood of Banbury. Paper read at the annual meeting of the Warwickshire Naturalists' and Archæologists' Field Club, March 5, 1872.

1875.—JUDD, Prof. J. W. The Geology of Rutland, and parts of Lincoln, Leicester, Northampton, Huntingdon, and Cambridge. Memoirs of Geological Survey.

1877.—TOMES, R. F. On the Stratigraphical Position of the Corals of the Lias of the Midland and Western Counties of England and of South Wales. "Quarterly Journal of Geological Society."

1879.—WALFORD, EDWIN A. On some Middle and Upper Lias beds in the neighbourhood of Banbury. From Proceedings of the Warwickshire Naturalists' and Archæologists' Field Club.

1883.—WALFORD, E. A. Notes on some Fossils from the Transition-bed between the Middle and Upper Lias of Northamptonshire. "Journal of the Northamptonshire Natural History Society."

DAVIDSON, Dr. T. A Monograph of the British Fossil Brachiopoda. Palæontographical Society. Various years.

THOMPSON, B. Notes on Local Geology. "Journal of the Northamptonshire Natural History Society." Various papers. 1881-3.

LIST OF FOSSILS FROM THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
REPTILIA.				
Teleosaurus (?) vertebra	Walford			×
Ichthyosaurus vertebræ and teeth		×	×	
,, coprolites	Beesley	×		
PISCES.				
Hybodus spine	Walford		×	×
Fish remains (vertebræ, scales, teeth)		×	×	×
CEPHALOPODA.				
Amaltheus margaritatus, *Mont.*		×	×	
,, Engelhardti, *d'Orb*	Beesley	×		
,, spinatus, *Brug.*			—	
Phylloceras heterophyllum, *Sow.*				×
Stephanoceras annulatum, *Sow.*				×
,, commune, *Sow,*			×	×
,, Holandrei, *d'Orb*				×
,, crassum, *Y. & B.*			×	
,, subarmatum, *Y. & B.*	Walford			×
,, fonticulum, *Simp.*	Walford			×
Harpoceras cæcilia, *Rein*				×
,, Normanianum, *d'Orb*	Geol. Survey		×	
,, serpentinum, *Rein*				×
,, acutum, *Tate*			×	×
Nautilus striatus (?), *Sow.*	Walford			×
,, semistriatus, *d'Orb*	Beesley		×	
,, truncatus, *Sow.*	Beesley		×	
,, obesus, *Sow.*			×	
Belemnites clavatus, *Blain*	Beesley	×		
,, apicicurvatus, *Blain*		×		
,, cylindricus, *Simp.*	Walford			×
,, breviformis, *Voltz*	Beesley		×	
,, paxillosus, *Schl.*		×	×	

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
Belemnites Brugierii, *d'Orb*	Beesley, Geol. Sur.		×	
,, subaduncatus, *Voltz*	Walford			×
,, tripartitus, *Schl.*	Beesley, Walford		×	×
,, elongatus, *Sow.*			×	
,, Fournelianus, *d'Orb*	Beesley		×	
,, sp. (?)		×	×	×
Gasteropoda.				
Dentalium elongatum, *Münst.*	Walford			×
,, liassicum, *Moore*				×
Nerita sp. (?)				×
Cryptænia expansa, *Sow.*		×		×
,, consobrina, *Tate*			×	×
,, solarioides, *Sow.*				×
,, rostelliformis, *Dunker*	Beesley	×		
Pleurotomaria heliciformis, *Desl.*			×	×
,, helicinoides, *Röm.*				×
,, rustica, *Desl.*	Walford			×
,, Hierlatzensis, *Hornes.*				×
,, similis, *Sow.*	Beesley		×	
,, Anglica, *Sow.*	Geol. Survey		×	
,, liasina	Beesley		×	
,, complanata, *Desl.*	Beesley	×		
,, araneosa, *Desl.*				×
Discohelix aratus, *Tate*	Beesley	×		
,, Dunkeri, *Moore*, var.	Beesley		×	
Trochus Pandion, *Dumort*	Walford			×
,, Thetis, *Dumort*				×
,, Pluto, *Dumort*	Walford			×
,, Ariel, *Dumort* (? lineatus, *Moore*)				×
,, Pethertonensis, *Moore*				×
,, Mysis, *d'Orb*; near to				×
,, rotulus, *Stol.*	Walford			×
,, nodulatus, *Moore*			×	
,, glaber, *Quenst.* (?)				×
,, carinatus	Beesley		×	
,, concinnus	Beesley		×	
,, Gaudryanus, *d'Orb*				×
,, ,, var.	Walford			×
,, Æolus, *d'Orb* and var.	Walford			×
,, Deschampsii, *d'Orb* (?)				×
,, similis, *Moore* (?)				×
Phasianella turbinata, *Stol.*				×
Pitonillus sordidus, *Tate*			×	
Turbo lineatus, *Moore*				×
,, cyclostoma, *Benz.*		×		×
,, aciculus, *Stol.*		×		×
,, linctus, *Moore* = Turbo nudus, *Moore*		× (?)		×
,, varians, *Moore*	Walford			×
,, Lucilius, *Dumort*	Walford			×
,, bullatus, *Moore*	Walford			×
,, elegantissimus, *Moore*				×
,, Rutteri, *Moore*				×
Eucyclus Nireus, *d'Orb*	Walford			×
,, conspersus, *Tate*				×

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
Litorina biornata, *Tate*	Walford			×
Turritella Dunkeri, *Terq.*	Walford			×
,, Juliano, *Dumort*	Walford			×
Cerithium liassicum, *Moore*				×
,, reticulatum, *Desl.*				×
,, confusum, *Tate*				×
,, ferreum, *Tate*				×
,, Moorei, *Tate*	Walford			×
,, asperulum, *Moore*				×
,, varicosum, *Moore* (?)	Walford			×
,, coronatum, *Moore* (?)	Walford			×
,, Ilminsterense, *Moore*				×
Chemnitzia foveolata, *Tate*				×
,, semitecta, *Tate*				×
,, undulata, *Ziet.*	Walford			×
Actæonina Ilminsterensis, *Moore*			×	×
Cylindrites Whitfieldi, *Moore*				×
Orthostoma fontis, *Dumort* (?)		×		×
*Nerinea liassica, *Moore*				×
Alaria unispinosa, Moore				×

(To be continued.)

METEOROLOGICAL NOTES.—June, 1886.

The mercurial column was rather unsteady during the month, but the changes in barometric pressure were generally slight, the extreme range being only 0·591 of an inch. The highest reading, 30·297 inches, occurred on the 30th, the lowest, 29·706 inches, on the 12th. The mean pressure was rather lower than that of June, 1885. Temperature was about 2½ degrees below the average. The former and latter portions of the month were warmer than the middle. The highest maxima were 81·0° at Henley-in-Arden, on the 29th; 78·3° at Loughborough, on the 28th; 75·1° at Hodsock, on the 29th; and 73·3° at Coston Rectory, on the 28th. In the rays of the sun, 134·5° at Hodsock, and 132·1° at Loughborough, on the 30th. The maximum (sheltered thermometer) was below 60° on seven days at Loughborough; while the mean of maximum readings was 2·6° lower than that of June, 1886. The lowest readings were 34·3° at Coston Rectory; 35·0° at Hodsock,and 37·3° at Loughborough, on the 4th; and 39.0° at Henley-in-Arden, on the 5th. On the grass, the thermometer recorded 31·5° at Hodsock, and 35·5° at Loughborough, on the 4th. Rainfall was decidedly below the average, the total values being 0·74 of an inch at Hodsock; 1·18 inches at Henley-in-Arden; 1·36 inches at Coston Rectory; and 1·56 inches at Loughborough. The heaviest falls, ranging from 0·98 to 0·37, were on the 1st, and the number of "rainy days" varied from eight to thirteen. Thunderstorms occurred at Coston Rectory and Loughborough on the 1st, and at Henley-in-Arden on the 19th. Sunshine was deficient. The wind was generally light, and its prevalent direction from westward. Harvest operations were much retarded, and vegetation suffered from the cold drought.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

* It appears that this is not a Nerinea, but until a new name has been assigned to it I retain the one by which it has for a long time been known.

Natural History Notes.

Epiphytal Plants.—On Saturday afternoon, when botanising at Churchill, Worcestershire, I noticed an unusual number of plants growing high up on pollard willows and other trees. Thus on one willow were common nettle, hawthorn, a willow herb, probably *hirsutum*, and the Wood Betony. Upon another willow I found a young ash tree, an alder, and a small willow herb. Again, upon one tree were a small filbert tree and a hawthorn; while a wild raspberry occurred on one tree, and also a young gooseberry bush side by side with another young ash. Several tufts of grass were growing on the trees, but there seemed very little soil or decayed vegetation up where these plants were nourished, though the spot was very damp from an adjoining brook and marshy ground, in which latter I was glad to find *Mimulus luteus* at one spot, a long way from any cottages.—Horace Pearce, F.L.S., Stourbridge.

Students' Garden, Cannon Hill Park.—In a note to a very interesting paper on the Flora of the Rea Valley, which appeared in the June number of the "Midland Naturalist," the writer, the Rev. H. Boyden, refers to this garden, and makes two suggestions, which he will be pleased to hear have not been overlooked. As soon as the site of the garden was decided upon I saw that the pool adjoining would form a very valuable adjunct, and that not only aquatic but possibly also marsh and bog plants might be grown there. Accordingly a series of "pockets" have been constructed around the margin of the pool, and these, as well as the "bays" between them, will, I hope, soon be stocked with water-loving plants. The naming of the trees and shrubs, too, was a part of my original suggestion to the Park Committee, and the labels are in course of preparation. They will give the botanical and common names, together with the natural order and the countries of which the tree or shrub is native, so that while helpful to the student of botany it is hoped that they may also prove instructive and interesting to the general visitor.—Joseph W. Oliver.

Ellesmere Excursion.—On Wednesday, June 23rd, I joined the botanical excursion of the Midland Union to Blakemere, Colemere, Crosemere, and Ellesmere meres. It was a bright, sunshiny day, though rather too windy for examining the more exposed meres. I had but a short time for collecting, but the list of micro-organisms, etc., that I recognised, which is subjoined, shows that there is a very good field for further study there. The most interesting find was *Melicerta Janus*, which had not been previously found in England, having been found first in Scotland by Mr. John Hood. Frog-bit (*Hydrocharis morsus-ranæ*), bladder-wort (*Utricularia vulgaris*), water-milfoil (*Myriophyllum spicatum*), horn-wort (*Ceratophyllum demersum*), *Fontinalis antipyretica*, *Chara*, *Nitella* (in fructification), *Bulbochæte*, *Rivularia angulosa*, *Volvox Globator*, *Docidium nodulosum*, *Pediastrum Boryanum*, *Planorbis crista*, *Daphnia mucronata*, *Moina rectirostris*, *Polyphemus pediculus*, *Sida crystallina*, *Camptocercus rectirostris*, *Nais proboscidea*, *Tathrocampa annulosa*, *Floscularia cornuta*, *Stephanoceros Eichhornii*, *Melicerta ringens*, *Melicerta Janus*, *Œcistes crystallinus*, *Notommata aurita*, *Forficula ensifera*, *Asplanchna priodonta*, *Rotifer macroceros*, *Rotifer vulgaris*, *Salpina mucronata*, *Pterodina patina*, *Metopidia acuminata*, *Euchlanis triquetra*, *Hydra vulgaris*, *Ophrydium sessile*, *Spongomonas intestinalis*, *Centropyxis aculeata*.—Thomas Bolton.

Reports of Societies.

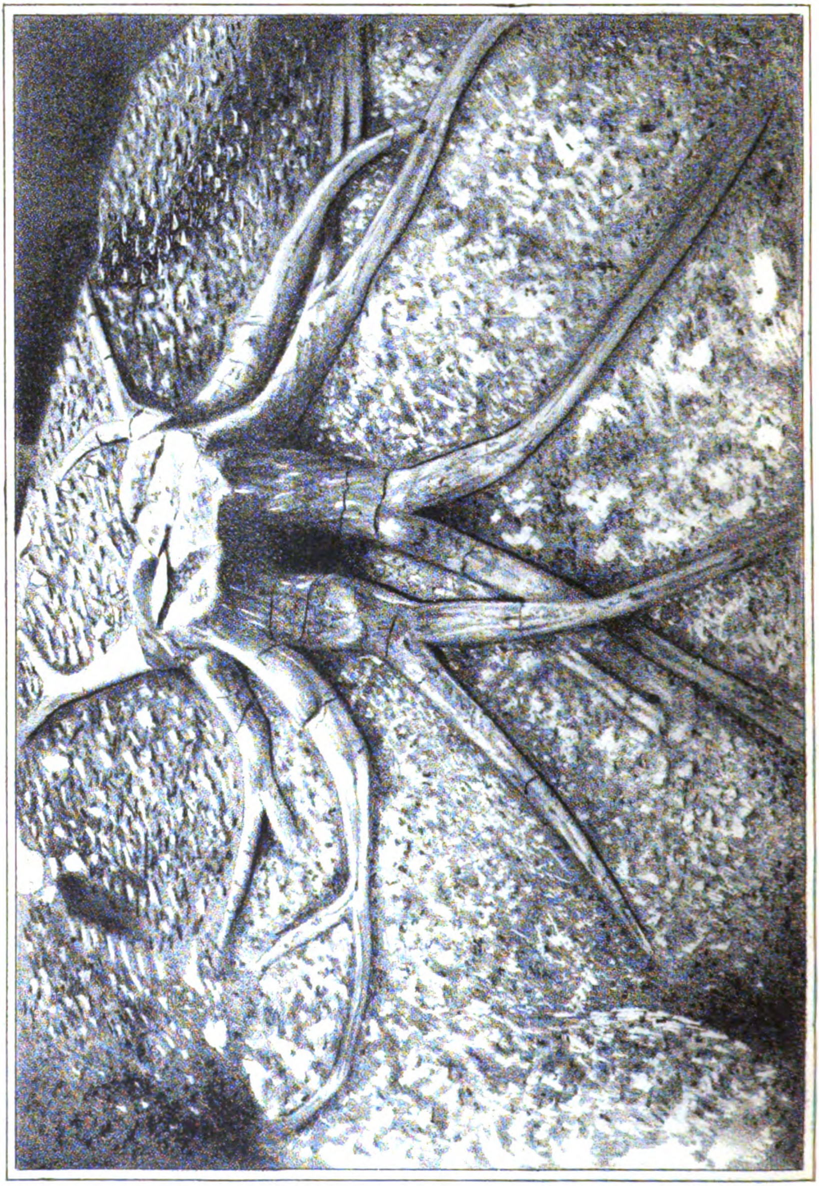
BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, June 29th. Thos. Waller, Esq., B.A., B.Sc., in the chair. Exhibits:—Mr. Bolton, (1) *Melicerta Janus*, a rotifer found in one of the Shropshire Meres at one of the excursions of the Midland Union of Natural History Societies on Wednesday last. The rotifer had previously been found only in Scotland by Mr. Hood. (2) A few live specimens from Tenby, including (*a*) *Noctiluca miliaris*, (*b*) The Beroe, (*c*) The beautiful Clavelina, (*d*) Larval Crabs, (*e*) *Spirorbis nautiloides*. Mr. Hughes for Mr. Walliker, crystals of salt and stratified salt from cistern at Middlesbrough Salt Works; also, for Professor Lapworth, rock salt from Middlesbrough; also, for comparison, crystals of salt from Lake Utah; also, models in wood of the cubic forms of crystals, nearly fifty in number, in many varieties of facetting. Mr. J. E. Bagnall, for Mr. W. R. Hughes, *Cynoglossum officinale*, *Orchis ustulata*, *Helianthemum vulgare*, *Anthyllis vulneraria*, *Polygala depressa*, and other rare plants from the oolite soils of Cheltenham. Mr. Madeley, of Dudley, *Labechia conferta*, *Heliolites interstincta*, *Halysites catenularius*, *Heliolites megastoma*, *Favosites Forbesi*, *Favositella interpuncta*, *Favosites Hisingeri*, *Stromatopora typica*, *S. Carteri*, *S. concentrica*, *S. discoidea*, *Clathrodictyon vesiculosum*, *C. fastigiatum*, *C. variolare*, *C. striatella*, *Favosites Gothlandica*, *F. Bowerbanki*, *Heliopa cærulea* (recent), *Pocillopora* (recent), *Callopora Fletcheri*, *Monticulipora pulchella*. Mr. J. E. Bagnall, *Nardus stricta*, *Carex pulicaris*, *Carex binervis*, *Myosotis collina*, *Scirpus fluitans*, all new to Stour basin, from near Walford. Mr. Madeley read a most interesting and instructive paper on Stromatopora. A hearty vote of thanks was given to Mr. Madeley at the close of the paper.—GENERAL MEETING, July 6th. Mr. H. T. Hassall in the chair. Mr. W. H. Wilkinson exhibited a specimen of *Chrysanthemum leucanthemum* (the great Ox-eye Daisy), in which the flower was a union of three flower heads, and the stem was fasciated. He also exhibited the following lichens, sent by Mr. W. B. Grove, B.A.:—*Lecanora ventosa, forma lepadolemma*; *Lecidea contigua, forma limitata*; *Lecidea geographica, forma contigua*; *Graphis scripta*, from Cader Idris; also *Umbilicaria cylindrica*, from Arran Mowddy.—MICROSCOPICAL AND GENERAL MEETING, July 20th. Mr. J. E. Bagnall, A.L.S., exhibited *Symphytum officinale*, *Rhamnus catharticus*, *Potamogeton flabellatus*, *Geranium pratense*, and *Melilotus officinalis*, all from Halford, Stour basin; also, *Epilobium roseum*, from Aston. Mr. Bagnall also exhibited, from Rev. H. P. Reader, *Cephalanthera rubra*, from Gloucestershire, and a collection of mosses, amongst which were the following:—*Brachythecium glareosum* and *Hylocomium loreum*, also from Gloucestershire.—GEOLOGICAL SECTION, July 27th. Thos. Waller, Esq., B.A., B.Sc., in the chair. Exhibits: Mr. Wilkinson, a pink proliferous rose, in which the second bud was supported on a stem an inch long from the centre of the larger rose, from Handsworth. Mr. Morley, Dendrites on a stone from Pennsylvania. Mr. Waller gave his promised lecture on granites (illustrated by fine specimens of typical and other granites, and a large series of micro-sections), which was fully appreciated by a good attendance of members and friends.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 21st. Mr. H. Insley showed specimens of *Cotyledon umbilicus* and *Saxifraga tridactylites*, from Maxstoke; Mr. J. Madison, a collection of land and freshwater shells, made during a visit to Scotland, including specimens of *Linnæa peregra*, var. *Burnetti*, from Loch Skene, so far its only habitat; Mr. C. P. Neville, *Trigonia costata*, *T. incurva*, and other fossils, from Portland; Mr. H. Hawkes, specimens of *Thalictrum alpinum*, *Saxifraga nivalis*, *Lycopodium alpinum*, and *L. annotinum*, from Snowdon; Mr. A. T. Evans, fossiliferous pebbles from the drift, containing *Cyathophyllum*, *Atrypa*, and *Orthis*. Mr. C. F. Beale, a complex thorn of *Univaria procumbus*, from South Africa. Under the microscopes: Mr. Mulliss, leg of mining bee, with pollen; Mr. H. Hawkes, section of stem and fruit of *Lycopodium alpinum;* Mr. J. W. Neville, larvæ of an Australian tettigonia, found on the eucalyptus tree.—June 28th. Mr. Deakin exhibited a specimen of English adder; Mr. J. Madison, a collection of land and fresh-water shells from the Continent; Mr. Jerome Harrison, jun., a Palæolithic implement from a gravel bed in the north of France, and two of neolithic age from Loughborough, and the peat beds, Denmark; Mr. Corbet, a spider crab, *Maia squinado*. Under the microscope: Mr. J. W. Neville, leaf of an Australian sundew, with captive insects; Mr. H. Hawkes, a section of dock, showing the natural colouring. A paper was read by Mr. C. F. Beale, on "Ancient Flint and Stone Implements." The writer said it would be impossible to find a use for all the implements that had been found. They were classed in two sections, the Palæolithic and Neolithic. The former were almost always made of flint, and were associated with the remains of the mammoth; the latter were made of all kinds of material, from sandstone to jasper, obsidian, and chalcedony, and were associated with the remains of animals found living at the present time. Arrow heads were of three kinds—triangular, lozenge, and leaf-shaped, sometimes finished with serrated edges. Stone hammers were either grooved or bored, when they were fixed to the handle either by thongs or in the ordinary way. The writer called attention to the strong resemblance between stone implements from different parts of the world, and the superstitions that had surrounded them from the earliest times, and concluded by expressing a hope that members would use their eyes in this neighbourhood, that some of these interesting relics might be brought to light. The paper was illustrated by a large assortment of implements of different kinds, from roughly chipped to highly finished specimens, and some were contrasted with spurious ones—the work of "Flint Jack."—July 5th. Mr. C. P. Neville exhibited a specimen of the long-eared bat, *Plecotus auritus;* Mr. Deakin, *Trichobasis suaveolens* and *Puccinia variabilis;* Mr. Corbet, *Uromyces ulmariæ;* Mr. J. W. Neville, *Helix erronea* and *H. rivolii*, from Ceylon.—July 12th. Mr. A. T. Evans showed cast of a calymene, amethystine quartz, &c., in pebbles from the Moseley drift; Mr. J. Madison, specimens of *Limnæa stagnalis*, var. *fragilis variegata*, from Malham Tarn; Mr. J. Harrison, jun., skull of a Siluroid fish, *Doras maculatus*, from South America. Under the microscopes: Mr. Wagstaff, a new annelid, *Nais Hamata*, from Sutton Park; Mr. Mulliss, palate of *Trochus zizyphinus*. Mr. Sanderson then read a paper on "Birds I have met with in the Yorkshire Dales." The writer described the fauna as very different from that of the Midlands, and gave a list of birds common with us yet only rarely met with in Yorkshire. Lists were given of the various species, with notes of observations on them, the writer regretting that birds adding so much to the beauty of the solitude as the raven and heron, should be constantly sacrificed by the gamekeeper, the former to grouse, the latter to trout.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, July 21. Attendance, 6 (2 ladies). Three new members were elected, viz.: Mr. W. H. Winterton, Miss Sloane, and Miss Mary Sloane. The Chairman reported that at the Field-day Excursion last week only three members attended. They went by rail to Elmsthorpe, and walked by Burbage Wood and Common to Hinckley. In the pond in which *Utricularia vulgaris* was found several years ago they found the plant still abundant, but not in flower. In a pond in Burbage Wood, *Equisetum limosum*, variety *fluviatile*, was found in its extreme and most typical form. The following objects were exhibited, viz.: By Mr. and Miss Grundy, growing plants of *Drosera rotundifolia*, *Anagallis tenella*, *Botrychium lunaria*, *Sphagnum cymbifolium* in fruit, all from North Wales; also a piece of heart-wood from a very large decaying yew tree, said to be 900 years old, growing in the same district, the annual rings of wood being plainly visible and about one-eighth of an inch in thickness, indicating an increase of about one foot diameter in fifty years during the period of vigorous growth. By Dr. Finch, fresh specimens of *Colchicum autumnale* in fruit, the length of the stem from the corm to the capsule being just one foot, the capsule itself 1½ inch, and the decaying leaves one foot long. By the Chairman, a specimen of the moth, *Abraxas ulmata*, taken in Burbage Wood. The Chairman read a paper on "The hairless condition of the human skin," arguing against Darwin's theory that it has been produced by sexual selection.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—June 15th. ANNUAL MEETING.—Mr. E. Wheeler in the chair. Report read and officers elected: president, the Very Rev. the Dean of Peterborough; secretary and treasurer, Mr. J. W. Bodger.—June 17th. Botanical ramble, conductor Mr. J. W. Bodger, from gravel walk by Low Farm and tan yard, along Roman bank eastward. Plants collected, *Sagina apetala*, *Malachium aquaticum*, *Barbarea vulgaris*, *Geranium molle*, *G. dissectum*, *Senebiera coronopus*, *Conium maculatum*, *Torilis nodosa*, *Cicuta virosa*, *Callitriche verna*, *Pryonia dioica*, *Solanum dulcamara*, *Veronica beccabunga*; *Holcus mollis*, *Alopecurus geniculatus*, &c., &c.—June 24th. Geological excursion to Hetton Brickfields, Oxford Clay section. Among fossils obtained were teeth of *Acrodus nobilis*, *Belemnites puzosianus*, one having the phragmacone chamber filled with the clay, and containing two small bivalves pyritized (*Nucula?*), *Avicula inæquivalvis*, *Trigonia gibbosa*, *Serpula vertebralis*, and *Ceritheum*.—July 1st. Botanical ramble by North Bank; plants collected—*Chelidonium majus*, *Ranunculus circinatus*, *R. fluitans*, *R. heterophyllus*, *Iris pseudo-acones*, *Hottonia palustris*, *Scrophularia aquatica*, *Spargarium ramosum*, *Alisma plantago*, *Convolvulus sepium*, and others.—July 8th. Excursion to Cambridge, conducted by Dr. W. Easby. The Fitzwilliam and Antiquarian Museums were visited, under the direction of the Rev. L. S. Lewis, M.A., and Dr. Waldstein, the latter gentleman giving an informal address on some of the treasures exhibited; Mr. Lewis taking charge of the party. The Chapel and Hall of Peterhouse were explored, also the libraries of Corpus Christi, Trinity, and St. John's Colleges, so rich in rare and illuminated manuscripts. The tower of St. John's was ascended, from the top of which a splendid panoramic view of Cambridge and the surrounding country was obtained. Magdalen and King's Colleges were also visited, the party returning to Peterborough highly pleased with so delightful an outing. Geological excursion the same evening, under the guidance of Mr. E. Wheeler, to Oxford Clay section at Fletton.

A FOSSIL TREE.



Herald Press Lith Bum

A FOSSIL TREE AT CLAYTON, YORKSHIRE.

BY W. S. GRESLEY, F.G.S.

As it is very rarely that an opportunity offers of seeing and (for those who wish it) examining a really good specimen of the remains of a fossil tree *in situ*, it has occurred to me that a short description of what is undoubtedly the finest or most perfect example of a fossil of this description hitherto discovered in Great Britain, if not in the world, would be interesting to readers of this magazine.

Most of us probably will be unable to pay the fossil a visit, but I can assure those who are particularly interested in fossil botany, and in the question of the formation of coal, that an inspection of it will amply repay them for undertaking the journey. I am informed that the owner of this unique object is not likely to allow it to be removed from its natural position; at all events for the present.

Locality. About three miles to the south-west of Bradford, and about four to the north-east of Halifax, at the Fall Top Quarries at Clayton, which are worked by Messrs. J. Murgatroyd and Son. The situation is high up on the hills (perhaps 600 or 700 feet above sea level), but is within ten minutes' walk from either the Clayton or the Queenberry Railway Stations on the Great Northern Line (Bradford and Halifax section).

Geological Horizon. The fossil tree occurs in the sandy shales of the Lower Coal Measures or Ganister series; in beds which overlie the Elland Flagrock, a well-defined and persistent geological boundary, dividing the Lower Coal Measures into two distinct parts; the upper embraces the strata beneath the Silkstone or Blocking Coal; the lower, the measures containing the Halifax Hard and Soft Coals. The quarry is wrought for landings, flags, building, paving, and roofing slabs, and it was whilst removing the "baring" that the fossil was discovered. The strata dip about 1 in 10 to the south-east. The bed containing the specimen is a bluish-grey micaceous sandy shale, containing numerous fossil roots, and here and there streaks of coaly matter. It occurred about twelve feet beneath the surface and nearly the whole of the covering has been carefully removed so as to completely expose the whole of the fossil with the exception of the extremities of one or two of the roots, which either pass downwards into the shale, or run out of sight into the face of the quarry.

Description of the Fossil Tree.—It consists of a very perfectly preserved lower end of a fossil trunk of a tree with its roots and rootlets attached thereto, and freely spreading or branching out on all sides in a natural manner (see Plate III). The specimen has all the appearance of being *in situ*, *i.e.*, of occupying the actual spot where it grew, flourished, and then died. But this of course was not upon the hill-top where it now is, but doubtless at or near the sea level in carboniferous times. That this must have been the case is evident from the character and lie of the beds of sandy material enclosing it.

The height of the tree stump, including the roots, is about four feet, and the diameter three feet nine inches. I could not learn that the stem had been noticed to extend upwards beyond what is now visible. Strictly speaking the fossil is not a "*tree*," but the *roots of one only*. These magnificent roots extend away in a gently sloping direction all round from the stump. They include an area of say fifty or sixty square yards of ground, and the average length of each root is probably about twelve feet; the largest is fifteen feet long. I consider there are four main roots, all much the same size, and placed nearly equidistant round the stump. As each main root leaves the stem it immediately divides into two, and at about six feet away from the stem each root bifurcates and extends away (without again forking) in straightish lines to its extremity. There are thus sixteen distinct extremities to the roots, derived from eight forked branches, which originally proceed from four splittings-up of the base of the tree stem. The specimen consists principally of the *Stigmaria ficoides*, and possesses its thousands of rootlets or filaments extending themselves into the shale around the roots. The well-known quincuncial or spiral arrangement of the little round scars giving attachment to the rootlets is well preserved, particularly so upon two of the roots. But the size of the sketch accompanying this notice scarcely admits of their being clearly shown. That the tree which these splendid roots supported was the *Lepidodendron* or the *Sigillaria* seems certain, and from what little can now be made out upon the exterior of the specimen I am inclined to think that it represents the latter. Palæo-botanists tell us that but little difference existed between the roots of these two widely differently marked tree trunks. The material of which the specimen at Clayton is composed is hard sandstone, a good deal impregnated with hydrous iron oxide, while the roots themselves are embedded in a comparatively soft sandy shale; and this circumstance has enabled the owners to so successfully expose its entire form without destroying any of its substance, excepting, of course, the rootlets which came away with the shale surrounding it. One of two of the roots overlap one another, which is interesting, and there seems to be another specimen of *Stigmaria* intruding itself amongst the roots of the "fossil tree." It is unfortunate that sufficient of the stem has not been preserved so that its species could have been determined with certainty, and also that none of the actual terminals of the roots are exposed to view or preserved. I suppose the fossil may be termed an all but perfect *cast* of the base of a tree with its whole system of roots intact, for I question if any internal structure exists beyond the usual central (?) pith ring-mark so characteristic of the fossil *Stigmariæ*.

I regret my inability to describe this strange and unique fossil in correct botanical phraseology. My chief object has been to help to make it known.

It has been examined by several eminent geologists and botanists, including Prof. Williamson, of Manchester, whose monograph upon the *Stigmaria*, illustrated by a very exquisite series of plates (which by his kindness I have had the good fortune to look over) for the forthcoming volume of the Palæontographical Society, in which no doubt he will refer to the Clayton *find*, will be very anxiously awaited. I may say that the price of each annual volume of this most beautifully got-up work is only a sovereign. One large quarto volume is issued yearly.

Enquiries for this book should be addressed to the Rev. Thomas Wiltshire, M.A., F.G.S., 25, Granville Park, Lewisham, S.E. Photographs of the "Fossil Tree" have been taken by two people, namely, for Mr. Davis, F.G.S., of Chevinedge, near Halifax, by E. Wormald, Great George Street, Leeds; and by J. Exley, of Southfield Lane, Great Horton, near Bradford, of whom the following can be purchased:—

(*a.*) *Fossil Tree* from edge of quarry, size about 14″ × 12″. Price 3s. 6d. each.

(*b.*) *Fossil Tree*, same view, cabinet size, at 1s. each.

(*c.*) *Fossil Tree*, nearly same view, with *a root* partly displaced before restoring to natural position, cabinet size, 1s. each.

(*d.*) *Fossil Tree* and general view of quarry and surroundings, cabinet size, 1s. each.

I need scarcely add that to see the fossil in its freshly exposed state, and whilst it is still in its natural position, a visit to Clayton should not be delayed.

Should the specimen be taken away, it is to be sincerely hoped that it will be secured for our Natural History collection (British Museum, South Kensington), where it would vastly enrich a collection, I am sorry to say, at present either greatly behindhand in possessing itself of good typical coal-flora fossils of this description, or at all events in its exhibition and arrangement of the same.

NOTES OF AN AMERICAN TOUR.

BY W. P. MARSHALL, M.I.C.E.

(Continued from page 211.)

San Francisco, the capital of the West, stands on the shore of a large sheltered inland bay that forms a noble harbour, opening to the Pacific Ocean by a side channel that leads off at right angles and leaves the harbour quite protected from the sea. The entrance of the channel from the sea is called Golden Gate, said to be so called from the splendid golden sunsets that are seen from the hills of San Francisco, looking out over the open sea, which extends clear across to Japan at 5,000 miles distance. San Francisco is very hilly, excepting the portion alongside the water, and some of the streets are too steep for horse traffic, and only workable by the cable tramways, which were originated there, and are now very extensive.

The great Palace Hotel in San Francisco is celebrated as one of the largest in the world, and is a very fine and complete building, with a large centre court 70 feet width and 140 feet length, open to the top of the building, roofed with glass, and having galleries all round at each floor, into which the room doors open. This hotel gives a good example of the large American hotels, with the important conveniences that they contain. In the large entrance hall, besides the general business counter at which all the business of the hotel is concentrated and conveniently and promptly managed, there is the railway counter of a general ticket agent, where tickets can be obtained to every part of the country and every information is given about travelling; also a telegraph office and a railway bookstall, with the inevitable American barber's shop. Railway tickets are not got at the stations as a rule, but are obtained at a general ticket agent's office in a principal hotel or in the main street near at hand; this is a great convenience and advantage to travellers, and the tickets can be obtained a long time previously, even available for any time during the year.

A great curiosity in San Francisco is the Chinese quarter, a portion entirely occupied by Chinese, and singularly situated in the immediate neighbourhood of the best parts of the city. The Chinese are very numerous in San Francisco, and also in many other parts of California; Chinamen do the house work in the hotels instead of chambermaids and housemaids. The Chinese are very steady, industrious, and careful, and Chinese washermen do all the washing and laundry work in California and the neighbouring States.

A sea-side place close to Golden Gate is a favourite resort of the San Francisco people, where there are the celebrated Seal Rocks; rocks near to the shore swarming with seals, which are strictly preserved as a great attraction for visitors. The climate of San Francisco is very mild and equable, free from both the cold of winter and the heat of summer.

From San Francisco a visit was paid to the Cloverdale Hot Springs and the Calistoga Petrified Forest, about 100 miles north. The Petrified Forest is a remarkable example of silicified trees, which are found lying nearly horizontal at or near the surface of the ground, and one very fine specimen of a tree is sixty feet in length and eleven feet in diameter at the base.

San Francisco is, like New York, cut off by water from the railways of the main land, which start from Oaklands on the opposite shore of the bay; and the traffic is all ferried across. Also the trains at Benicia, thirty miles distance, after starting, have to cross an inner arm of the bay, and each train is then conveyed over bodily, engine and all, by the largest ferry boat in the world; it has lines of railway running the whole length of the deck, and the first half of the train runs direct on to one line on the boat with the engine at the head, and then the second half is pushed on to a second line of railway on the deck by a pilot engine at the tail end. The pilot engine takes the voyage across with the train, and on arrival at the opposite shore, the train engine runs off with its half of the train, and the pilot engine runs after it with its second half, which is then coupled up again, and away the train goes. The whole time occupied in crossing the two miles of water and shunting the train at each side is only twenty minutes from arrival at the one side to starting from the other side.

The railway in passing eastward rises very rapidly towards the mountains, having as much as 7,000 feet rise in the first

100 miles; and at the summit level in crossing the mountain range there is a snow-shed covering in the line for as much as forty-five miles length to protect it from avalanches on the mountain side, through which the train travels for nearly two hours.

Salt Lake City was reached in two days and nights' journey from San Francisco; it lies in a fine position, a great fertile plain 4,000 feet above the sea, bounded on all sides by ranges of snow-capped mountains at distances of about 30 to 130 miles, all showing bright and near in that clear atmosphere, so that it is impossible to form any idea of their real distance. The Great Salt Lake is ten miles away from the city, and is really an inland sea seventy miles long. The water is intensely salt, and said to be seven times salter than sea water, and it gives an odd sensation of buoyancy in bathing in the lake; you cannot touch the bottom after reaching little more than four feet depth, but float about ignominiously like a cork.

Salt Lake City is a strange rambling place, with the main streets very wide, but generally only in the condition of country roads, and they have rows of trees on each side, with open running streams of water. Looking down from the high ground north of the city, the sight is very singular; a great number of the houses, large and small, stand in gardens, and only in some of the principal streets are the houses joined up together to a continuous frontage. State Road runs through the city from north to south, and extends in a continuous straight line for a length of twenty-five miles, on to the foot of the surrounding mountains. At the head of it are the great Mormon Tabernacle and their Temple, which has now been thirty years building, but has not yet got a roof on, and from all appearance may now never be finished, as Mormonism seems to have got its death-blow in the place.

From Salt Lake City a run of 600 miles through the Rocky Mountain district brought us again to Pueblo, where the out-going course of the journey was crossed. This run was of special interest, through extraordinary rock gorges, showing very fantastic forms of gigantic rocks standing up like ruined castles and fortifications; and passing over several lofty summits, one of them 11,000 feet above the sea, about the highest railway in the world. The intermediate valleys were singularly beautiful with flowers, and at one part there was something like twenty miles length of railway, with the ground on each side literally carpeted with great masses of flowers of lovely varied colours, and extending as far as the eye could distinguish on each side of the line. It was a nearly level plain, bounded by mountain ranges at various distances, from ten to fifty miles probably; with a light sandy soil having very little grass to be seen, but covered with flowering plants in great patches. Otherwise it looked a desert, with scarcely a trace of human or animal life, and hardly any trees to be seen.

Chicago was next reached, which is the third largest city in the States, having more than 500,000 population. It is situated on the shore of Lake Michigan, one of the gigantic inland seas 70 miles across and nearly 300 miles in length, which has waves breaking on the shore and quite a rough sea sometimes. Chicago is remarkable for the rapidity with which it has been rebuilt in the fifteen years since a terrible and most destructive fire destroyed a large portion of the city, and for the handsome and substantial character of the new buildings that have been erected.

A special feature of the place is the great stock yards for cattle and pigs, and large grain warehouses, containing the largest store of both in the world; also the great manufacture of tinned meats in connection with the stock yards, and the special mode of killing the cattle by a rifle shot, the most humane and also most economical system.

The grand Niagara Falls were then visited,—"Thunder of Waters," as the name is said to mean in the Indian language,—the largest of waterfalls as regards the enormous volume of water passing over the falls, though much exceeded in height by other falls. The finest view is from the high banks on the Canadian side, where a complete view of the whole is obtained:—the great Horse-shoe Fall in front, half-a-mile width at the edge of the fall, with twenty feet thickness of water in the centre, and the American Fall beyond, a quarter-of-a-mile width, with Goat Island dividing them, and the three small Sister Islands at the extremity stretching out into the Upper Rapids. The great Whirlpool Rapids are two miles below the Falls, where the whole mass of water is forced through a narrow rocky channel, only 220 feet width. The deep indentation formed in the centre of the Horse-shoe Fall by the wearing away of the rocks is well seen in this view.

The return to New York by railway, 450 miles from Niagara, gave an illustration of American competition in railways, which is being carried on to a ruinous extent in many districts; there are two rival lines for this distance which have cut down the fares to only ½d. per mile (1 cent per mile).

The voyage back to England was by one of the largest of the New York steamers, 8,000 tons, tearing along through the ocean at a great speed, 18½ knots, or twenty-one miles an hour, day and night continuously, for five days of the run. The passage was exceptionally fine and quick, with bright sunshine and smooth calm sea every day but one; we left New York on Saturday morning and landed at Liverpool the next Saturday evening, including in the passage a stoppage at Queenstown to land the mails; the great steamer was like a floating castle, so substantial and firm, and full of comforts like an hotel, with electric lighting throughout.

Such was the conclusion of a most delightful and enjoyable trip, one to be remembered with great pleasure and interest.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT SHREWSBURY, JUNE 22ND AND 23RD, 1886.

ADDRESS BY THE REV. J. D. LA TOUCHE, PRESIDENT OF THE UNION.

(Continued from page 207.)

From the subject of geology to that of archæology seems a long step, yet in fact each shades off into the other by insensible gradations. The earliest traces of man are found in the implements and works of art which he has left behind him—far more imperishable than his skeleton. These not only furnish unequivocal proofs of his presence in the remote past, but tell us something as well of the degree of intelligence at which he had arrived when he formed them. I am not aware of more than one locality in the county in which relics of this description have been found, and that is the neighbourhood of Clun. Owing to the diligence and perseverance of Mr. Luff, a very considerable number of flint arrow heads and other stone implements have there been brought to light, proving that the place must in pre-historic times have been the centre of a large population, and possibly was the site of the manufacture of these weapons. Mr. Luff informs me that on Upton Rock Hill, near Clun, he has discovered the traces of this Neolithic settlement. Refuse of pre-historic workshops are here very abundant, and a large number of flint and stone implements, beautifully executed, have turned up, proving the ingenuity, inventive faculty, and manual dexterity of our early ancestors. Until lately no trace of polish has been discovered on these remains. In a similar settlement on the Pennine Hills, and where, as here, well-chipped implements of a very distinctive type are found, a complete absence of polish may also be noted. However, lately, on the slope of Rock Hill, a beautifully polished miniature whetstone has turned up, proving that any theory as to their age, founded on their rude character, would be erroneous. Mr. Luff has also made some interesting observations on the position of a large obelisk of basalt, and its position in relation to a stone circle N.W. of it, at a distance of 120 yards. He finds that this stone is situated nearly in a line with the point of the horizon where the sun would be seen from the circle to rise on the shortest day of the year. He has taken great pains to arrive at accurate data on this point, the result of which is that the stone lies 6deg. out of this direct line. Now since, in consequence of the precession of the equinox, the sun 8,000 years ago rose 2deg. nearer the south than at present, it would seem that, supposing the Neolithic men did at that time place this boulder in its present position for some rite connected with sun-worship, an error of only 4deg. appears to have been made by them. Mr. Lewis, who has made the orientation of out-lying stones in connection with stone circles his special study, says that absolute accuracy in this matter is very rare, and that the position of the Clun Menhir is remarkably correct. His chief conclusion is that the custom of placing these outlying stones was inherited by the Neoliths, and that they practised it not knowing its exact signification. Mr. Luff well remarks, in the note which he has been so good as to furnish me with on this subject, that we have here a thought full of mystery. Who were these original sun-worshippers? Do we here get a glimpse of the religion that affected the minds of men in those remote ages? I cannot pass from this subject without an allusion to a note I have had from Mr. Symonds, to whose eloquent lectures on geology and many kindred subjects our Field Clubs have been so often indebted, and who would have been glad to be present on this occasion but for the ill-health from which he is suffering. Mr. Symonds wishes me to draw particular attention to the evidences of the existence of man, which all late discoveries and investigations tend to confirm, at the time when the Mammoth was an inhabitant of our island, and before the Isle of Wight was separated from the mainland, and before Southampton Water and the Solent had any existence. He has, he tells me, been again investigating the evidence for this, and is more than ever convinced that such was the case. For those who may desire to study this subject, treated in a popular form, and within short compass, I may refer to his essay on the Malvern Straits.

Coming to later times, we have the remains of the Roman city of Uriconium, which will be visited by the archæologists. A county which was the boundary of two races often engaged in hostility may be expected to abound in forts and castles. Such is the case here, and an excellent example of a gentleman's mansion of the 13th century, fortified and made suitable for defence against the wild border-tribes, will be found in Stokesay Castle, to be visited by one of the sections.

The botanical treasures of a county like Shropshire, possessing a considerable variety of soil and surface, may naturally be expected to be of much interest. But I hope that in drawing attention to these I may be excused if I observe a certain amount of caution and reserve. Geologists have this advantage over botanists—that the specimens which they rejoice in collecting are practically inexhaustible, whereas plants are, even where very abundant, easily exterminated. I have even heard grave doubts expressed whether the familiar and homely primrose is not likely to disappear from our woods and hedgerows, where it has so long gladdened the eyes and hearts of the lovers of Nature, owing to the exigencies of a certain school of political thought, and whether it might not fairly claim the *protection* which is, I believe, a prominent feature in that creed. Anyhow, one of our greatest varieties—a curious rush, called the *Scheuchzeria*,—which but some ten years ago was tolerably abundant at Bomere, is now all but extinct there, owing to the ill-advised efforts of a certain teacher in Shrewsbury School (whose name I do not know) who carried off large quantities of it to send up to London to certain professional collectors there. Acts like this justly appear to the true botanist a crime no less revolting than is the destruction of a fox to the moral sense of a Shropshire squire. I have seen a party of excursionists, most of whom cared nothing and knew nothing about botany, on being told that a rare plant might be found at a particular spot, flinging themselves like birds of prey upon the spoil, and carrying off not only sprays, but roots of it, probably to be afterwards forgotten and thrown aside, and thus in their ignorance doing an irreparable injury to science. The occurrence of rare plants opens to the naturalist an inexhaustible fund of information, not only as regards their own history, but the history of the locality where they grow, its changes of climate, of level, &c. For example, the fact pointed out by Mr. Ball that of 1,157 species of plants characteristic of the Alps, two-thirds are found in the Carpathians, one-half in the Pyrenees, and one-fourth in the Altai, is clearly of much importance in determining the physical conditions to which those mountains have been subjected. Then, again, under what circumstances did plants like the *Astrantia major* at Stokesay, and the *Potentilla rupestris* at the Breiddens, find their way to those localities? The former is found not nearer to Britain than Central France, and yet it occurs rather abundantly in the woods over Stokesay Castle. Is it the sole survivor of an extinct flora, or has it been conveyed hither, as has been supposed by some—perhaps accidentally—in the time of the Roman occupation? I am glad to see that, at the last general meeting of the Midland Union, a vigorous effort was set on foot to check the reckless destruction of rare plants, and to co-operate with the society which has been formed in France for this special purpose.

In relation to some of the lower forms of vegetable life, much attention is being paid to them by several of our local botanists, under the stimulus of the Microscopical Society which has been formed in this town. A few years ago a committee was appointed by the Caradoc Club to obtain information upon a curious phenomenon which occurs in some of the numerous lakes of greater or less size which are situated in the north of this and the adjoining parts of the border counties. At certain seasons the water becomes extremely turbid, making it useless for household purposes, and so uncomfortable for the fish that they refuse to take any bait. The result of these investigations has been an able paper by Mr. Phillips, published in the Transactions of the Archæological Society. It soon became evident that the "breaking of the meres," as the phenomenon is termed in the district, was due to the appearance at certain seasons of minute algæ in enormous quantities. These have been fully described by Mr. Phillips, and include the following:—*Rivularia articulata*, *Anabæna circinalis*, *Cœlospherium Kützingianum*, *Dolichospermum Ralfsii*, *Aphanizomenon Flos-aquæ*. It is remarkable that while in some of these meres the breaking lasts sometimes during a considerable part of the year, in others it is much more rare, and one has never been known to break, although connected by a wide ditch with the next one, which is conspicuous for doing so. I have further to report the discovery by Mr. Beckwith of *Nitella gracilis*, an alga which had previously been recorded only for North Britain and Ireland. Mr. Phillips is devoting his attention to the fungi especially, and a list of the *Hymenomycetes* of the county has already appeared in the Transactions of the Shropshire Archæological Society. Mr. Beacall has added many new localities for some of the rarer plants found in the county; and, lastly, to advert to an altogether different branch of natural science, I may mention that Mr. Beckwith has been publishing a very able and interesting series of papers in relation to the birds of Shropshire, giving much valuable information as to their habits and their natural history.

III.—The third and last subject which I have proposed for consideration—The Work of Charles Darwin and its Influence on Modern Science—is one which I most deeply feel would tax the powers of a much more able pen than mine. But in a town distinguished as the birthplace of so remarkable a man, and on an occasion like the present, when we are assembled to share, in however humble a degree, in the great work to which his life was devoted, it seems as if some tribute to his memory and some notice of that work were called for. From the time that, early in my life, I read Humboldt's "Cosmos" and "The Vestiges of Creation," two books which then attracted a good deal of attention, I have been much impressed with the conviction that the belief then, and even still so commonly prevalent in sudden, spasmodic, isolated acts of creation, as the means by which organised beings have from time to time appeared on this earth must ultimately be modified or abandoned, and that some account, consistent with the general laws which govern the rest of the universe, must inevitably take its place. The first of these books unfolded the sublime conception of the nebular hypothesis, whereby our solar system, as well as the myriad orbs which spangle the heavens, are shown to have been evolved from primordial matter in a state of extreme tenuity, and spread through inconceivably vast tracts of space; and the latter seemed to give a not unreasonable account of the process whereby successive generations of living beings might become modified in virtue of the conditions which surrounded them, and thus give rise to species and varieties. Besides, had not Newton revolutionised astronomy and physical science, putting to flight for ever the empiric and fanciful theories of the schoolmen? Was it unreasonable to expect that another Newton might arise to reduce the complex and mysterious phenomena of organic life to a definite system, and prove that they move onwards in obedience to laws not less distinct and unalterable? That master mind at last appeared in the person of the illustrious Darwin. It is true, indeed, that from very early times thoughts strangely similar or leading up to the theory which he has propounded have been expressed by other writers. One of the most remarkable and wonderfully able authors of antiquity was Lucretius. His speculations seem to anticipate some of the most profound discoveries of modern times. And though, as Mr. Houghton has pointed out to me, there is no passage in his writings which can be said to shadow forth Darwin's definite explanation of the origin of created things, *i.e.*, the evolution of animals or plants by natural selection, on the contrary Lucretius frequently insists on the unchangeable nature of animals. "All things," he says, "are so constant, that the different birds, all in succession, exhibit in their body the distinctive marks of their kind; each creature has its powers defined, its boundary mark deeply set." At the same time there are some very striking and interesting passages, which shadow forth *particular points*, which bear on and are necessitated by the Darwinian explanation, especially in relation to what we now call *Teleology*, or the doctrine of final causes. He says to Memmius: "In this matter you must vehemently shun and anxiously avoid the weakness of erroneously supposing that the bright lights of the eyes are made in order that we might be able to see, and that the extremities of the shanks and thighs were attached to the feet as a base in order that we might take long steps on the road, or, moreover, that the fore-arms were fitted to the strong upper arms, and that ministering hands on each side were given in order that we might be able to perform the needful duties of life. Other explanations of a similar kind are given, but all of them put effect for cause (*præpostera*, *i.e.*, last put first) through wrong reason (*perversa ratione*), for nothing was born in the body in order that we might use it, but that which is born begets for itself a use." He elsewhere speaks of things used in accordance with the wants of life, "things made by man for the purpose of being used, as javelins, shields, beds, and cups," but records his opinion that, on the contrary, "the birth of the tongue was long anterior to language, and the ears were made before sound was heard, and in fine that all the members existed before there was any employment for them, and that they could not therefore have grown for the purpose of being used." The validity of this reasoning may appear to some in the present day as questionable and objectionable, as, doubtless, they did to the followers of Plato and Xenophon and other teachers, who laid great stress on the argument of design; but I have troubled you with a quotation from the work of an author born 100 years before our era, both for its great intrinsic interest, as well as to emphasise what appears to me to be the most distinguishing feature in the character and system of Darwin, as in his brilliant predecessor, and that is his concentration on the simple teaching of nature, without allowing himself to be swayed one way or the other by preconceived notions and prejudices. The light which reaches us from the most distant star is the same in its nature as that which our own sun furnishes. Thus, true genius in every age, and under the most diverse conditions, moves in obedience to the same principles, and often arrives at identical results. Again, in more recent times, Lamarck, in the first year of the present century, published his profound speculations on the Origin of Species, views which were afterwards adopted and made popular by Chambers in his "Vestiges of Creation." These and others in their several lines were working towards the same end. But, after all, the theories they put forth were but speculations; most of them, and especially that of Chambers, with the defect that they presupposed successive inscrutable acts of creation; and it was long before even the most candid thinkers, such as Sir Charles Lyell, could free themselves from a view that rendered any really comprehensive generalisation possible. It was the great merit of Darwin to emancipate himself entirely from this bondage, and guided, not by the dim, uncertain light of hypothesis, or the ingenious speculations of supposed analogies, but by the teaching of careful experiment, of long-continued and patient observation, aided by a singular candour of mind, which was ever ready to listen to and weigh the strongest objections which could be urged against his views and to admit frankly all that told against them, it was reserved for a man who combined an almost childlike simplicity with a most powerful intellect to give a new departure to scientific thought, and to be the founder of a school which can alone elucidate what it is possible for us to know of the mysterious problem of life. It will not be expected that I should here attempt to give even an outline of the theory with which the name of Darwin has been identified, or to apportion the share which his predecessors had in its elaboration; though I must say, in passing, that it would be most unjust, as Mr. Hughes has pointed out in his address to the Birmingham Natural History Society, to ignore the claims of Mr. Herbert Spencer to having previously enunciated the great doctrine of evolution throughout the universe. A delightful little volume, recently published by Mr. Grant Allen, in Longman's series of English Worthies, places within the reach of any one who may desire it the history of the whole subject, as well as a clear exposition of Darwin's views and discoveries. That such an hypothesis as this should have met with bitter resistance in many quarters is not surprising, considering how opposed it was to pre-existing opinions. Nor is such resistance to be deprecated unless it takes the form of a bigoted and blind hostility to truth. It is the ordeal whereby the newer teaching is sifted and purified from the residuum of error which must ever attach more or less to all human knowledge that is not absolutely demonstrative. But on the whole, the Darwinian hypothesis, as it is called, has been steadily gaining ground, until now, even in quarters where a few years ago it was denounced as destructive of all that men held most sacred, it is often admitted to be quite consistent with religion.

I feel that it would not be suitable to take advantage of the position which I have the honour to hold on this occasion to introduce matter which might be subject to a difference of opinion. What I have said has been with the view of emphasising what I think we shall all agree is the great object which societies, such as those which have met here this day, should place before them, and that is the steady search for truth, and a patient and reverent study of Nature, with minds unalloyed by prejudice or passion. And though it may be that the birth of truth, like that of all living things, is often accompanied with pain, let us endeavour to minimise and not increase the resistance to the reception of it, which is the cause of that pain. St. Augustine has somewhere said with a fine intuition, that it is "impossible for science to be opposed to religion." Let us not fear. It is to the free expansion of truth and the elimination of error that we owe all the blessings we now enjoy, as well as our emancipation from the bondage of ignorance and superstition. The saying of the Hebrew prophet Micah, "What doth the Lord require of thee but to do justly and to love mercy, and walk humbly with thy God," is not far in spirit from that of the heathen philosopher, Lucretius "A happy life is not possible without a clean breast." Sentiments like these are eternal, indestructible, and are independent of all science and all human knowledge.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

A Meeting of the Management Committee was held on the 19th of August, at which the Malvern Field Club was admitted to the Union; and the invitation from the Club for the Meeting of the Union for 1887, which accompanied the application, was accepted.

The exact date was not fixed, but will no doubt be about the usual time, and Secretaries of Societies are requested to bear the Meeting in mind when arranging for Lectures, Meetings, &c.

Any Members of the Union who may have Papers or Lectures which they would be willing to deliver to other Societies in the Union are requested to communicate with the Hon. Secretary, Thos. H. Waller, 71, Gough Road, Birmingham, who will be happy to send their names to Secretaries of Societies who may signify their wish to have such Lectures delivered to them.

The completeness of the preparations for the Meeting at Shrewsbury in June, and the excellent manner in which they were carried out, makes the balance sheet, which the Local Committee who had the care of the arrangements communicated to the Meeting of the Management Committee, of considerable interest, especially to some of the Societies in small towns, as showing that the Meeting of the Union does not necessarily involve any great expense. The accounts showed that the total cost of the meeting had been about £35, and that the sale of tickets for the Conversazione and the Excursions had, within sixpence, covered this amount.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 218.)

STRATFORD-ON-AVON.—*Anne* [*Hathaway*], *w. of Wm. Shakespeare*, 1623. *Haines*.

In the chancel, near the grave of Wm. Shakespeare, is a brass plate 15½in. by 7½in., with this inscription:—

HEERE LYETH INTERRED THE BODY OF ANNE WIFE
OF WILLIAM SHAKESPEARE WHO DEPTED THIS LIFE THE
6TH DAY OF AVGV. 1623 BEING OF THE AGE OF 67 YEARES

Vbera, tu mater, tu lac, vitamqu. dedisti
Vae mihi pro tanto munere saxa dabo
Quam mallem amoueat lapidem bonus angel' ore
Exeat Christi Corpus, imago tua.
Sed nil vota valent : venias cito Christe, resurget
Clausa licet tumulo mater et astra petet.

The following is a rough version in English :—

Thou, mother, gavest life and suck to me:
And I, alas, give but a stone to thee.
Oh! might some angel roll the stone away
That thou, like Christ, might'st rise again to-day.
Vain wish: come quickly Lord, then shall she rise—
Though now entombed—and ascend the skies.

TANWORTH. I.—*Robert Fulwode and w. Margaret.* 1531.

Unfortunately nothing remains of this brass (which is not recorded by Haines) except a group of ten children, and the following inscription (mentioned by Dugdale) upon a plate 2ft. 2in. by 3½in. :—

Orate p aīab' Roberti fulwode Armigeri & Margarete Uxoris suae. Qui q̊ dē | Robert' fuit Excellentissīe doctrinat' siue litterat' in cōīe lege Anglie et obiit | xx° die mensis octobrs A° dni m°ccccccºxxxj° cui' aīe ppicietur deus. amen.

Translation :—

Pray for the souls of Robert Fulwode Esq., and Margaret his wife. Which Robert was excellently well learned or read in the common law of England, and died the 20th day of the month of October, A.D. 1531. Whose soul God pardon. Amen.

II.—*Margt. dau. of Simon Ralegh, Esq., and w. of Andrew Archer Esq.* 1614. *Haines.*

This is a mural brass 19in. by 13½in., now set in an oak frame. The drawing is extremely delicate and refined. The lady kneels at a prayer-desk, upon which is an open book. Upon her head is a graceful Paris hood, underneath which her hair is brushed back. Her neck is encircled by a ruff, and she wears a bodice with tight sleeves, and a plain skirt. Over these is a loose sleeveless gown of brocaded material, open in front, and arranged in graceful folds upon the tiled floor. On the lady's right is a shield of arms with tasteful mantling: ARCHER, az., three arrows, or., impaling RALEGH Arg., a cross moline, betw. twelve crosses crosslet gu. Above the arms are the crests of the two families, respectively a dragon's head arg., issuing out of a mural coronet gu., and a boar's head erect, arg.

Beneath the figure is this inscription :—

MEMORIÆ SACRVM

Margaretæ Archer filiæ Simonis Ralegh
de Farmborough Armigeri quæ fuit
mitiſſima coniux Andree Archer de
Tanworth Armigeri nec non adiutrix
pauperum et ægrotantium dum vixit quæ
obiit deci : tertio die Augusti An° 1614.

In English :—

Sacred to the memory of Margaret Archer, daughter of Simon Ralegh of Farmborough Esq., who was the most gentle wife of Andrew Archer of Tanworth Esq., and during her lifetime the helper of the sick and needy. She died the 13th day of August A.D. 1614.

There is an illustration of the brass in Dugdale.

III.—*Inscription. Anne Chambers.* 1650.

A brass plate about 16in. by 12in., now in an oak frame. At the top are engraved the crest and arms of CHAMBERS. Then follows :—

M. S. A. C.

Juxta hunc locum jacet humatum exspectans iustorum resurrectionem corpus Annæ uxoris | amantiſsimæ Johannis Chambers de Woodend hujus parochiæ generosi quæ obijt in Domino | 15° die February 1650 annoque ætatis suæ 35° unica existens filia et hæres Edwardi | Baylyes nuper de Haselor tres filios (scilt) Willm̄, Edmund, et Johēm Chambers | unamque filiam nomine Elizabeth̄ post se ex eodem marito reliquit.

Siste pedem quæso, cujus cinis estque requiras :
Hic pietas, virtus, forma, pudorque jacet.
Virgo pudica fuit, pia conjux, almaque mater
Quæ multo fletu conditur hoc tumulo.
Digna quidem vixiſse diu florentibus annis
Ablata est generis spesque decusque sui.
Nondum terdenos cum quinis vixerat annos
Parca ferox ultra cum supereſse negat.
Nil pietas virtus possunt, nil forma pudorque,
Nil juventa potest : mors rapit omne cito.
Et nunc Anna vale ; tu terque quaterque beata es,
Vivere cui Christo contigit atque mori.

J. C. composuit
E. C. sculpsit
W. C. dedit.

Translation:—

Sacred to the memory of Anne Chambers. Near this place lies buried the body of Anne the dearly beloved wife of John Chambers of Woodend in this parish gent.; who departed in the Lord Feb. 15, 1650, in the 35th year of her age, being the sole surviving daughter and heiress of Edward Bayleys late of Haselor. She left behind three sons, to wit, William, Edmund and John Chambers, and one daughter Elizabeth—by the same husband.

Stay, prithee, and ask whose ashes these are: here lieth Affection, virtue, beauty, and modesty. She was a modest maid, a dutiful wife, a loving mother, who mid much 'grief is buried in this tomb. Worthy indeed to have lived to a hale old age yet she was snatched away, the hope and pride of her race. Ere she had lived thirty and five years, grim fate forbade her longer to survive. Affection, virtue avail nought, nought beauty and modesty, nor youth: death seizes everything anon. So now Anna, fare thee well: thrice, yea, four times blessed art thou whose hap it was to live and die in Christ.

John Chambers composed this.
Edmund Chambers engraved it.
William Chambers presented it.

IV.—*Inscription. Margaret Chambers*, 1666.

A plate 1ft. by 9½in., in an oak frame, very similar to the last, but with larger and more deeply incised letters. The inscription is:—

Hic iacet corpus Margaretæ uxoris amantiffimc Edmundi
Chambers de Studley in com. Warr. Gen. filiæ et heredis
Thomæ Anderton defuncti quæ obiit 16° die Maii
Anno dom. 1666°, Annoq. ætatis suæ 30°.

Hic maneas paulum festinans quæso viator
Aspice quos cineres hæc capit urna pios.
Virtutum cultrix & relligionis amatrix
Vxor & alma parens hac tumulatur humo.
Natura poteras bene Margarita uocari
Viua ferens talem nomine & ore tuis
MARGARETA uale, tu felix terq. beata
Quæ iufu Christi fcandis ad aftra poli

Translation:—

Here lieth the body of Margaret the dearly beloved wife of Edmund Chambers of Studley in the county of Warwick gent., daughter and heiress of Thomas Anderton defunct; who died May 16, 1666, aged 30.

Pause here a little in thy haste, I pray thee, traveller: behold what pious ashes this urn doth hold. A cultivator of the virtues, a lover of religion, a fostering wife and mother is here interred. By nature thou wert well fitted to be called pearl, exhibiting it alike in name and conversation while living. Margaret, farewell: fortunate art thou and thrice blessed, since at Christ's bidding thou soarest to heaven.

V.—*Inscription. John Chambers.* 1670.

A plate 11in. by 8in., in an oak frame, very similar to Nos. III. and IV. The inscription and six elegiacs are not very deeply incised, and cannot be accurately made out from the rubbing in the writer's possession.

TYSOE. I.—*Thomas Mastrupe, priest,* 1463. *Haines.*

In the north aisle is an effigy, 14in. long, of a tonsured priest, holding a chalice, and clad in amice, chasuble, apparelled albe, maniple, and stole. (Compare the brass at Coleshill.)

Upon a plate, 16in. by 2in., is this inscription:—

Hic jacet dñs Thomīs Mastrupe quōā capellan' isti eccē Qui obiit | xxix die mēs' novēbri A° dñi m°ccccc°lx°iii cui' aīe ppiciet' deus amē.

Here lieth Sir Thomas Mastrupe, sometime chantry-priest of this church, who died the 29th day of the month of November, A.D. 1463. Whose soul God pardon. Amen.

II.—*Nicholas Browne and w. Jane,* 1598.

Haines has made a slight mistake in describing this brass, which lies in the north aisle near No. 1. It consists of a demi-figure of a woman, 8in. long, and a plate, 19½in. by 5in., with an inscription. The figure is similar to that of Barbara Eliot at Sutton Coldfield, the costume being a large hood, ruff, dress with tight sleeves and pointed stomacher of overlapping scales.

The inscription is as follows:—

IN HOC TVMVLO CONDVNTVR CORPORA NICHOLAI BROWNE ET JANÆ VXORIS EIVS, FILIÆ NATV MAXIMÆ ROBERTI GIBBS DE HONNINGTON ARMIGERI, ET MARGERIÆ PRIDIOX PRIMÆ EIVS VXORIS. QVAE JANA DIEM OBIJT VNDECIMO DIE AVGVSTI, ANŌ DOMINI MILESIMO QVINGENTESIMO NONAGESIMO OCTAVO.

Translation:—

In this tomb are buried the bodies of Nicholas Browne and Jane his wife, who was the eldest daughter of Robert Gibbs of Honnington Esq. and Margery Pridiox his first wife. Which Jane died on the 11th of August, A.D. 1598.

III.—*Tomizane Browne second w. of Nich. Browne* 1611.

This is not mentioned by Haines. It is a plate, 10½in. by 7½in., and lies near the last. Upon it is engraved a shield, bearing a chevron between three horses' heads couped at the neck and bridled. A similar coat is ascribed (Kittermaster's Arms, &c., of Warw.) to the family of Horsey, of Honnington.

The inscription is:

HERE LYETH THE BODY OF | TOMIZANE BROWNE SECOND | WIFE OF NICHOLAS BROWNE | WHO DECEASED Y^{E} 5 DAY OF MAY | 1611.

UFTON.—*Rich. Woddomes, parson, &c.*, 1587, *and w. Margery, with* 7 *chil. Haines.*

At the east end of the north aisle is a plate, 18in. by 16½in., engraved with the kneeling figures of a man and three sons, all in the gown so frequently described in these pages (see CHADSHUNT, BARTON, SOLIHULL II.), and a lady and four daughters. The lady has a high-crowned wide-brimmed hat, a ruff, and sleeveless gown open in front and worn over a dress with tight sleeves. The girls are similarly dressed, but wear closely-fitting caps instead of the hat. A prayer desk, upon which are two open books, separates the groups.

Beneath the figures is this inscription:—

Here lyeth the Boddyes of Richard Woddomes pars | son and pattron and vossioner of the Churche & parishe | of Oufton in the Countie of Warrike who died one | Mydsomer daye. 1587. And Margery his wiffe wth | her seven childryn as namelye Richard John & John | Anne Jone Elizabeth Ayles his iiii dawghters | whose Soule restethe with God.

"Vossioner" is supposed to mean advowson-holder.

(To be continued.)

BRITISH ASSOCIATION.—The fifty-sixth meeting commences at Birmingham on September 1st, and continues to the 8th. The President, Sir Wm. Dawson, C.M.G., M.A., LL.D., F.R.S., F.G.S., Principal of McGill College, Montreal, Canada, will deliver the Presidential Address on the evening of September 1st. The arrangements of the local committee have been carried out in a manner which will be greatly appreciated by the distinguished visitors who will attend the meeting, which bids fair to be a great success.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART II.

PALÆONTOLOGY.

(Continued from page 224.)

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
LAMELLIBRANCHIATA.				
Ostrea submargaritacea, *Brauns*		×	×	×
,, sportella, *Dumort.*		×	×	×
,, cymbium, *Lam.*, var. obliquata		×	×	
,, cymbium, *Lam.*, var. depressa		×	×	
Gryphæa gigantea, *Sow.*	Beesley	×		
,, Maccullochii, *Sow.*, = Ostrea cymbium	Beesley	×		
Anomia numismalis, *Quenst.*				×
Pecten lunularis, *Röm.* ,, liasinus, *Nyst.*		×	×	×
,, æquivalvis, *Sow.*		×	×	×
,, dentatus, *Sow.*, a var. of P. æquivalvis			×	
,, textorius, *Schl.*			×	×
,, calvus, *Goldf.*			×	
,, substriatus, *Röm.*				×
,, priscus			×	×
,, pumilus, *Lam.*	Walford			×
,, Humberti, *Dumort.*	Walford			×
,, articulatus	Beesley		×	
,, paradoxus, *G. S.*	Beesley		×	
,, demissus, *Phil.* (?)			×	
,, cingulatus, *Goldf.*	Geol. Survey		×	
,, acutiradiatus, *Godlf.*				×
,, acuticostatus, *Lam.*	Walford			×
,, angulatus	Geol. Survey		×	
Hinnites tumidus, *Ziet.*, = H. velatus, *Goldf.*			×	×
,, Davæi			×	
,, abjectus, *Phil.*	Judd		×	
Lima Hermanni, *Voltz*			×	×
,, punctata, *Sow.*			×	×
,, Eucharis, *d'Orb.*	Walford			×
,, gigantea, *Phil.*	Beesley	×	×	
,, pectinoides, *Sow.*	Walford			×
,, scabricula, *Tate*	Beesley		×	
,, Galathea, *d'Orb*	Walford			×
Limea acuticosta, *Münst.*		×	×	×
,, Juliana, *Dumort.*				×
Plicatula spinosa, *Sow.*		×	×	×
Harpax pectinoides, *Lam.*	Walford			×
,, Parkinsoni, *Brown*	Walford			×
Monotis cygnipes, *Y. & B.*		×		
,, calva, *Schl.*				×

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
Monotis inæquivalvis, *Sow.*		×	×	×
" novemcostæ, *Brown*		×		
" Munsteri, *Brown*		×		
" deleta, *Dumort.*			×	
" papyria, *Quenst.* (?)	Walford		×	
" echinata, *Chap. & Dew.*; nr. to	Walford			×
Gervillia oblonga, *Moore* (?)		×		×
Inoceramus substriatus, *Münst.*	Walford			×
" cinctus, *Münst.*	Beesley		×	
Pinna folium, *Y. & B.*		×		
" sp. (?)		×		
Modiola scalprum, *Sow.*		×	×	
" numismalis, *Oppel.*		×	×	×
" subcancellata, *Buvig.*		×		×
Macrodon Buckmanni, *Rich.*				×
" undatus, *Walford*				×
Cucullæa Münsteri, *Ziet.*	Walford			×
" cancellata, *Phil.*		×		
" transversa, *Moore*				×
Arca interrupta, *Moore*		×		
" elongata, *Quenst.*		×	×	
" liasina, *Röm.*	Beesley	×		
" truncata, *Buckman*		×	×	×
Nucula variabilis, *Dumort.*	Beesley	×		
" Palmæ				×
" Hammeri, var. Cardiiformis, *Def.*				×
Leda Galathea, *d'Orb*	Beesley	×		
" complanata, *Goldf.*	Walford		×	×
Trigonia Lingonensis, *Dumort.*		×	×	×
Astarte striato-sulcata, *Röm.*				
" amalthei, *Quenst.*	Walford			×
" fontis, *Dumort.*	Walford			×
" Voltzii, *Goldf.*				×
" Camertonensis, *Moore.*				×
" subcarinata, *Münst.*				×
" subtetragona, *Münst.*		×	×	
Cardita multicostata, *Phil.*		×		
Cardinia antiqua, *Phil.*		×		
" lævis, *Y. & B.*		×		
" crassissima, *Sow.*			×	×
" concinna, *Sow.*				
" Philea, *d'Orb.*	Beesley	×		
" cuneata, *Stuch.*	Walford			×
Cypricardia cucullata, *Münst.* (?)		×	×	
" pellucida, *Moore*	Beesley	×		
Hippopodium ponderosum, *Sow.*		×		
" ovale, *Moore.*	Walford			×
Myoconcha decorata, *Münst.*	Walford			×
Tellina Lingonensis, *Dumort.*				×
" gracilis, *Dumort.*		×	×	
Protocardium truncatum, *Sow.*	Walford			×
" substriatulum, *d'Orb* (?)	Beesley, Walford	×	×	(?) ×
Lucina pumila, *Münst.*				

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
Unicardium subglobosum, *Tate*		×	×	×
Tancredia Lingonensis, *Dumort.*	Walford			×
Lithodomus sp. (?)	Beesley		×	
Pholadomya ambigua, *Sow.*		×	×	
,, Simpsoni, *Tate*		×		
,, obtusalis, *Simp.*		×		
Goniomya heteropleura, *Agassiz*		×		
,, hybrida	Beesley	×		
Gresslya donaciformis, *Phil.*		×		
,, lunulata, *Tate*		×		
,, Seebachii, *Brauns*		×		
,, intermedia, *Simp.*		×	×	
Pleuromya liasina, *Schub.*		×		
,, costata, *Y. & B.*		×	×	
Ceromya petricosa, *Simp.*		×	×	×
,, bombax, *Quenst.*				×
Isocardia liassica, *Moore* (? Ceromya petricosa)			×	
,, Slatteri, *Walford*	Walford		×	×
Arcomya arcacea, *Seeb.*		×		
,, concinna, *Tate*		× (?)		×
,, hispida, *Simp.*		×		
,, vetusta, *Bean.*				×
BRACHIOPODA.				
Lingula Beanii, *Phil.*	Beesley	×	×	
Crania Griffini, *Dav.*	Beesley		×	
Thecidia (?)	Walford			×
Spiriferina Walcotti, *Sow.*	Beesley		×	
,, rostrata, *Schl.*			×	
,, oxygona, *E. Desl.*			×	
Terebratula punctata, *Sow.*			×	
,, punctata, var. Radstockiensis, *Dav.*			×	
,, subpunctata, *Dav.*			×	
,, Edwardsi, *Dav.*			×	
,, Walfordi, *Dav.*			×	×
,, Bakeriæ, *Dav.*	Davidson		×	
Waldheimia resupinata, *Sow.*			×	
,, indentata, *Sow.*			×	
,, cornuta, *Sow.*			×	
,, subnumismalis, *Dav.*			×	
,, florella, *d'Orb*	Walford		×	
,, Mariæ, (?) *d'Orb*	Walford		×	
,, Darwini, *Desl.*	Walford			×
Rhynchonella tetrahedra, *Sow.*			×	×
,, tetrahedra, var. Northamptonensis, *Walker*			×	×
,, tetrahedra, var. Dumbletonensis, *Dav.*	Walker		×	
,, subconcinna, *Sow.*			×	
,, variabilis, *Schl.*		×		×
,, acuta, *Sow.*			×	
,, rimosa, *Von Buch.*	Geol. Survey		×	
,, capitulata, *Tate*	Walford		×	

Name.	Authority.	Margaritatus Zone.	Spinatus Zone.	Transition Bed.
Brachiopoda.				
Rhynchonella fodinalis, *Tate*			×	
,, amalthei, *Quenst.*				×
,, Bouchardi. *Dav.*				×
Crustacea.				
Crustacean claws (? sp.)			×	×
Entomostraca. two large sp. (*Mr. Stuttard*)	Walford		×	
Cythere Moorei, *Jones*	Walford			×
Annelida.				
Serpula gordialis, *Goldf.*	Walford			×
,, tetragona, *Desl.*				×
,, triedra, *Quenst.*	Walford			×
,, capitata, *Phil.*				×
,, lumbricalis, *Schl.*	Walford			×
,, quinquecristata, *Münst.*				×
,, segmentata (?), *Dumort.*	Walford			×
Ditrypa circinata, *Tate*		×		×
,, etalensis, *Piette*				×
Echinodermata.				
Cidaris amalthei, *Quenst.*			×	
,, spines (2 sp.)	Walford			×
Acrosalenia Banburiensis, *Wright*				×
Hemipedina (sp. ?)	Beesley		×	
Millerocrinus Hausmanni, *Röm.*				×
Pentacrinus gracilis, *Charles.* } ,, Johnsonii, *Austin* }		×	×	
,, Jurensis, *Quenst.*		×		×
Actinozoa.				
Montlivaltia (sp. ?)	Beesley		×	
Thecocyathus tuberculata, *Tomes*				×
Thamnastrea Walfordi, *Tomes*	Walford		×	
,, Etheridgei, *Tomes*	Tomes		×	
Cyclolites cupuliformis, *Tomes*	Tomes		×	
Polyzoa.				
Diastopora liassica, *Goldf*			×	×
,, diluviana	Beesley		×	
Rhizopoda.*				
Nodosaria	Slatter			×
Cristellaria varians, *Borne*	Walford			×
,, cassis, *M. F.*	Walford			×
Plantæ.				
Wood (coniferous drift wood)		×	×	
Fucoids		×		

(*To be continued.*)

* A good list of Foraminifera is given in Mr. Beesley's pamphlet, but as no distinction is made between "Capricornus" and "Margaritatus" Zone they could not well be quoted here.

Correction.—At page 195 (July number), Dr. Callaway is made to say that because the rocks which rest upon the Wrekin volcanic axis and are partly derived from it are Cambrian, *therefore* the Wrekin series is *Upper* Cambrian. It should of course be *Præ*-Cambrian.

Natural History Notes.

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS.

NAME.	DATE 1886.	DATE 1885.	ASPECT. 1886.	SOIL, SITUATION, &c. 1886.
Corylus avellana	Feb. 14	Feb. 1	N.	Hedge. Pistillate fl. only open.
Mercurialis perennis	,, 14	Jan. 4	N.	Bank.
Daphne laureola	,, 28	—	W.	Under trees.
Helleborus viridis	,, 28	Feb. 15	Open	Meadow. Inflorescence & foliage only.
Tussilago farfara	Mar. 7	Feb. 8	S.	Railway bank. Same station both years. In 1884 the date was Jan. 12th.
Ulmus montana	,, 28	—	Open	Hedge-row.
Anemone pulsatilla	April 4	Apl. 12	—	Lower chalk escarpment.
Viola odorata	,, 4	—	—	Bank.
Potentilla fragariastrum	,, 4	Mar. 15	Open	Wood.
Anemone nemorosa	,, 4	,, 15	,,	,,
Caltha palustris	,, 4	,, 27	,,	Meadow.
Ranunculus ficaria	,, 4	,, 8	,,	Wood. March 6th in 1884.
Salix capræa	,, 4	,, 8	,,	Wood.
Petasites vulgaris	,, 7	April 3	,,	Moist meadow. Many flowers in 1886, very few 1885.
Adoxa moschatellina	,, 11	Mar. 22	S.	Bank. Plentiful.
Prunus spinosa	,, 23	Apl. 12	W.	Hedge.
Nepeta glechoma	,, 23	,, 3	S. W.	Warm bank.
Ranunculus auricomus	,, 23	,, 28	W.	
Orchis mascula	May 16	May 5	Open	Moist meadow.
Geranium robertianum	,, 23	,, 28	,,	Coppice, a few yards over the county border in Herts.
Cratægus monogyna	,, 23	,, 17	,,	Hedge.

The retardation of vegetation by the extreme cold of the winter months was most noticeable in the earlier spring flowers. *Tussilago farfara* has been observed in the same station for six or seven years, and was several weeks later than in any of those seasons.

JAMES SAUNDERS, Luton.

FLORA OF WARWICKSHIRE.—On the 14th of August I found, in a copse on the border of Packington Park, a large number of plants of Agrimonia which at once arrested attention by their unusual height. On measurement I found that they varied between 4ft. and 6ft., some of them even exceeding the latter height. At that time none of the fruits were ripe, but paying a visit to the same locality about a fortnight afterwards I found the ripe fruits to agree with the characters of *A. odorata*. This is the first record of this rare plant for North Warwickshire. In the same copse also *Genista tinctoria* was growing. —W. B. GROVE.

METEOROLOGICAL NOTES.—July, 1886.

The barometer was unsteady during the month, but its fluctuations were not large, the extreme range being less than an inch. The highest reading was 30·318 inches on the 3rd, the lowest, 29·346 inches on the 26th. Temperature was slightly above the average, resulting chiefly from the "hot wave" at the commencement of the month. On the 4th the sheltered thermometer rose to 87 degrees at Henley-in-Arden; on the same date the maximum at Loughborough was 85·1 degrees; at Hodsock, 82·8 degrees; and at Coston Rectory, 80·8 degrees. In the rays of the sun, 139·0 degrees was recorded at Loughborough, and 138·2 degrees at Hodsock, also on the 4th. From the 8th to the 17th temperature was much lower, the maximum at Loughborough on the 14th being only 61·9 degrees. From the 18th to the 21st there was another short "spell" of warm weather, the thermometer rising to 80·9 degrees on the 21st. The lowest readings were 39·0 degrees at Henley-in-Arden, on the 28th; 39·6 degrees at Coston Rectory, on the 18th; 41·3 degrees at Hodsock, on the 10th; and 45·3 degrees at Loughborough, on the 16th. On the grass, the thermometer registered 32·2 degrees at Hodsock on the 10th. Rainfall was rather above the average, the total values being 2·84 inches at Hodsock; 2·67 inches at Henley-in-Arden; 2·66 inches at Coston Rectory; and 2·44 inches at Loughborough. The number of days on which 0·01 of an inch, or more, fell, varied from 16 to 18. There was a remarkable absence of thunderstorms. Thunder was heard at Loughborough on the 2nd, 21st, and 25th, and at Coston Rectory on the 25th. The wind was generally moderate, and its prevalent direction from westward. A solar halo was seen at Loughborough on the 3rd.

Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Biological Section, August 10th. Mr. W. B. Grove, B.A., in the chair. The minutes of the last meeting were read and confirmed. Mr. J. Edmonds exhibited *Polyporus squamosus*, a fungus from an ash tree in the General Cemetery, measuring twenty inches across. Mr. W. B. Grove, B.A., exhibited *Equisetum maximum*, from the source of the Stour, near Halesowen; he also exhibited the following fungi:—*Lactarius piperatus*, *Boletus scaber*, *B. subtomentosus*, and *Russula vesca*, from the source of the Stour; *Panus torulosus*, *Cyathus striatus*, *Didymocladium ternatum*, from Packington; *Gomphidius gracilis*, from Rubery; *Stachylidium cyclosporum*, and *Polyporus blepharistoma* (new to county), from Lappal Tunnel.—Microscopical General Meeting, August 17th, Mr. W. B. Grove in the chair. Mr. H. Miller exhibited the samphire, *Crithmum maritimum*, gathered from rocks in Lee Bay, North Devon. Mr. W. B. Grove exhibited *Agrimonia odorata* from Packington (new to North Warwickshire); and the following fungi:—*Ag. phalloides*, *Ag. infundibuliformis*, *Ag. rugosus*, *Ag. lanuginosus*, *Lactarius fuliginosus*, *Russula rubra* (rare), *Boletus Satanas* (very poisonous), *B. variecolor* (new to the county), all from Packington; *Hygrophorus conicus*, from Marston Green; and (for Mr. J. Hamson) *Paxillus atro-tomentosus*, from near Bedford.—GEOLOGICAL SECTION, August 24th. Mr. Edmonds exhibited a dahlia with two flower-heads, placed back to back, on one stalk. Mr. W. B. Grove exhibited *Ag. phalloides*, *Ag. columbetta* (new to county), *Ag. stanneus* (also new), *Ag. asterosporus*, *Gomphidius viscidus*, *L. cilicioides*, *L. cyathula* (new), from Ham's Hall and Coleshill; *Ag. Bongardii* (new to county), *Ag. confluens*, *Ag. infundibuliformis*, *Clavaria cristata*, and *Helminthosporium clavariarum* (new), from Edgbaston Park; *Diderma vernicosum*, from Marston Green; (for Mr. H. Hawkes) *Gomphidius viscidus* and *Cantharellus cibarius*, from Kingswood; and (for Mr. J. Hamson) *Ag. chrysophæus* and *Ag. humilis*, from Bedford.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 19th. Mr. J. Madison exhibited a type specimen of *Unio tumidus*, and three varieties of the same, *ovalis*, *ponderosa*, and *radiata*; Mr. A. T. Evans, pebbles from the Moseley Drift, with fossil fucoid forms, carboniferous sandstone, with fossils, &c.; Mr. H. Hawkes, the following fungi:—*Melampsora tremulæ*, *Protomyces macrosporus*, and *Puccinia ægopodii*; Mr. J. Harrison, jun., auditory ossicles of human ear. Under the microscope Mr. Tylar showed *Alcyonella fungosa*; Mr. Hawkes, female flower of *Anacharis alsinastrum*. An exhibition of microscopical slides was then made, Mr. H. Insley showing a series of botanical mounts in glycerine, which, as a mounting medium, he held to be superior to jelly or gelatine. The further exhibition and discussion was adjourned to August 9th.—July 26th. Mr. J. Madison showed specimens of *Helix rotundata*, var. *pyramidalis*, a caddis case wholly made of shells of *Planorbis alba*, and a small collection of foreign marine shells; Mr. Deakin, the white variety of *Erica tetralix*, from Sutton Park; Mr. J. Moore, British marine shells; Mr. A. T. Evans, pebbles from the Moseley Drift, containing Orthis, Modiola, head of trilobite, etc.; Mr. J. Harrison, jun., a stalactite from Matlock. A paper was then read by Mr. Corbet, on "A Visit to the Buckstone." The writer described the Buckstone as a large boulder in the Forest of Dean, composed of old red conglomerate, and estimated to weigh about eighty tons. It tapered to a point, and, resting on a slab formed a rocking stone, and probably owed its origin to denuding agencies. The writer described the damage it sustained at the hands of visitors who rocked it until it rolled down the hillside and was broken into several pieces, and though now restored to its former place and still worthy of a visit, it had lost much of its interest.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—July 15th. Botanical excursion. Conductor, Mr. J. W. Bodger. By Thorpe Meadows to Orton Stanch, thence by river side to Peterborough. Plants collected, *Sedum acre*, *Allium vineale*, and varieties, *bulbiferum* and *compactum*, *Spiræa Ulmaria*, *Thlaspi arvense*, *Lychnis Githago*, *Galium mollugo*, *G. palustre*, *Lythrum Salicaria*, *Stellaria glauca*, *Thalictrum flavum*, *Veronica anagallis*, *Geranium pratense*, *Cornus sanguinea*, *Achillea Ptarmica*, *Epilobium hirsutum*, *Butomus umbellatus*, etc.—July 22nd. Geological excursion, conducted by Mr. E. Wheeler, to Forest Marble Section, St. Botolph's Field.—July 29th. Botanical excursion, by lane from Thorpe to Milton. *Trifolium fragiferum*, *Ononis arvensis*, *Ballota fœtida*, *Stachys Betonica*, *S. sylvatica*, *Campanula Trachelium*, *Ligustrum vulgare*, *Bunium flexuosum*, *Bromus asper*, *B. erectus*, and *Festuca gigantea*, were among the plants collected.

A THREE-EYED REPTILE.

BY A. B. BADGER.

Australia and New Zealand have long been celebrated for the remarkable character of their fauna. They possess no representatives of the great families of mammals which inhabit other parts of the Old and New worlds, none of the Carnivora, of the Ungulata, of the Edentata, or of the Quadrumana; but in Australia, filling the places of these animals in the economy of Nature, we find numerous species of the Marsupials. In Australia, too, alone of all lands, lives that curious creature, half mammal, half reptile, the Ornithorhynchus, which lays an egg like a reptile, but has teats, and is covered with hair, like a mammal. New Zealand is much more deficient in animal life than Australia, but it possesses a reptile, *Hatteria punctata*, so peculiar that it has an order all to itself. In many respects it is very much like the lizards, in others it resembles the crocodiles; then, again, there are hooked processes on its ribs as there are on those of birds. The circumstance, however, with which we are now especially concerned is the presence of three fully developed eyes.

This wonderful fact was recently discovered by Mr. W. Baldwin Spencer, of Lincoln College, Oxford, and has been termed, by Professor Jeffrey Bell, the most remarkable discovery of the last twenty-five years.

Two of these eyes are the ordinary lateral organs of Vertebrates, while the third is median, and lies on the surface of the brain at the bottom of a small hole perforating the parietal bone of the skull. It is, however, surrounded by connective tissue and is covered externally by the skin, so that the question arises of what use it can be to the animal. At present no answer can be given, but what is far more important, the existence of this eye in Hatteria has shown the homology* of a structure which is present in all Vertebrates, but the significance of which was hitherto unknown. The structure referred to is a small papilliform outgrowth from the upper surface of the brain, called the *pineal gland*, a name utterly misleading, as it has no secretory function; it is also better known as the *epiphysis*. In most Vertebrates it is simply composed of connective tissue, but in Hatteria Mr. Spencer†

* Homology is the "relation between parts in different animals which results from their development from corresponding embryonic parts." (Darwin.)

† Mr. Spencer's attention was drawn to this subject through reading a paper by Graaf, a German observer, who had been working out the development of the epiphysis.

has found that it has all the structure of a perfect eye—that is, lens, choroid, and retina are present, the nervous elements of the latter being connected with the brain by nerve-fibres. All stages between this perfect state and the ordinary form of a mass of simple tissue have been discovered by Graaf and Mr. Spencer in various lizards and amphibia, and consequently the " pineal gland " is proved to be a median eye.

It is, however, important to note that this median eye differs essentially from the ordinary lateral eyes of Vertebrates in the arrangement of the layers of the retina. Now this structure is composed essentially of a layer of nerve-fibres, which unite at one point to form the optic nerve, and of a layer of minute bodies called *rods* and *cones*. The latter are connected with the nerve-fibres, and by them the energy of light waves is converted into a form capable of affecting nervous tissue. In the vertebrate type of eye the former of these two layers lies between the light and the rods and cones; but in the invertebrate type the position is reversed. This difference between the eyes of the two great classes of animals is due to their radically different modes of development, a subject of some difficulty, which need not be treated in a popular paper. Briefly, the nervous part of the vertebrate eye is developed as a hollow outgrowth from the brain, which is not the case in the Invertebrates.

The median eye of Hatteria has its layer of rods and cones placed between the light and the layer of nerve-fibres, and in this respect resembles the invertebrate type, but since it is formed as an outgrowth from the brain, we must regard it as really developed on the vertebrate type.

Now the presence in a Vertebrate of a third eye is sufficiently interesting, but beyond this it confirms certain theories respecting the ancestry of the Vertebrates, and it is here that the importance of the discovery lies. To appreciate it, however, we must consider a group of animals much lower in the scale of organisation.

There may often be found attached to the rocks and stones of our sea shores, when uncovered at low water, lumps of greyish, leathery substance, irregular in shape and size, which the casual observer would scarcely imagine to possess life, and certainly would not credit with being animals. If, however, one of them be roughly touched, a stream of salt water suddenly ejected into his face will disabuse his mind on these points, for this " Sea-squirt," or more scientifically, *Ascidian*, holds a high place in the animal kingdom, and belongs to that great division of it which is characterised by possessing a back-bone. This amazing fact has been ascertained by following the life-history of certain species of Ascidia from the egg onwards, and the course of development is such as to leave no doubt but that these animals possess a median dorsal structure homologous with the "back-bone" of the Vertebrata. The Ascidia and Vertebrata ought, therefore, to be placed together in one class, the former being removed from their position near the Mollusca, with which animals they have no affinity. As, however, the back-bone of an adult fish or mammal is divided into a number of segments or *vertebræ*, whilst that of the Ascidia is not, the latter could not be classed as "Vertebrata," therefore all animals possessing a back-bone at all have been classed as "Chordata," from χορδή, a string of a lyre. The term "Vertebrata" is restricted to those animals which possess a segmented back-bone in adult life, though it is an important fact that in all of them when embryos it is gelatinous and unsegmented as it is in the Ascidians. Hence, in this condition, in both groups of animals, it is called the *notochord*, from νῶτον, the back. On the other hand, as the notochord is present in the tail only of the Ascidia, they have been termed "Urochorda," from οὐρά, the tail. It may be mentioned in passing that the curious degenerate Lancelet is also placed in a separate group of the Chordata.

The egg of the Ascidian is a simple cell, and after fertilisation becomes segmented; that is to say, it becomes divided first into two halves, then each of these becomes similarly divided, and so on, until at last when the process is complete we have a little mass or *morula* composed of a great many cells, from which the various organs of the Ascidian will be built up. After various changes our embryo becomes pear-shaped and hollow, having an aperture at the posterior end, the cavity being the primitive alimentary canal. Its dorsal surface now becomes flattened and grooved in a line parallel to the long axis of the embryo, the *medullary groove* being thus formed. The edges of the groove thicken and soon grow up over it, finally coalescing with each other along its whole length, thus forming a tube of cells—the *spinal cord*—enclosing the *medullary canal*. Meanwhile the notochord has been formed near the posterior end of the embryo, between the spinal cord and the primitive alimentary canal—that is, in exactly the same position as the back-bone in a man. It does not, however, extend into the trunk of the animal, but is confined to the tail which is now formed, and which continues for some time to elongate.

The development of the nervous system proceeds by the enlargement at its anterior end of the medullary canal into a cephalic lobe, which may be described as the brain; hence we have a brain and spinal cord as in man. From the fore-part of the brain a single eye and a single auditory organ are developed.

Contemporaneously with these changes a mouth, œsophagus, stomach, and intestine have been formed, while on either side of the body, on a level with the brain, two branchial sacs or gills have been developed. As in a fish, water is taken into the mouth and driven out through the gills.

Below the mouth three papillæ grow out, and from the outer layer of the body a cuticular test is deposited.

The larva is at first confined within the egg-membrane, but soon escapes and swims about, now much resembling a tadpole. But unlike the tadpole, instead of developing into a higher form, it retrogrades, becomes fixed to a stone, loses its tail and the greater part of its nervous system, and when adult is the degraded form we started with—the Sea-squirt. In this stage, the gills open into an *atrial* chamber which has an aperture near the mouth, and it is through this that water is ejected when the animal is irritated. It is interesting to note that there is one Ascidian—*Appendicularia*—which does not retrograde in development but keeps the tadpole form throughout life.

It is on account of the presence of the following structures in both Ascidia and Vertebrata that they are classed together:--

1. There is a notochord which lies between the nervous system and the alimentary canal.
2. The nerve-cord is dorsal and not ventral as in worms, insects, molluscs, &c.
3. Gill-slits are present which perforate the walls of the pharynx.

From this and other evidence it has been conjectured that the ancestral forms of the back-boned animals had a notochord as their sole axial skeleton; a ventral mouth surrounded with suctorial structures; and very numerous gill-slits. It must not, however, be supposed that the Ascidians are direct ancestors of the Vertebrates; on the contrary, they are only degenerate off-shoots from the ancestral stock.

Now, although the Ascidian larva closely resembles the Vertebrates in the most important points, yet in several details it differs, and most obviously in possessing a single median eye instead of two lateral eyes. This eye is developed as an outgrowth from the brain, and in that respect resembles the vertebrate eye, but it is very much simpler in structure, and, strange to say, is placed on the inner surface inside the brain. From this fact Professor Lankester argues that the ancestral form must have been a transparent animal and have had an eye or a pair of eyes inside the brain. To explain the presence of the two lateral eyes in the Vertebrates we could suppose either that the single eye of the Ascidian was shifted to one side, and a second developed on the other; or that the ancestral Chordate had two lateral eyes, one of which the Ascidian larva has lost; or that two lateral eyes have been developed independently of the median which has disappeared. The latter theory is doubtless correct, as the median eye of Hatteria is evidently homologous with the single eye of the Ascidian. Probably the arrangement of the retinal layers according to the invertebrate type is due to the direction of the eye in Hatteria being altered, as it looks away from the brain instead of into its cavity. But a study of its development in various animals will no doubt explain this difficulty.

The discovery, then, of this median eye in Hatteria confirms the theory that the Ascidians are closely connected with the Vertebrates, and adds another detail to the idea previously formed of the ancestor of the Chordata—that it had a single median eye.

In conclusion I would remind all readers of this paper that our knowledge of this and kindred subjects will be materially increased by the investigations of the Marine Biological Association, and would suggest that subscriptions to its funds will speedily result in definite acquisitions to that knowledge. From this and other sources we may hope to glean such information that ere long we shall be able clearly to trace that most interesting of pedigrees, the descent of Man.

ON THE DISCOVERY OF ROCKS OF CAMBRIAN AGE AT DOSTHILL, IN WARWICKSHIRE.

BY W. JEROME HARRISON, F.G.S.

The Geological Survey Map of the Warwickshire Coalfield was executed between 1851 and 1854. It shows Dosthill as a mass of greenstone—bounded on the west by a line of fault which is also the boundary of the coalfield—and on the east breaking through, tilting, and burning the coal seams of the district.

The real structure of the little Dosthill ridge is rather different. When I made my first visit, on May 29th, 1882, I found at least two varieties of igneous rocks penetrating annelidean shales of Cambrian age. There is a line of fault on the east, as well as on the west, by which the Cambrian and igneous rocks are sharply divided from the coal measures.

Dosthill lies twelve miles north-east of Birmingham, and two miles south of Tamworth. It is close to the Midland Railway (Birmingham and Burton branch), lying on the west of the line nearly midway between the stations at Wilnecote and Kingsbury. The extent of the ridge is one mile from north to south, and a quarter of a mile from east to west. The River Tame meanders over a plain of Keuper Marls on the west side of Dosthill, and the little eminence rises almost precipitously from this plain to a height of perhaps 200 feet. On the east side the slope is more gentle, though still rapid. Attacking Dosthill from the west, we find at the foot of the highest and steepest part an exposure of a hard brown grit or quartzite; then comes the mass of the ridge, in which exposures are not good or frequent. Where the rock is exposed we can clearly distinguish (*a*) a dioritic rock of a dull greenish colour, remarkably tough and refractory; (*b*) narrow dykes—similar to those called "dun-dykes" by the Hartshill quarrymen—of a brownish colour, very rotten and decomposed; (*c*) pale-grey shales—precisely similar to certain beds in Merevale Park, &c., on the opposite side of the coalfield—traversed by innumerable worm-borings, which usually run either parallel to the bedding, or at right angles to it. I have found obscure traces of other fossils, but the time at my disposal has not hitherto allowed me to make any thorough search of the beds. All these rocks are very much jointed. The exact similarity of this group of strata, the associated igneous and aqueous rocks being precisely alike in their characters, to the strata between Atherstone and Nuneaton on the east side of the Warwickshire coalfield, which it was my pleasure to aid Professor Lapworth in proving, also in May, 1882, to be of Cambrian age, compels us to assign these Dosthill Shales also to the Upper Cambrian Period.

At the southern end of the Dosthill ridge there is a field-quarry in which an admirable section is shown of a "neck" of igneous rock, rising through the Cambrian shales and spreading out above and over them. The shales show small signs of alteration, and that only in immediate contact with the dyke, where their surfaces look burnt, and discoloured by an irony deposit. A stream-course in this field runs across the ridge and ought to yield a good section, but on the occasions of my visits it has been so overgrown with vegetation as to be impassable.

Another junction of Cambrian shales with trap-rock is found just south of the little cross road—a cul-de-sac—which leads to a house near the highest point of the ridge; and there is another outcrop in the next field west of this.

At the northern end of the Dosthill ridge the gardens of Dosthill Lodge occupy part of the site of an old quarry. The igneous rock here is of the grey decomposed kind, with a central harder vein. It can be traced northwards like a wall for some little distance, looking like a miniature Derbyshire "edge." A little further north still there is a roadside section of coal-measure shales and sandstones, in a line with, and east of Dosthill House.

At the eastern part of the Dosthill ridge the Midland Railway cutting shows a fine and continuous section of sandstones, ironstone, shale, &c., cf Carboniferous age, including the outcrop or "smut" of five coal seams.

All the Carboniferous rocks here have a very high easterly dip, amounting to seventy-five or eighty degrees, where they are seen close to the line of fault which separates them from the Cambrian strata. Thus the latter are sandwiched, as it were, between Coal-measures on the east and Keuper Marls on the west.

When the Dosthill mass was believed to be an intrusion of greenstone into coal-measures, it was reported that the coal was "burnt" at the junction. But old colliers and "viewers" whom I have questioned have described to me the coal seam as being broken and even reduced to powder, but they had none of them noticed any appearance of charring or coking. Doubtless all the effects observed can be explained by the breaking of the strata along the line of fault. The coal seams have here been followed vertically from their outcrop, and at the present time a line of collieries is in full work quite close to the fault, and within a few yards of Cambrian strata. In few places are they brought into such close proximity.

FLORA OF WARWICKSHIRE.—I should like to correct a statement which occurs on page 255 of the last number of "The Midland Naturalist," in which *Agrimonia odorata* is said to be "new to North Warwickshire." This I found at Austrey, near Tamworth, in August, 1885. This is one of very many plants that I have been able to add to the Flora of North Warwickshire during the past twelve months. As the "Flora" is being prepared for publication in the book form, I have not considered it needful to rush into print every time I have found a new plant, or a rare plant in a new station. I invite botanists to be obliging enough to send me notes of any new finds in Warwickshire, and I shall gladly acknowledge them in the proper place when a new edition of the "Flora" appears.—J. E. BAGNALL, 84, Witton Road, Aston, near Birmingham.

THE BOLETI OF THE BIRMINGHAM DISTRICT.

BY W. B. GROVE, B.A.

The discovery this year of three species of Boletus, new to the Birmingham district, suggests a few notes concerning them, to draw attention to their abundance here, in species, if not in individuals. It is well known that several kinds of Boletus are good eating, but it is probable that one which I find to be abundant is usually passed over, because it has not ordinarily the reputation of being edible. For the sake of those not much acquainted with fungi, it may be premised that the genus Boletus is one which contains large fleshy species, with a central stem and a cap or pileus more or less like a common mushroom in shape, but having instead of gills a mass of contiguous vertical tubes, the lower ends of which consequently present a number of roundish openings, called pores.

Taking the "Handbook" as our guide—because none of the species since added to the British Flora have been discovered here—we find in the first place that every member of the section "Viscipelles" is recorded for this district. I found the first, *Boletus luteus*, in Sutton Park in 1881. Mr. J. E. Bagnall, A.L.S., records it for Middleton, and also *B. elegans* for Coleshill Heath and Great Packington. The common yellow ringed Boletus, in all places near Birmingham, is *B. flavus*, which was first described under this name by our own botanist, William Withering. It was previously figured by Bolton as *B. annularius*, and was mistaken by Sowerby for *B. luteus*. There is undoubtedly a very striking likeness between these species; one may often see large numbers of Boletuses growing together, some showing the bright yellow pileus, characteristic of *B. flavus*, and others a browner pileus, reminding one of *B. luteus*, but all evidently the same species in various stages of growth. The reticulation of the yellow apex of the stem of the former, above the ring, by the decurrent pores, is well known to be a specific character, and certainly when compared with the white glandular* apex of a typical *B. luteus* would seem to afford an easy means of distinction. But on examining a large number of specimens it will be found that this reticulation gradually disappears until the apex of the stem becomes merely scabrous, although remaining yellow. Still I have

* The glandular aspect is caused by little groups of the subferruginous spores clinging to the fibres which roughen the stem. These spores have no tinge of yellow, as those of *B. flavus* have.

not, for the last five years, seen in any wood round here specimens which could be safely referred to *B. luteus*. *B. flavus* I have found in Sutton Park, at Hampton, Coleshill Pool, Marston Green, Bradnock's Marsh, Earlswood, Lickey Hills, and Rubery; Withering found it in Edgbaston Park, and Purton in Ragley Woods and on Oversley Hill; Mr. Bagnall recorded it from Middleton at the same time as *B. luteus*. It seems, according to authors, to be much more common in England than on the Continent.

The next species, *B. laricinus*, is recorded by Mr. Bagnall from Middleton, and I have found one specimen at Oscott, which I think belonged to this species. I have seen *B. granulatus* not far from Barnt Green Station. Though reputed edible, it looks too slimy to be tempting. Withering found it in Edgbaston Park. Mr. Bagnall records *B. bovinus* from the neighbourhood of Coleshill, and I have found it at Trickley Coppice and Rubery.

A not uncommon species, according to my experience, is *B. badius*; it occurs in large quantities in Sutton Park, and at Bradnock's Hayes, Middleton, Coleshill Pool, Streetley, Hints, Edgbaston Park, and the Lickey Hills it can be found sometimes in considerable numbers. This is the species referred to as not being currently reputed edible, and it must be confessed that the disagreeable blue-green tint assumed by the pores (and to a less extent by the flesh) on touching them is not at all inviting. This discoloration, however, passes away in a short time. By itself, this fungus is not to be recommended, but its thick and substantial flesh makes it a welcome addition to that mixture of species in which the confirmed fungus-eater usually indulges. Cooked with a quantity of *Ag. rubescens*, such as can nearly always be gathered at the same time and place, it makes a delicious dish. The tubes and stem should be removed (the tubes separate remarkably easily), and the pileus cut into slices as one would cut a loaf of bread, and fried in the rich liquor yielded by the other species and a lump of butter; pepper and salt to taste.

The next species, *B. sanguineus*, owes its detection and its name to Dr. Withering. He found it in Edgbaston Park; Purton found it on Oversley Hill; and it has been discovered, though rarely, in various places on the Continent. Last July I came across a group of specimens in Packington Park exactly agreeing with Withering's description; both the "button state" and the "expanded state" grew together, and thus confirmed the accuracy of their identification, of which he expressed a slight doubt.

The last species of this section, *B. piperatus*, I found once near Berkswell; Mr. Bagnall records it for Middleton. Its pungent taste, which was very decided, rendered its identification easy.

In the next section, "Subtomentosi," every species but one is found here, the exception being the very rare *B. rubinus*. Mr. Bagnall had the good fortune to find the curious *B. parasiticus* in the Middleton district in 1884. He records *B. striæpes* from the same locality, and has kindly informed me that Mrs. Russell found it at Kenilworth. I came upon magnificent specimens of *B. variegatus* in the woods around Coleshill Pool, and of *B. variecolor* on the edge of Packington Park. The peculiar fasciculate scales on the pileus of the former, and the beautifully reticulated stem of the latter, distinguish them easily from their allies.

The two remaining species of this section are rather common; *B. chrysenteron* abounds in Sutton Park, and I have found it more sparingly about Four Oaks, Hints, Water Orton, and Bradnock's Marsh. *B. subtomentosus* is more frequent. I have seen specimens at Sutton Park, Coleshill Pool, Middleton, Berkswell, Packington Park, Bradnock's Marsh, Edgbaston Park, Halesowen, Rubery, and the Lickey Hills. Withering found it also at Edgbaston, and Purton in the Ragley and Oversley Woods. Mr. Bagnall records it from Crackley Wood, Kenilworth. These two species closely resemble each other, especially in the cracked pileus; they are most easily distinguished in the field by the fibrous and crimson-streaked stem of *B. chrysenteron*, and the smoother, but ribbed, yellower stem of *B. subtomentosus*; in the latter, moreover, the stem usually tapers at the base.

In the next section, "Calopodes," again one species is unrecorded for this district. Of the other two, *B. olivaceus* appears, so far as can be judged, to be the species intended by Withering under this name. He gives the locality as "Hedgebanks, Church Lane, Edgbaston," where, I fear, it would be useless to look for it now. What he calls "*B. olivaceus*, var. 2," from Packington Park, is probably *B. pachypus*, the third species of this section; this is also recorded by Mr. Bagnall from Middleton, etc., and by Mrs. Russell from Kenilworth. While not throwing any doubt on the occurrence of this species here, I feel bound to state that all the specimens which I have seen exhibited under this name were, in my opinion, merely irregular forms of *B. edulis*, with which their colours exactly agreed.

The next section, "Edules," contains four species, one of them not recorded for the district. *B. edulis*, the "edible Boletus," is not particularly common, though I have found it in Sutton Park, New Park, Middleton, and Packington Park, and at Hints, Berkswell, Langley, and Coleshill Pool. Withering found it in Edgbaston Park, and at "Barr," Staffordshire; Purton on Oversley Hill; Mr. Bagnall at Baddesley Clinton; and Mr. Southall at Yardley Wood. This species certainly does not deserve the name "edible" more than *B. badius*, which I fancy is often mistaken for it. In fact, I was induced to venture upon eating the latter species by this belief, confirmed by the strong resemblance which the figures named *B. edulis* in Berkeley's "Outlines" (pl. 15, f. 6), and in the first edition of Cooke's "Plain and Easy Account of British Fungi" (pl. 15), bear to *B. badius*—a resemblance so striking as to induce one to believe that they may have been actually drawn from specimens of the latter species, especially as they do not particularly resemble that which they are said to be. The inference is that many a British mycophagist must have eaten *B. badius*, when he believed himself to be indulging safely in *B. edulis*.

To the next species of this section, *B. impolitus*, I have referred, but very doubtfully, a few specimens which I gathered near Bradnock's Marsh in the summer of 1884; these must wait for confirmation. The last of the four, *B. æstivalis*, I have found at Fen End. It is a most striking species, especially from its very thick stem.

The fifth section, "Luridi," also contains four species, all intensely poisonous; one, again, is not on record. The first, with a fine significant name, *B. Satanas*, I have found in Packington Park and at Fen End. The second, *B. luridus*, equally poisonous, is more common. I have seen it at Streetley, Langley, Berkswell, Hampton, in Packington Park, and near to Lappal Tunnel. Mr. Southall gathered it at Yardley Wood; Mr. Bagnall at Shustoke and Middleton; Mrs. Russell at Kenilworth; Withering found it in Edgbaston Park; and Purton at Oversley Hill and near Cold Camfort. The crimson pores and stem, and the olive or lurid-red pileus of this are in themselves sufficient to warn one against it, and its disagreeable aspect is increased by the fact that the bright yellow flesh, when broken, turns to a nauseous green so swiftly that it really requires a little knowledge of gymnastics to be able to catch a glimpse before it changes.

To the third species, *B. erythropus*, I refer some specimens gathered in Sutton Park and at Coleshill Pool, in 1883, which resembled *B. luridus* but differed in their more slender stature and stem everywhere punctato-scabrous and not reticulated. They did not exactly agree with the description of that species, it is true, but I do not know where else to refer them, and they cannot in any case be placed far from *B. luridus*. The fourth species, *B. purpureus*, has not occurred here; I saw some magnificent specimens at Hereford last year.

This concludes the Boleti which are said to have ochraceous spores. In the next section "Dermini," with subferruginous spores, there are three species, one of which is not known from this district. The second, *B. versipellis*, is probably that found at "Barr" by Withering, and in Oversley and Ragley Woods by Purton. They called it *B. aurantiacus*, and Purton's, at least, seem to be identical with what Sowerby figured in his pl. 110 which is now referred to *B. versipellis*. The third species is the common *B. scaber*, which is edible and indeed more pleasant to the taste than the other Boleti I have tried. One can easily distinguish it by its stem, which is strongly attenuated upwards and rough with numerous blackish fibres, the upper ends of which are free. It may here be remarked that the stems of Boleti seem to me oftentimes to offer more definite field characters than the other parts of the fungus.

In the next section "Hyporrhodii," the spores are of a rosy colour. These species are very rare; Fries records only two for the whole of Europe, both of which have been found in England. The first, *B. alutarius*, is not known here; I once thought I had found it, but was assured by a friend on whose judgment I can rely that this was a mistake. Last August, however, I found the other species, *B. felleus*, in Sutton Park, and exhibited a specimen at the opening Conversazione of the British Association Meeting. Dr. M. C. Cooke on seeing it informed me that he had not met with this species for the ten previous years, but that this year it had unexpectedly appeared in several distant places. He himself found specimens afterwards in another part of Sutton Park, on one of the excursions made thither during the Meeting of the Association.

In the last section, "Leucospori," there are only two species, both rare, neither of which has been found in this district. But the single species placed in the next genus, Strobilomyces, which is considered by Fries to be a true Boletus, was found in 1861, at the "Valley," Bromsgrove, by Mr. Wm. Mathews, M.A. This rare and wonderful fungus seems to have its favourite home farther to the west, in the district sacred to the Woolhope Club.

The foregoing certainly does not exhaust our list. I have found at least two other forms not identical with those previously mentioned, but which unfortunately I was not able to refer to any species described in the books at my command. The number of those included in this notice is twenty-six, of which one or two may be considered doubtful.

SCENES ON THE JOHNSTONE RIVER, NORTH QUEENSLAND.

BY CLEMENT L. WRAGGE, F.R.G.S., F. R. MET. SOC.

Having lately returned to Adelaide from my meteorological inspection tour, I can now send a few notes of my travels in Queensland, which I think will be of interest to my many friends at Home. Among other regions I visited the district of the Johnstone River in the vicinity of the sugar plantations—probably the most fertile piece of country in Australia. The Johnstone is navigable for vessels of light tonnage. The signal station for ships stands on a rocky capelet, open to the great Pacific, which forms a natural breakwater between the embouchure of the river and the swell of the ocean, thus forming a beautiful bay. Immediately to northward the neck of land widens, and becomes a luxuriant tropical garden. My visit was in November last. Here I wandered with much satisfaction, now strolling amid little groves of bananas, then wandering listlessly among fine clumps of cocoanut palms—shading in delicate tracery the wooden shanties of the station—and threading my way between long rows of tempting pineapple. Anon I pass shady bowers formed by the broad leaves of the granadilla, and then saunter into the dense native scrub at the back. The air is thick with butterflies, embellished with the most delicate colouring, and myriads more are settled on the bushes, sipping the nectareous juices of the flowers and fruits and the sacchariferous matter exuding from the foliage. My mind would swiftly travel to the other end of the world and draw contrasts between these lavish scenes and the cold fogs and drizzling rains enshrouding the leafless trees of my beloved Churnet Valley, while bleak Ben Nevis came in for his share in the thoughts. New beauties discover themselves at every turn. North and West are the noble hills, part of the Bellenden Ker range, covered with a great mantle of jungle stretching down, in tier upon tier of lustrous leaves, to the edge of the sea; while the contour of the coast-line is nicely broken by the broad flats backed by the green slopes at the mouth of the river. At length I rejoined the steamer and proceeded towards Geraldton. The temperature of the river at the mouth was 81·6°; dry bulb, 81·1°; wet bulb, 74·0°; at 11.15 a.m. I took a great number of observations throughout the trip, but only give a few selected values.

And now we are fairly in the Johnstone River. Can this be Australia? As we steam along, vivid recollections of other parts of this continent, visited by me during former voyages, crowd upon the brain. I picture myself wandering again over the stony deserts and dreary blue-bush plains of South Australia; anon I am tramping once more through the monotonous mallee scrub bordering the River Murray. Again my mind leads me to the endless vistas of cracked salt-pans and stunted mangroves of the plains of Carpentaria. I look up and make yet another contrast—for such contrasts form one of the keenest charms of travel. Behold! the luxuriance of the Johnstone fairly beggars description. The banks are clad with dense masses of tangled jungle—the very hot-bed of Nature. Flowering vines wrestle with lawyer-palms and wild bananas for the supremacy of existence. They mingle in one ravelling thicket of loveliness and health, now one kind predominating and then another. Beautiful evergreen trees shoot up boldly from the depths of the forest, decorated by gigantic festooning creepers of the convolvulus family, whose delicate white flowers against the various shades of green give a most pleasing effect. Then graceful cabbage palms proudly rear aloft the delicate outline of their quivering branches, forming an exquisite picture against the background of hills. Numberless tree-ferns push forth their huge and varied fronds from amid the thick undergrowth, and gracefully expand themselves to the light and life of the river. We soon reached Geraldton, the capital of the Johnstone district, and here the temperature of the river had risen to 83·9°. The place stands on the right bank. The architecture of the low shanties constituting the township, the old gnarled tree-stumps—all charred and black—where the adjacent land had been cleared, and the delicate green of the luxuriant bananas, unite the characteristics of scenes I have beheld around Colombo and Galle, and in the backwoods of Canada, with the bush aspect of a Queensland settlement. Verily such a picture is singularly fascinating. It is so essentially Colonial—so suggestive of the active wild life of the settler, and of a delightful freedom from the conventionalities of civilised life.

Forward again went the launch up this beautiful river of the tropics. On both sides the wealth of vegetation is marvellous, testifying to the powerful influence of a rainfall averaging 0·400 inch daily. In festooning wreaths, delicately wrought by the lavish hand of Nature, the graceful creepers hang over the water. There again is *Convolvulus multivalvis*, with its white flowers so chastely delicate peeping out from among the tangle of ferns and palms; and there is *Entada* *scandens*, the famous "match-box bean," with its giant pods. Densely packed to right and left are still the beautiful cabbage-palms, *Archontophœnix Cunninghami*, formerly known as *Seaforthia elegans*. The trunks of these graceful trees, so characteristic of the Johnstone scenery, are used for making bridges over creeks, while the upper portion of the stem is eaten by the wild native. Lawyer-palms, *Calamus caryotoides*, continue equally abundant.

But anything I may have written already in attempted description of the scenery on the river's banks will convey but a very poor idea of the prodigality of vegetable life in the thick of the Johnstone scrub. In the course of my voyages I have seen many of Nature's beauties, but, to my mind, not even Ceylon equals the Johnstone in the lush of tropical flora. In the deep recesses of the jungle, besides the plants already mentioned, flourish magnificent specimens of the fan palm, towering up here and there, and mingling with the others in extravagant profusion. Even the birds'-nest fern, *Asplenium nidus*, must have a place, and attaches itself to any excrescence high up the trunks of various trees. *Kentia monostachya* and *Areca aliceæ* are other examples of the palms. I also saw *Bowenia spectabilis* of the cycads, *Selaginella leptostachya* of the lycopods, and *Oplismenus compositus*, *Eleusine Indica* and *Centotheca lappacea* of the *Gramineæ*, and obtained specimens. I also came across a member of the *Solanaceæ*, strongly allied to the "Dead Sea apples," which I gathered some years ago near Jericho when travelling in Palestine. I have also seen a similar plant at Botany Bay.

Did space and time allow I could write a volume on my Queensland travels. I took extensive meteorological observations on the coast between Brisbane and the Albert River in the Gulf of Carpentaria, and have obtained samples of many of the mollusca inhabiting these seas; besides making geological and botanical collections, and taking voluminous notes during long journeys inland.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 249.)

WARWICK, St. Mary's. I.—*Thos. de Beauchamp, Earl of Warwick*, 1401. *and Countess Margt. Haines.*

These magnificent effigies, which are 5ft. long, are now mural, and are placed above the entrance to the Beauchamp

Chapel. The Knight wears a bascinet, chain camail, and suit of plate armour with roundels at the elbow-joints and gussets of mail at the armpits and insteps. The skirt of his hawberk, ornamented with a fringe of small bunches of rings, is visible beneath the *jupon*. The edges of the bascinet are ornamented with the well-known "ragged staff," the epaulières, coutes, gauntlets, genouillières, and sollerets are profusely chased. The *jupon*, a short close-fitting cassock with escalloped skirt, is diapered with an elaborate design, and upon it are emblazoned the Beauchamp arms, Gu. a fess bet. six crosses crosslet or. Round the Knight's hips is a transverse belt supporting a sword and dagger, all highly decorated. At his feet is a chained bear.

At the Earl's right side is the Countess, whose hair, gathered in a caul at the top of her head, falls down on each side of her face to be again gathered in a smaller caul on each side. Upon her kirtle, with its long buttoned sleeves, are emblazoned the arms of Ferrers of Groby, to which family she belonged: and upon her mantle the Beauchamp arms. A small lap-dog sits at her feet.

Thomas Beauchamp, 4th Earl of Warwick, had a chequered career. He served Edward III., and was appointed one of the governors of Richard II. When that King assumed the government, Beauchamp retired to Warwick, built the N.E. tower of the castle, and enlarged S. Mary's Church. The Earl was subsequently charged with high treason and condemned to death, the sentence being changed for one of banishment to the Isle of Man. Upon the deposition of Richard by Henry IV., Warwick was recalled and reinstated. Haines gives references to illustrations of this brass in Dugdale, Gough, Vol. II., Pl. 2, and Waller, Pl. 6. The first-named gives a picture of the original tomb, which was destroyed by fire.

II.—*Thos. Oken*, 1573, *and w. Jone. Haines.*

These figures are 23in. high, and are now mural in the N. transept. The husband has close-cropped hair and a pointed beard. He wears a fur-lined civilian's gown with false sleeves, over a long belted doublet. Upon his feet are round-toed shoes.

The wife wears a small circular cap with lappets covering her ears, and a loose over-gown with falling collar and puffed sleeves. It is confined by a sash at the waist, but being open from that point downwards displays an underdress, the neck of which is visible above the falling collar.

Round the lady's neck is a narrow ruff, or it may be the edging of the *partlet*, "a kind of habit-shirt of fine materials with ornamental edging."

The following is the inscription:—

giue
Of your charyte thanks for the Soules of Thomas Oken & Jone | hys wyff on whose Soules Jesus hath m'cy Jesus hath m'cy amen | Remember ye charyte for the pore for ever Ao dni mcccccl xxiii.

The story of Thomas Oken's dream will be found pleasantly told in "Historic Warwickshire," by J. Tom Burgess. Thomas Oken's benevolence appears to have reached "all sorts and conditions of men" in Warwick, Banbury, and Stratford, to the Bailiff and Aldermen of which place he bequeathed money, part for the delivery of a sermon to them, "the rest they themselves to make merry with, and at the end of their mirth, give God Thanks and say the 'Lord's Prayer.'"

III.—*Inscription. Eliz. Chowne.* 1597.

A plate 20in. by 10in., on the floor of the chancel, not mentioned by Haines.

AN EPITAPHE VPON THE DEATH OF M^RES^ ELIZABETH
CHOWNE WHO DIED THE LAST DAY OF AVGVST, 1597.
HERE LIES ELIZABETH, TWICE HAPPIE WIFE,
OF TWO GOOD VIRTVOVS MEN, BLEST FROM ABOVE;
WITH BOTH, SO WITHOVT BOTH, A GODLY LIFE
TILL SEAVENTIE FIVE SHE LIVED, IN PERFECT LOVE.
RESTING A WIDDOW EYGHT, AND TWENTIE YEARES,
JOYEING TO SEE HIR DEAREST ISSVE WED,
BEFORE HIR GOD IN GLORY SHEE APPEARES,
HIR CORPS FEEDE WOORMES, HIR SOWLE BY CHRIST IS FED.
ANNO ÆTATIS SVÆ 75°.

IV.—*Inscription. Cisseley Puckering,* 1636. *Haines.*

This memorial, which is near the last, consists of three brass plates. Upon the first, 17½in. by 10½in., is the following inscription:—

MEMORIÆ SACRVM.
CECILIÆ PVCKERING FILIÆ NATV
SECVNDÆ THOMÆ PVCKERING
MILITIS ET BARONETTI QVÆ
XTO DESPONSATA OBIIT 9° DIE
APRILIS ANNO DNI 1636
ÆTATISQ. SVÆ 13°.

In English :—

Sacred to the memory of Cisseley Puckering second daughter of Thomas Puckering Knight and Baronet; who being wedded to Christ died the 9th of April, A.D. 1636, in the 13th year of her age.

A second plate, about the same size as the last, bears this anagram (compare MERIDEN) :—

Miftres Ciffeley Puckering
I fleep fecure, Chrift's my King.

Death's terrors nought affright mee, nor his fting
I fleep fecure, for Chrift's my fovereigne King.

A third plate, 22in. by 13½in., bears this epitaph :—

Birth, breeding, beauty, grace and carriage fweet
In thee Deare Saint did all togither meet.
The funne ne're faw a comelier face then thine
Nor Heaven received a fpirit more Divine.
Thrice happy Parents fuch a child to breed
Begott agayne of God's immortall feed.
Ceafe forrow then fith Saints and Angels fing
To fee her matcht with an eternall King.

V.—*Inscription. Thomas Rous of Rouslench.* 1645.

Upon a plate 14in. by 8in. :—

MEMORIÆ SACRVM THOME | ROVS FILII NATV QUARTI THOME | BARRONETTI ROVS DE ROVSLENCH IN COMI- | TATV WIGORNIE QVI PRIMIS | ANNIS ÆTATIS SVÆ OBIIT | NONO DIE SEPTEMBRIS ANNO | DNI 1645.

In English :—

Sacred to the memory of Thomas Rous fourth son of Thomas Rous of Rouslench in the county of Worcester Bart., who died in his infancy. A.D. 1645.

WARWICK, S. Nicholas.—*Robt. Willardsey, first vicar,* 1424. *Haines.*

A very graceful figure, 17in. long, now in the vestry. It represents a tonsured priest vested for mass, in amice, chasuble, appareled albe, maniple, and stole (see COLESHILL). The amice, maniple, stole, and apparels of the albe are ornamented with cinquefoils. The folds of the chasuble are excellently represented.

The inscription is upon a plate, 18in. by 4in., and runs:

Hic iacet Robtus Willardsey prim' vicari' isti' | Ecclie qui obiit xvio die mens' marcii anno dni | millo ccccxxiiii. cui' aie ppicietur deus ame.

Translation:

Here lieth Robert Willardsey first vicar of this church who died the 16th of March A.D. 1424. Whose soul God pardon. Amen.

This brass was stolen at the restoration of the church, but was fortunately recognised in a *bric-à-brac* shop in London by the late Rev. W. Staunton, and has been replaced in S. Nicholas' Church.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART II.

PALÆONTOLOGY.

(Continued from page 253.)

The list of fossils from the "*Margaritatus*" and "*Spinatus*" *Zones* and the "*Transition-bed*" of Northamptonshire includes 94 genera and 273 species. This is by no means a complete list, however, because I have a good number of fossils still awaiting identification, and Mr. E. A. Walford, F.G.S., I know, intends to publish a supplementary list from the Transition-bed at no very distant period.

A reference to the list will show that both *reptiles* and *fishes* are poorly represented in Northamptonshire, as indeed they are everywhere in these zones, in the British Isles.

Cephalopods are represented by 6 genera and 28 species at least, but so far as the Ammonites are concerned, the list is somewhat deceptive; for, with the exception of the three belonging to the Amaltheus group, they are all Upper Lias forms, and are only met with at or near the junction with that formation, *i.e.*, in the Transition-bed or upper part of the Rock-bed. *Ammonites margaritatus* has a considerable vertical range in this district, as it has in many others, and hence is of very little use by itself as an indicator of the zone to which it has given a name. *Ammonites Valdani* seems a much more useful form on which to rely for drawing a palæontological boundary between the "*Margaritatus*" *Zone* and the beds below. This latter ammonite is abundant in some of the lower beds, and passes upwards very near to, but just short of the "*Margaritatus*" *Zone*. *Ammonites margaritatus* is most common in bed "F," and is very variable in form; the varieties *A. gibbosus* (*Schl.*), *A spinosus* (*Quenst.*), and *A. subnodosus* (*Y. & B.*), and *A. depressus* (*Quenst.*) being all probably represented. *Ammonites spinatus* is decidedly rare in Northamptonshire, and appears to be met with only near the top of the Rock-bed. *Ammonites acutus* is very abundant in, and characteristic of the Transition-bed, but it is found occasionally just below or just above this zone. It is not uncommon to find forms having decided transitional characters leading to other members of the "falcifer" group, which are common in the Upper Lias. A flattening of the sides, brought about, not by a thinning of the shell, but by a filling out of the inner and outer edges of the whorls, with a consequently more abrupt fall into the umbilicus, and the development of a more distinct ribbing, seem to be changes which take place contemporaneously. It may be of interest to note here that the average specimens found at Tilton, in Leicestershire, are larger than the average ones found in Northamptonshire, and that the changes noted above may be more often observed in these larger ones.

I have already called attention to the abundance of *Gasteropods* in the Transition-bed, and the table of fossils well shows it; but the upper bed of the "*Margaritatus*" *Zone*—bed "F"—sometimes contains a large number of specimens, although the number of distinct species is small. Some recent work has revealed to me the fact that they are much more abundant in this bed than I had before suspected. The list of fossils does not show a very marked difference between the "*Margaritatus*" and "*Spinatus*" *Zones* as regards the distribution of the Lamellibranchiata, yet the former zone does contain a very much greater number of these than the latter. Speaking generally, *Pectens* are the only Lamellibranchs which are very common in the "*Spinatus*" *Zone*. Hinnites and Limas are practically not found below this zone, but they are not very common in it.

Pecten liasinus (*Nyst.*) occurs pretty evenly distributed in all the three zones, and the same remark applies to *Pecten æquivalvis*, though the variety *Pecten dentatus* (*Sow.*) seems particularly characteristic of the Rock-bed "B."

One thing which can scarcely fail to attract the attention of anyone studying beds of the "*Margaritatus*" and "*Spinatus*" *Zones* is the large number of *Cardinias* in certain restricted areas. *Cardinia antiqua* is fairly abundant in the lower beds in a good number of places, but more so at Milton than elsewhere. *Cardinia lævis* in bed "F," and *Cardinia concinna* in bed "B," are abundant only at Watford, and *Cardinia crassissima* only at Daventry; indeed, I have not found this latter form elsewhere in the county.*

The *Myas*, which are exceedingly abundant in beds "F" and "H," are scarcely ever met with in the "*Spinatus*" *Zone*. *Pleuromya costata*, chiefly in "F," and *Pholadomya ambigua*, chiefly in "H," are the commonest forms.

Passing on to the *Brachiopods*, we notice that although rather numerous in species, and exceedingly so in numbers, there is only a record of two from the "*Margaritatus*" *Zone*. In Northamptonshire I have never myself found a single brachiopod in beds that I knew to belong to the "*Margaritatus*" *Zone*, hence the suggestion I made in a previous part of using the brachiopods as indicators of the "*Spinatus*" *Zone*. There is a section near to Daventry which illustrates this rather remarkable phenomenon. A single bed of stone 3ft. or 4ft. thick yields in the lower part *Gasteropods* and large numbers of *Cardinias*, *Pectens*, *Astarte*, *Cardita*, &c., characteristic of the "*Margaritatus*" *Zone*, but no brachiopods; the upper portion contains thousands of *Rhynchonella tetrahedra*, but not a single specimen of the fossils enumerated above, with the exception of the *Pectens*.

Serpulæ, it will have been noticed, are well represented in the Transition-bed. The *ossicles of Pentacrinites* are sufficiently abundant to constitute thick layers in the Rock-bed at various places.

Corals are decidedly rare; nearly all of those quoted in the list came from the extreme south-western part of the county. *Thecocyathus tuberculatus* has, however, a fairly wide range.

It is interesting to notice that a number of the fossils found in the Rock-bed and Transition-bed of Northamptonshire are met with much lower down in the Lias in other localities, and here, too, we should in all probability find them if we had better opportunities for examination, whereas they are absent in intermediate zones. I might give as illustrations. *Trochus Thetis*, *T. Gaudryanus*, *Pecten textorius*, *Spiriferina Walcottii*, *S. rostrata*, *Terebratula punctata*, *&c.* The migration and return of these may perhaps be used to throw more light on the physical conditions existing during the periods of their exile and return.

(To be continued.)

* The section in which this fossil occurs was only exposed recently, hence a description of it does not occur in Part I.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Exposition of Part III., Chapter 3.

BY W. B. GROVE, B.A.

This chapter deals with the extension of the theory elaborated in the two previous chapters, to the Phanerogams, but it is so complicated and difficult to understand without diagrams that it will be advisable merely to state the conclusions arrived at, without attempting to show the reasons on which they are founded.

Mr. Spencer first shows that by observing the various forms of leaves of a Bramble stem, from the simplest to the most compound, we may have suggested to us the idea that the mid-rib of a leaf can assume the function of an axis; a phyllome becomes a caulome. The same thing is illustrated by Eucalyptus, Acacia, and Ruscus.

The chief problem to be solved is to show how the frond of an Acrogen can be transformed into a true caulome. After illustrating the change of leaf into stem by examples taken from the Euphorbiaceæ and Cactaceæ, it is pointed out that the first beginning of the process lies in that repeated proliferation of the frond of which examples may be found in the Jungermanniæ. By this means, a frond which was at first procumbent on the ground can take a step, literally, into a higher life. But before this process can be carried to any great extent, it will be necessary that the frond should be strengthened. This can take place in two ways, and, apparently, in two ways only:—(1) by an infolding of the margins of the frond, on the principle of a hollow iron column; this necessarily gives rise to the mode of growth called Endogenous; (2) by a thickening of the mid-rib; this produces that type of structure which is called Exogenous.

From this it follows that the unit of composition of a Flowering Plant is that portion of a stem which answers to the original frond; *i.e.*, an internode with its superjacent leaf. The proliferation of this gives rise to the internode above with its leaf. But occasionally a frond can give off a double proliferation. In this lies the origin of an axillary bud, when present. The axillary bud, therefore, is not essential to the leaf, contrary to the doctrine of those German theorists who would stifle all morphology within the iron folds of their artificial types.

A shoot of a flowering plant is thus an aggregate of the 3rd order, and the plants compounded of shoots in various degrees of complexity are aggregates of the 4th and higher orders.

If this theory is correct it must give an explanation of the remarkable coincidence of monocotyledonous seeds with endogenous growth, and of dicotyledonous seeds with exogenous growth. This it does with great facility; in the first case, where the strengthening of the frond is obtained by the infolding of the edges, it is shown that the second frond, which is necessarily enclosed within the first, must lag behind; in the second case, where the strengthening is achieved by the thickening of the mid-rib, the second frond can and may advantageously become equal to the first, and thus produce a dicotyledonous embryo.

MEETING OF THE BRITISH ASSOCIATION IN BIRMINGHAM.

BY A SECRETARY OF SECTION C.

The fifty-sixth Annual Meeting of the British Association commenced in Birmingham on Wednesday, September 1st. The Association was no stranger to the town, having met there previously in 1839, 1845, and 1865; in fact, Birmingham is the first town which has received a fourth visit from the the congress of scientists. The Meeting of 1865, under the presidency of Mr. John Phillips, was a remarkable one, but every effort had been put forth to surpass it on the present occasion, and the improved circumstances of the "Metropolis of the Midlands" enabled this to be done with complete success.

The proceedings commenced with the delivery of the annual address by the new President—Sir William Dawson, a distinguished Canadian geologist—in the Town Hall, on Wednesday evening. After glancing briefly at the advances in Science made during the twenty-one years which had elapsed since the Association met in Birmingham, he took for his main topic the history of the Atlantic, "That mighty ocean which unites, not separates, the people of two continents."

On Thursday morning the eight Sections into which the Association is divided began their work, sitting daily from eleven to three to listen to the addresses of their Presidents, and to hear the numerous papers—altogether about 400 in number—which had been contributed to the meeting. To give even an abstract of all these papers would require several numbers of this magazine, and we can only refer our readers to the daily papers published during the course of the Meeting, and to the annual volume which will contain the titles of all, and abstracts of most of them. In Section C (Geology) Prof. Lapworth and Mr. W. J. Harrison gave accounts of their recent discoveries in the geology of Warwickshire, and Mr. H. Johnson gave a valuable description of part of the South Staffordshire Coalfield. In Section F (Economic Science) Dr. Crosskey eloquently described the great work which is being done in the Birmingham Board Schools in the teaching of Science; in fact, each Section teemed with papers of local as well as of general interest, and we hope to print several of them in full in the "Midland Naturalist."

A new feature in the meeting was the institution of "Afternoon Walks" to places of scientific interest in the immediate neighbourhood, led by local scientists such as C. J. Woodward, J. W. Oliver, J. E. Bagnall, C. E. Beale, W. J. Harrison, and others.

Mr. G. B. Davis (Clerk) escorted large numbers over the Board Schools, and local manufacturers freely threw open their works to members of the British Association.

There were also half-a-dozen Garden Parties, to each of which from 200 to 300 guests were invited. These were given by various residents in the suburbs of Birmingham, and although the weather was somewhat uncertain, they proved very enjoyable.

Saturday afternoon (September 4th) and the whole of Thursday (the 9th) were devoted to excursions, which ranged over the Midlands, from Chatsworth on the east to Shrewsbury on the west, including Stratford, Warwick, Coventry, Enville, Lichfield, and including altogether seventeen places of interest. Everywhere the parties were cordially received, liberally entertained, and excellent arrangements were made that everything worth seeing should be seen under the most favourable auspices. The grand thunderstorm of Saturday evening met the returning tourists on that day, but the sight was so majestic and instructive that it more than compensated for the accompanying inconvenience.

The Exhibition of Local Industries in Bingley Hall proved a very great success, towards which Councillor Lawley Parker and Mr. G. H. Morley worked their hardest. The building is magnificently illuminated by the (Gülcher) electric light, and the rows of busy workers engaged in diamond cutting, watch making, cigar making, &c., with the sound of music and machinery, make a brilliant and interesting sight. The building has been crowded daily since its opening. The soirée given on Thursday evening, September 2nd, enabled the members of the British Association to see the Exhibition at its best. Among its many points of interest we must not omit to mention the Natural History Section, the perfection of which was largely owing to the efforts of Mr. R. W. Chase and Professor Hillhouse.

A second soirée—given by the Mayor, Thomas Martineau, Esq., in the Council House and Art Gallery on Tuesday evening, September 7th—enabled the visitors to see David Cox's pictures illuminated by an ingenious form of electric light, devised by Messrs. Hookham and Chamberlain. The light is partially screened from the eyes of the observers, but falls directly upon the pictures.

Evening Lectures in the Town Hall were delivered by Professors Rücker, on "Soap Bubbles;" Rutherford, "The Sense of Hearing;" and Chandler-Roberts, "Colours of Metals and Alloys." The last-named was delivered to an appreciative audience of working men, and was a model of what a popular science lecture should be.

That union of scientific jokers, "Ye Red Lion Clubbe," held its annual dinner at the Liberal Club on Tuesday evening, September 7th, when there was much roaring and wagging of tails on the part of the "noble beasts" and their attendant "jackals." Burlesque addresses were delivered, and ——but we draw the veil, for dire is the vengeance vowed by the "king of beasts" against those who "tell tales" of his revelries.

When the members met to hear the result of the meeting in the Town Hall on Wednesday, September 8th, the smiling faces of the officials betokened general contentment. It was announced that 2,470 tickets had been disposed of, and that the Council had been able to allot grants amounting to £1,300 in aid of scientific research. Sir Henry Roscoe was elected president of the Manchester meeting, which takes place in 1887, and it was resolved to "go to Bath" in 1888. An invitation from the Australian Colonies to hold a supplementary meeting at Sydney in January, 1888, was also accepted.

The work of the meeting proper was fitly ended by a performance of the "Elijah," in the Town Hall, on Wednesday night.

Among the excursions on the final day (Thursday) was one "long excursion," in which Professor Lapworth led numerous "knights of the hammer" to the Longmynd and North Wales. This excursion was to extend over six days; we trust, however, that the "scenery" will not be seriously damaged.

Not to lengthen our report, we may say in conclusion that the officials of the Association—and their great experience makes them the best judges—pronounced the meeting a "great success." The fine group of public buildings in the very centre of the town—the Council House, Town Hall, Mason College, Midland Institute, &c.—enabled all the sections to be well housed, and in close proximity to one another. Our colonial guests—and they were many—appeared highly delighted, and every one joined in the wish that the British Association would come again to Birmingham, and that with the least possible interval.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY. — BIOLOGICAL SECTION, September 14th. Mr. W. R. Hughes, F.L.S., in the chair. The following were exhibited:—By Mr. C. Pumphrey, *Polygonum acuminatum*, in fine flower, and *Acanthus mollis*, a South European plant; Mr. Thomas Clarke, the seed vessel of a gourd, which is filled with Valparaiso cayenne pepper, as used on board a Chilian war vessel now lying in the Tyne; F. Clarke, a nest of the weaver bird; Mr. A. Browett, the fruit of what was thought to be the rare *Pyrus domestica*, from the garden of Mr. Jasper Moore, M.P., near Shrewsbury; Mr. W. R. Hughes, *Acorus calamus*, the sweet flag, in fruit, from Hewell Grange; Mr. T. Bolton, the jumping bean of Mexico, being the fruit of one of the Euphorbiaceæ, infested with the larva of *Carpocapsa saltitans*, from the Southern States of America; Mr. W. H. Wilkinson, the ripe fruit of *Pyrus Japonica*; Mr. W. B. Grove, B.A., *Ag. obscurus* (new to the district), *Ag. sublateritius*, *Ag. maculatus*, *Ag. testaceus*, and *Peziza cochleata*, from the Lickey Hills; and for Mrs. Taunton, a flower of *Stapelia*. An interesting discussion arose out of each of these exhibits, in which the Chairman, Messrs. W. B. Grove, C. Pumphrey, A. Browett, J. E. Bagnall, and others joined.—GENERAL MEETING, September 21st. Mr. W. B. Grove, B.A., in the chair. Mr. W. R. Hughes, F.L.S., exhibited *Atropa Belladonna*, deadly nightshade, also *Solanum Dulcamara*, woody nightshade, both in fruit, showing the contrast of the two plants. Mr. W. B. Grove exhibited the following fungi:—*Ag. hydrophilus*, from Sutton; *Lentinus lepideus*, from Staniforth Street, Birmingham; *Cylindrium flavo-virens*, from Edgbaston Park; (for Mr. Wm. Matthews, M.A.), two magnificent specimens of the "Parasol Mushroom," *Ag. procerus*, from West Malvern, one of them 12in. high; (for Mr. J. Hamson), *Hygrophorus calyptræformis*, from Bedford (a rare species); and (for Mr. H. Hawkes)

Ræstelia lacerata, on fruit of hawthorn. Mr. T. Bolton exhibited *Palmodictyon viride*, from Yardley Wood; also a caterpillar, sent by Mr. Edwin Smith, from Bantry Bay, said to be poisonous to cattle. Mr. W. H. Wilkinson exhibited a collection of plants from the Wren's Nest, Dudley, including *Carduus eriophorus*, the woolly thistle; *Viburnum opulus*, *Gentiana amarella*, *Polygala vulgaris*; also *Peltigera canina*, *Lecanora varia* (in fruit), and other lichens.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION. -- August 9th. Mr. H. Hawkes exhibited the following fungi:—*Trichobasis fabæ*, *Xenodochus carbonarius*, *Sphærotheca castagnei* and *Erysiphe communis*; Mr. C. F. Beale, two roses, each with a bud growing from the centre of the flower; Mr. A. T. Evans, a pebble from the Moseley Drift, with fossil spirifer; Mr. J. Harrison, jun., specimens of quartz crystals, smoky quartz, chalcedony, jasper, etc. The exhibition of microscopical slides was continued, Mr. Hawkes showing a series of preparations of micro-fungi, notably one containing fourteen species on a slide, from simple *Uredo* spores to the complex Burnet brand; Mr. J. W. Neville, a series of preparations of whole insects without pressure; Mr. J. Moore, dissections of insects in balsam; Mr. Delicate, vegetable preparations in Deane's gelatine. A discussion on the advantages of certain media closed the meeting. August 16th.—Mr. H. Hawkes showed a collection of fungi from Symond's Yat, including *Uredo hypericorum* on *Hypericum perforatum*. Mr. W. Dunn then read a paper on "Low Life." The writer spoke of the development of low forms of life in infusions of oatmeal, fish, and tainted flesh, made with distilled water, spring water, and tap water; the latter gave the most speedy results. The infusion of oatmeal showed life in four days; that of fish the same. If the oatmeal was boiled a filamentous alga was the result, which grew to the end of six days and then gave place to animalcula. The manner in which water became sweet and clear after passing through stages of putridity was spoken of. A description of the life history of Amœbæ, Stylonychia, and Actinophrys brought the subject to a close.—August 23rd. Mr. C. P. Neville exhibited specimens of flying fish, and a small collection of marine shells, including specimens of *Pandora rostrata*; Mr. H. Hawkes, two fungi, *Peziza umbrorum* and *Cantharellus cibarius*; Mr. J. Collins, *Saponaria officinalis*; Mr. J. Madison, a two-banded variety of *Limnæa stagnalis*, several varieties of *Bulimus acutus*, including var. *nigrescens* from Portland, and var. *elongata* from Weymouth, and *Cyclostoma elegans* var. *fasciata* from Tintern and Portland; also a series of models of slugs, including seven varieties of *Arion ater*. Under the microscope Mr. J. W. Neville showed *Hispa atra*, a spiny beetle from Turkey; Mr. H. Hawkes, ova and young of *Balanus balanoides*, and cirrhi of adult; Mr. J. A. Grew, circulation in *Closterium lunula*.—August 30th. Mr. Hopkins showed larva of elephant hawk moth, *Chærocampa elpenor*. Mr. Holden then read a paper on "The Pennine Chain, its Scenery and Geological Structure." The surface of England though generally level or undulating has two large mountain systems—the Cumberland group and the Pennine Chain. The latter is of considerable extent, reaching from the Cheviot Hills to the Peak of Derbyshire, or about 170 miles, the width being about forty miles, but varying considerably. Several of its summits reach an elevation of 2,000 feet or more. The chain forms the water parting of the northern drainage, and separates the dialects of Yorkshire and

Lancashire. The most characteristic rock of this formation is a quartzose conglomerate, and besides containing five important coal fields, it also produces iron, lead, zinc, copper, and salt. The writer described the birth, growth, and decay of the chain, its scenery, the erratic boulders found on its slopes, and some of the superstitions connected with their distribution. An exhibition of fossils and rock specimens illustrated the paper.—September 6th. Mr. C. F. Beale exhibited a specimen of *Chonetes lata* from the Upper Ludlow, and *Anthapalæmon grossartii* in Gubbin ironstone; Mr. Bradbury, a series of photographs of the Rocky Mountain scenery. Under the microscope, Mr. H. Insley showed Atlantic ooze from 1,180 fathoms, and Orbiculina from Bermuda.—September 13th. Mr. H. Hawkes showed *Chlora perfoliata* and other plants, from Ross, also a number of fungi, including *Cladosporium depressum* and *Rœstelia lacerata*; Mr. C. P. Neville, an abnormal growth of fuchsia, a leaf growing out of each side of the tube of the corolla; Mr. C. F. Beale, a leaf of fossil fern, *Pecopteris hirsuta*, from the coal measures, Illinois. Under the microscope, Mr. Hawkes showed a section of *Rœstelia lacerata*.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, September 15th. Attendance, eight (two ladies). The following objects were exhibited, viz.: By Dr. Cooper, dried plants from North Wales, including *Spiræa salicifolia*, apparently wild. By Rev. T. A. Preston, a set of beautiful glass models, by Blaschka, of Dresden, of an obelia, showing the natural size of the polypidom, the same greatly magnified with the polyps in the cells, and the free medusæ in two stages; also models of several genera of sea anemones, and a few of Cole's microscopic slides. It was stated that the glass models could only now be got through Mr. Damon, of Plymouth, that the manufactory produces models of nearly a thousand species, but that the demand so much exceeds the supply that orders are rarely executed within twelve months, and small orders are scarcely attended to. By Mr. E. F. Cooper, dried plants for distribution from Saltby, in Leicestershire, including *Helianthemum vulgare*, *Asperula cynanchica*, and *Calamintha acinos*. By the Chairman, a metacarpal bone of *Bos longifrons*, the smallest of the old races of cattle, taken from the floor of the butcher's shop in the ancient Roman town of Uriconium, in Shropshire. The Chairman read a short paper on "Rats, and the occurrence of the Black Rat in Leicestershire"; exhibiting a specimen of the black rat recently captured at a farm about a mile from Leicester. The Chairman suggested that it would be useful and interesting work for the members of the section to practice the art of setting up life-groups of invertebrate animals, showing the history and habits of the species. These being small and easily preserved, groups could be set up pictorially without the apparatus of a special workshop, and such groups would be novel and extremely useful. He also stated that at the recent meeting of the British Association a committee was appointed to report on the Provincial Museums of the United Kingdom, and that he had undertaken the secretaryship of this committee, and he asked the members for information as to the existence of museums in various parts of the country, not established under the Public Libraries Act; of those under the Act he had a list already. The names of about a dozen such museums were at once suggested by the members present.

A YEAR WITH THE BIRDS.*

A very charming book bearing this title has recently been written by an Oxford Don, who is also a true lover of birds. It belongs to a class of books of which we have far too few—books in which interesting observations on natural history are preserved in a form to attract general attention. Our best book of the kind is White's "Selborne," and we do not think we are awarding too much praise to "A Year with the Birds" when we say it is a book of the same class. It is not necessary for its full enjoyment that the reader should be a scientific ornithologist. On the contrary, we should rather say it is a book written for the intelligent general reader, and more especially for those who, residing in the country, would gladly have their interest awakened in living things generally. It is strange that so few people care to know anything of the birds, insects, and flowers by which they are surrounded; this is probably due to defective education rather than to any other cause.

Chapters I. and II. are devoted to the birds the writer has met with at Oxford. "For several years past," he says, "I have contrived, even on the busiest or the rainiest Oxford mornings, to steal out for twenty minutes or half an hour soon after breakfast, and in the Broad Walk, the Botanic Garden, or the Parks, to let my senses exercise themselves on things outside me. . . . . In the peaceful study of birds I have found an occupation which exactly falls in with the habit I had formed—for it is in the early morning that birds are most active and least disturbed by human beings; an occupation, too, which can be carried on at all times of the day in Oxford with much greater success than I could possibly have imagined when I began it. Even for one who has not often time or strength to take long rambles in the country round us, it is astonishing how much of the beauty, the habits, and the songs of birds may be learnt within the city itself, or in its immediate precincts." The same may be said of many other spots in the Midland Counties, especially in all such where "the three chief requisites of the life of most birds" are to be found co-existent—"food, water, and some kind of cover."

As it is, perhaps, too much to expect that many adults who have reached or passed the meridian of life will be induced

* "A Year with the Birds." By an Oxford Tutor. Oxford: B. H. Blackwell; London: Simpkin, Marshall, and Co.

to follow our author's example, our chief hope of recruits must be in the children and young people. And here we cordially agree with the Oxford Tutor when he says, "I hold it to be an unquestioned fact that the direction of children's attention to natural objects is one of the most valuable processes in education. When these children, or at least the boys among them, go away to their respective public schools, they will find themselves in the grip of a system of compulsory game-playing which will effectually prevent any attempt at patient observation. There is, doubtless, something to be said for this system, though in my opinion there is much more to be said against it; but the fact is beyond question that it is doing a great deal to undermine and destroy some of the Englishman's most valuable habits and characteristics, and among others his acuteness of observation, in which, in his natural state, he excels all other nationalities. It is all the more necessary that we should teach our children, *before* they leave home, some of the simplest and most obvious lessons of natural history."

The book then proceeds to deal with Oxford birds in such a way that any reader, young or old, is enabled to recognise some of the most interesting species to be met with in the precincts of the city, and of course in other places too. The year is divided broadly into two seasons, winter—including the whole period from October to March; and summer—including all the warm season, from the commencement of Term time in April up to the heart of the Long Vacation. The familiar English names of the birds are invariably used, though for accuracy's sake a list of their scientific names is given in an appendix.

As specimens of the author's style and treatment of the subject we give the following extracts:—

"When we return to Oxford after our Long Vacation the only summer migrants that have not departed southwards are a few Swallows, to be seen along the banks of the river, and two or three lazy Martins that may cling for two or three weeks longer to their favourite nooks about the buildings of Merton or Magdalen. Last year (1884) none of these stayed to see November, so far as I could ascertain: but they were arrested on the south coast by a spell of real warm weather, where the genial sun was deluding the Robins and Sparrows into fancying the winter already past. In some years they may be seen on sunny days, even up to the end of the first week of November, hawking for flies about the meadow-front of Merton—probably the warmest spot in Oxford. White, of Selborne, saw one as late as the 20th of November, on a very sunny warm morning, in one of the quadrangles of Christchurch.

"It is at first rather sad to find silence reigning in the thickets and reed-beds that were alive with songsters during the Summer Term. The familiar pollards and thorn bushes, where the Willow Warblers and Whitethroats were every morning to be seen or heard, are like so many desolate college rooms in the heart of the Long Vacation. Deserted nests, black and mouldy, come to light as the leaves drop from the trees—nurseries whose children have gone forth to try their fortunes in distant countries. But we soon discover that things are not so bad as they seem. The silence is not quite unbroken; winter visitors arrive, and the novelty of their voices is cheering, even if they do not break into song; some kinds are here in greater numbers than in the hot weather, and others show themselves more boldly, emerging from leafy recesses in search of food and sunshine." * * *

"I mentioned Parsons' Pleasure just now; and we may take it very well as a starting-point, offering, as it does, in a space of less than a hundred yards square, every kind of supply that a bird can possibly want; water, sedge, reeds, meadows, gravel, railings, hedges, and trees and bushes of many kinds, forming abundant cover. In this cover, as you walk along the footpath towards the weir, you will very likely see a pair of Bullfinches. They were here the greater part of last winter, and are occasionally seen even in college and private gardens; but very rarely in the breeding season or the summer, when they are away in the densest woods, where their beautiful nest and eggs are not too often found. Should they be at their usual work of devouring buds, it is well worth while to stop and watch the process; at Parsons' Pleasure they can do no serious harm, and the Bullfinch's bill is not an instrument to be lightly passed over. It places him apart from all other common English birds, and brings him into the same sub-family as the Crossbill and the Pine-Grosbeak. It is short, wide, round, and parrot-like in having the upper mandible curved downwards over the lower one, and altogether admirably suited for snipping off and retaining those fat young juicy buds from which, as some believe, the Bullfinch has come by his name.*

"Parsons' Pleasure, *i.e.*, the well-concealed bathing place which goes by this name, stands at the narrow apex of a large island, which is formed by the River Cherwell—itself here running in two channels, which enclose the walk known as Mesopotamia—and the slow and often shallow stream by which Holywell Mill is worked. The bird-lover will never cross the rustic bridge which brings him into the island over this latter stream without casting a rapid glance to right and left. Here in the summer we used to listen to the Nightingale, or watch the Redstarts and Flycatchers in the willows, or feast our eyes with the splendid deep and glossy black-blue of the Swallow's back as he darted up and down beneath the bridge, in doubtful weather. And here, of a winter morning, you may see a pair of Moorfowl paddling out of the large patch of rushes that lies opposite the bathing-place on the side of the Parks; here they breed in the summer, with only the little Reed-warblers as companions. And here there is always in winter at least a chance of seeing a Kingfisher. Why these beautiful birds are comparatively seldom to be seen in or about Oxford from March to July is a question not very easy to answer. The keeper of the bathing-place tells me that they go up to breed in ditches which run down to the Cherwell from the direction of Marston and Elsfield; and this is perhaps borne out by the discovery of a nest by a friend of mine, then incumbent of Woodeaton, in a deserted quarry between that village and Elsfield, fully a mile from the river. One would

* The name is said to be a corruption of *bud-finch*. But Professor Skeat (Etym. Dict., s. v. *Bull*) compares it with *bull-dog*, the prefix in each case suggesting the stout build of the animal.

suppose, however, that the birds would be about the river, if only to supply their voracious young with food, unless we are to conclude that they feed them principally with slugs and such small fry. Here is a point which needs investigation." * * * *

"The island which I have mentioned is joined to Mesopotamia by another bridge just below the weir; and here is a second post of observation, with one feature that is absent at the upper bridge. There all is silent, unless a breeze is stirring the trees; here the water prattles gently as it slides down the green slope of the weir into the deep pool below. This motion of the water makes the weir and this part of the Cherwell a favourite spot of a very beautiful little bird which haunts it throughout the October Term. All the spring and early summer the Grey Wagtail was among the noisy becks and burns of the north, bringing up his young under some spray-splashed stone, or the moist arch of a bridge. In July he comes southwards, and from that time till December or January is constantly to be seen along Cherwell and Isis. He is content with sluggish water, if he can find none that is rapid; but the sound of the falling water is as surely grateful to his ear as the tiny crustaceans he finds in it are to his palate. For some time last autumn I saw him nearly every day, either on the stonework of the weir or walking into its gentle water-slope, or running lightly over the islands of dead leaves in other parts of the Cherwell; sometimes one pair would be playing among the barges on the Isis, and another at Clasper's boat-house seemed quite unconcerned at the crowd of men and boats. * * * *

"The Grey Wagtail is misnamed both in English and Latin; as we might infer from the fact that in the one case it is named from the colour of its back and in the other from that of its belly. It should be surely called the Long-tailed Wagtail, for its tail is nearly an inch longer that that of any other species; or the Brook-Wagtail, because it so rarely leaves the bed of the stream it haunts. All other Wagtails may be seen in meadows, ploughed fields, and uplands; but though I have repeatedly seen this one within the last year in England, Wales, Ireland, and Switzerland, I never but once saw it away from the water, and then it was for the moment upon a high road in Dorsetshire, and within a few yards of a brook and pool. Those who wish to identify it must remember its long tail and its love of water, and must also look out for the beautiful sulphur yellow of its under parts; in the spring both male and female have a black chin and throat, like our common Pied Wagtail."

Chapter III. of "A Year with the Birds" carries the reader away to the Alps, and a delightful jaunt it is; the only fault we can find with it is that it is much too short. The next two chapters relate to birds as seen in a Midland village, and Chapter VI. to "The Birds of Virgil.' In departing from our usual custom by presenting long extracts from this book, our object has been to excite our readers to buy a copy for their own bookshelves, and when they have done so we feel quite sure of their gratitude. The book is beautifully printed, and bound with much taste. It is dedicated "Patri meo qui cum aucupis nomine avium amorem filio tradidit." Our readers will readily infer the author's name.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

Exposition of Part IV., Chapters V. and VI.

"The Morphological Composition of Animals."

[Abstract.]

BY W. R. HUGHES, F.L.S.

In the opening sentence of the first of these two remarkable chapters Mr. Herbert Spencer directs attention to a previous section of the work (§ 180), and points out that "what was said respecting the ultimate structure of organisms holds more manifestly of animals than of plants." It will, therefore, be useful to quote this section almost in its entirety.

He says, in discussing the "morphological unit":—"Supposing that clay were the only material available for building, the proposition that all houses are built of bricks, would bear about the same relation to the truth, as does the proposition that all organisms are composed of cells. This generalization respecting houses would be open to two criticisms: First, that certain houses of a primitive kind are formed, not out of bricks, but out of unmoulded clay; and second, that though other houses consist mainly of bricks, yet their chimney-pots, drain-pipes, and ridge-tiles do not result from combination or metamorphosis of bricks, but are made directly out of the original clay. And of like natures are the criticisms which must be passed on the generalization, that cells are the morphological units of organisms. To continue the simile, the truth turns out to be, that the primitive clay or protoplasm out of which organisms are built, may be moulded either directly, or with various degrees of indirectness, into organic structures. The physiological units, which we are obliged to assume as the components of this protoplasm, must, as we have seen, be the possessors of those complex polarities which result in the structural arrangements of the organism. The assumption of such structural arrangements may go on, and, in many cases, does go on, by the shortest route; without the passage through what we call metamorphoses. But where such structural arrangements are reached by a circuitous route, the first stage is the formation of these small aggregates, which, under the name of cells, are currently regarded as morphological units."

Mr. Herbert Spencer then takes a comprehensive morphological survey of all the classes of the animal kingdom from the *Protozoa* up to the *Vertebrata.*

In the *Rhizopoda*, the lowest division of the *Protozoa*, "are presented, under various modifications, these minute portions of living organic matter so little differentiated, if not positively undifferentiated, that animal individuality can scarcely be claimed for them." The well-known *Amœba* is a type of this living matter or protoplasm in its simplest form. It is the "clay" from whence the "bricks" are to be evolved. Several examples follow, showing slight modifications. In *Difflugia* the pseudopodia are limited to one part only. In the *Foraminifera*, of which *Gromia* is an illustration, the sarcode is covered by a delicate calcareous shell, through the minute holes of which the pseudopodia protrude. The *Infusoria* are more highly developed, and "in them we find along with greater definiteness a considerable heterogeneity." The aggregate is an aggregate of the first order, but in these and in similar organisms "the compound individuality is scarcely enough marked to subordinate the primitive individualities."

In a higher division, the *Cœlenterata*, the typical form of which is the *Hydra*, "having specialized parts performing mutually-subservient functions; and thus exhibiting a total life distinct from the lives of the units." The *Hydra*, therefore, illustrates the aggregate of the second order and the "massing of secondary aggregates into tertiary aggregates is variously carried on among the *Hydrozoa*, the *Actinozoa*, and the *Molluscoida*." Mr. Herbert Spencer, however, directs attention to the fact that in these divisions "the component individualities are very little subordinated to the individuality of the mass they form—there is only physical unity and not physiological unity." The united animals in nearly all the cases illustrated may fitly be compared to societies, the members of which co-operate to gain certain ends. It is pointed out that in some of the oceanic *Hydrozoa*—the Rhizostomes for instance—the integration is carried so far, "that the individualities of the polypes are almost lost in that of the aggregate they form."

Before considering the next higher division — the *Annulosa*—several beautiful illustrations are given wherein "successive individuals arising by continuous development are so budded-off as to form a linear series," and it is remarked that "survival of the fittest must tend continually to establish types in which the connected individuals are more unlike one another, at the same time that their several individualities are most distinguished by the integration consequent on their mutual dependence." In the *Annulosa* and especially in the *Annuloida*, from "traits of structure development and mode of multiplication," it is shown that "every segment is in great measure a physiological whole—every segment contains most of the organs essential to individual life and multiplication; such essential organs as it does not contain being those which its position as one in the midst of a chain prevents it from having or needing." The *Annulosa* are therefore aggregates of the third order.

In approaching the consideration of a still higher division—the *Mollusca*—Mr. Herbert Spencer reverts to a previous section, and emphasizes the truth that "As before explained under the head of Classification, organisms do not admit of uni-serial arrangement either in general or in detail; but everywhere form groups within groups. Hence having traced the phases of morphological composition up to the highest forms in any sub-kingdom, we find ourselves at the extremity of a great branch, from which there is no access to another great branch, except by going back to some place of bifurcation low down in the tree." The *Mollusca* differ materially from their allies the *Molluscoida*—both considered as groups—in that they are single and not compound. "No true Mollusk multiplies by gemmation, either continuous or discontinuous; but the product of every fertilized germ is a single individual." The significant fact is then dwelt upon that homogenesis holds throughout an entire sub-kingdom, and that "there is no case in which the organism is divisible into two, three, or more like parts. There is no clustering as in the *Cœlenterata* or segmentation as in the *Annulosa*, the simulation of segmentation by one of the group of the *Mollusca*—the *Chiton*—being limited to the shell only, and to this segmentation being adaptive instead of genetic. The conclusion arrived at is therefore that a Mollusk is an aggregate of the second order. "Not only in the adult animals is there no sign of a multiplicity of like parts that have become obscured by integration; but there is no sign of such multiplicity in the embryo."

In the highest sub-kingdom—the *Vertebrata*—as among the *Mollusca*, homogenesis is universal. The two highest sub-kingdoms "are like one another and unlike the remaining sub-kingdoms in this, that in all the types they severally include a single fertilized ovum produces only a single individual." Occasional spontaneous fission of the vitelline mass in the eggs of certain Gasteropods which may or may not form two individuals, and a probably similar fission imperfectly carried out among the Vertebrates, are regarded as abnormalities. "The vertebrate animal, under its simplest as under its most complex form, is like the molluscous animal in this, that you cannot cut it into transverse slices, each of which contains a digestive organ, a respiratory organ, a reproductive organ, &c. The organs of the least developed fish as well as those of the most developed mammal form but a single physiological whole; and they show not the remotest trace of having ever been divisible "into two or more physiological wholes." Embryology and comparative morphology of the Vertebrata respectively furnish evidence to show that "that segmentation which the vertebrate animal usually exhibits throughout part of its organisation is the same in origin and meaning as the segmentation of a Chiton's shell; and no more implies in the vertebrate animal a composite structure, than do the successive pairs of branchiæ of the *Doto*, or the transverse rows of branchiæ in the *Eolis*, imply composite structure in the molluscous animal." Mr. Herbert Spencer's inference is, therefore, "that the vertebrate animal is an aggregate of the second order, in which a relatively superficial segmentation has been produced by mechanical intercourse with the environment." He finally says:—"We shall hereafter see that this conception leads us to a consistent interpretation of the facts, shows us why there has arisen such unity in variety as exists in every vertebral column, and why this unity in variety is displayed under countless modifications in different skeletons."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART III.

The Middle Lias Economically Considered.

(Continued from page 277.)

Building Stone.—Northamptonshire is usually regarded as a county possessing very little good building stone, for nearly all the new buildings in both towns and villages are built of brick. An excellent freestone is, however, obtained from the Lincolnshire limestone (inferior oolite) in the north-eastern parts of the county, and in the middle portion of the county some good work has been done with the more calcareous beds of the Northampton sand, which is also a member of the inferior oolite. In the west and south-western parts of the county the building material of the past was undoubtedly the Rock-bed of the Middle Lias. If we draw on a map of the county a line in a general north-easterly direction connecting ROTHERSTHORPE, BUGBROOK, WEEDON, DODFORD, and DAVENTRY; and another nearly at right angles to this through BADBY, BYFIELD, CHIPPING WARDEN, BANBURY, and then to KING'S SUTTON, it will indicate the general direction along which the Middle Lias occupies a superficial position, and consequently the neighbourhoods in which to look for it, and in which we shall find abundant evidence of the uses to which the Marlstone Rock-bed has been put. Many of the villages have been built almost entirely of it, including the churches, and from the general appearance of such villages, we can scarcely regard the use of bricks as a necessity, except perhaps from a pecuniary point of view. In these places the stone is also used for doorsteps, the floors of houses, gravestones, fences, and road-metal; indeed, the (now only occasional) roadside heaps, and old walls often afford good opportunities for studying the palæontology of the bed.

The Rock-bed is the only hard bed of the Middle Lias used for building purposes, but this, when carefully selected, and built up as it occurs in the bed, forms a very useful and durable stone, and certainly looks much nicer than the more modern red brick.

In most quarries the stone is met with in two different conditions, the upper weathered portion of a rich brown colour, and lower down a more compact grey or greenish-blue stone; the former is no doubt much the better for general use, although I have seen both kinds used. Several reasons may be urged for preference being given to the more weathered stone. (1.) The weathered stone is much more easily worked than the harder unweathered. (2.) The stone should always be so placed in a building that the planes of lamination are horizontal, for the action of frost on a porous stone, such as the marlstone always is, would cause it to flake off if it were placed so that these planes were in anything approaching a vertical position, the pressure from above considerably aiding this action when so placed, whereas this same pressure would help to counteract it, and at all events tend to mask its effects when the stones were placed so that the lamination was horizontal. Now when the hard compact stone has been quarried it is seldom possible to tell in what direction shaling will take place under ordinary weathering influences; hence it is exceedingly probable that much of the stone would be dressed and placed in a very unfavourable position for its lasting qualities. The weathered portions have already developed those characteristics by which its proper position in a building may be decided. (3.) The hard stone has retained its bluish-green colour owing to the fact that it has not been subjected to the action of percolating water and the gases contained therein; hence, if it were used in a building, the ordinary atmospheric influences would produce chemical changes in it such as have already occurred in the more porous or more superficial parts of the same bed, and these could scarcely be otherwise than detrimental, because they would be taking place first and most rapidly in the exposed parts. With building stones generally it is desirable that all chemical changes likely to take place through the presence of iron or other bodies should be completed before their use—that is to say, for building purposes the seasoned stone is preferable to the green.

Owing to the porosity of these weathered portions of the stone, which are chiefly used for building, a thicker wall is required than when bricks are used.

I may remark that buildings constructed of marlstone can scarcely be distinguished at a little distance away from those built of the more ferruginous portions of the Northampton sand.

Bricks are sometimes made from the clays of the "*Spinatus*" *Zone*, as at Market Harborough; and I believe some of the lower beds of the "*Margaritatus*" *Zone* are so used at and near Banbury, though I have never seen bricks made from them in Northamptonshire.

Road-Metal.—In those positions where the Rock-bed has been quarried most—that is, really where it is nearest the surface of the ground, the upper portion is generally rubbly in character, very much broken up, and the pieces too small for building purposes; this is used for road-metal still, but not very extensively, for slag from furnaces and Hartshill stone find their way almost everywhere now, the former of these two being very inexpensive, and the latter much superior for public roads where there is considerable traffic. Of course, the harder portions of the Rock-bed have also been used for road mending.

It might be thought that since the Marlstone Rock-bed has been so largely used for several purposes, quarries would be plentiful, but they are not so. The stone is so easily obtained where it is used, and dug to such an inconsiderable depth, that a quarry may be opened for a particular purpose, such as building a house or mending a private road, and then closed again and grassed over. So quarries appear and disappear with the exigencies of the district.

The only other hard bed of the Middle Lias used for economic purposes is the bottom one, "L" of typical section. Considerable quantities of this have been used in the south-western parts of the county for road making, for which purpose it is probably better adapted, as it there occurs, than the Rock-bed. It used to be largely quarried at Overthorpe. As was pointed out in the description of this bed given in Part I., it alters very much in a direction at right angles to the strike. Some of this bed was recently extracted in making headings in a well at Messrs. Phipps and Co.'s brewery at Northampton, and it was partly used for repairing a road. But although exceedingly hard, so much so as to require blasting in order to extract, it proved to be a very inferior stone for road making. Under ordinary atmospheric influences and a small amount of traffic it was reduced to a powder. This, however, was not equal in quality to the stone from the same bed further west. Frost and the chemical changes set up in the green ferruginous matrix by weathering may probably be credited with the easy disintegration of the stone.

Ironstone.—The Middle Lias Rock-bed of the Midland Counties is the equivalent of the "Pecten Seam," or the "Cleveland Main Seam" of ironstone in Yorkshire, and hence the prevalence in it of a considerable quantity of iron is what might be expected. The stone is rich enough in iron in the south-western parts of Northamptonshire to have induced speculators to commence quarrying it for smelting purposes, but so far such works have not been successful, although in Oxfordshire to the south-west and Leicestershire to the north-east, such undertakings are yielding good results.

Some years ago (1874) extensive preparations were made by a company, under the title of the "Nell Bridge Iron Ore Company," for working a bed of this ironstone in the parish of King's Sutton, about four miles south of Banbury, by the side of the Great Western Railway. Very little came of the attempt, and the quarry has been untouched for some years. The circular issued by this company describes the ore as purely oolitic, yielding thirty per cent. of metallic iron, and thirty-three per cent. of lime, the proportion of lime being sufficient for the ore to flux itself, and making it especially valuable for mixing with refractory ores. What the particular cause of failure at King's Sutton was, I am not in a position to say, but only a little over a mile from this spot, at Adderbury in Oxfordshire, the stone is extensively worked. It seems at least improbable that within this short distance the stone can have so far altered in character as to render its working unprofitable.

According to Mr. Thomas Beesley, F.C.S.,* the average percentage of iron in the King's Sutton stone is higher than that in the Adderbury stone, for specimens of the former yielded from 18·7 to 34 per cent. of iron, whereas some of the best specimens of the latter only yielded from 18 to 24 per cent. It appears, therefore, that the statement which occurs in Professor Phillips' "Geology of Oxford and the Valley of the Thames," that the Adderbury stone yields one ton of iron to three tons of stone, and that 30,000 tons of iron to the acre might be reckoned upon, requires modifying. Mr. Beesley further states that the richer stone at King's Sutton is sandy, but that the phosphatic concretions are sufficiently abundant to pay for picking out.

I do not anticipate that the Marlstone of Northamptonshire will ever be much used as an ironstone. It is rather remarkable that here, as in Yorkshire, and, I believe, Leicestershire, the quantity of iron in the Rock-bed diminishes with a decrease in the thickness of the bed. Thus the average thickness for Northamptonshire is about six feet, but the instances in which it is less are numerous; whereas in the south-western parts of the county, where alone it has been used, the thickness is about twelve feet.

It is unnecessary to enter largely into a consideration of the condition of the iron in the Middle Lias of Northamptonshire, considering that there is such a small prospect of its being used as a source of iron. Suffice it to say that the grey, green, or greenish blue colour of the unweathered portions of the Rock-bed, and parts of some of the other beds, is due to carbonate of iron chiefly, modified by the presence of phosphate or silicate of the protoxide of iron,† or both, the blue tint where present being particularly due to the former.

* "A Sketch of the Geology of the neighbourhood of Banbury," by Mr. Thomas Beesley, F.C.S.

† The green colour is usually regarded as due to an earthy mineral, called glauconite, which consists essentially of the hydrous silicate of iron and potash, but often contains magnesia, or other things.

The sometimes green oolitic character of the rock has been described as due to grains of silicate of iron; this may be so in some cases, but, so far as my experience goes, it is more often due to concretionary particles of carbonate of lime, coloured only with the silicate or phosphate of iron. This is also the general character of the matrix of bed "L" as found near Northampton.

The weathered portions of the ironstone are richest in iron, and, therefore, most preferred, chiefly because the carbonate of iron has been oxidised, and converted into the brown hydrated peroxide by aid of the gases dissolved in percolating water, and the calcic carbonate partially removed by the same water. The stone in the immediate neighbourhood of cracks and fissures, at least in superficial beds, always shows this same change of appearance and composition.

There are some hard stone beds near the base of the Upper Lias with intercalated clay beds, which, over much of the district marked as Marlstone in the maps of the Geological Survey, cover the Rock-bed. These beds, by affecting the intake of water, and consequent weathering of the Rock-bed, have considerably influenced its character as an ironstone or building stone.

The whole of the Middle Lias, as we have considered it, is ferruginous, and some of the thinner hard beds in the "*Margaritatus*" *Zone* are decidedly rich in iron, but because of their thinness and variability, they require little consideration. The top bed of the "*Margaritatus*" *Zone* in Yorkshire is worked as an ironstone under the name of the "Bottom Seam" or "Avicula Seam," but we have nothing which could be identified with it on that account.

The thin layers of ironstone found in the "*Spinatus*" *Zone* at Market Harborough, and in the "*Margaritatus*" *Zone* in some other places, exhibit, in addition to concretions, the cellular or box-like characters met with so commonly, and on a large scale, in the Northampton sand. The casings are highly ferruginous, but they generally contain clay or other matter in the interior. They are supposed to have been formed by the transfusion of the ferruginous matter from the interior outwards.

Agriculture.—The marlstone yields a rich red soil, well adapted to the growth of corn and other cereals, and also root crops, and being very porous, it suffers very little from wet seasons. It is probable that the richness of these red lands is largely due to the phosphates, so often present in the Rock-bed. Commonly near the base of this bed flattened argillaceous nodules occur in considerable abundance, sufficiently so to give the rock a conglomeratic appearance; these concretionary nodules are rich in phosphates; indeed, they might perhaps be ground and employed with advantage as a dressing for other lands. Phosphoric acid is, however, met with in most parts of the Rock-bed, and as has been pointed out before, it is probably the cause of the bluish appearance of the unweathered stone. This is the more evident from the fact that two or three times I have found pieces of the Rock-bed coated with a bright blue incrustation, which, on analysis, proved to be nearly pure phosphate of iron (Vivianite). I have found such stones in the neighbourhoods of THENFORD and EDGCOTT.

LIME.—Sometimes the Rock-bed is burnt for lime, though I know of no instance in which it has been in Northamptonshire. The presence of any considerable quantity of argillaceous or siliceous matter would no doubt be detrimental to this mode of treatment, but where these were not considerable, the lime produced might reasonably be expected to be more valuable for agricultural purposes than that made from the ordinary Great Oolite limestone of the district, because of the phosphoric acid present.

(To be continued.)

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Continued from page 275.)

WELLESBOURNE-HASTINGS.—*Sir Thos. le Straunge, Constable of Ireland*, 1426, *with SS. collar.* *Haines.*

This particularly neat, soldierly-looking, effigy is about 2ft. long, and lies in the chancel. The knight is clad in *a complete suit of plate armour*, not a link of mail being visible; compare the brass at WIXFORD. The most noticeable features of this brass are the collar of SS. (see description of the brass at BAGINTON), the skirt of six overlapping plates called *taces*, and the shield-shaped plates at the armpits, which take the place of the usual *roundels*.

At the four corners of the stone are shields, two plain and two emblazoned with the arms of LE STRAUNGE, gu., two lions pass. in pale arg., crowned or.

The following is the inscription, which has been restored:—

Hic iacet dominus Thoms le Straunge miles | nuper Constabularius Regis in Hibernia qui obiit | tertio die Maii Anno domini mcccc | xxvi et regni Regis Henrici sexti quarto cuius animæ ppitietur deus.

Translation:—

Here lieth Sir Thos. le Straunge, Knight, late the King's Constable in Ireland, who died on the 3rd day of May, A.D. 1426, and in the 4th year of the reign of King Henry VI.: to whose soul God be merciful.

Dugdale gives an engraving of this brass.

WESTON-UNDER-WEATHERLEY.

I.—*Inscription. Anne Danet,* 1497. *Haines.*

Of this memorial, which is upon the chancel floor, nothing but the inscription remains, upon a plate about 18½in. by 6½in. Dugdale gives an illustration showing an effigy and shields of arms, and the matrix of a child's figure. At the top left corner of the stone is the matrix of a shield; the other matrices are not visible, and may have been filled up with cement. Inscription:—

Here lyeth Anne danet wyf of Gerard danet Gentilman | doughter & oon of the heires of John huggefford lord of | Edmondescote Wolffricbstone & Merston Wapenbury Wolstorp | & Eythorp in the countes of Warr & leyscet, which Anne | decessed the xviii day of August the yere of or lord god mo ccccIxxxxvii. On whose sowle Jhū have mcy amen

II.—*Inscription. Margaret, w. of Sir Edw. Saunders, knt.* 1563. *Haines.*

A large plate, 2ft. 5in. by 22in., inlaid in a Purbeck moulded panel, at the end of the north aisle. At the top of the plate are engraved the arms of SAUNDERS Per chev., sa. and arg., three elephants' heads erased, counterchanged, and tusked or.; ENGLEFELD, THROKMORTON, and DANVERS.

Below these are the following Latin elegiacs:—

MARGERIE SAVNDERS ARTVS SVNT MORTE SOLVTI,
PERPETVA FÆLIX MENS REQVIETE JACET.
DONEC ENIM VIXIT CŒLESTIA SEMPER AMABAT,
ASSIDVA VENERANS RELIGIONE DEVM.

Cōivgis Edwardi casto flagravit amore,
Prefvit et magna cvm ratione domi.
Morbvs et exhavstvm corpvs cvm frangere cæpit
Ad dominvm ivnctas svstvlit illa manvs.
Inde crucis Christi simvlachrvm læta poposcit,
Hoc ocvlis animo sensibvs ægra notat.
Hinc neqvit evelli mens in meditando trivmphans,
Atqve svvm colvit non saciata devm.
Egregiam vitam mors est præclara secvta;
Margerie fælix vitaqve morsqve fvit.

And for the benefit of those who do not read Latin the following translation comes directly below the elegiacs:—

Here Margery Savnders lieth whose mortall lymes ar dede
Bvt to enioy imortall rest her sowl to Heavē ys fledd.
Whyles lyf did last she was a paterne of good lyfe,
Devowte to God, good to the poore, a chast ād perfit wyf.
A howswyf of great skill, settinge her hole delight
In her iust love ād wedded mate s^r Edward Savnders Knyght.
For Christ his crose she calld amiddis the pangis of death
Which she with mind and ie behelld ṽtill her later breath
And so gave vp her gost to God which lyf did lend
Who for her good and worthi lyf gave her a happi end

The corps of Dame Margerie Savders dawghter of s^r Thomas | Englefelde Knyght ād of Dame Elizabeth his wyf on of y^e | Davghters of s^r Robert Throgmortō Knight lieth ī this tomb | Whos sovl God pdō she died y^e 11 of Octobris Ao Dnī 1563.

"Sir Edward Saunders Knight" is described on a tablet of alabaster on the north wall as "sometime Chief Justice of England, and after Chief Baron of the Exchequer."

III.—*Inscription. Joyce Tomer*, 1566. *Haines.*

A small plate, 18in. by $8\frac{1}{2}$in., on the south wall of the chancel. Joyce Tomer was evidently Sir Edw. Saunders' family doctor, for the inscription says:—

Artis · Apolliēe · fveras · qvi · mista · iodoce :
Hev · mortis · iacvlo · victe · Tomere · iaces :
Cvivs · in · interitvm · tvlit · hec · solatia · tristem :
Savndervs · vere · pignora : : amicitiæ (*scroll*)
(*cinquefoils*) Anno · Dmi : 1566 : Decembris 22 (*scroll*)

Then in very elegant Gothic characters is appended this translation :—

Heare · lyeth · Joyce · Tomer · slayne · by · death :
That : : had : : of : : physsicke : skyll : : (*scroll*)
Whose : losse : these : comfortes · Saunders · shewes :
As : : tokens : : of : : good : : wyll : : (*scroll, &c.*)

The word "mista" is of course a Latinised form of the Greek *μύστης*, "one initiated."

WHATCOTE. — *Wm. Auldington, parson,* 1511 (?). *Haines.*

In the chancel is the figure of a priest, about 15in. high, head lost, vested for mass (see COLESHILL, TYSOE, WARWICK), and holding a chalice. The drawing is coarse.

Upon a plate, 9½in. by 2½in., is inscribed :—

pray for the sowl of Sr. Wyllm̄ Aul | dington somtyme parson here | on whos sowle ihū have myrcy.

Wm. Auldington was succeeded at Whatcote by Robt. Maud in 1511 (see Dugdale), and probably died in that year.

WHICHFORD.—*Nich. Asheton, rector,* 1582. *Haines.*

Of this effigy, which is 18in. high, Mr. M. H. Bloxam says it portrays Nicholas Asheton "habited in the cassock, open in front, but with sleeves wide at the wrists, so as to display his doublet; over the cassock, however, is worn the sarcenet tippet (the so-called scarf of modern days)." ("Trans. of Archæolog. Sect. of Mid. Instit.," 1874, p. 18, where also an engraving of the brass will be found.) This post-Reformation brass should be compared with that of Sir John Fenton, at Coleshill, and here it should be added that Mr. Bloxam considers that the latter is vested in a cassock, and not in a Genevan gown.

There is a shield of arms at each corner of the tombstone, and the following inscription beneath the effigy, upon a plate, 20in. by 5¼in. :—

Hic Jacet Nicolaus Asheton sacræ theologiæ Bacchalaureus | Cantabr: Cappellanus Comitis Darbie: Nuper Rector istius | Ecclesiae: ac olim vicarius de kendalle Lancastrensis apud | magnā leaver: qui obiit ultimo die mensis Septembris Anno | dñi Millessimo quingentessimo octogessimo secundo regni | Elizabethae Reg: vicessimo quarto

Translation :—

Here lieth Nicholas Asheton B.D. of Cambridge, chaplain of the Earl of Derby, late rector of this church, and sometime vicar of Kendal near Great Leaver Lancashire: who died on the last day of September A.D. 1582, being the 24th year of the reign of Queen Elizabeth.

An engraving of the brass will be found in Bloxam's "Gothic Architecture," p. 254.

WHITNASH. I.—*A Civilian and w., circ.* 1500. *Probably Benedict Medley, Clerk of the Signet to Henry VII. Haines.*

This brass is now mural, in the chancel. The figures are about 2ft. high, and represent a civilian with long hair, a loose fur-lined gown with wide sleeves, and a closely-fitting under-tunic; and a lady with the kennel head-dress, a long flowing gown with tight sleeves having fur at the cuffs, and a waist-band fastened with a large buckle, the loose end falling as low as the feet. A modern inscription has been placed beneath the figures, which says, "The above figures of Benedict Medley and his wife were fixed here at the restoration of the chancel 1856. He was Clerk of the Signet to King Henry VII., and Lord of this Manor. He died A.D. 1504 and was buried with his wife in this church."

According to Dugdale, the manor was sold to Benedict Medley by Sir Henry Willoughby, grandchild of Sir Hugh Willoughby, the first husband of Margaret, wife of Sir Richard Bingham, whose brass is at Middleton. Sir Henry Willoughby was father of Dorothy Fitz-Herbert, whose brass also at Middleton (see above).

II.—*Rich. Bennet, M.A.*, 1531. *Haines.*

A figure, 17in. high, of a tonsured priest, vested for mass and holding a chalice, above which is a wafer. This figure is peculiar in not having a *maniple*, and should be compared with the effigies of W. Abell at COLESHILL, and R. Willardsey at S. Nicholas', WARWICK.

Upon a plate 23in. by 4in. is the following inscription :—

Hic loci sepelitur dm̄n̄s Richardus Bennet artis laice magister | atq. huius quonda̅ ecclesie diligens pastor qui fatis co̅sessit | viii die me̅sis Januarij a̅no dn̄i mcccccxxxi cuius misereatr de.

Translation :

In this place is buried Sir Richard Bennet, M.A., formerly the faithful pastor of this church, who paid the debt of nature on the 8th of January, 1531. On whom God have mercy.

The chalice now used in the church is a faithful copy of that represented on this brass.

III.—*Inscription. Nich. Greenhill, M.A., Rector,* 1650.

This is a small brass plate, not mentioned by Haines, upon the north wall of the chancel. It bears the following verses, composed by Richard Boles, M.A., rector of the church in 1682 :—

This Green hill Periwigd with Snow
  Was leauild in the Spring :
This Hill y^e^ Nine & Three did know,
  Was sacred to his King.
But he must downe, although so much divine,
  Before he Rise never to set, but shine.
  RĪ. BOLES. M^R.^ ART. 1682.

IV.—*Inscription. Rich. Boles, M.A.* 1689.

A small plate, 7in. by 4½in., similar to and near the last, and not mentioned by Haines.

Richard Boles seems to have been fond of writing epitaphs, and composed his own some time before his death. He says :—

This mirrour makes me slight a life half done,
  Because a Better comes when this is Fled ;
The Time and Place where I doe live are knowne
  My Death and Grave none knowes but God alone.
My Death is Certain and Vncertaine : Then
  Mortalls beware, Death comes you know not when.
    I value not a Tombe ; Obscure to lie
    With Virtue is an Immortalitie.
My Life runns on Five yeares beyond Four Score,
Once I must die and then shall die no more.
RĪ. BOLES. Anō. Dn̄i. 1689. Ætat. meæ 85.

WITHYBROOK.—*A civilian, circ.* 1500.

I am indebted to Mr. W. S. Brassington, of Moseley, Birmingham, for a rubbing of this brass. It is in the nave, and measures 16½in. It represents a civilian, and closely resembles the brass of Benedict Medley at WHITNASH, which see. There are matrices for a lady, two groups of children, and an inscription, the brass plates being lost. A full description of the brass will be found in the "Local Notes and Queries" column of the *Birmingham Weekly Post*, Feb. 27th, 1886.

Dugdale mentions brasses at Withybrook to Richard Wright and wife, 1501, and to Christopher Wren and wife, 1543. It is impossible to say whether this is part of one of these memorials.

(To be continued.)

EDELWEISS.

Take, dear Lady, take these flowers
Children born of sun and showers.
Summer sun and winter snow
Crushed the rock from which they grow;
Strength of immemorial chalk
Fed the fibres of their stalk;
Lightning, hurricane and storm
Shaped their pliancy of form;
Gleam and gloom with varying sway
Stained their petals ashen grey,
Which, like loving hearts, enfold
In their midst one spot of gold.
Fearless head and steady foot
Tracked the cradle of their root.
Now a link in friendship's chain
From the mountain to the main.
  Nurslings of the central sea,
Such as late I gave to thee,
Lull the senses, charm the eye,
Bloom and wither, breathe and die.
These, by sterner process made,
Slow engendered, slowly fade.
And they bring where'er they fare
Just a whiff of Alpine air.
  Lady, take these simple flowers,
Emblem meet of sun and showers.

OSCAR BROWNING.

Macmillan's Magazine, October, 1886.

METEOROLOGICAL NOTES.—September, 1886.

Atmospheric pressure was unsteady, but the mean for the month was above the average. On the 16th the mercury reached 30·543 inches, the lowest reading being 29·609 inches on the 10th. Temperature was about one degree above the average. The maximum readings were generally high, and the minima in no instance so low as usual. The range was occasionally very small. The highest observed were 80·0° at Henley-in-Arden, on the 14th; 74·7° at Loughborough; 73·5° at Hodsock; and 73·0° at Strelley, on the 4th; and 72·8° at Coston Rectory, on the 1st. In the rays of the sun, 135·4° at Loughborough, on the 13th; 124·3° at Hodsock, on the 5th; and 122·1 at Strelley, on the 1st. The lowest minima were 34·8° at Hodsock, and 37·0 at Henley-in-Arden, on the 16th; 37·5 at Coston Rectory, on the 11th; 39·0° at Loughborough, on the 23rd; and 40·1 at Strelley, on the 11th and 16th. On the grass the mercury fell to 30·4° at Hodstock, on the 16th; and to 33·2° at Strelley, and 33·7 at Loughborough on the 23rd. In 1885 the sheltered thermometer registered 30·4° at Loughborough, on the 28th September. The rainfall was less than in any of the last eight years, though but slightly different from that of September, 1884. The total values were, 2·09 inches at Henley-in-Arden, 1·54 inches at Coston Rectory, 1·15 inches at Strelley, 1·09 inches at Loughborough, and 1·01 inches at Hodsock. The number of "rainy days" varied from ten to fifteen. The atmosphere was rather drier than usual. Sunshine was very deficient. Lightning was observed at Coston Rectory and Loughborough, on the 4th. The weather was favourable to harvest operations, which were, for the most part, completed before the end of the month.

Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Reviews.

The Flora of Oxfordshire; being a Topographical and Historical Account of the Flowering Plants and Ferns found in the County. By George Claridge Druce. 8vo, pp. 53-451; 10s. 6d.—Oxford: Parker & Co.

This is a most ably compiled Flora and a valuable addition to British botanical literature. Treating, as it does, of a county which can boast, not only of a rich and varied Flora, but also of having had amongst her workers, botanists whose names are historic, whose published works are among our classics, the greatest of our botanical luminaries, this work cannot fail to interest all who love the fascinating science of botany. Throughout the work there is evidence, not only of truly industrious and discriminating field work and critical observation, but also of a thorough acquaintance with the past literature and work pertaining to Oxfordshire botany.

The introduction comprises an able account of the topography, geology, and drainage of the county, and a full description of the seven botanical districts which are based on the river drainage. To each of these districts is added a full list of the more noticeable plants that are peculiar to the district. To this are also added observations on the meteorology and temperature of the county, followed by the plan of the Flora, list of books, MSS., etc., quoted in the work, principal Herbaria quoted, and list of principal persons who have contributed notes or rendered assistance in the preparation of the Flora.

The Flora proper, which occupies some 366 closely-printed pages, then follows. In this the author gives the localities for each district of the more local plants, also frequent personal notes on their special peculiarities, and, what is most interesting, copious notes from the older authorities and from the numerous works that have been consulted in compiling the work; noticing, also, in many instances, the occurrence of the plant in the contiguous counties of Berks, Bucks, Warwick, Northants, and Gloucester. This is followed by a careful summary, giving the classes of citizenship, from which we find that the native plants of Oxfordshire number 818 species.

Denizens	49
Colonists	43
Total	910
Extinct	17
Ambiguities and errors	19
Casuals and aliens	169

About 310 varieties have also been noticed.

Under the head of aliens and casuals the author has probably included several plants scarcely worth noting in a Flora. The following are the types of distribution:—

	Great Britain.		Oxford.
British	532	..	469
English	409	..	308
Intermediate	37	..	8
Scottish	81	..	7
Highland	120	..	—
Germanic	127	..	51
Local or doubtful ..	49	..	9
Total	1,355		852

Comparative notices are also given of the contiguous counties, by which we find that 85 species occur in Warwickshire that have not been found in Oxfordshire, whilst Oxford has 88 species not at present recorded for Warwickshire

Then follows a most interesting and pleasantly-written chapter on Oxfordshire Botanologia, in which are given biographical notices of the various botanists who have been associated with Oxfordshire botany, from Turner, the father of British botany, to the most recent of her workers. Among the more noticeable appear Gerarde, Parkinson, Bobart, Sherard, Dillenius, Sibthorp, Lightfoot, Banks, Goodenough, Baxter, and also other more or less historic names.

The work concludes with the mosses and hepatics of Oxfordshire, which is a full and possibly exhaustive account of the various species and varieties, with their localities, by one of our leading bryologists, Mr. Henry Boswell. There are also catalogue lists of the fungi and lichens that have from time to time been recorded, and a very useful map, so coloured as to show at a glance the different drainage districts. The work is printed in small but clear type, is attractive in appearance, and does credit to both author and publisher.

J. E. BAGNALL.

Nature-Musings; on Holy-days and Holidays. By the REV. NEHEMIAH CURNOCK. With an Introduction by the REV. W. H. DALLINGER, LL.D., F.R.S. London: T. Woolmer.

THE fact that this delightful little book is introduced to the reader by Dr. Dallinger is a sufficient guarantee that it is worthy his attention. The author, a Wesleyan minister, who "believes that all knowledge of God's works is helpful to faith and Christian usefulness," writes with the object of attracting young people to a study of Nature. This he seeks to do by describing the habits and structures of various "common objects" of English shores and ponds, lanes and gardens, justifying the publication of a new book on such familiar matters, by the fact that our best naturalists tell us that even the commonest phenomena of Nature cannot be too frequently described, provided the work is done truthfully. As might be expected, he writes from a purely religious standpoint, "Bible in hand," and explains everything by the theory of special creation, but all in a simple yet most genial and attractive manner. Now he tells us about the Polyzoa and Hydroids found on the sea-weeds attached to the pier at Bournemouth, now he takes us to certain "Cheshire water-worlds" rich in animal life, or again, discourses on the fortunes and misfortunes of a "Disinherited whelk," and everywhere with a light, graceful, and scholarly touch. An example will best show his general style; he is talking about the "bird's head processes" of certain Polyzoa:—

"But what is the meaning of these *vulture-heads* placed at intervals on the stalks. Imagine a crystal hare-bell of gigantic size, with the head of a vulture fastened to the stem just below the flower. No legs or wings or body; nothing but an awful head! See! it rises, slowly; and then more quickly falls. But for its shape, it might be a passing bell, ringing out in measured tones some awful doom. And ever and anon, as that solemn head rises, the beak opens wider and wider."

There are various illustrations of average merit, while the printing and paper are all that could be desired. We would suggest that if a second edition be reached, a good index should be added, as at present it is very difficult to find the place where any given animal is described. In conclusion, we heartily recommend this book, not to young people only, but to all who are as yet unacquainted with the wonders of the organised world.

A. B. B.

Natural History Notes.

MILDNESS OF THE SEASON.—Laburnums bloomed in many places during October. On October 6th and 11th ripe strawberries were gathered out of doors in a garden near Maidstone. About the same time "a magnificent lot of raspberries, quite in perfection," were picked in the garden of Cormer Hall, Hemel Hempstead. Similar reports come from several other districts. At Hemingford, St. Ives, a second crop of raspberries was gathered on the 12th, "accompanied with the song of the thrush and the blackbird."

BURNT EARTH FOR ALPINE PLANTS.—Mr. Geo. Maw, F.L.S., has published an interesting note on this subject in the *Gardener's Chronicle*, October 16th. Plants which grow naturally in fissures only, such as many of the hard-foliaged Saxifrages, Androsaces, etc., are, it is well known, very difficult to maintain in health in gardens. It is with plants of this class that Mr. Maw has been experimenting for three or four years. He finds that when grown in pulverised fire-brick refuse (technically known as "ground sherds"), with a very slight admixture of peat and loam, they thrive admirably. Pulverised red brick produced very similar results, but the preference is given to the fire brick.

PLANT FOOD.—Mr. Edmund Tonks, B.C.L., recently delivered an interesting and instructive lecture on this subject to an audience of practical gardeners in Birmingham, in the course of which he pointed out the value of artificial manures, and gave much useful information about them. The lecture has been printed, and may be obtained from Messrs. Cornish Brothers, Birmingham. The price is sixpence.

WASPS.—A number of letters have appeared in the newspapers remarking on the almost entire absence of wasps this autumn in the Midland Counties. This agrees with our own experience, for we have seen only two or three at most. Various reasons have been assigned for their scarcity, the most feasible being the prevalence of cold, bitterly cold, east winds during April and early in May; and several successive wet days in May, which drowned or destroyed their nests. Up to the first week of May, queen wasps were very abundant. In some districts we learn that wasps have been as numerous as ever, and one writer ("D. T. F." in *The Garden*, Oct. 9th) says that in East Anglia on Oct. 4th he saw large quantities—"many thousands" is his expression—swarming among the open flowers of ivy, although during the season he has destroyed "fifty nests and occupants."

TOADSTOOLS.—It is a very old-established belief in many districts that toads commonly sit upon fungi; this idea has arisen from a misunderstanding of the meaning of the word "toadstool" or "paddock stool." One meaning of the word "paddock" is "toad," and in old times, when the toad was looked upon as ugly and venomous, poisonous fungi were supposed to arise spontaneously from its dung; the second syllable, "stool," being really the old word which is synonymous with dung, or the place where dung is laid down.—Worthington G. Smith, in *The Gardening World*.

BOTANICAL.—Mr. J. D. Siddall, of Chester, has recently had printed for the use of students a "Classification of the Vegetable Kingdom, showing the position therein of the British and some of the larger exotic Natural Orders of Plants, with abbreviated details of the floral structure of each." This is printed on one sheet, demy, and includes 120 natural orders from Ranunculaceæ to the lowest forms of the Cryptogamia. It is very ably compiled, and will be of the greatest service to students preparing for examination.

THE BRITISH ASSOCIATION.—The following important Committees on subjects of local interest were appointed at the recent Meeting in Birmingham, on the recommendation of the Committee of Section D, Biology:—

"That Mr. Valentine Ball, Mr. H. G. Fordham, Professor Haddon, Professor Hillhouse, Mr. John Hopkinson, Dr. Macfarlane, Professor Milnes Marshall, Mr. F. T. Mott, Dr. Traquair, and Dr. H. Woodward be a Committee for the purpose of preparing a report upon the Provincial Museums of the United Kingdom; that Mr. Mott be the Secretary, and that the sum of £5 be placed at their disposal for the purpose."

"That Professor Hillhouse, Mr. E. W. Badger, and Mr. A. W. Wills be a Committee for the purpose of collecting information as to the Disappearance of Native Plants from their local habitats; and that Professor Hillhouse be the Secretary."

"That Professor Milnes Marshall, Dr. Sclater, Canon Tristram, Dr. Muirhead, Mr. W. R. Hughes, Mr. E. de Hamel, and Professor Bridge be a Committee for the purpose of preparing a report on the Herds of Wild Cattle in Chartley Park and other parks in Great Britain; and that Mr. W. R. Hughes be the Secretary."

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MEETING, October 5th. This being the opening of the session, the Chairman and President, Mr. R. W. Chase, gave an interesting address, in which he drew the attention of the members to the necessity for taking further steps to foster the love of natural history, and said he could assure the members that no efforts would be spared by the committee to ensure interesting and instructive meetings. He insisted upon the necessity of the hearty co-operation of the members who were capable of giving papers and otherwise assisting in the practical work of the society, and said that the interest shown by the visitors to the natural history annexe of the exhibition at Bingley Hall clearly demonstrated that there was a desire among people generally to become better acquainted with natural history. One of the great wants of Birmingham was a good natural history museum, and he trusted that the time was not far distant when it would possess such a museum. He announced that Mr. Morley, who had filled the office of honorary secretary to the society for upwards of twelve years, was compelled to retire for a time from those duties he had so well performed, and referred to the many obligations which the society was under to Mr. Morley for his untiring work in their interests. He trusted that the well-earned rest which Mr. Morley would now enjoy would enable him so to improve in health that the members might soon see him again among them. Mr. John Udall had been appointed to act as deputy secretary till the end of the year.—Mr. R. W. Chase exhibited Bluethroat, *Cyanecula suecica*, shot at Blankeney, Norfolk, Sept., 1884; dipper, *Cinclus aquaticus*, Richmond, Yorkshire, Aug. 8th, 1884, showing white feathers in wings and tail, an unusual occurrence in this species; black-bellied dipper, *Cinclus melanogaster*, Humber Bank, Lincolnshire, Oct. 24th, 1885; St. Kilda wren, female, *Troglodytes hirtensis*, St. Kilda, July 10th, 1886; Kentish plover, male and female, *Ægialitis cantiana*, Breydon Flats, Norfolk, April 29th, 1886; great snipe, *Gallinago major*, near Yarmouth, very rare in spring. Birds in down.—Hobby, *Falco subbuteo*, Weethley Wood, near Alcester; Arctic tern, *Sterna macrura*, common tern, *Sterna fluviatilis*, Farne Islands; and little tern, *Sterna minuta*, Towyn. Nests and eggs.—Reed warbler, *Acrocephalus streperus*, two nests placed one above the other upon the same reeds, both nests containing eggs, with the addition of a cuckoo's egg in the upper nest, Ely, June 22nd, 1886; grasshopper warbler, *Locustella nævia*, Blaydon, June 9th, 1886; peregrine falcon, *Falco peregrinus*, Isle of Lewis, April 5th, 1886; merlin, *Falco æsalon*, Isle of Lewis, May 21st, 1886; common teal, *Querquedula crecca*, Norfolk; garganey teal, *Q. circia*, May 1st, 1884, Hickling; whimbrel, *Numenius phæopus*, Shetland, May 24th, 1885. Prof. W. Hillhouse, M.A., exhibited an ingenious apparatus to measure the amount of water given off by the leaves of a plant. Dr. Crooke exhibited tubercle bacilli, in a lymphatic gland from the horse; bacilli, stained red, shown under a Zeiss $\frac{1}{12}$ oil immersion objective; also, anthrax bacilli, in the lung of a mouse. Mr. Horace Pearce, F.G.S., exhibited granites from Aberdeen, and other rock sections, amongst which were the following: granite, very micaceous, and jasper, from the shore, Aberdeen; and granite from Peterhead, prepared by G. Healey, Esq., Bowness. Lepidodendron, tree stem from coal measures, Halifax; and Sternbergia, fossil stem of tree, from Oldham, Lancashire. Mr. W. B. Grove, B.A., exhibited the following fungi, from the neighbourhood of Birmingham: *Lactarius torminosus*, *L. vellereus*, *Boletus badius*, *B. piperatus*, *Agaricus heteroclitus*, *Ag. cervinus*, *Ag. testaceus*, *Russula integra*, *R. citrina*, *R. ochroleuca*, *Hygrophorus chlorophanus*, *Hydnum repandum*, *Ag. speciosus*, *Marasmius peronatus*, and an abnormal form of *Polyporus sulphureus*. Mr. F. J. Cullis, *Dipsacus Fullonum*, the fuller's teasel, compared with *Dipsacus sylvestris*, the common teasel. Mr. T. Bolton, *Corethra plumicornis*, developed from pupa of glass larva in the Bingley Hall Exhibition; *Pterostylaria parasitica*, called by some the polite worm, from its graceful movement; *Stephanoceros Eichhornii*, *Floscularia ornata*, *Leptodora hyalina*, *Plumatella repens*, &c. Mr. W. H. Wilkinson, *Anacharis alsinastrum*, showing the circulation of cell contents; also, sections of the following lichens: *Solorina saccata*, showing the spores *in situ*; *Collema granulosum* and *Lecidea sanguinaria*, both being double stained. Mr. W. P. Marshall, M.I.C.E., Mr. J. Edmonds, and Mr. J. Udall were also amongst the exhibitors. BIOLOGICAL SECTION, October 12th, the President in the chair.—Mr. W. R. Hughes, F.L.S., exhibited the fruit of the sumach. Mr. W. B. Grove exhibited the following fungi: *Ag. muscarius*, *Ag. flavo-brunneus*, *Ag. columbetta*, *Ag. jubatus*, *Ag. sericellus*, *Ag. lampropus*, *Ag. pennatus*, *Ag. mesophæus*, *Cortinarius torvus*, *C. bolaris*, *C. paleaceus*, *Gomphidius gracilis*, *Russula depallens*, *Lactarius pyrogalus*, *L. torminosus*, *Clavaria inæqualis*, *Lycoperdon cælatum*, and *Ræstelia cancellata*, from various places in Warwickshire; (for Mr. C. T. Parsons) *Ræstelia cancellata*, from Pershore, Worcestershire; (for Mr. J. Hamson) *Ag. clavipes* and *Ag. semiorbicularis*, from Bedford. Mr. W. P. Marshall exhibited *Tubularia indivisa*, *Coryne pusilla*, *Plumularia pinnata*, *Noctiluca miliaris*, *Obelia dichotoma* and gonozoids of the same, zoëa of barnacle, larvæ of crab and shrimp, and young hermit crab, all mounted specimens, made during the Tenby excursion. Mr. J. Potts exhibited thirty-seven photographs of places in Pembrokeshire, taken during the same excursion. Mr. R. W. Chase exhibited the razorbill, *Alca torda*, adult male; common guillemot, *Lomvia troile*, adult male, also in down, and eggs; ring-eyed guillemot, *Lomvia lacrymans*, adult male, all in breeding plumage; black guillemot, *Uria grylle*, adult in summer plumage, and young in winter plumage, also adult changing to winter; little auk or rotche, *Mergulus alle*, male in winter plumage; puffin, *Fratercula arctica*, adult female in summer plumage, and young in first plumage; also, four photographs of the guillemot colony on the Pinnacle Rock, at the Farne Islands, and a photograph of the egg of the great auk, *Alca impennis*, natural size. Mr. W. P. Marshall then read the "Report of the Excursion to Tenby, in June, 1886," which will be printed in due course. MICROSCOPICAL GENERAL MEETING, October 19th. Mr. W. B. Grove in the chair. Mr. Bolton exhibited (for Mr. B. W. Westwood) an abnormal growth of pear, a small pear growing out from the centre of a larger one. Mr. Thos. Clarke exhibited joints of the stem of an encrinite, probably *Poteriocrinus crassus*, from the lower carboniferous limestone, Holy Island; these are called "seals" by the natives, and used as such; they attribute to them a vegetable origin. He also exhibited a number of flies, bred from larvæ, which fed on a fungus belonging to the genus Russula, from Witton. Mr. W. B. Grove exhibited a very fine specimen of *Polyporus frondosus*, fourteen inches across and eight inches high, which grew at the foot of an oak tree in Hagley Park, and (for Mr. H. Hawkes) *Polyporus salignus* (new to the district), also *Ag. jubatus*, *Ag. melaleucus*, *Ag. glutinosus* (new), *Ag. chalybæus*, *Ag. mammosus*, *Ag. sinapizans* (new), *Ag. spadiceo-griseus*, *Hygrophorus pratensis*, *H. unguinosus* (new), *Clavaria fumosa* (new), *Fistulina hepatica*, *Bovista nigrescens*, and other fungi, from Hagley Park. A discussion ensued, in which Mr. J. Levick, Mr. W. H. France, and others took part.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting, Wednesday, October 20th. Attendance, ten (two ladies). The following objects were exhibited, viz.: By Mr. W. A. Vice, a number of fresh fungi, including *Schizophyllum commune*, a *Peziza*, *Hygrophorus niveus*, and several Agarics. By Mr. E. F. Cooper, pieces of dead sticks thickly covered with the beautiful pink fungus *Tubercularia vulgaris*. By Miss Grundy, a dwarfed specimen of *Campanula glomerata* from the Chalk Downs, and a pencil sketch of a beech tree with several boughs naturally inarched and grown together. By Dr. Finch, specimens of *Helix ericetorum*, and *H. virgata*, from the Downs at Eastbourne; and a fine example of the pendant nest of a wasp on a branch of cedar of Lebanon, from the grounds of the borough lunatic asylum. The nest was nearly globular, about five inches in diameter, and when taken was deserted, the gardener having seen the wasps fly away in a body carrying something with them which appeared to be either eggs or larvæ. By the Chairman, dried specimens for distribution of *Erodium moschatum*, *Lamium hybridum*, &c. The Chairman, in the absence of the author, read a paper by Mr. H. E. Quilter on "The Metamorphoses of *Galereuca nymphea*, a coleopterous insect," describing the larvæ collected from the floating leaves of *Polygonum amphibium*, and the phenomena of their changes into pupæ and perfect beetles, carefully watched and recorded by himself. The Chairman remarked that this paper was a useful contribution to a branch of entomology, in which there was still a wide field for amateur work.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 20th. Mr. Deakin exhibited the jaws of a shark; Mr. Dunn (for Mr. Baxter) larvæ of *Orgyia pudibunda* and pupæ of *Grapta C. album*. Under the microscopes, Mr. Corbet showed *Tabellaria flocculosa*, a diatom from tap water; Mr. J. W. Neville, a plant bug, Tingis, from Turkey; Mr. H. Hawkes, *Isaria farinosa*, a fungus growing from the abdomen of a spider; Mr. Mulliss, anthers of *Malva moschata*.—September 27th. Mr. J. Madison exhibited continental specimens of land shells; Mr. A. T. Evans, a pebble from the Drift, containing several specimens of *Orthis budleighensis*; Mr. J. Harrison, a belemnite, illustrating the difference between ancient and modern cuttle fish—in the latter the phragmacone is missing, and the guard almost so; Mr. Wagstaff, Australian gum-enclosing insects. Mr. J. A. Grew then read a paper—"Notes on a Foreign Tour." The route taken was from Dieppe, through Rouen, Paris, and Nancy, to Strasbourg. The notes comprised sketches of the archæology, architecture, and natural history. The writer regretted that improvement schemes had coffined so many of the old houses of Rouen in the dust of the past. The cathedrals of Rouen and Strasbourg were particularly spoken of as monuments of architectural beauty. The natural history was not widely different from our own, except that some objects rare with us were abundant there. An account of the Lepidoptera seen by the way concluded an interesting paper.—October 4th. Mr. Deakin showed a specimen of *Pholadomya fidicula* and fossil wood from the Lias of Dorsetshire; Mr. Wagstaff, an improved microscope lamp with metal chimney, the advantages claimed for it being efficiency with economy; Mr. H. Hawkes, a number of fungi, including specimens of *Cortinarius helvolus*, *Clavaria vermiculata*, *Russula emetica*, and *Sphærobolus stellatus*. Under the microscopes, Mr. H. Hawkes showed a fungus, *Sporodinia dichotoma*; Mr. H. Insley, a section of *Aristolochia latifolia*; Mr. Mulliss, stained section of fern.—October 11th. Messrs. Deakin and Evans showed a coral, plant-remains, and other fossils in pebbles from the Drift; Mr. H. Hawkes, the following fungi:—*Dædalea quercina*, *Boletus badius*, *Clavaria inæqualis*, and *Agaricus prunulus*. The subject of the evening was Practical Microscopy—"Mounting whole Insects." Mr. J. W. Neville demonstrated the simplicity of preparing whole insects for microscopical investigation by describing and showing the processes they pass through. Several objects were prepared and mounted, and afterwards exhibited to the meeting.

ON A DEEP BORING IN THE NEW RED MARLS (KEUPER MARLS) NEAR BIRMINGHAM.

BY W. JEROME HARRISON, F.G.S.

The Triassic strata which form the country surrounding Birmingham consist of the usual divisions of sandstone and marl; the sandstones predominating below, the marls above. In the immediate neighbourhood of the town, the sandy beds are divided from the marly or clayey strata by a dislocation or line of fault which runs from north-east to south-west, taking a line from Erdington to Rubery, and traceable altogether for a distance of about twenty miles. The fault runs through the town of Birmingham nearly parallel to the River Rea, and from a quarter to half-a-mile west of the present bed of the river. The Lower Keuper sandstone, which forms a surface band one to two miles in width on the west of this fault, is a porous stratum about 200 feet in thickness. It is underlain by the Bunter Pebble Beds, 300 to 400 feet in thickness, which crop out further to the west, and which contain an inexhaustible supply of water. From three deep wells in the suburbs of Birmingham—two on the north at Perry and Witton, and one on the south near Selly Oak—the Corporation Waterworks obtain daily a supply of over eight million gallons of water, most of which comes from the Pebble Beds, which occupy the lower portion of each well or bore-hole. The water is of good quality, showing from nine to fifteen degrees of hardness.

On the east of the line of fault a very different state of things prevails. The rocks on this side have been dropped vertically some six or seven hundred feet. Here the surface is composed of the Keuper Red Marls, which form a broad band ten or twelve miles in width, extending from Birmingham to Shustoke. The water-supply of this tract—which has a considerable extension to north and south from Tamworth to Warwick and Redditch—is wholly derived from superficial sources, such wells as exist drawing their water from the post-glacial sands and gravels which lie here and there in hummocks on the Red Marls.

As the population on this agricultural plain of Warwickshire is comparatively small and scattered, and as there are no manufacturing towns in the district, it is, perhaps, not surprising that until quite recently no attempts have been made to reach the buried waters which probably exist in the Bunter and Keuper Sandstones that underlie the Red Marls on the east of the line of fault. The chief obstacles to such an undertaking are the unknown—certainly considerable—thickness of the Red Marls; and the fact that no one likes to be the first to experiment in a matter in which—while there is certainly a possibility of failure—any good result obtained would be quite as much for the benefit of one's neighbours as for one's self. It would seem that such borings might well be executed by Government, or by the County Boards which it is proposed to establish, the cost being defrayed by a small tax levied on the landowners of the district.

The work of the Geological Survey has given us some information as to the probable thickness of the Red Marls. Prof. Jukes, writing of South Staffordshire,* says:—"The total thickness of this sub-formation cannot be much less than 600 feet;" and Mr. Howell, speaking of this very district,† states that "south of Birmingham the Keuper Marls attain a thickness of nearly 600 feet," and again adds "in this district, the Red Marl attains a maximum thickness of about 600 feet." However, he gives a section of a boring on the Lindley Hall Estate (four miles north of Nuneaton), about which, although a depth of 660 feet was attained, he says "it does not seem certain that they got through the Red Marl series; some of the lower beds, however, may belong to the Lower Keuper Sandstone." In a deep boring for water, at Rugby, after passing through 400 feet of Lias and seventy feet Rhaetic Beds, the New Red Marls were pierced, and found to be 670 feet in thickness; at a depth of 1,140 feet the Keuper Sandstone was reached, and a rush of water flooded the borehole; unfortunately this water was so impregnated with salt and with gypsum as to be unfit for domestic purposes.

About eight or ten years ago the Birmingham Corporation put down a bore-hole in Small Heath Park (a southern suburb of Birmingham) in search of water for certain baths and wash-houses which it was proposed to build there. A depth of 440 feet was attained, entirely in the Keuper Red Marls, before the boring was abandoned. I have seen numerous specimens of fibrous gypsum obtained from varying depths in this bore-hole.

Early in the present year Messrs. Bates, of the King's Heath Brewery, three miles south of Birmingham, resolved to make a deep boring for water through the Red Marls on

* *Warwickshire Coalfield*, Survey Memoir, 1859, pp. 41-44.

† *South Staffordshire Coalfield*, Survey Memoir, 1859, p. 4.

which their buildings stand, at a distance two miles to the east (down-throw side) of the line of fault already described. They entrusted the work to Messrs. Le Grand and Sutcliffe, of 100, Bunhill Row, London, who have successfully carried out similar undertakings in many parts of the country. The work has been rapidly carried forward, and the latest statement of results is as follows:—

Contractors' Notes.	Depth in Feet.	Geological Notes.	Feet.
Dug well	32	Post-glacial Sands ...	36
Red Sand	4		
Red Marl and Pebbles ...	8	Boulder Clay	20
Rough Ballast	12		
Red Marl	158	Keuper Marls	611
Red Marl and Gypsum...	131		
Marl, Shale, and Gypsum	309		
Marl and Shale	3½		
Red Stone and Shale ...	9½		
Total depth reached ...	667		667

There is no thick bed of gypsum, but this mineral occurs persistently in streaks and fibrous deposits throughout the greater part of the strata. Many of the cores of marl brought up are remarkably hard, affording a great contrast to the ordinarily soft and crumbling nature of the strata as we usually see them in a weathered condition in brick-pits, &c.

It is possible that the "red stone and shale"—a hard sandy marl—which forms the bottom bed now reached, marks the incoming of the Lower Keuper Sandstone. Similar strata were found at the bottom of the Lindley Hall boring. Certainly the depth already reached—667 feet—is the point at which our previous knowledge would lead us to expect the change to occur. For although the first 56 feet is occupied by surface deposits, leaving 611 feet for the Red Marls, yet it must be remembered that we are only two miles east of the fault, and that the upper portion of the Marls—to what extent we cannot precisely tell—must have been removed by denudation.

Just as the boring has reached this most interesting point, an unfortunate accident has temporarily delayed its progress. A tool has broken in the very bottom of the boring, and the removal of the broken piece is a difficult operation. But doubtless this obstacle will quickly be overcome. As to the quality of the water to be obtained from the Keuper Sandstones, the promoters of the boring doubtless hope that it will be similar to that at Burton, where the presence of a moderate amount of gypsum in the water from deep wells sunk through the Red Marls is found to be of great value in brewing operations.

The action of a fault when it brings a thick bed of impervious material like clay or marl side by side with a porous sandy stratum—the sandy beds dipping towards the line of fault—is strikingly shown both at Birmingham and Stourbridge. In Birmingham there is any quantity of water to be had from the Sandstones and Pebble Beds right up to the line of fault. The Artesian well, about 200 feet deep, in Digbeth, must be within a few yards of the fault-line, and the water obtained is used in the manufacture of mineral waters, and is so highly prized that it may be frequently seen conveyed in a large barrel on wheels to various establishments in the town.

At Stourbridge exactly the same thing happens. A north and south fault brings Permian Marls on a level with the Bunter Pebble Beds and Keuper Sandstones, the latter dipping towards the Marls. The water is banked up by the Marls and yields an unlimited supply to the wells of the Stourbridge Water Company, which lie just on the right (west) side of the line of fault.

The Railway Company occupies the land on the marly side of the fault, and in years gone by they sank well after well in the marls in vain search for water, and the officials were much chagrined and surprised at its absence, seeing that any quantity of the precious fluid was being pumped up within a few yards of their land!

REPORT OF THE BRITISH ASSOCIATION MEETING, 1886.*

BY W. HILLHOUSE, M.A., F.L.S.
(Delegate to the Conference of Corresponding Societies.)

[ABSTRACT.]

Officially, this report refers only to such matters as came under my cognisance as your delegate to the Conference of Corresponding Societies held in connection with the meeting of the British Association, but I have extended it so far as to endeavour to bring together all those matters connected with the recent meeting in which this society or its members were directly concerned. It may thus serve as a convenient record

* Transactions of the Birmingham Natural History and Microscopical Society.

of the part the Birmingham Natural History and Microscopical Society has, directly or by its members, taken in the work of the Meeting.

As you will remember, the meeting commenced on Wednesday, September 1st, and closed on Wednesday, September 8th. In the preparatory work the members of this society naturally took an active part. Out of the (approximately) seventy-five who constituted the Executive of the Reception Committee, this society provided twenty, including one of the local secretaries. These were apportioned as follows:—

Local Hon. Secretary.—Rev. H. W. Crosskey, LL.D., F.G.S. (President, 1872).

Finance Sub-Committee.—Ald. Avery, J.P., H. Heaton, J.P., J. H. Lloyd, M.A.

Exhibition Sub-Committee.—R. W. Chase (President, 1885-6), Chairman of the Natural History Sub-Committee; Ald. W. Cook, Prof. Hillhouse, M.A., F.L.S. (Vice-President, 1885-6); Wilson Lloyd, M.P.; W. P. Marshall, M.I.C.E. (President, 1869); Edmund Tonks, B.C.L. (President, 1877); S. Walliker. A. W. Wills, J.P. (President, 1871).

Book Sub-Committee.—Prof. Lapworth, LL.D., F.G.S.; W. Mathews, M.A., F.G.S. (Vice-President, 1868); C. J. Woodward, B.Sc.

Excursions Sub-Committee.—G. H. Kenrick.

Hospitality and Lodgings Sub-Committee.—G. S. Albright, M.A.

Conversazione Sub-Committee.—Prof. Haycraft, M.B., B.Sc., F.R.S.E.; Lawson Tait, LL.D., F.R.C.S. (President, 1876).

Of the various sections into which the association is divided, the following members of the society found places on the sectional committees:—

Section A.—*Mathematical and Physical Science.*—C. J. Woodward.

Section B.—*Chemical Science.*—C. J. Woodward, Sectional Secretary.

Section C.—*Geology.*—Rev. H. W. Crosskey, Prof. C. Lapworth, and W. Mathews, all Vice-Presidents of the section; Rev. P. B. Brodie, M.A.; Alfred Browett, Rev. G. Deane, D.Sc.; G. A. Panton, F.R.S.E.; Horace Pearce, C. J. Watson, C. J. Woodward.

Section D.—*Biology.*—Prof. T. W. Bridge, M.A., and Prof. Hillhouse, sectional secretaries; R. W. Chase, M. C. Cooke, M.A., LL.D.; W. B. Grove, B.A.; Prof. J. B. Haycraft, W. R. Hughes, F.L.S. (President, 1864-6. 1873); Prof. A. Milnes Marshall, M.A., F.R.S.; W. Mathews, Lawson Tait, A. W. Wills.

SECTION F.—*Economic Science and Statistics.*—Rev. H. W. Crosskey.

SECTION G.—*Mechanical Science.*—W. P. Marshall, Vice-President of the section; Ald. T. Avery.

SECTION H.—*Anthropology.*—Lawson Tait.

The following Papers were communicated by members of the society:—

SECTION C.—*Geology.*—Prof. C. Lapworth: (1) Sketch of the Geology of the Birmingham district; (2) The Cambrian Rocks of the Midlands; (3) The Ordovician System in Shropshire.

T. H. Waller, B.Sc. (President, 1883-4): On the Petrography of the Volcanic and Associated Rocks of Nuneaton.

W. Mathews: On the Halesowen Coal Boring.

Rev. H. W. Crosskey: (1) Report on the Erratic Blocks of England and Wales; (2) On the Glacial Formations of the Birmingham district.

C. J. Woodward: On the Mineral District of Western Shropshire.

Rev. P. B. Brodie: (1) On the Discovery of Fossil Fish in the New Red Sandstone (Upper Keuper) in Warwickshire; (2) On the Range, Extent, and Fossils of the Rhætic Formation in Warwickshire.

SECTION D.—*Biology.*—Prof. Haycraft: (1) On the Sense of Smell; (2) Some New Points in the Physiology of the Tortoise.

W. B. Grove (Vice-President, 1886): Two Fungus-Diseases of Plants.

J. Morley (Vice-President, 1874-5): Note on the Cultivation of Fern Prothallia for Laboratory purposes.

Prof. Hillhouse: (1) Preliminary Note on the Fall of Leaves; (2) On an Apparatus for determining the rate of Transpiration in Plants; (3) On *Beggiatoa alba*, a bacteriad of marshes.

SECTION F.—*Economic Science and Statistics.*—Rev. H. W. Crosskey: The Character and Organisation of the Institutions for Technical Education required in a large Manufacturing Town.

SECTION G.—*Mechanical Science.*—W. P. Marshall: English and American Railways.

As one would naturally expect, the members of the society have mainly worked in connection with the sections of Geology and Biology. The meeting of the Association this year was *par excellence* a geologists' meeting. With this feature of the meeting the communications from members of this society sympathise.

Of the *Afternoon Walks*, C. J. Woodward conducted one to Moseley, Sept. 2nd, and to Pouk Hill Quarry, Sept. 3rd; J. E. Bagnall, A.L.S. (Vice-President, 1884-5), to Sutton Park, Sept. 6th; Prof. Lapworth, to the Lower Lickey Hills, Sept. 6th.

The *Excursions*: Ald. J. B. Stone and J. E. Bagnall, one to Sutton Coldfield; E. de Hamel, to Tamworth; W. R. Hughes, to Stratford-on-Avon; E. W. Badger (President, 1881), to Lichfield, Lapworth, Hartshill; all these on Saturday, Sept. 4th. W. R. Hughes, to Redditch and Bromsgrove; Prof. Lapworth, to Church Stretton, on Thursday, Sept. 9th.

The "Handbook of Birmingham," issued in connection with the meeting, was largely contributed to by our members.

Part II., Chap. VIII., C. J. Woodward, the article on "Manufacturing Industries of Modern Birmingham."

Part III., "Geology and Physiography," was edited by Prof. Lapworth, who also wrote the introduction, and that part referring to the Palæozoic Rocks; Rev. P. B. Brodie, the Liassic and Rhætic Rocks; Rev. H. W. Crosskey, the Glacial and Post-Tertiary Deposits; Petrography, by S. Allport, F.G.S. (President, 1868); C. J. Woodward, the Minerals of the Birmingham District.

Part IV., "Zoology," was edited and introduced by W. R. Hughes; E. de Hamel wrote Chap. I., on the Mammals and Reptiles; R. W. Chase, Chap. II., the Birds; G. Sherriff Tye (Vice-President, 1877), Chap. III., Fishes and Mollusca; and T. Bolton, Chap. V., Microscopic Fauna.

Part V., "Botany," edited and introduced by W. Mathews; J. E. Bagnall contributed Chap. I., the Flowering Plants, Ferns, &c.; and Chap. II., the Mosses, Hepatics, and Lichens; A. W. Wills, Chap. III., the Algæ; W. B. Grove, Chap. IV., the Fungi.

These contributions as a whole amount to nearly one-half of the "Handbook."

It may be interesting to note that a paragraph in Mr. de Hamel's account of the Mammalia of the Birmingham district, in the "Handbook of Birmingham" (p. 272), has caused the formation by the Association of a committee of seven members, of whom four are members of this society, to prepare a report on the Herds of Wild Cattle in Chartley Park and other Parks in Great Britain. Of this committee Mr. Hughes is secretary.

In the work of the committees of the Association, appointed or reappointed this year for the investigation of special points, the members of this society naturally take only a small share. The following are the personal statistics, so far as I am able to collect them:—

Prof. T. W. Bridge, Committee to report on Herds of Wild Cattle in Chartley Park and other places in Britain.

E. de Hamel, Wild Cattle Committee.

W. R. Hughes, Sec. Wild Cattle Committee.

E. W. Badger, Committee on Preservation of Native Plants.

A. W. Wills, Native Plants Committee.

Prof. W. Hillhouse, Sec. Native Plants Committee; Committee on Provincial Museums.

Prof. Milnes Marshall, Wild Cattle Committee; Committee on the Translation of Foreign Memoirs; Committee on Naples Zoological Station; Committee on Plymouth Marine Biological Laboratory.

Dr. Crosskey, Sec. Committee on Erratic Blocks; Committee on Circulation of Underground Waters and Water Supply; Committee on the Teaching of Science in Elementary Schools.

As your delegate, I attended both meetings of the Conference of Delegates of Corresponding Societies. At these, certain subjects were submitted for discussion, which it is specially desired should be brought under the notice of Local Natural History and other Societies. These subjects, or such of them as come within the possible scope of this Society's action, are—

1.—A Committee for the purpose of investigating the circulation of the underground waters in the permeable formations of England, and the quality and quantity of the water supplied to various towns and districts from these formations.

Standing as Birmingham does on the verge of a great coal-field, the Natural History and Geological Societies of the district have peculiarly favourable opportunities of enquiring into this subject. Dr. Crosskey is a member of this Committee.

2.—A Committee, with Dr. Crosskey as Secretary, for the purpose of recording the position, height above the sea, lithological characters, size, and origin of the erratic blocks of England, Wales, and Ireland, reporting other matters of interest connected with the same, and taking measures for their preservation.

3.—A Committee, with your Delegate as Secretary, to collect information as to the disappearance of native plants from their local habitats, and to report thereon. Of this, see below.

4.—A Committee, with Mr. F. T. Mott, of Leicester, as Secretary, to report on the provincial museums of the United Kingdom. This report is with a view to "suggesting means by which such museums can be rendered still more useful to general science and to popular education," and possibly to obtaining some systematic assistance from the National Collections in London. Your Delegate is the member of this Committee for the Midland district.

5.—A Committee for the purpose of making arrangements for assisting the Marine Biological Association's Laboratory at Plymouth. Of this Committee Mr. Percy Sladen is Secretary. Assistance, both financial and moral, is needed for this institution, which it is hoped will in course of time furnish a very valuable adjunct to the ordinary appliances for scientific research.

With one of these committees the Society is connected by links of no common order—that on the preservation of native plants. This question was first brought before the members of the Birmingham Natural History and Microscopical Society in 1884 by Mr. A. W. Wills, J.P., and an article on the subject written in the "Midland Naturalist"* for August of that year. At the meeting of the Midland Union of Natural History Societies at Birmingham in June, 1885, Mr. Wills, in conjunction with Mr. E. W. Badger, and the writer of this report, brought the matter, in the first instance, before the Council, and afterwards, with their cordial co-operation, before the Conference of Delegates from Societies constituting the Union. The appeal passed by the Conference† I brought before the Committee of Section D of the British Association at its meeting at Aberdeen last year, and I was delegated to lay the matter, in the name of that Committee, before the Conference of Delegates of Corresponding Societies. This I did, and although the Conference is by its constitution prohibited from initiating resolutions, the following protest met with unanimous support, and is incorporated in the Report of the Conference submitted to the Council of the British Association at its recent meeting:—"We view with regret and indignation the more or less complete extirpation of many of our rarest or most interesting native plants. Recognising that this is a subject in which Local Societies of naturalists will take great interest, and can exercise especial influence, we urge upon the Delegates of Corresponding Societies the importance of extending to

* Vol. VII., p. 209.

† *Ibid.*, Vol. VIII., p. 227.

plants a little of that protection which is already accorded by Legislature to animals and prehistoric monuments, and of steadily discouraging and, where possible, of preventing any undue removal of such plants from their natural habitats; and we trust that they will bring these views under the notice of their respective Societies."

At the recent meeting of the Association I again brought this matter under the notice of the Committee of Section D, having in the meantime strengthened my position by communications from various parts of the country, and with such success, that upon its recommendation, Mr. Wills, Mr. Badger, and I were appointed by the General Committee of the British Association, at its meeting September 8th, a Committee—"To collect information as to the disappearance of native plants from their local habitat, and to report thereon." Mr. Wills is to be most heartily congratulated upon such a result within two years of his first drawing special attention to the subject. It now only remains for me, as your Delegate, to solicit, in the name of the Conference, the active and sympathetic interest in the work of all members of this Society, and of all readers of the "Midland Naturalist," especially in the compilation of personally-vouched-for statistics of plant extirpation or disappearance, and in the cultivation of a healthy public sentiment upon the question.

At a subsequent date I hope to lay before you an account of the Natural History Exhibition forming a part of the great collection, illustrating the various natural products and industries of the district, which was brought together in Bingley Hall as a special adjunct to the meeting of the Association.

EXCAVATIONS AT WALSALL.

I beg to submit the following short account of some vegetable and animal remains found during the making of excavations for a deep sewer through land formerly called the Racecourse, and also for a subway under the railway at the bottom of Bridgeman Street, both in Walsall.

The Racecourse, the greater part of which has very recently been converted into a Goods Wharf for the Midland Railway Company, lies chiefly in a valley, through which the

River Tame runs, the high land on the east side being due to the upheaval of the limestone hill on which the parish church stands, while the opposite or western high land is composed of ironstone and coal-measures. The valley between these high lands seems to have been formed by alluvial deposits, consisting of alternate layers of soil—fine river sand—clayey soil, &c. At a depth of about six to eight feet, very many trees, lying flat or horizontally, were come upon. They had to be chopped through. One piece was about a foot in diameter.

What was very singular, too, in cutting this sewer, a little pocket of small coal cinders was found, none larger than a small bean, at a depth of about three feet; and I was also told by the contractor that a rough-made shoe, of leather, with pointed toe, holes to lace up in front, and made apparently out of a single piece of hide, was found. It was placed near a fire to dry, but through the ignorance or stupidity of the watchman was burnt.

In the deep cutting for the subway near the old bed of the river the following was the approximate order of the deposits gone through :—Soil 1ft., clayey soil 3ft., sandy 2ft., two seams of bluish clay, one coarser than the other, 8in. or 9in.; gravelly soil about 3ft. or 4ft, another clayey deposit, and then quicksand to possibly 30ft.

Above the last clayey deposit, and about ten feet from the surface, a number of bones were found. I regret that the "navvies," not understanding the difference in value between recent and "fossilised" bones, mixed with the older remains some bones found at an earlier stage of their excavations, and therefore of very little value.

There was also found in making this subway, but whether by itself or among the lowest "find" of bones I could not learn, a human skull. Before I was informed of this last discovery, one of the men, from superstitious motives, buried it again in the quicksand, and though I offered a good reward for its recovery, it could not be found, owing most probably to an accident happening to the timber supports of the excavation, and the filling of the cutting with water, and a great influx of running sand. I was exceedingly annoyed at my non-success in recovering the relic, but it was thought to have got so deep among the buried timber that was abandoned to help in making firm ground for the foundations, that there was no hope of obtaining it, though every reasonable effort was made by the obliging overlooker.

A. D. Aulton, LL.D., Walsall.

THE MONUMENTAL BRASSES OF WARWICKSHIRE.

BY E. W. BADGER, M.A.

(Concluded from page 304.)

MORTON-MORRELL.—I am indebted to J. A. Cossins, Esq., for a rubbing of this brass plate, which reached me too late for notice in its proper alphabetical order. The plate is inlaid in a stone with incised inscription to the memory of *Anna Bagshaw*. It is 15in. square, and bears the crest, a bugle-horn stringed, and some good mantling surrounding a shield on which is a similar horn between three roses. Upon a shield of pretence are two squirrels addorsed cracking nuts.

SHUCKBURGH, UPPER.—By the kind permission of Lady Shuckburgh I have been able to obtain rubbings of the brasses in Shuckburgh Church, which is situated in her ladyship's grounds. The rubbings were, however, obtained too late for notice in alphabetical order. Dugdale gives illustrations of three memorials, comprising altogether sixteen brass plates. Since Dugdale's time the sixteen plates (which are still extant) have been unfortunately removed from their original matrices, mixed up, and relaid in great confusion. Wrong inscriptions and arms have been associated with the effigies; the inscriptions have been placed in wrong positions upon the tombstones, and four memorials have been constructed out of the original three. I will describe the brasses as they now exist, and point out the mistakes which have been made.

I.—*Margt. dau. of Thos. Shukburrgh and w. of John Cotes. Circ.* 1500. *Haines.*

This brass consists of a shield, 6½in. long, bearing the Shuckburgh arms, sa. a chevron between three mullets, pierced, arg.

Below this and *above* the effigy is a plate, 20in. by 3½in., with this inscription:—

Hic iacet Margarete Cotes ux' Johñ Cotes filii et hered' | Thome Cotes de honingham armig'i quōdā filie Thōs Shukburrgh | senyor' de Shukburrgh armig'i cui' aīe ppicietur deus. amen.

In English: Here lieth Margaret Cotes wife of John Cotes (son and heir of Thomas Cotes of Honingham, Esq.) late daughter of Thomas Shuckburgh Esq, Lord of Shuckburgh: whose soul God pardon. Amen.

Below this is an effigy, about 20in. long, representing a lady in a flowing dress. Only the plate bearing part of the dress remains; the rest of the figure has been incised in the stone recently, and was doubtless copied from Dugdale's engraving of the original figure.

The shield does not properly belong to this memorial, and the inscription should be in its usual place at the feet of the effigy. See Dugdale's illustration.

II.—*Tomas Shukburghe Esq & w. Elizabeth.* 1549 (or 1560?). *Haines.*

At the head of the tombstone is a shield, 11in. long, with the arms of SHUCKBURGH quartering NAPTON arg. on a fesse, az., three escallops of the first.

Below this are the figures of a knight and lady, about 22in. long. They are evidently by a provincial artist, and should be compared with the brasses at ASTON, COMPTON VERNEY II., and SOLIHULL I. The knight's hair is long and curly, his armour is of the ridged type, with pass-guards, roundels at the elbow joints, three tuilles, and cuspidate genouillières. He wears sabbatons, a hawberk of mail, and gauntlets which leave the fingers exposed. Upon his breastplate (or possibly hung to a band surrounding his neck) is a small crown. The same feature will be noticed in the brass of R. Verney, already referred to; indeed, the absolute similarity of the brasses is most striking. The lady wears the kennel-shaped head-dress, an outer dress with puffed and banded sleeves, and a flowing skirt which is caught up under the left arm and reveals an under-dress

There is no inscription, but the following, upon a plate, 2ft. by 4in., which has been assigned to other effigies, doubtless belongs to this brass. See Dugdale.

Hic Jacēt Tomas Shukburghe armiger & Elizabethe vxor ei' quondā | dn̄s & patronus de supiori Shukburghe qui obiit Anno dnī | Millesimo quīgētesimo . . . . . . ix (lx?) prīō die mensis | Octobris Quorū animab' propitietur deus. amen.

Translation: Here lie Thomas Shuckburgh Esq. and Elizabeth his wife, late lord and patron of Upper Shuckburgh, who deceased A.D. 15 . 9 (or 1560) on the first day of October. Whose souls God pardon. Amen.

Part of the date appears to have been obliterated; probably the word was "quadragesimo," as Thomas Shuckburgh was, according to Dugdale, "in Commission for Conservation of the peace from 18 H. 7. to the end of that King's Raign, and for many years in H. 8. Time."

III.—*Anthony Shukburgh Esq. & w. Anne*, 1594. *Haines.*

As now arranged, this memorial consists of a shield like the one already described in No. I., the inscription just quoted, and two effigies, about 2ft. long. Nothing of the man remains but the head, with close-cropped hair and beard, moustache, and ruff. The rest of the figure has been engraved upon the stone recently. The lady's effigy has lost part of the head-dress, which is that known as the "Paris hood." She wears a ruff, an under-dress with embroidered skirt, and gathered in pleats at the throat, and gown with wide falling collar, open in front, except just at the waist, where it is confined by a loose sash. The figure should be compared with that at EXHALL.

The shield of arms over Margt. Cotes belongs to these figures, but the inscription is wrongly assigned to them, for they represent Anthony Shuckburgh and his wife, 1594. The late style of costume proves this, and any doubts will be set at rest by a comparison with Dugdale's illustration. Upon the same stone should also be a group of three boys in civilian gowns and ruffs, another of five girls attired as the lady described above; two shields emblazoned arg. two bars gules for FOXLEY, and a plate, 11in. by 9in., engraved with the SHUCKBURGH crest altered and a shield of six quarterings, SHUCKBURGH, DYSERT, LUNELL, and three others. The groups of children, the last-mentioned shields, and the following inscription of Anthony Shuckburgh form the fourth brass as they are now placed:—

Here ly buried the Bodies of Anthony Shukburgh Esquire | and Anne his wiffe: the sayde Anthony departed this lyfe the | first of Aprill in the yeare of our lorde God 1594.

Mors Mortem Vincit: per mortem post mortem Viuemus.

In English: Death conquers death: through death we shall live after death.

WIXFORD. I.—*Thos. de Cruwe, Esq., and w. Juliana*, 1411. *Haines.*

This is the finest brass in the county. The two effigies, each 5ft. long, are placed beneath a double canopy 8ft. high and 3ft. 2in. wide, with crockets upon the pinnacles and finials. At the upper left corner of the tomb is a shield bearing the Beauchamp arms; on the right of this another shield bore the arms of Cruwe (a lion rampant) impaling the arms of Juliana de Cruwe. A third shield bore the lion rampant, now obliterated, and a fourth (restored) has the cross of S. George. Below the shields and between the pinnacles and finials are four representations of a left foot, and the same badge occurs in the pediment of the canopy, in panels at its base, within circles at its lower corners, and between the words of the marginal inscription. No explanation of this seems forthcoming, except that it is "a family badge." At the base of the canopy in the centre is another shield of arms. The knight is in a complete suit of plate armour; bascinet with opening for the face, gorget, breastplate with skirt of seven taces, and baguette, epaulières, palettes at the armpits emblazoned with the cross of S. George, brassarts with straps and buckles, coutes, roundels, vambraces, and gauntlets. The legs are covered with cuisses, genouillières, jambs, and sollerets. The sword-belt has been omitted. At the knight's feet is a lion.

The lady, who is at the knight's right hand, wears the crespine head-dress, kerchief, mantle drawn together with cords, and a kirtle fitting closely, with long sleeves reaching to the knuckles, and buttoned underneath with sixteen buttons. At her feet is a lap-dog with a collar of bells.

Round the margin of the tomb is this inscription, with the family badge after each word:—

Hic jacent Thomas de Cruwe Armiger | qui istam capellam fecit fieri qui obiit . . . die mensis . . . Anno domini millimo cccc° | . . . et Juliana uxor eius que obiit | vicesimo die mensis decembr Anno dñi millesimo cccc° undecimo quorum animabȝ ppicietur deus. Amē. Amen.

Translation:

Here lie Thomas de Cruwe Esq. who caused this chapel to be built who died . . . day of the month . . . A.D. 14 . . . and Juliana his wife who died Dec. 20. 1411. Whose souls God pardon. amen.

It is evident that the lady died first.

Thomas de Cruwe was attorney to Margaret Beauchamp in 1406 (see the brass at S. Mary's, Warwick). He was knight of the shire in the "Layman's Parliament" at Coventry. He was also steward to Richard Beauchamp, Earl of Warwick, which connexion is commemorated by the first shield upon his tomb. He died in 1418.

II.—*Inscription.* *Jane Alline*, 1587.

Upon a plate, 17½in. by 7½in., on the floor of the nave is the following:—

Here lieth the bodye of Jane Alline sometime the wi | ffe of John Alline which did bequeathe her selfe to | be buried in Wixforde Churche and this said Jane | Alline had Issbew by her trewe and lawefull husband | tenn cheldren that is to saye Anne Margret Marge | ry Anne Elizabeth John Marye Alse John Issabell this | Jane Alline departed this transitory life the xviiith | daye of Aprell Anno domini: 1587. Jesus.

III.—*Rise Griffyn*, 1597. *Haines.*

A plate 15¼in. by 10in., upon which is engraved a shield with the arms of Griffyn sa., a griffin segreant arg. with eleven quarterings. Below this is engraved an arch upon columns, beneath which at a prayer desk kneels a boy in a civilian's gown.

Underneath is this inscription:—

HERE LYETH THE BODIE OF RISE GRIF-
FYN FOVRTH SON OF RISE GRIFFYN OF
BROME IN Yᵉ COVNTIE OF WARWIKE ESQV-
IER, HE DECEASED . . . DAYE OF JANVARY
AND BEING IN HIS INFANCYE BEING BVT
THREE QVARTERS OLDE ANNO DNI 1597.

The whole is in an oak frame in the vestry.

WOOTTON-WAWEN. I.—*John Harewell, Esq.*, 1505, *and w. Dame Anna.* *Haines.*

The figures are about 3ft. long, and lie upon an altar-tomb in the chancel.

Above the effigies are two shields, one of which is ar. upon a fess wavy sa. three hares' heads couped or, for Harewell. Below the effigies are groups of five sons and five daughters, and below these two more shields with various quarterings.

The man wears his hair long. Over his mail shirt is plate-armour of a heavy massive kind, the upper edges of the pauldrons being lengthened and curved upwards (especially upon the left shoulder) to form *pass-guards* and protect the neck from a sword-cut. Haines says "the breast and back-plates have a large skirt apparently composed of small oblong plates, with one tuilette depending from it at the front and two at the sides. This peculiarity . . . is perhaps intended for the skirt of lamboys (Gall. *lambeau*), which was a puckered skirt of cloth or velvet, worn over the thighs, and sometimes imitated by plate-armour." The feet of the knight are encased in broad sabbatons, and his sword is worn at the left side. The lady wears the kennel head-dress, a close-fitting under-dress, and an outer gown with loose sleeves. Round her waist is a belt fastened with three metal rosettes, from which depends a chain supporting an elaborate pomander. Compare COLESHILL II.

Round two edges of the tomb runs this inscription :—

Hic iacet Johēs harewell Armig' & dnā Anna quondm uxor eius Ac nup | uxor Edwardi Grey militis qui quidm̄ Johannes obiit x die aprilis Anno dnī m v: v° Et que quidm̄ Anna obiit die A° dn̄i m° v quor aīabʒ ppicietur deus.

Translation: Here lieth John Harewell Esq. and Dame Anna late his wife and formerly wife of Edward Grey, knight; which John died the 10th of April 1505, and which Anna died the . . . . day . . . . A.D. 15 . . . whose souls God pardon.

These spaces were left to be filled in when the wife died.

II.—*Inscription. Lady Agnes Smyth*, 1562.

Upon a plate, 20½in. by 6in., mural, in the S. Chapel used as a vestry.

> HERE LYETH THE BODIE OF LADYE AGNES SMYTH
> LATE WIFE OF S^R JOHN SMYTH KNIGHT ONE OF THE
> BARONS OF THESCHEQVIER, DAVGHTER OF JOHN HAR
> WELL ESQ. & ONE OF Y^E COHEIRES OF THOMAS HARWELL
> ESQ. HER BROTHER W^CH AGNES DYED Y^E 15^TH OF FEBR. 1562

BRASSES IN PRIVATE POSSESSION.

BADDESLEY-CLINTON HALL.—*A lady in heraldic mantle. Circ.* 1500.

By the kindness of Mrs. Dering, of Baddesley-Clinton Hall, I am enabled to furnish an account of this brass, of which Haines makes no mention. It is preserved in the private chapel of the Hall, and probably was once in the parish church. It represents a lady kneeling upon a cushion embroidered with quatrefoils, her hands clasped in prayer. Upon the first and third fingers of the left hand are rings. She wears the kennel-shaped head-dress, a mantle drawn together with long tasselled cords, and a kirtle. Upon the mantle are emblazoned the arms of Brome: sa., on a chev. arg. three broom sprigs vert., quartering ARUNDELL sa., six hirondelles, arg. 3. 2. 1.

The kirtle appears to be emblazoned ermine.

It is supposed by a writer (the Rev. Father Norris) in *The Oscotian*, Vol. IV., No. 15, Dec., 1885, that "it is a memorial of Elizabeth Arundell who married Nicholas Brome, or of their daughter Constance who married Sir Edw. Ferrers."

The figure has been prepared by coarse hatching to receive enamel or some resinous composition, to express the sable tincture, but no traces of colouring matter remain.

WROXALL.—*A lady.* *Circ.* 1430. *Haines.*

This effigy, 2ft. 1in. long, is now in the possession of J. B. Dugdale, Esq., of Wroxall Abbey, who kindly allowed the writer to make a rubbing. The lady wears that development of the crespine head-dress, called the horned head-dress, which arose from the side cauls of the former being so enlarged that the outer edges stood above the forehead. Over this is thrown a kerchief which falls upon the shoulders. Over her kirtle the lady wears a long gown with falling collar. It is girt under her breasts, and has very deep sleeves, close and edged with fur at the wrists. A precisely similar figure will be found in *Haines*, p. 210.

The brass is "said to have been originally in Brailes Church, but no matrix corresponding to it remains there." *Haines.*

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

EXPOSITION OF PART IV., CHAPTERS VI. TO XII.

"THE MORPHOLOGICAL COMPOSITION OF PLANTS."

BY W. HILLHOUSE, M.A., F.L.S.

[ABSTRACT.]

The subject of these chapters is the progressive differentiation of plants, either as wholes, or as to their several members considered separately. The ability to approach the subject at all is dependent upon the possibility of defining vegetable forms *per se*, and of strictly correlating the modifications to which their members are subject. From *a priori*

* Birmingham Natural History and Microscopical Society, Sociological Section, Dec. 17th, 1885, and Jan. 21st, 1886.

considerations this should be possible, seeing that every plant of whatever kind consists, at some stage of its existence, of a single vegetable cell; hence all the changes which it subsequently undergoes are in the nature of modifications impressed upon the organism either by external or internal causes. Could we classify and analyse internal forces in the same sense that those operating from the exterior are subject to classification and analysis the matter might become easy.

The forces bearing upon and producing morphological differentiation Mr. Spencer considers to be :—

(1).—*Growth*, by altering the relations of the organism with the factors of nutrition, and therefore affecting different parts in differing degrees.

A remarkable yet simple illustration of this is to be derived from our modern knowledge of the method of development of starch-grains. Adhering to, or half immersed in, the side of the "feeder" from which they derive their nourishment, their form at first is globular, for nutrition is practically equal in all parts. As they enlarge, the parts remote from the feeder receive less food than the proximal portions, and in proportion to their remoteness. Hence the form becomes progressively more and more eccentric, the eccentricity increasing in geometrical proportion.

(2).—*Mutual influences, e.g.*, the pressure of new units on old ones, etc. Thus, two typically globular cells, passing into permanent union, would do so by flat contact-faces. Break a filamentous alga, and the flat end-walls of the cylindrical cells at the rupture-point will bulge and become hemispherical by removal of pressure. Again, very actively growing cells will stretch less actively growing cells in union with them. Hence the production of spiral vessels with exceedingly open spirals in the immediate neighbourhood of the pith of an actively growing stem. Again, the new units may cut off light from those older, and, at least in such cells as are dependent on light, will bring about manifest changes. In like way would come about the evolution of a mechanical tissue. Compress the vital operations of a vegetable cell into smaller compass, and you produce equivalent increase in mechanical development. Hence the need to support a weight in itself induces ability to support it.

To these two forces ought probably to be added another, at present, however, indefinable, but to which we can give the name of *inherited tendency*. Neither growth nor mutual influences can account for the development of, for example, hairs upon an epidermis.

(3).—External forces act unequally on different parts and sides of an aggregate.

This is most markedly manifest in respect to light, but holds good equally for all exterior forces, bearing in mind that, in addition to the sides, commonly so called, the plant likewise has outside and inside.

In order to obtain the classification of form he hypothecates, Mr. Spencer proceeds to give certain definitions, such as *asymmetrical* for utterly irregular forms, *unsymmetrical* for those approximating to regularity. Of symmetry itself, we have that of the sphere, *spherical symmetry*, as the most primitive. He asks you then to consider the gradual flattening of a sphere to a plane, this latter having *radial symmetry*. Another kind of symmetry appears needed here, that of the cylinder, showing equi-radial symmetry in a series of consecutive planes. Further, there is *bilateral symmetry*, which may be *triple*, *i.e.*, divisible into equal and similar parts in three planes at right angles, *e.g.*, a brick or shuttle, *double*, divisible in two planes at right angles, *e.g.*, a canoe, and *single*, divisible in but one plane, as in a boat. These terms might be conveniently replaced by triaxial, biaxial, and uniaxial symmetry respectively.

The process of evolution would theoretically progress from perfect spherical to single bilateral symmetry. This is apparently true in fact.

The simplest plants, amongst aggregates of the first order, that is, unicellular organisms, are spherical. The author selects *Protococcus* as his illustration; the coccus forms of bacteria would perhaps provide the best illustration, as, being independent of light, and of aquatic habit, they can be symmetrical from the point of view of external forces also. Spherical symmetry is indeed due to the equality of internal and incident forces. The most modern theory of cell-nutrition is that the nucleus is, in the ultimate, the feeder. For spherical symmetry the nucleus should be central; this it apparently is. Directly the nucleus becomes a-central, spherical symmetry would be lost, unless counterbalanced in some way. Triaxial symmetry exists in diatoms and desmids, and is associated with motility, and triaxial symmetry in the arrangement of forces. A cylinder may possibly be looked upon as a case of multiaxial symmetry.

In *Caulerpa* we have a fixed unicellular organism. In all fixed organisms the primary difference is between the free and fixed ends, *i.e.*, the disappearance of the spherical and tendency to radial or to multiaxial symmetry. Another illustration can be obtained from the mycelium of a unicellular fungus; this is independent of light, and therefore simpler in its external relations. Spencer looks upon this as asymmetrical; rather is it not radially symmetrical? The segments, truly, are not exactly like, neither is exactitude demonstrable in spherical symmetry. Transitions to aggregates of the second order are found in filamentous algæ, *e.g.*, *Spirogyra*. These show radial symmetry of the cylindrical type. Primævally the cells, doubtless, were spheres with flattened contact-walls; the action of forces has brought their form through the barrel to the cylinder. *Nostoc* and *Batrachospermum* supply connecting links.

(To be continued.)

METEOROLOGICAL NOTES.—October, 1886.

There were some remarkable variations in the barometric pressure of the month, which showed the unusual range of 1·719 inches. A fall of rather above an inch in the mercurial column took place from the 14th to the 15th; the 6 p.m. readings being, on the 14th 29·666 inches, on the 15th 28·631 inches. From this latter date the mercury rose steadily, reaching 30·356 inches on the 25th. The month was generally mild, the mean temperature being nearly three degrees above the average. On the 5th, 77·1° was registered at Loughborough, and 71·0° at Strelley; 74·0° at Coston Rectory, on the 1st; and 71·1° at Hodsock, on the 4th. In the rays of the sun, 118·5° at Loughborough, on the 1st; 117·0° at Hodsock, on the 3rd; and 107·5° at Strelley, on the 4th. The high temperature of the 4th and 5th was unprecedented at Loughborough in this month during the previous eight years. The minimum temperatures were above the average; the lowest recorded being 31·1° at Hodsock, on the 23rd; 34·2° at Coston Rectory, on the 22nd; 35·5° at Strelley, on the 22nd; and 35·7° at Loughborough, on the 23rd. On the grass, 27·0° at Hodsock, on the 14th and 23rd; 32·0° at Strelley, on the 22nd; and 32·1° at Loughborough, on the 23rd. Rainfall was rather excessive, though above an inch less than in October, 1885. The total values in inches were:—Strelley, 4·74; Loughborough, 4·48; Coston Rectory, 3·98; Hodsock, 3·08. The number of "rainy days" varied from eighteen to twenty-two. Severe thunderstorms visited Strelley and Loughborough during the afternoon of the 20th. Sunshine was very deficient.

Wm. Berridge, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Note.

The Boleti of the Birmingham District.—A few days after my article on this subject was printed, I found several typical specimens of *Boletus luteus* in Sutton Park, and near to them some very fine specimens of *B. piperatus*, both in Westwood Coppice.—W. B. Grove.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—At a meeting of the Biological Section held on Tuesday last, Mr. W. P. Marshall in the chair, Mr. J. E. Bagnall exhibited on behalf of Mr. J. B. Stone, J.P., several beautifully prepared specimens of the Cactus tribe of plants from Mexico, representing the genera *Mamillaria*, *Opuntia*, *Echinocactus*, and *Cereus*, with notes on their morphology, habitats, and geographical distribution. A copy of Gerarde's "Herball," 1636, was also exhibited, from which Prof. Hillhouse, M.A., read the quaint description given by this author of *Cereus*, which had just then been brought into cultivation; also, in illustration of a previous exhibition, the graphic description given by Gerarde of the origin and development of the Barnacle Goose. An interesting discussion followed.—MICROSCOPICAL SECTION, November 16th. Mr. R. W. Chase in the chair. Mr. Pumphrey exhibited a series of beautiful photographs of flowers, some taken by himself and others by Mr. Wills.—GEOLOGICAL SECTION, November 23rd. Mr. T. H. Waller in the chair. Mr. W. P. Marshall read a paper on the "Motion of Glaciers" (modern theory of), which will be printed in a future number. Mr. R. W. Chase exhibited *Mustela martes*. Mr. Grove exhibited a number of fungi. Mr. Bolton exhibited a flagellate monad, probably new.—An enthusiastic meeting was held on Tuesday, November 30th, at the Mason College, when Mr. R. W. Chase occupied the chair, the subject of the evening being "Photo-Microscopy." Mr. J. Edmonds in his lucid style gave a popular description of the apparatus he used, which was of simple construction, and as he took the views at night, no camera was needed. He explained that the negatives were taken on the Ilford ordinary plates, while the positives were on Mr. Alfred Pumphrey's new lantern plates, which gave very brilliant effects. The views were thrown on to the screen by the use of the new large oxyhydrogen lantern belonging to the society, which was very skilfully manipulated by Mr. Charles Pumphrey. Mr. Edmonds then explained the views as they appeared on the screen, his descriptions sometimes causing a laugh amongst the audience, as some well-known tiny object appeared of an enormous size on the screen, and showing the intricate and beautiful structure, the uses of which he explained at the same time. Of the insects that were shown were the following, amongst many more:—The scorpion fly, the mosquito, showing the lance; several new crustaceans and a new caddis worm in its bottle-like home, the jaws of a spider, the head of a wasp, with its trowel-like tongue and other appendages; the compound eye of a beetle, which could see round a corner, so that the old adage, "blind as a beetle," is a very questionable quotation; the tongue and gizzard teeth of the cricket, the spiracles and trachæa of the water beetle, showing the breathing tubes ramifying into the smaller vessels, and then a greatly magnified view showing the "water-markings" caused by the crossing of the lines. He also showed photos of sections of plants, as the stem of the bracken fern (*Pteris aquilina*), illustrating its structure and the scalariform vessels *in situ*; also a variety of diatoms and other objects. Mr. T. H. Waller, B.A., then exhibited a series of photos of rock sections, which he described as Mr. Pumphrey threw them on to the screen, amongst which were spherulites in the obsidian of the Yellowstone Rock, U.S.A.; section showing the lava flow in rock from the Wrekin; and another showing the junction of granite and schist in the Cornwall Rocks; also sections of rocks from Nuneaton. Some views were then exhibited of instantaneous pictures showing the breaking of a wave, the ripple on a river, etc., and some interesting Alpine views recently taken by Mr. Watson. Mr. W. H. Wilkinson exhibited a specimen of the "mazewort" (*Dædalia quercina*), from Clent, a fungus which (unlike most of its family) does not soon perish, as this specimen was as perfect as when gathered four years ago; also a fine cluster of *Xylaria hypoxylon* in fruit, from Shrewsbury. There was a large attendance of members, who throughout the evening evinced the deepest interest in the very varied and instructive exhibitions, and a hearty vote of thanks was carried by acclamation to Mr. Edmonds and to Mr. Pumphrey.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 18th. Mr. J. W. Neville exhibited a specimen of lace sponge, *Euplectella aspergillum*; Mr. J. Madison, *Planorbis lineatus*, var. *albina*, from Deal, and *Ancylus fluviatilis*, var. *albida*, from Earlswood; Mr. C. F. Beale, two fossil fish, *Platysomus parvulus* and *Elonichthys Egertoni*; also a mandible of *Megalichthys Hibbertii* from Deep Mine ironstone, Longton; Mr. Corbet, a fossil fern, *Pecopteris longitita*; Mr. J. Harrison, black and white crystals of quartz from Japan. Under the microscopes Mr. J. W. Neville showed spicules of lace sponge; Mr. H. Hawkes, section of *Peziza vesiculosa*, showing sporidia in asci; Mr. H. Insley, dendritic spot on paper; Mr. Wagstaff, *Campanularia neglecta*.—October 25th. Mr. Deakin exhibited a nest of bullfinch; Mr. Hawkes, specimens of *Agaricus dryophilus*; Mr. Rodgers, specimens of *Helix cantiana* from Fenny Compton; Mr. H. Insley, spine of *Pleuracanthus livissimus* from the coal-measures, Bentley. Under the microscope Mr. Hawkes showed a section of bud of horse-chestnut, showing the future flower scape. A paper was then read by Mr. J. Harrison, "Notes on Fishes." The writer took as a type the common codfish, describing in passing the various kinds of fish scales, as placoid, cycloid, and ctenoid. The lateral line was described as a sensitive surface, and its peculiar scales shown. Fins were described as steering organs, and the teeth, kidney, air sac, and auditory organs were dealt with at some length. A description of the heart and its action, the ovary, and methods of reproduction brought the paper to a close. The subject was well illustrated by diagrams and specimens.—November 1st. ANNUAL MEETING. Mr. C. Beale, C.E., the retiring president, delivered an address congratulating the members on the result of their work during the past year, and suggesting various ways of widening the usefulness of the society by admitting associates and other means. The impetus given to science by the late meeting of the British Association was referred to, and the interest excited by the Natural History section of the exhibition gave promise of abundant fruit in the future. The growing love for natural objects was likely to make this section a popular feature in most future exhibitions. The fossiliferous pebbles from the Drift were specially mentioned as showing what careful and patient work could accomplish. The address concluded by pointing out the good work being done by the "Practical Naturalists' Society," a society that all scientific workers would do well to recognise. Mr. John Edmonds was unanimously elected president for the ensuing year, and Messrs. C. F. Beale and F. Holden vice-presidents.—November 8th. Mr. C. P. Neville exhibited a series of quartz crystals from Welsh lead mines; Mr. H. Hawkes, the following fungi:—*Russula emetica*, *Lactarius* *rufus*, *Lycoperdon saccatum*, and *Polyporus sulphureus* from Handsworth Wood; Mr. Beale, a cluster of various corals from the Wenlock beds, Dudley; Mr. J. Harrison, a specimen of *Trigonia gibbosa* from the great Oolite; Mr. C. F. Beale, *Helix caffra*, *H. rivolii*, and other tropical shells. Under the microscope Mr. H. Hawkes showed a vertical section of flower of mignonette. A paper was then read by Mr. H. Insley on "The Probable Condition of the District at the Close of the Coal Period." The writer described the various rocks accompanying the coal seams, and spoke of the conditions they indicated, tracing the rise and decay of forest conditions from the bottom coal through the "thin," "herring," and "brooch," to an attenuated 4½in. seam which indicated a final vegetable struggle, resulting from a slight recurrence of past conditions. The overlying beds of fireclays, shales, sandstones, and marls were described, their fossils showing them to be strictly coal-measures, dwindling and dying out in a shaly bed 200yds. below the surface at Hamstead. The rocks indicate that the coal period ended in a great lake aspect, around or near which coal plants struggled and ultimately died out. A number of sketches and fossils illustrated the paper.—November 15th. Mr. A. T. Evans showed fossiliferous pebbles from the Drift containing *Sigillaria*, *Stigmaria* rootlets, &c.; Mr. C. F. Beale, ancient cornelian arrow points from Arabia; also a shell celt from Barbadoes; Mr. J. W. Neville, seedling plants of gorse, showing the transition from trifid leaves to thorns; also photo-micrographs of insects; Mr. Deakin, land shells from Bridport, including specimens of *Helix virgata*, var. *minor*, and a conical variety of the same.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly Meeting. Wednesday, November 17th. Attendance, fourteen (two ladies).—The chairman stated that Mr. Vize had sent him a specimen of *Tremella albida*, a fungus not previously recorded in the county. He also said that he had found at Beaumont Leys, a fortnight ago, a large group of the very handsome fungus *Agaricus rachodes*, which was formerly considered poisonous, but was now known to be edible. He had had several of them cooked and found them particularly excellent. Mr. Garnar exhibited specimens of the small crustacean *Asellus aquaticus*, common at the bottom of ponds, and in which the circulation of the internal fluid was very distinctly seen under the microscope. He read an account of this animal extracted from several works, but stated that the principal work upon the subject was in French, and was not procurable in Leicester. Mr. E. F. Cooper, F.L.S., exhibited dried specimens of several rare British plants, and stated that a white rat and a white-headed blackbird had been seen in the gardens of Mr. A. Paget, J.P. Dr. Finch exhibited a dried specimen of a remarkable variety of the common foxglove. Dr. Tomkins read a short paper on "The Cultivated Bacillus of Anthrax." He described the disease of anthrax, or woolsorters' disease, or malignant pustule, or splenic fever, which appeared at Arnesby in this county some months ago in some cattle, probably caused by their drinking from a stream polluted by the washing of foreign skins. Several men caught it from the cattle and one died. Dr. Tomkins had obtained matter from the pustule, and found it swarming with the characteristic bacillus, mixed with a common micrococcus. He had cultivated the two together in nutritive gelatine, and found that in these conditions the micrococcus gradually overpowered and finally extirpated the bacillus.

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WORTHINGTON SMITH DEL. ET SC

PRINTED BY WRIGHT, DAIN, PEYTON, AND CO.,

AT

THE HERALD PRESS, UNION STREET, BIRMINGHAM

PREFACE.

Once a year the appearance of Title Page and Index enables the editors of the "Midland Naturalist" to temporarily establish personal relations with its contributors, subscribers, and readers. A great many people—how many the list of contributors only partially shows—share in the labour of laying its monthly numbers before the public, and amongst these the editors are far from the most hardly worked. It is meet, then, that we should, as most gratefully and willingly we do, express our own indebtedness, as well as that of the general body of readers, for the hearty assistance without which it would be impossible to maintain the issue of our monthly numbers. Both to old and tried fellow-workers, who have stood by us from the beginning, and to the recruits who year by year are added to our ranks, we desire to offer this expression of our gratitude, and, we may add, also of our hopes.

But though the labour of producing the "Midland Naturalist" is shared by many, the responsibility is borne by the editors alone, and how anxious this responsibility is few of our readers can know. A Magazine which has completed ten years of active useful life ought to be out of the reach of accident, and the only care weighing upon its conductors ought to be that of properly editing the materials at their disposal. This is, however, very far from being the case, and it is fully within the power of our readers to relieve us of the more anxious part of our responsibility. Contributors and subscribers alike are needed. We are quite sure that our pages could be made far more interesting and far more valuable, but we cannot do it ourselves. We are not ubiquitous; we should only be a nuisance if we were; but in the Midland district, at any rate, our readers are well-nigh everywhere, and it is not unfair to ask them to try to repay the pleasure they receive from the observations of others, by contributing their own observations to enhance other people's pleasure, and to broaden the general knowledge. Every accurate observer is a potential public benefactor.

PRINCIPAL CONTRIBUTORS TO THIS VOLUME.

A. B. Badger, New College, Oxford.
E. W. Badger, Birmingham.
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Wm. Mathews, M.A., Birmingham.
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Kineton Parkes, Birmingham.
James Saunders, Luton.
B. Thompson, F.G.S., F.C.S., Northampton.
Thos. H. Waller, B.A., B.Sc., Birmingham.
W. H. Wilkinson, Birmingham.

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PRESIDENT'S ADDRESS.*

BY R. W. CHASE.

Last year, when you conferred upon me the honour of electing me President of your Society, I undertook the office with considerable diffidence and misgiving, feeling that I was not competent to satisfactorily carry on the various duties of that position; but through the assistance and consideration shown me, not only by my colleagues on committee, but also by every member with whom I have been brought in contact, I have been able to get through my year of office, and I now take the opportunity of thanking one and all for their kind courtesy, as without it I should not have been able to fulfil my duties either to the advantage of our society—which we all desire to do—or with comfort and pleasure to myself.

Consequent upon being President, I have made the acquaintance of many members, and I hope I may say the friendship of not a few, which I trust may be further cemented in years to come, and if for this reason alone, I shall always look back upon my official year with pleasure.

Before entering upon the special subject I have chosen for my address to you this evening, I should like to mention one or two matters connected with our society which have occurred during the year. You will see from the annual report that the work of the society has been carried on as usual, details of which are set out fully in that report, therefore it is unnecessary for me to make any comments.

One subject I wish to draw your attention to is connected with our soirées, which, on account of the Midland Union of Natural History Societies meeting in Birmingham last year, was held in the summer instead of winter in conjunction with that meeting, and would have been successful in every way if the attendance had been larger. The falling off is

* Transactions of the Birmingham Natural History and Microscopical Society.

to be deplored, as it evidently shows a lack of interest by the general public in the study of Natural Science. The meagre attendance was still more remarkable when we consider the fact that all members of this society had tickets forwarded to them, the cost of the same being covered by the annual subscription. The method of resuscitating the interest in Natural History must be by making our meetings more popular and attractive to the majority of members. I hope some plan will be devised whereby this can be attained.

The innovation of continuing the soirée on a second evening, when all the teachers of the elementary schools in the immediate neighbourhood were invited, was so eminently satisfactory that I hope to see the same arrangement adopted in the future. When I considered the fact that we had over one thousand visitors—all of them engaged in teaching—to view the various objects arranged for their inspection in the Town Hall, and when I heard the universal expressions of pleasure and delight, and beheld the considerable interest displayed by many in what they saw, I felt that the small additional expense entailed upon the society was both wisely and profitably incurred.

I think we may take it for granted that out of so large a number some will carry away with them the desire for a more intimate knowledge of some of the wonders and mysteries of Creation, and perhaps the cursory inspection of that evening may be the means of causing many to take up Natural History as a study, so providing both healthful and intellectual employment for their leisure. But apart from Natural History pure and simple, the art student might with advantage study some of the beautiful forms as displayed by the microscope; take, for instance, some of the desmids, diatoms, etc., etc. What more beautiful forms can man's device construct? If our workmen would only take natural objects for their models, how much more pleasing and artistic, in my mind, would their work be than the grotesque and unnatural monsters they often turn out, as much like what they are intended to represent as, let me say, the manipulator himself. Only the other day an entomological friend told me that he often lent specimens from his cabinet for jewellers to work from, and that the results were so superior that the same course might be adopted in many other crafts. Some time ago I looked at a costly set of china plates painted to represent our various native birds, the majority of which were simply abortions of what was intended to be illustrated; the artist had evidently wasted his time by copying badly stuffed specimens in some museum.

I venture to think that considerable advantage would accrue to many if they were to join some Natural History Society and obtain an opportunity of peeping into "the book of Nature."

At the meeting of the Midland Union a strong appeal was made for the protection of native plants, which I hope has met with some success. I now wish to raise my voice on behalf of the feathered tribes, my especial favourites, who, to satisfy the demands of a certain fashion, are being slaughtered all over the world, to decorate both hats and dresses of fashionable ladies. Criticising such decorations from a naturalist's point of view, they are neither beautiful nor real; you often see the wings of one bird associated with the head and tail of another, or *vice versâ*, and arranged contrary to all natural laws. This slaughter is no light matter, when skins are ordered by the thousand and tens of thousands, if we wish to preserve from total extinction a number of birds, many of them the brightest gems in creation. The formation of the Anti-Plumage League has not been started too soon, and every Natural History Society ought—in fact it is a duty—to assist as far as possible in putting an end to this "barbaric fashion." If the fair wearers would only consider for a moment the cruelty and suffering caused in obtaining the necessary skins to trim even one dress, I feel sure their kind feelings and tender hearts would cause them to shun such a fashion. You may say that I am the last person qualified to advocate the preservation of birds, having so many victims in my possession, but I do not hesitate to say that one milliner's warehouse would contain more skins than all my collection. If the Press would only take this matter up in the same spirit they do if a single rare migrant is shot, which in all probability would not stay in this country, I fancy the slaughter of the "innocents" would soon come to an end.

The subject I have chosen for my address is not only interesting to an ornithologist, but to naturalists in general, especially to evolutionists, viz., "The coloration of eggs and form of nest: whether governed by inherent instinct or not."

It has been affirmed that birds construct their nests not from instinct, or, more properly speaking, inherent knowledge how to form their nests, but from imitation and memory, and statements in support of such theory are given, such as this—that birds in confinement do not make a nest typical of their species. Perhaps not, because in all probability the bird has not the proper materials wherewith to construct one; but surely even a cage bird must have been hatched in one, and therefore, according to the argument, ought to have built one after the pattern of the only one it had ever seen.

Let us consider for one moment what opportunity a bird has for learning the art of nest building. In the first place, the nest is constructed before the eggs are laid, consequently the young when hatched can have had no opportunity to see the operation of building, neither can they have had pointed out to them the proper and most likely places where to obtain suitable materials. Again, the principal characteristic of nests is the manner of construction, and with the same materials—moss, lichen, and hair—two distinct species will produce quite a different edifice. Therefore, when we consider that the young are often only in the nest from fourteen to twenty-one days, is it to be believed that they can possibly in that short time learn the art of nest building simply from examination of their home during their occupation, and that the details are so impressed upon their memory; in fact, that the young ones have learnt their lessons so well as never to forget it? I think certainly not. To suppose birds build their nests from imitation and memory seems to me to at once allow them the power of reason, which I am certainly unwilling to grant, although I know it is a very debatable point where instinct ends and reason begins, the two being divided by such fine and delicate distinctions that it is difficult to define a hard and fast boundary to either. Again, how can the young birds know what bird produces the feathers that line the nest they are in? Surely when the time arrives for them to build they do not hunt about until they find a facsimile to those in their old home, nor are the architectural details so vividly impressed upon their memory that after often a period of months and in some cases years they are able to construct a counterpart. I have no hesitation in saying that supposing you were to exchange the eggs from the nest of a robin and place them in that of a hedge-sparrow, that the young robins would, when the time came for them to construct a nest, make one after the type of their real, instead of that of their foster parents.

Or if you exchange eggs with a blackbird and thrush, I am certain, although the thrushes were reared in the blackbird's nest, they would in their own nests use the characteristic lining of their species, and would not use the only nest they were acquainted with as a model.

In support of the imitation theory it is urged that the young birds have "an opportunity of examining old nests," and also seeing some constructed prior to the time of their own nidification; this would hardly apply to those species that do not arrive at maturity before three years, as generally they do not associate with the adult breeding birds, but congregate together in flocks, away from the nesting stations. If this imitation tendency is so powerful, how is it that the kestrel has never developed nest building, although Nature has endowed her with the same means or tools in the way of beak and claws as the sparrow hawk? but instead of constructing a nest of her own she makes use of an old or deserted one of a crow. The young kestrels, while in the nest, cannot possibly know the nest was not constructed by their parents, therefore this propensity of using another's nest must surely be put down to inherent instinct. Some no doubt will say that an ancient pair of kestrels, more advanced in wisdom than their fellows, adopted the plan of utilising deserted nests in years gone by, and that their descendants follow their example at the present time; but how would it be possible for the original wise pair to impart their knowledge to their offspring?

Again, why should not the cuckoo develop a propensity to construct a nest similar to that in which it was reared? I say, simply because it would be contrary to its inherent instinct. But it is argued that supposing a young cuckoo is brought up in a wagtail's nest, that individual would in the future look out for a wagtail's nest to deposit her eggs in likewise; but supposing the young cuckoo proved a male—I believe males largely preponderate—the desire to use a nest of the same species must end in this case, as the male cuckoo takes no part whatever in domestic duties; the transmitting of this trait must, therefore, rest entirely with the female bird. The consequence of this would be to very much restrict the number of species whose nests are used by the cuckoo, whereas the contrary is the case, as each year fresh species are added to the list in which a cuckoo's egg has been found.

If this imitation theory is correct, how are we to account for a cuckoo's egg being found in the nest of Podiceps minor? such find being on record; because it would be an impossibility for a cuckoo to be reared by such foster parents. Whence, then, had the parent cuckoo her desire to deposit her egg in such an unsuitable nest?

It has always been a mystery to me how the cuckoo is able to ascertain if incubation has proceeded in the eggs of the bird she wishes to use as a foster parent for her progeny, because I have generally found that the legitimate eggs as well as the alien one hatch almost simultaneously. Various explanations have been given; one is that the cuckoo destroys one of the eggs in the nest before depositing her own to ascertain if the clutch is fresh. I think this is probable, as I have often found egg shells in proximity to a nest containing a cuckoo's egg, evidently destroyed by some bird. Another explanation is that the cuckoo watches the nest being built, and as soon as the first (one or two) eggs are laid then deposits her own, as after incubation had commenced she would have little opportunity of effecting her purpose, the intended foster parent being rarely absent from the nest. The belief held by many, that the cuckoo is able to produce an egg closely resembling those in the nest she contemplates making use of, is so illogical that if it were not for the wonderful similarity in colouring often observable between the cuckoo's egg and those belonging to the nest, it would soon die out; but quite as great contrast is also found. If the cuckoo had this power of discriminating colour, it is certain that after laying the egg and ascertaining the peculiar tints she would have to carry it about either in mouth or feet until she found a clutch of analogous hue.

Now, when we consider that the cuckoo cannot know the colour of her egg until it is extruded, supposing one lays an egg very like a meadow pipit's and deposits such egg in a nest of that species, it is very likely that in that same neighbourhood several instances will be found of this close resemblance, which is easily accounted for, as the cuckoo lays about four or five eggs, if not more, in the season; and I also have no doubt that all laid by the same bird are alike in colouring, and in case pipits' nests were plentiful, I see no reason why the cuckoo should wish to exert herself in finding others; hence we should get a number of examples of this close similarity of colouring.

I will give you an instance that came under my notice which clearly proves that a bird lays eggs always alike in colour and markings. Two years ago my father showed me a clutch of blackbirds' eggs in a spinney near his house, of unusual coloration, having all the markings collected in a band or zone at the larger end, instead of being speckled all over. I took these eggs, but, unfortunately, they were hard set, therefore did not make good specimens for the cabinet; about three weeks later, I was informed that the same pair of birds had nested again, and upon putting the old bird off her nest, I found a clutch of eggs exactly like those I had previously taken.

(To be continued.)

AN EXCURSION TO TENBY.*

June 5th to 19th, 1886.

BY W. P. MARSHALL, M.I.C.E.

This was a fortnight's excursion made by a party of Members of the Natural History and Microscopical Society in June last; there were eighteen in the party, fourteen of whom stayed the whole fortnight. An entire house was taken for the party, "Worcester House," on the Esplanade, Tenby; very conveniently and pleasantly situated, and well suited for our purposes, with a handy work-room on the ground floor for marine collections and microscopical work. The rocky cliff in front was covered with flowers, especially fine masses of Viper's Bugloss and red and white Valerian.

At the foot of the cliff is an extensive sandy beach, which is covered at high water, but at low water gives access to St. Catherine's Rock in front; a rock that is perforated with sea caves, in which are numerous rock pools, that afford a fine supply of marine objects.

The coast for a long distance from Tenby is a very irregular line of bold, rough cliffs, worn by the sea action, which is very severe at times, the coast being exposed to the force of the Atlantic waves; and the rocks are hollowed out into caves and natural archways, with detached isolated rocks standing out in the sea. These caves, where accessible at low water, contain an extensive and fascinating collection of marine life.

Excursions were made to many specially interesting and pleasing spots; particularly numerous fine specimens of ruined castles and ivy-covered church towers.

The following land excursions were made by the party:—

Monkstone Bay, two miles, where numerous rock pools were found at low water. The rocks showed a very interesting example of contorted and dome-shaped strata.

Carew Castle, six miles, a picturesque ivy-covered ruin on the edge of one of the long inlets from Milford Haven, which runs in to a distance of fifteen miles from the sea.

Lamphey Palace, eight miles, and Pembroke Castle, ten miles from Tenby, finely situated on another inlet of Milford Haven. Pembroke Castle is a remarkably good example of an ancient castle, and has a fine large keep in good preservation, which forms a conspicuous and picturesque object

* Transactions of the Birmingham Natural History and Microscopical Society, read October 12th, 1886.

for a wide distance round. Several successful photographs of the castle were taken by one of the party, Mr. Potts, who was very active in photographing the various objects of interest met with in the excursions, and took more than forty photographs.

Manorbere Castle, five miles from Tenby, is picturesquely situated on the southern coast, and affords a particularly good example of an ancient baronial residence; it is in good preservation, and a portion is now occupied as a summer residence by a gentleman's family.

Lydstep Caves, four miles from Tenby, are a special locality for marine specimens; the best portions are only accessible at low tides, and abound in well-stocked rock pools. The rocks are very bold, and present a striking appearance from the beach at low water, with their caves and natural arches. Amongst the marine objects found there was *Tubularia indivisa*, a lovely rose-coloured polype, growing in a small sheltered hollow of the rock.

Stack Rocks was a long excursion, sixteen miles from Tenby, where two detached pinnacles of rock, 300 feet in height, stand out in the sea. These isolated rocks are the special resort of enormous numbers of birds, which have bred there annually from time immemorial; and they completely cover the whole of the top of the rocks, and the ledges on the face. The birds are chiefly Guillemots, called locally "Elegugs," and are conspicuous from their white breasts, and they present a striking appearance of large white patches on the rocks, and long white lines on the ledges of the rocks.

One sea excursion was made in a steamer from Tenby along the south coast, round Linney Head, and up Milford Haven to Pembroke; a very striking and beautiful view was obtained of the bold rocks along the coast, and particularly of the Stack Rocks, the steamer passing very near to the rocks, as the weather was fortunately suitable. While passing, a gun was fired, and an extraordinary mass of birds rose up suddenly into the air, leaving the rocks black where they were before white.

It is only during the period of rearing their young that the Guillemots frequent the ledges and crevices of the precipitous sea cliffs, appearing about April and leaving in August; performing a partial migration, as after the young are full grown they forsake the breeding stations and keep some distance out to sea, and until the following spring only occasional birds are seen in shore. The number of these birds congregated together at the breeding stations is astonishing; the ledges or shelves of the cliffs are simply packed close with the birds, and most comical they look in their upright position side by side, forming long rows upon the narrow ledges, which are often only a few inches wide, the birds appearing like white lines drawn upon the face of the cliff. Such a breeding station is a busy scene, and one not easily forgotten; thousands of birds continually on the move, flying down from rock to sea, and up again from sea to rock, whilst thousands are busy in the water after their finny prey.

The Guillemot lays one egg only, of enormous size in comparison to the bird, upon the bare rock; the eggs vary infinitely both in colour and markings, it being almost impossible to obtain two eggs alike, unless laid by the same bird. There are other similar breeding stations, at Lundy Island, in the Bristol Channel; Flamborough and Bempton Cliffs, Yorkshire; Farne Islands, Northumberland; the Bass Rock, Frith of Forth; the Hebrides; and the Orkney and Shetland Isles. The information about these birds has been kindly supplied by our president, Mr. Chase.

Amongst the plants collected in the excursions were specially noticed fine large specimens of Columbine, *Aquilegia vulgaris*, in the hedges near the sea; *Orchis latifolia*, the smaller Butterfly Orchis, at Monkstone Bay; the little Burnet Rose, *Rosa pimpinellifolia*, abundant on the sandhills close to Tenby; *Echium vulgare*, Viper's Bugloss; and *Centranthus ruber*, the red Valerian, on the rocks at Tenby. Also amongst ferns, *Asplenium marinum*, *Asplenium adiantum-nigrum*, and *Ceterach officinarum*.

Dredging was only tried one day in Milford Haven at Pwllcroghan, using the small-sized dredge from a sailing boat. The water was shallow and the bottom muddy, and satisfactory results were not obtained.

The special collecting that was done in this excursion was with a surface tow-net, using a new construction of net, which we tried then for the first time. It was designed by Mr. Giles, of Madras, and was described by him in "Science Gossip" for March last (page 52), and it appeared to us so good an idea that we determined to make trial of it upon the first opportunity. In the ordinary tow-net, with a glass bottle attached to the tail end, the bottle is filled at once with water that has passed through the net containing objects in it; but the further supply of objects into the bottle can only be obtained by their chance passage from the bottom of the net into the bottle, as no more water can enter the bottle after it is once filled except by the chance displacement of some of the water to make room for more.

In the new tow-net, instead of a bottle an open glass tube is attached to the tail end of the net, through which the water flows, and the outer extremity of the glass tube is expanded to a wide mouth, three inches diameter, across which a fine muslin strainer is fixed. This allows a constant current of water to pass through the glass tube whilst the net is towed along, carrying with it the minute organisms that are floating in the water; but whilst the water passes through freely, these organisms are all retained in the glass by the fine muslin strainer. The net used was a strong, coarse muslin funnel 3½ft. in length and 1½ft. in diameter at the mouth, which was kept open by a light brass hoop to which the towing cord was attached. An inner shorter funnel 1½ft. in length was attached to the same mouth ring, ending in an opening about six inches diameter; this inner funnel serves as a trap to check the escape from the net of any objects that enter it. After towing the net at a very slow speed for about ten to fifteen minutes it was drawn up, and the glass plunged at once into a basin of water to prevent the water sinking down in the glass so low as to risk damage to the contained objects by their getting too closely packed. The net was then untied from the glass, and the contents of the glass poured out for examination. Some minor modifications were made in the apparatus in the course of the trials, such as dispensing with a cork float originally fitted upon the glass tube, and some further minor improvements may probably be made as the results of experience, but the plan proved a thorough success and very efficient in working.

The tow-net collecting was mainly in Tenby Bay, near St. Catherine's Rock, from a rowing boat, and quantities were obtained there of *Noctiluca miliaris*, the minute globular organism that is the most usual cause of phosphorescence of the sea; and this phosphorescence was brilliantly shown after the specimens were taken ashore, and even remained visible in some after bringing them to Birmingham.

Quantities were also obtained of the medusiform gonozoids of *Obelia dichotoma*, which are the minute free swimming larval state of a polype that in its mature state is stationary in a fixed branched form; these formed very beautiful objects for the microscope when in the living state, actively moving by the flapping pulsation of the medusa umbrella. The delicate and beautiful *Cydippe pileus*, or Sea-acorn, was also found in abundance.

The larger Medusæ, or Jelly-fish, were also caught in the tow-net, and sometimes caused trouble by choking up the entrance to the glass tube; and to prevent this, the addition of a light wire sieve of about an inch mesh is desirable at the mouth of the net.

On the shore of St. Catherine's Rock a fine specimen of a large Jelly-fish, *Rhizostoma Cuvieri*, was caught entangled in the sea-weed; the bell measured seventeen inches diameter and eight inches height, and it was composed of a thick, tough, cartilaginous substance of an opaque white.

Many beautiful specimens of Sea Anemones were found upon the rocks, but they were difficult to remove in most cases, on account of shrinking back into holes in the honey-combed surface of the rocks. Under the overhanging rocks that were uncovered at low water, large numbers were seen hanging as long jelly-like pendants from the holes and crevices. The common *Actinia mesembryanthemum* was very plentiful, of great variety of colour; a few of a very beautiful green, and one or two bright scarlet. *Sagartia venusta*, the orange-disc anemone, was in great numbers, but in very inaccessible places; *Sagartia nivea*, the snow anemone, not so plentiful, and very difficult to get at, as they generally lay so deep in the crevices of the rocks; *Dianthus plumosus*, very plentiful; *Telea crassicornis*, only a few. These particulars of the Sea Anemones have been kindly supplied by Mrs. Rabone.

Specimens of Serpula and Spio brought away upon pieces of stone and placed in a small aquarium glass, formed very interesting and beautiful objects for examination with the microscope, in a living state, and feeding upon small crumbs dropped into the water; numbers of the larva of Spio recently escaped were also seen floating about.

In water holes in St. Catherine's Rock there was found the branched polype, *Plumularia pinnata*, and a special piece of microscope work that was done was the mounting of specimens of *Plumularia* with the tentacles remaining expanded. This was effected by the plan of one of the members, Mr. Clarke; he administered minute doses of gin and sugar to the polypes at short intervals, until after about a quarter of an hour or longer they were found to be dead with their tentacles well expanded.

Trials were made of different media for mounting, and on the whole *Hainsch's fluid* (consisting mainly of glycerine and alcohol) was found the most favourable for preserving delicate objects, such as the medusiform gonozoids; but further trials and longer experience are required respecting this point.

We were also specially indebted to Mr. Bolton for his efficient aid in collecting and preserving specimens, and exhibiting microscopic objects in the living state.

We had the pleasure of the company on several occasions of Mr. F. Walker, of Tenby, an enthusiastic naturalist, who has for many years closely studied the fauna and flora of that district, and who afforded us valuable information and assistance.

In conclusion, it has to be added that for the organisation and effective carrying out of this delightful and instructive excursion we were entirely indebted to our esteemed friend Mr. Morley, to whom our best thanks are due.

LIONS BRED IN CONFINEMENT.

It will probably astonish many to learn that in the gardens of the Royal Zoological Society of Ireland, Phœnix Park, Dublin, within the last thirty years, no less than 131 lion cubs have been born. The breeding stock was started by a pair of African lions imported from Natal in 1855. The first litter was born in 1857, and between that date and 1885, of the 131 produced, twenty-one only were lost, and they were either born dead or died shortly after birth; and of the 110 reared, eighty-six were sold, so that zoological gardens, not only in Europe, but also in America and even Africa, have been supplied with lions born at Dublin.

The first lion, Natal, lived in the gardens for eight years; his progeny by three different lionesses amounted to forty-two. The second lion, Old Charley, a son of the above, was the father of forty-six cubs; he died at the age of ten years. His son, Young Charley, died when twelve years old, having had twenty-seven cubs, one of whom, Paddy, is at present in the gardens, and is now rising seven years old. Seven lionesses were bred from in the gardens, the most remarkable being Old Girl, the offspring of the first pair. She was mated when two and a half years old, and was the mother of fifty-five cubs in eleven years, forty-one of which were disposed of, realising no less a sum than £1,400 for the society. Old Girl died at the age of sixteen years, having become very feeble and diseased. The number of cubs in each litter varied from one to eight, but the general number was four. The period of gestation is fifteen weeks.

Of the 131 cubs produced, the sex of one born dead was not recorded; the remaining 130 were seventy-four males and fifty-six females. The cubs at birth were distinctly spotted with dark brown on a light brown ground; these spots generally disappear, but are sometimes to be found on the lower parts of the adult animals, especially of the lionesses. The spots were never arranged in bands, as sometimes stated.

Those who may wish for further particulars will do well to refer to an exhaustive article on the subject in the "Transactions of the Royal Irish Academy," Vol. XXVIII., Part 24, Aug., 1886, entitled—"Observations on Lion Breeding in the Gardens of the Royal Zoological Society of Ireland," by V. Ball, M.A., F.R.S., Director of the Science and Art Museum, Dublin, and Hon. Sec. of the Royal Zoological Society of Ireland.

A VISIT TO CHIRK.

On Easter Monday last, April 26th, about fifty members of the Birmingham Natural History and Microscopical Society and their friends made their first excursion of the season to the interesting village of Chirk. Among those present were the Rev. H. Bonner, Messrs. W. P. Marshall, M.I.C.E., W. B. Grove, B.A., J. Potts, J. H. Wright, J. Rabone, W. H. France, W. B. Malins, W. Phillips (Shrewsbury), J. Morley (Hon. Sec.), and others, including many ladies.

Proceeding by the 8.32 Birkenhead express train, they reached Chirk Station at 10.45. The rendezvous was the Chirk Castle Arms, or, as it is popularly called, the Hand Hotel. Some years ago it was known as the Red Hand, and a large signboard bore a representation of an open red hand. It was so called from the circumstance of the red hand being the crest of the Biddulph family, who are the owners of Chirk Castle, and of large estates in the county. The only representation of the old "red hand" now to be seen at the hotel is a small bright golden hand displayed in the lamp over the door. The Hand is a favourite public-house sign in Montgomeryshire and Denbighshire, as, for example, the "Hand" at Llangollen and other places. The open red hand, which forms part of the arms of the Province of Ulster, commemorates the daring of a bold adventurer, one O'Neile, who made a vow to be the first to touch the shores of Ireland, but finding the boat in which he rowed outstripped by others, he cut off his hand and flung it ashore, to touch it before the others could make a landing. The open red hand in the armorial coats of some baronets, as in the case of Sir Thomas Holte, of Aston Hall, which may be seen in a window in Aston Church, thus originated. Two hundred baronets were created by James I. on payment of £1,000 each, ostensibly for the relief of Ulster, but really for his personal aggrandisement, and they were therefore allowed to place upon their coats of arms the open red hand, or the "bloody hand," borne by the O'Neiles, whose estates had been seized by the King. They were called "Ulster baronets." The "bloody hand" was often, in the popular mind, associated with some deed of blood, supposed to have been perpetrated by the individual in whose arms it was placed. Thus, Sir Thomas Holte was said to have murdered his cook some 250 years ago, and when pardoned by King James was ordered to bear a "bloody hand" ever afterwards on his coat of arms, when the sole reason was, as we have shown, that he had paid into the King's exchequer a thousand pounds for a mere title.

On leaving the railway a pleasant walk of an hour was taken by the excursionists into the valley of the Ceiriog, to view the aqueduct and viaduct which cross that river. The aqueduct which carries the Ellesmere Canal was designed by Telford; it is 690 feet long, and 65 feet above the river; the viaduct is 100 feet above the bottom of the valley. The view was especially fine, and the botanists of the party found abundant occupation in their favourite pursuit. The church was next inspected. It is an ancient structure, but calls for no especial remark, as it was some years ago restored, at an expense of upwards of £2,000. It contains some monuments and stiff effigies of the Myddelton family. The oak roof over the older part of the church is in good preservation. Tradition has it that Dr. Sacheverell was once rector of this church, from which he was suspended for three years, and two objectionable sermons preached in it by him were burned by the common hangman. This, however, is a mistake, as it was a neighbouring parish over which he presided. The aged yews in the churchyard are particularly fine, and well accord with the solemnity of the place.

After a substantial luncheon at the hotel, a walk of some two miles or so through pretty and diversified scenery brought the visitors to the castle. Chirk Castle is a quaint structure, partaking of the features of both castle and mansion, with the angles strengthened by four exceedingly clumsy bastion-like towers, each of which is surmounted by a small turret. The present structure was built by Edward I., though a castle had stood upon the same site two centuries earlier. It was in 1595 the property of Sir Thomas Myddelton, who afterwards became Lord Mayor of London, and was the brother of the celebrated Hugh Myddelton, the projector of the New River from Hertfordshire to London to supply the metropolis with water. The estates have continued in the same family to the present day, although the name of the owner has become changed from Myddelton to Biddulph. In the time of Charles I. Sir Thomas Myddelton declared himself against the Royal cause, and achieved several brilliant exploits, although he did not take the field till he was near sixty years of age. His estates were sequestered, but he afterwards obtained repossession of his patrimony at Chirk. A year before the Restoration, however, he had changed his views, and had precipitately declared in favour of the second Charles's return. For this his Castle of Chirk was besieged and taken, the trees in the park were cut down, the timber sold, and damage was done to the extent of £80,000.

Entering by the gateway tower, the visitor passes into a large quadrangle, which has evidently undergone much modern restoration. These alterations, with considerable internal embellishment, were the work of the elder Pugin. The great hall contains a vast number of ancient implements of war, and others for domestic use, including several fine black-jacks, tall hats of the Cromwellian period, &c. A curious bird's-eye view of the castle in the seventeenth century was shown; it is made of mosaic, the several minute pieces of which it is composed being of ivory and bone inlaid into a black oak background. It was made about forty years ago from the handles of old tooth-brushes and other articles of bone or ivory. It is inscribed in the same material, "Chirk Castle, Denbighshire, the seat of John Myddelton, Esq.; done by the porter, Roberts." The frame is of the same material, and altogether the work is ingenious and very effective. To describe all the beauties and rarities contained in this interesting building would much exceed the space at our disposal. The rooms are of grand size and proportions, and the ceilings and walls throughout are adorned with arabesques and gilding in profuse extent. The walls of the various rooms contain many paintings, chiefly portraits. There are portraits of the great Duke of Ormond; Charles II.; Barbara Villiers, Duchess of Cleveland; the Duke of Monmouth; Fair Rosamond; Queen Mary; Jane Shore; Sir Thomas More, by Holbein; the Countess of Warwick, afterwards the wife of Addison; Sir Orlando Bridgeman, in his robes, and Lady Bridgeman; and many other historical portraits: Landscapes and other artistic works are not wanting to give variety and grace to the collection. Several landscapes by Wilson, the father of the English landscape school, as he is called, attracted especial attention. A curious painting of Orpheus charming the brutes was particularly droll. One of the chief of his charmed listeners was a full-grown unicorn, which would not have disgraced any Royal arms with which he might have been connected, while the lion had a singularly human face, with an aquiline nose. Most of the furniture of the show rooms of the castle was very fine, and in good condition. In one of the rooms was a magnificent cabinet or *prie-Dieu*, presented by Charles II. to Sir Robert Myddelton. At the Restoration the King offered him a peerage, which he declined, upon which the King said, "Then take this cabinet home with you as a memorial of my regard." The cabinet is made of ebony, and contains twenty-five or thirty panels, in every one of which is an exquisite painting by Rubens. They are upon copper. Those on the outside are classical, while those within are scriptural subjects. On a large flap inside, about twenty inches by ten, is an exquisitely painted representation of Christ blessing little children, which contains many figures. The interior of the cabinet has many drawers, and is veneered throughout with tortoiseshell and choice woods. The frames and fittings of the pictures are all of richly chased silver, and it is estimated to be of the value of at least £10,000. Charles I. slept in the castle in the year 1645, and the bedroom he occupied was shown, but the bed was not as it was then in use.

The painting which was the object of the greatest curiosity is a landscape and a marine view combined. It was painted by a foreign artist, who was commissioned to paint the Waterfall of Pistyll Rhaiadr, in Montgomeryshire. The Myddelton for whom it was painted suggested that the introduction of some sheep would materially improve the picture, but in his Welsh pronunciation he said he wanted some *sheeps* in it. The artist accordingly altered the picture, and made the water as falling into the sea, on which he painted some *ships* lying at anchor close to the rocks. Now, considering that the Pistyll Rhaiadr is more than thirty miles from the sea in any direct line, the picture is as curious an anomaly as was ever perpetrated on canvas. A descent into the dungeon was made by most of the visitors. It was a gloomy chamber about thirty feet below the surface, the only air or light obtainable being through an aperture a few inches square at the top of a shaft in one of the walls of the room. A more horrid place for a human being to exist in can scarcely be conceived. Watt's dyke passes through the castle grounds, and Offa's dyke at a mile distant, but time did not permit of a visit to either, though they had been included in the programme. Offa's dyke, which extended from the Dee to the Wye, is here to be seen in as almost perfect a state as when it was constructed by him in the eighth century to defend his country, Mercia, from the incursions of the Welsh.

After the visit to the castle a return was made to the hotel, where tea was served, and the party arrived in Birmingham at half-past seven. The comfort of the party was greatly enhanced by the courtesy of Mr. Paxton, of the Great Western Railway, who provided saloon accommodation, and in other ways made special arrangements to promote their convenience. The conduct and arrangement of the excursion was made by Mr. J. Morley, the honorary secretary.

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Part IV., Chapters VI. to XII.

"The Morphological Composition of Plants."

BY W. HILLHOUSE, M.A., F.L.S.

[Abstract concluded.]

Spherical symmetry is rare in aggregates of the second order, but a case is met with in *Volvox*. No doubt the comparatively perfect symmetry of this plant is due to its being free and motile, so that the distribution of forces can be equalised. Most of these higher organisms are fixed, and spherical symmetry becomes necessarily lost; a tendency to it is, however, shown amongst Florideans, while *Fucus* shows bilaterality or asymmetry. It must be borne in mind that in large developments perfect and absolute equality of part is an impossibility; hence many organisms which, like the mycelium of *Mucor*, Mr. Spencer tends to consider asymmetrical, may be just as symmetrical as, from a finer point of view, *Protococcus* is. Thus to the naked eye view the cap of an ordinary Agaric is radially symmetrical, but if you insist on mathematical accuracy, probably radial, or any other, symmetry does not exist. All these aggregates of the first and second orders the botanist speaks of as morphologically undifferentiated into members; *i.e.*, as constituting a *thallus*.

* Birmingham Natural History and Microscopical Society, Sociological Section, Dec. 17th, 1885, and Jan. 21st, 1886.

The aggregates of the third order are with very few exceptions fixed, and even in those exceptions (*Lemna*) show distinct bilaterality, or dorsi-ventrality. In uniaxial plants, the bird's eye type is radial symmetry, *e.g.*, a Palm. Divergences, where met with, affect usually the flower only, *e.g.*, Foxglove, Wild Hyacinth. In multiaxial plants the general type again is radial, but constantly broken, even in the open, by inequality of sun's rays, and the prevalent direction of the wind. The type of the root is more distinctly radial, in cases, indeed, we might almost describe it as hemispherical, but divergences arise from inequalities in the hardness of the soil, and in the distribution of moisture, and of internal food supply.

The nearest approach to simple spherical symmetry in branches is in the "buds" of the yeast plant, and the conidia of many fungi. The most of simpler plants have their branches radial in type, and often radial in development, and in these, as in all cases, the branch is either a repetition or a simplification of the axis, and the attached differs strongly from the free end. Florideæ, Characeæ, and Equisetaceæ furnish abundant illustrations. Of the larger plants, many do not branch at all; those which do produce their branches originally in radial wise, though by stress of circumstances they may ultimately become strongly bilateral, *e.g.*, the Lime and the Fir; the two main agents in this change are light and gravity. The influence of the action of light is very strongly manifest in such a case as the Ivy; where growing out free above a small tree which it has enveloped, it seems hardly the same plant as when clinging to the face of a wall.

In leaves, highly differentiated as they are, spherical symmetry is entirely wanting, and even radial (peltate) symmetry is rare. This latter is met with in certain cases, such as *Oxalis* and *Marsilia*, amongst compound leaves, and *Nelumbium*, *Tropæolum*, *Victoria regia*, and *Hydrocotyle*, amongst simple leaves. In all these cases we have either vertical leaf-stalks, from a more or less creeping stem, or else leaf-stalks so long that they can carry out the laminæ to a considerable distance from the centre. Interesting transitions are furnished by such a plant as the Lupine, in which the radical leaves show proximate radial symmetry, but with the external leaflets longest while the cauline (stem) leaves successively become more strongly bilateral. The influence of light is here probably the most important factor, each leaf, or leaflet, tending to grow uncovered by the shade of its next successor. An illustration of this is provided by two semi-aquatics of generally like habit; in the Water-cress, with the shade near the stem, the terminal leaflet is largest, in *Helosciadium*, with less shading, the proximal leaflets are largest. This is evidently quite akin to the varying thickness of leaves on one and the same tree, according to whether they are growing on the outside, exposed to full sun-light, or in the interior in comparative shade. In the beech, for example, the former can be as much as three times the thickness of the latter.

Before quitting this subject of leaves, we ought, while clearly acknowledging that they furnish many of the most beautiful illustrations of relations to external forces, nevertheless to draw attention to the manifold dangers of inductive biology founded upon such variable members as leaves are. In many cases their forms may be due, not to present, but to ancestral conditions of life, and the plant may not be equiplastic in morphology and in physiology. Thus, while we acknowledge that radial (peltate) leaves have erect leaf-stalks, and are, in general, radial, it is not true that radial leaves tend to be peltate. The great majority of erect growing leaves are sword-shaped or grass-like.

The consideration of the evolution of flowers opens up a series of most interesting and important facts. Referable as floral parts are to the leaf-type, they have deviated as a rule widely from it, though the deviation of the bract of *Helleborus fœtidus* from the form of the radical leaves of the same plant is at least as great as the flower shows. The plasticity of the flower is about equivalent to that of the leaf. Floral branching, however, commonly differs widely from stem-branching, and the former may be present where the latter is not.

The fundamental arrangement of leaves is no doubt primitively spiral, and the primitive arrangement of floral parts followed the same type, and produced the cone. The radial, or cyclical, arrangement for leaves, excepting on a very restricted scale, is rare; the cyclical arrangement of floral parts is, for some part or other of the flower, well-nigh universal, at least in external appearance. The study of the organogenesis of the flower would suggest, however, that the cyclical state is an after state even in the individual flower, and that the parts, even when they are joined together, may be, in a limited sense, of different ages. But if equivalence comes about at all there is a tendency for it to be produced at progressively earlier periods, and hence fundamental spirals can ultimately give origin to true cyclism.

No doubt an erect growing flower would tend to be radial, but *Pinguicula* and *Viola*, both fundamentally erect-growing flowers, diverge widely from the radial type. Interesting examples of the kind of agency which may effect change are provided by the Candy tuft, the wild Guelder rose, and several Umbellifers, as well as by a large group of the Compositæ. In all these cases the flowers form a more or less flattened group, and while the central flowers are radial (as far as general contour goes), the external flowers are entirely bilateral, extending largely on their external side. Clearly here, as in the inverted flowers of Orchids, and the pendant raceme of the Laburnum, mechanical conditions, though of a different class, come into play. Again, the under half of a bilateral flower tends to project beyond the upper half. Whence is this? As Mr. Spencer points out, these parts contain no chlorophyll, and hence, he assumes—"the tendency to grow most where the supply of light is greatest is less decided, if not absent." But perhaps he has told here but half of the tale. The tendency of green parts to grow largest in the greatest light is strongly marked; but it is equally true that light has certain mechanical effects which are *disadvantageous* to growth, and that, therefore, in a part whose growth is independent of light, the growth, *cæteris paribus*, will be greatest where the light is least. Nor do I think the mechanical reasons referred to above must have undue weight attached to them. The most marked cases of bilaterality in flowers are those where insect agency is the medium for fertilisation, and the progressive influence of this agency upon the flower introduces a disturbing factor of the first class.

Another point of prime interest in an enquiry such as this can be only touched upon here, and it is this: that while in the flower as a whole the radial type greatly outnumbers the bilateral, in the ovary the bilateral type hugely preponderates. Excluding Leguminosæ and Euphorbiaceæ there is no natural order of primary numerical importance which has not a bicarpellary ovary.

As to the question of the shapes of vegetal cells, discussed by Mr. Spencer with great brevity in Chapter XI., space will not permit us to do more than indicate a few points of importance. Mr. Spencer's own conceptions are remarkably circumscribed. A point we should like to lay stress upon is the different shapes of cells in the interior tissues of the leaf. Taking a typical flatly exposed leaf, under its upper surface are one or more layers of cells whose long axis is vertical to the surface, and in the same leaf the number of these layers will vary with the exposure of the leaf. The more light, the more the layers. In plants of shady places, and in shaded leaves, they are either entirely or well-nigh wanting. They are manifestly intercepting cells. Over the under epidermis of the leaf the tissue hardly varies at all. It is a spongy parenchyma, with abundant air-spaces. In vertically growing leaves the layer of vertical cells ("palisade layer") may be present on both sides, or on neither. There is here, therefore, manifest relation of structure and light. Again, the elongation of fibres and of the elements of vessels is due, in part at least, to the stretching influence of actively growing cells in their neighbourhood, and the reality of this factor may be recognised by the elements sometimes being even torn asunder. As to the origin of the diversity of form of free-growing cells, and of the hairs on an epidermis, let us at once acknowledge our complete and absolute ignorance; and in conclusion point out that even in those cases where the matter appears to our finite knowledge to be perfectly clear, we are arguing in the absence of a general factor of vital importance—in the absence, viz., of any excepting the feeblest glimmerings of knowledge as to the historical conditions of life of the plant in question.

THE PRINCIPLES OF BIOLOGY.

The Sociological Section of the Birmingham Natural History and Microscopical Society completed their study of this work on Thursday, December 17th, 1886, when Dr. Alfred Hill, F.I.C., delivered an exceptionally able and interesting address on the final chapters of Part VI., LAWS OF MULTIPLICATION, viz., "Multiplication of the human race" and "Human population in the future." There was an unusually large attendance, and a discussion followed, in which the President (Mr. W. R. Hughes, F.L.S.), Mr. F. J. Cullis, Mr. R. W. Chase, Mr. W. H. France, Miss Dalton, and others took part. A hearty vote of thanks was passed to Dr. Hill on the conclusion of his address, which occupied upwards of two hours in delivery.

This important work, which forms the second division of Mr. Herbert Spencer's system of "Synthetic Philosophy," unifies in the great doctrine of Evolution all the leading generalisations of Biological science. The work was issued by the author in instalments, commencing January, 1863, and terminating March, 1867, when it was published in two volumes. It was selected by the Sociological Section for examination and exposition, in preference to the first division of the system—FIRST PRINCIPLES—as being specially suitable for study by the members of a Natural History Society. The "Principles of Biology" consists of six parts, and the following is a record of those members who have conducted the study at the monthly meetings of the Section during 1883-4-5-6:—The opening meeting was held on the 4th October, 1883, when Dr. Hill introduced the system by a discourse on "Organic Matter." Part I., "The Data of Biology," was conducted by Dr. Hill, F.I.C., Mr. F. J. Cullis, Mr. J. O. Barratt, B.Sc., and Mr. W. Greatheed. Part II., "The Inductions of Biology," by Mr. W. W. Collins, Mr. C. H. Allison, Dr. W. L. Hiepe, Mr. L. J. Major, Mr. W. B. Grove, B.A., Professor W. Hillhouse, M.A., F.L.S., and Mr. Wm. Matthews, M.A., F.G.S. Part III., "The Evolution of Life," by Miss Naden, Dr. Hiepe, Mr. W. H. France, and Mr. C. H. Allison. Part IV., "Morphological Development," by Mr. W. B. Grove, B.A., Mr. W. R. Hughes, F.L.S., Professor Hillhouse, M.A., F.L.S., and Mr. F. J. Cullis. Part V., "Physiological Development," by Mr. W. K. Parkes and Professor J. B. Haycraft, M.A., F.R.S. Edin.; and Part VI., "Laws of Multiplication," by Mr. W. B. Grove, B.A., Mr. W. R. Hughes, F.L.S., Mr. F. J. Cullis, and Dr. Hill, F.I.C. Abstracts of most of the papers read have already appeared in the "Midland Naturalist," and these will be followed by the remainder. The only exception is that of Miss Naden's paper on "The Special Creation Hypothesis" and "The Evolution Hypothesis," which was published by the Section *in extenso*.

During the progress of the study numerous illustrations by the microscope and otherwise were given, not only by the before-mentioned members of the section but also by other members of the Society, and notably by Mr. Thomas Bolton, F.R.M.S. W. R. H.

THOMAS BOLTON, F.R.M.S.

Our readers will be interested to hear that at the meeting of the British Association recently held in this town a movement was originated among the members attending the committee of Section D (Biology), having for its object an application to Government for a small grant out of the Civil List to Mr. Thomas Bolton, of 57, Newhall Street, Birmingham (formerly of Kinver, Staffordshire), whose important services to science as a naturalist and microscopist have long been well known and appreciated by professors and teachers of biology not only locally but in every part of the United

Kingdom. Mr. Bolton established Science Classes at Kinver many years ago. It will also be remembered that at the recent International Fisheries Exhibition in London Mr. Bolton was awarded the Gold Medal for his exhibits of the microscopic food of fishes. The jury consisted of Professor Allman, Professor Ray Lankester, and other distinguished Naturalists. A memorial setting forth Mr. Bolton's claims, discoveries, and special circumstances was prepared by Mr. W. R. Hughes, late President of the Birmingham Natural History and Microscopical Society, and was signed by Sir J. W. Dawson, the President of the British Association, and by a large number of eminent men of science. It also received the signature of the Mayor of Birmingham. The memorial was recently presented to Lord Salisbury, as First Lord of the Treasury, and the following communication has just been received by Mr. Hughes from his lordship:—

10, Downing Street, Whitehall, December 18th, 1886.

Dear Sir,—Lord Salisbury has given his careful consideration to the memorial which you have placed before him on behalf of Mr. Thomas Bolton, and the representations of the numerous men of science by whom the memorial was supported, and his lordship desires me to say that he has had pleasure in recommending to Her Majesty that a Civil List Pension of £50 per annum should be conferred upon Mr. Bolton. Lord Salisbury has received the sanction of the Queen to this award, and steps will be taken to carry it into effect. The pension will commence as from the 1st July last.—I am, dear Sir, yours faithfully,
J. F. Daly.

W. R. Hughes, Esq.

The numerous body of microscopists and others interested in natural science who have derived benefit from Mr. Bolton's useful researches in connection with minute animal life, and especially with the microscopic fauna of this district (on which it will be remembered he contributed an article to the recently published "Handbook of Birmingham"), will be gratified by this prompt and substantial recognition of Mr. Bolton's merits. Amongst those who signed the memorial were Professor Michael Foster, Cambridge, Secretary of the Royal Society; Sir John Lubbock, Bart, M.P., F.R.S.; William Carruthers, F.R.S., President of the Section of Biology at the meeting of British Association; Professor Ray Lankester, F.R.S., London; Professor Moseley, F.R.S., Oxford; Professor Bayley Balfour, F.R.S., Oxford; Professor Milnes Marshall, F.R.S., Manchester; Professor Allman, F.R.S.; Professor Alfred Newton, M.A., F.R.S.; P. L. Sclater, Ph.D., F.R.S.; Professor A. Macalister, F.R.S., Cambridge; Mr. H. B. Brady, F.R.S., F.L.S.; and the Rev Dr. Dallinger, F.R.S., President of the Royal Microscopical Society. The memorial was also supported by Sir James Sawyer, M.D., Professor of Medicine, and Professor B. C. A. Windle, Professor of Anatomy at Queen's College, Birmingham; Professor Tilden, D.Sc., F.R.S., as President of the Birmingham Philosophical Society; Professors Bridge, Hillhouse, and Haycraft, of Mason College; and by Mr. R. W. Chase, President of the Birmingham Natural History and Microscopical Society. In a circular letter, thanking his numerous friends, Mr. Bolton assures the memorialists that this recognition of his work will be a great encouragement to him in continuing those biological researches in which he has always taken so deep an interest.

JOHN MORLEY, F.R.M.S.

One of the best-known naturalists of the Midland Counties has departed from our midst. On the tenth of last month, at the early age of fifty-seven, Mr. John Morley passed peacefully over to the great majority.

> "He's walked the way of Nature,
> "And, to our purposes, he lives no more."

Secretary of the Birmingham Natural History and Microscopical Society since 1876, Vice-President in 1875 and 1874, Librarian for the three previous years, and Curator in 1870, his connection with the Society, of which he was one of the earliest members, has lasted officially for seventeen years. During all these years, and especially during those in which the Society has been most active in its work, Mr. Morley's energies have been devoted, ungrudgingly and unselfishly, to furthering the interests of the Society and the pleasure and improvement of its members. In husbanding its resources, in laying out its work, in planning its excursions, his unfailing business faculty, his time, and his ever-ready help were always at the service of the Society, and have benefited it in a measure which cannot be over-estimated. His loss can scarcely be replaced, and the gap his departure from among us has made in the ranks cannot be filled except by the combined efforts of several persons.

Mr. Morley's scientific studies were confined chiefly to botany, and especially to the British ferns, of which his knowledge was very extensive. He was fond of growing strange varieties of the common species, and discovered or reared several forms which have been possessed by no other grower, including one from Ireland which is called after his name.

It was in connection with the excursions of the Birmingham Natural History Society, and particularly in the case of the marine excursions organised to distant places, that Mr. Morley's administrative talent was seen at its best. No such gathering, of which he had the direction, ever failed to please and instruct all those who took part in it. None of the little details of management upon which the success of an excursion depends was ever forgotten or misplaced. The last one in which Mr. Morley took part was that to Tenby, and the previous one that to Chirk, accounts of which are printed in the present number. The first sign that he was breaking down under the incurable disease from which he has suffered for several years was perceived during the Tenby excursion, but though the end was rather sudden, recovery was hopeless, and death a relief from pain.

Mr. Morley was emphatically what is known as a "good fellow." His genial temperament and inexhaustible good nature have smoothed over many a difficulty for his colleagues, and his loss will be felt by all those with whom he came in contact, not so much as that of a fellow-worker as of a friend who could always be trusted.

METEOROLOGICAL NOTES.—November, 1886.

The mercury, after a slight rise, fell to 28·874 inches on the 6th, its lowest point for the month, and, after fluctuating, rose to 30·705 inches on the 24th, its highest point, from which it again descended rather rapidly. Temperature was about two degrees above the average, the means, both of maxima and minima being in excess. The highest readings were on the 1st, when 59·0° was recorded at Henley-in-Arden, 58·7° at Loughborough, 57·1° at Hodsock, 56·0° at Coston Rectory, and 54·9 at Strelley. In the rays of the sun, 100·9° at Hodsock, 99·7° at Loughborough, and 92·3° at Strelley, also on the 1st. The lowest readings were 25·5° at Coston Rectory, on the 19th; 26·0° at Henley-in-Arden, on the 8th; 28·1° at Hodsock, on the 26th; 29·0° at Loughborough, on the 8th; and 29·2 at Strelley, on the 22nd. On the grass, 21·9° at Hodsock, on the 19th; 24·5° at Loughborough on the 8th; and 26·2° at Strelley, on the 22nd. Rainfall was nearly an inch below the average. The total values were 2·26 inches at Henley-in-Arden, 2·25 inches at Coston Rectory, 1·64 inches at Strelley, 1·25 inches at Loughborough, and 1·15 inches at Hodsock. The greater portions fell in the early part of the month. The number of "rainy days" varied from thirteen to twenty-one. The prevailing winds were south-westerly. Sunshine was rather deficient. Owing to the mildness of the weather, and the absence of severe frost, the foliage remained on the trees much later than usual; indeed, it was not till quite the end of the month that a general fall of leaves set in.

Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Note.

NAIS HAMATA (A Fresh Habitat for).—Lately I have again found this interesting annelid, first discovered by Mr. T. Bolton in Sutton Park last year (1885), and described by him in the "Midland Naturalist." I mention this fact because Mr. Bolton describes it as *rare*. However, it has turned up this last October in considerable numbers in a well-known boggy pool near the town, and as was the case in Sutton Park, it was accompanied by a large number of beautiful forms, both animal and vegetable, amongst which I may mention, just as an example, the following:—*Conochilus Volvox*, *Volvox Globator*, *Anuræa serrulata*, and many other free-swimming rotifers, a large variety of the testaceous Rhizopoda, *Amœba princeps* (this in abundance), desmids, including Micrasterias, Closteriums, Peniums, Euastrums, Spirotæniums, and an abundance of that pretty typical palmellaceous Alga the *Eremosphæra viridis*. I shall be glad to find *Nais hamata* very common if it is *always* found in such good company as the above seems to indicate.—E. H. WAGSTAFF.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, December 7th.—Mr. W. B. Grove, B.A., exhibited *Rosellinia mammæformis*, from Sutton (new to the district); for Mr. H. T. Soppitt, *Ag. licmophorus*, with a photo of the same; *Geoglossum glabrum* and *G. viscosum*, from Yorkshire; for Mr. J. Hamson, *Xylaria polymorpha*, *Ag. proboscideus* (new to Britain), from Bedford; for Mr. W. H. Wilkinson, *Crucibulum vulgare*, from Wemyss Bay, and *Peziza purpurascens*, from Crieff. Mr. Blakemore exhibited an egg shell showing a kind of fungous growth inside the shell. Mr. W. H. Wilkinson then read a paper entitled "A Ramble amongst the Lichens," in which he described the results of a ramble on the Island of Bute, in search of these interesting, although lowly, plants. He exhibited nearly thirty specimens collected on that occasion, the chief characteristics of which he described, with the "habitat" in which each was found. His remarks were further illustrated by sketches on the blackboard and sections under the microscopes.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 22nd.—A paper was read by Mr. Wagstaff on "Old and New Forms of Fine Adjustment." The writer described the subject as one of great and growing importance to every microscopist, and one that was felt in proportion to the number of high powers used, and it ranked as one of the three essentials of every good instrument. The paper mentioned the weak points of many fine adjustments, one of the commonest being the apparent lateral motion of the object. Various movements were then reviewed, including the old side bar, side lever, Zentmayer's, Swift's patent climax, Campbell's, Royston Pigott's, said to read off the 400,000th of an inch, and Nelson's quicksilver adjustment; the latter as yet only existing in theory. The writer thought the Campbell arrangement, owing to its simplicity and efficiency, was likely to win favour in the future. The paper was illustrated by diagrams and instruments. November 29th.—Mr. C. F. Beale exhibited bony plates from the sturgeon. Mr. H. Hawkes, *Phragmidium mucronatum*, *P. bulbosum*, vars. *violaceum* and *rubi*; *P. obtusatum*, *P. gracile*, and *P. acuminatum*; Mr. J. Madison, *Zonites draparnaldi* and *Limnæa peregra*, va. *acuminata*. Under the microscope Mr. Hawkes showed slides of *Trichobasis suaveolens* and *Puccinia syngenesearum*. Mr. J. W. Neville, specimens of *Chalcis minuta*, from Turkey; Mr. H. Insley, ovary of *Loasa aurantiaca*. December 6th.—Mr. P. T. Deakin showed specimens of *Clausilia*, *Bulimus*, &c., from Palestine. An exhibition by the lantern microscope was given by Mr. W. Tylar, a large number of entomological and geological slides being shown. December 13th.—Mr. H. Insley showed a number of coal measure fossils, including a specimen of calamite with branches *in situ*. Mr. Mulliss exhibited some results of experiments in single and double staining vegetable tissues. A discussion on the fixing of the dyes closed the meeting.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, Wednesday, December 15th. Attendance seven (three ladies). The chairman introduced a discussion on the question "Is Bird-Song Music?" It had recently been asserted by the Rev. H. R. Haweis, and repeated by others, that there was no music in nature, and that the song of birds was not music. The answer to this question must of course depend upon the definition of the word "music." It was admitted that a musical tone depended upon the regularity and the rapidity of the air-waves. There could be no doubt that there were many musical tones in nature, including the notes of many birds. But it might be said that music consisted of musical tones arranged in musical phrases, and that bird-song was not so arranged. Surely, however, the phrases of the thrush, the blackbird, the nightingale, &c., were often musical in the truest sense. The programme for the ensuing quarter having been discussed and determined, the chairman read a short paper on "Foreign Fruits available for acclimatisation in England," describing the processes by which plants might be rendered hardy in climates to which they were not originally adapted, and pointing out nine valuable fruits on which it would certainly be worth while to try the experiment of gradual acclimatisation.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—December 13th.—Opening of the Society's Museum in the new premises, Minster Close. The Very Rev. the President occupied the chair, and was supported by the Mayor (H. P. Yates, Esq.) and Lieut.-Colonel Strong. The Dean in the course of his address said they were gathered on an historical site, the building having originally been a chapel founded in honour of Thomas à Beckett, by Abbot de Waterville, the same abbot who built the transept and central tower of the Norman cathedral, and completed by Prior Benedict, his successor; and full of zeal for the friend he had lost he brought with him certain precious relics, consisting of the shirt and surplice Thomas à Beckett had worn, and some of his blood gathered from the stones of Canterbury Cathedral; these the abbot deposited in the chapel. Abbot George pulled down the nave of the chapel—it was only the chancel they met in—and gave the materials for the building of the parish (St. John Baptist's) church. Later it ceased to be used as a chapel and was handed over by order of Henry VIII. for the purpose of a King's School, and King's School it had remained until a year ago, when they had to move the school to the new site, and so the chapel was left empty. He rejoiced that for the present this society should find its home and dwelling place there, but hoped that it would occupy a first place in connection with a Free Library and other public buildings before many years had passed; and was sure they would all feel that the opening of the Museum that night was an augury of future success and would all do their utmost to promote the welfare of the society. The Mayor next addressed the meeting and was very surprised at the altered appearance of the building from what it was when he was first acquainted with it in 1828. He welcomed the society there but thought the building ought to be used for the Chapter Library, but that could not be at present. Seeing the society were desirous of purchasing all the back numbers of the Palæontographical Society's works he should be most happy to give £5 towards that object. Mr. J. W. Bodger, the Hon. Secretary and Treasurer, then gave an interesting report of the history of the society from its commencement in 1871, through the instrumentality of the late Mr. Bentley. The Museum was commenced in 1880, and owing to the kindness of the Dowager Lady Huntly, the President, the Mayoress, and many others, they now could call the treasures displayed that evening their own, excepting a few groups of specimens which were as yet only lent to the society, including the magnificent Roman bronze equestrian figure, the property of Dr. T. J. Walker. Lieut.-Colonel Strong proposed a vote of thanks to the President, to the Mayor and Corporation for their attendance, and he wished to include the name of Mr. Bodger in the vote of thanks, as he had for the past thirteen and a half years worked so hard for the society as Honorary Secretary. The Dean in acknowledging the compliment said he almost felt ashamed because the kind friends in Peterborough so over-rated the little he had done, but he did feel the Secretary did merit their most hearty thanks, as it was mainly owing to his exertions the society was in its present position. The President then declaring the Museum open, microscopical exhibits were made by Messrs. A. Gee, C. A. Beale, and G. W. Leigh. Mr. Beale exhibited young oysters, Polycistina from Barbadoes, gold quartz, eye of drone fly, micro-photographs, and by polarised light, sulphate of calcium, cocoon of silkworm, and various kinds of hair. By Mr. A. Gee, elytron of diamond beetle (*Entimus nobilis*), gemmules of sponge (*Gossia*), embryo oyster shells, Polycistina from Barbadoes and San Domingo, fossil diatoms from Stoney Ford, Armagh, polyzoa (*Bugula plumosa*), diatoms *in situ* on algæ (*Isthmia nervosa*), North Atlantic soundings (two miles deep), ditto (422 fathoms deep), injected skin of salamander, section of human skin showing perspiration glands and ducts. For Mr. J. W. Bodger, various plant sections illustrating the different forms of tissue, plumes of moth (*Nepticula*), bones from the mouth of a star-fish, cartilage from ear of common mouse, sting of wasp, leaf of sundew (*Drosera rotundifolia*) with insects *in situ*. By Mr. Leigh, section of human scalp showing roots of hair. Section of young palm, ooze from the Atlantic bed (2,000 fathoms); *Ptilota serrata*, North America; eye of gadfly, spiracles of water-beetle (*Dytiscus marginalis*). The Roman and Saxon remains from Peterborough and the neighbourhood attracted considerable attention.

PRESIDENT'S ADDRESS.*

BY R. W. CHASE.

(Continued from page 6.)

Returning to the cuckoo. I believe that, being a voracious feeder, it requires a considerable tract of country to sustain one, and that upon arriving, each bird takes up its abode in a certain neighbourhood, and uses such nests as are plentiful in that locality. It is the scarcity of suitable nests that causes us to hear of a cuckoo's egg being found in the nest of such species as the magpie, &c.

Concerning the coloration of birds' eggs in general, these beautiful tints and varied markings must at once strike even a casual observer.

I think there is little doubt that the chief use of colouring in eggs is protective, or, I may say, entirely so. The means by which the various colours are produced is more difficult to assign.

Some writers consider that the colour in eggs is influenced by the plumage of the bird, and that the colour, etc., of one is dependent upon and analogous to the other; to a certain extent this may be so, as food and organic substances introduced into a bird's system affect the colour of the plumage. I see no reason why the colouring matter of the egg shell should not likewise be acted upon. It is a fact that the same species inhabiting distinct and different localities will differ in the colour of their plumage and eggs; for instance, denizens of Fenland will have full and darker plumage and lay more richly coloured eggs, whereas those occupying high, dry, sandy districts will be pale in comparison. That birds are able to control or alter the normal markings upon their eggs, at will, I consider absurd, although we find an endless variation, both in ground colour and markings, in most eggs, but especially so in some species, the tree pipit, for instance. At the same time, I am convinced that the bird is quite an involuntary agent in the matter. Nor can I agree to the supposition that birds who now lay spotted or marked eggs in covered or domed nests will ultimately lay white or unmarked eggs, because there is no further necessity or use for the markings, as the nest affords protection from discovery.

* Transactions of the Birmingham Natural History and Microscopical Society.

Neither can I believe it likely that those species who now lay white eggs upon the ground in open nests will some day develop markings as a means of protection.

Let us notice a few birds that lay their eggs on the bare ground in exposed situations, trusting entirely to the close similarity of the colouring of their eggs to their surrounding for safety. For instance, take the eggs of the oyster catcher, or ring dotterel, laid on the bare shingle or sand, which you will frequently walk over without discerning them from the surrounding material, and I know instances where a nest has been found and left, with the intention of securing the eggs upon the return journey, when it was impossible to come across them again the second time. Norfolk plover, lapwing, Arctic and Sandwich terns are like examples.

This marvellous harmonising with the surroundings does not strike you when you see a clutch of eggs lying upon cotton wool in a cabinet, or holding one in your hand, but you require to view in the open on their bed of shingle, or earth, to thoroughly appreciate the beauty of such an arrangement. The young of those species with these nesting habits depending entirely for safety upon their coloration, when first hatched are covered with down, the tints of which are in such complete harmony with the stones and lichens that often you would not discover the immovable crouching little beauties unless you happened to see a bright little eye watching you.

I well remember the difficulty I had in finding some young golden plovers in Perthshire, amongst the heather, so closely did they resemble the golden moss and lichens, and as they had ran from the nest I was more than half an hour in securing three. Upon the first symptom of alarm the parents at once leave their offspring and endeavour to draw attention upon themselves by their actions and cries, well knowing that their presence with their—often—conspicuous plumage in proximity to their young would at once proclaim their hiding place.

Other ground nesting species, such as grouse, partridge, pheasants, do not trust to the colour and markings of their eggs for protection so much as to the harmonious blending of their own plumage with the adjacent greys and browns of hedgerow and moor. Cases are known where the old bird has had to be touched before she would leave her nest and so expose the treasures she was covering.

In the case of the pheasant the male takes no part in incubation but leaves those duties to his sombre-coloured mate; this species is polygamous like most of the gallinaceous genera.

The nightjar might also be mentioned as another example. Many of the Anatidæ, or ducks, also nest upon the ground and lay nearly white or cream-coloured eggs, which would be most conspicuous if exposed, but the old duck before leaving carefully covers up the eggs with down plucked from her own body. She also, as a further safeguard, skulks away some distance from the nest before taking wing. The eider ducks in the Farne Islands exemplify this habit to perfection, covering their eggs with the greatest care, to protect them from the gulls, who would very soon make short work of a nest of eggs if exposed to view.

The Anatidæ ought certainly to have developed markings to protect their eggs,—if what the evolutionists tell us is correct—that their ancestors formerly nested in holes where no protective markings were required.

The majority of birds laying white eggs usually deposit them in holes amongst rocks, in trees, or in burrows in the earth, as the swift, rock dove, owl, woodpecker, wryneck, kingfisher, shearwater, and petrel; others that lay white eggs in exposed situations are notably the ring and turtle dove, whose eggs seem to court your notice, placed on a slight platform of twigs and roots, only an apology for a nest, so scanty, in fact, that you can often see the white eggs showing through. Now supposing that these species have descended from hole-breeding ancestors—the rock dove breeds in holes at the present time—how is it that they have not developed colour and markings as a means of protection? I expect the answer will be that a sufficient time has not elapsed for them to have developed the means, but that they will do so. I have never yet heard of an instance where even slightly marked eggs have been found, which would show some tendency towards that result. The other cases where white eggs are exposed mostly occur either in those species which breed in colonies, and are able by their numbers to repel attacks from their natural enemies, or else in the Falconidæ, like the Hanius, who lay generally white eggs exposed to view. I think in this case that the eggs are rarely left without one of the old birds, as it is well known that amongst this order, incubation commences directly the first egg is laid, and also that the male brings food to the nest for his mate, consequently she is not obliged to go far from home, and, I imagine, the natural enemies of such birds have little chance of destroying eggs so well guarded. I do not class man amongst the natural enemies of "Bird Life," because when he steps in the balance of nature is sure to be upset, but with respect to such vicissitudes and dangers as each would have to combat with for their existence in an undisturbed state of nature, we find that in all cases ample provision has been made for the needs of each individual species, so as to preserve the balance of creation. "Each has its allotted space to fill and duties to perform."

I now come to the largest group, viz., those birds that lay beautiful eggs cradled in perfect gems of ornithological architecture. I think we shall find that in these species there is a considerable amount of affection and tender care displayed for the progeny. You must certainly know with what valour and determination a robin or a flycatcher will defend their nest from a cat, for instance, by exerting their puny powers to the utmost, returning again and again to the attack, and will often succeed in driving off the intruder. Moreover, the young when hatched are naked, perfectly helpless, unable to feed themselves, and frequently blind; an exact opposite to those species who deposit their eggs on the ground, and have the young covered, and able, immediately upon leaving the shell, to procure their own food. I think the variation of ground colour and markings is considerably more in this group than in any other. I therefore place considerable importance upon the structure and material of the nest in determining the species, as they do not vary in anything like the same degree as the eggs. Take, for example, the willow and wood wrens; it is quite possible to find two clutches of eggs so much alike that they would answer to either species; but, supposing one clutch was found in a feather-lined nest and the other without, I should have no hesitation in assigning the eggs found in the feather-lined nest to the willow wren, as that species always uses feathers, whereas the wood wren does not. Take the nest of the blackbird and thrush; the former constructs its nest of mud fibres and bents, forming strong walls, lined with finer bents or fibres. The latter constructs a similar one, but usually lines it with a smooth coating of cow-dung. The differences in the nests of these closely allied species are not to be accounted for by any acquired knowledge or experience, but clearly show that Providence has, for some wise purpose, ordained each of these species to construct its nests most conducively to the well-being of their offspring, and it is our ignorance that prevents us from ascertaining the particular reason for such difference.

Those species forming compact nests with helpless young rarely leave the nest for any length of time, but one or other of the parents keeps watch in close proximity, to render protection in case of need. The magpie is a notable instance as an exception; to obtain food for the young, the parents often have to go far, and leave the nest for a considerable period, so as a means of protection a covering of twigs is placed over the nest, leaving a hole at the side for entrance. How came the magpie to adopt this method? From experience? I think the only schoolmaster employed was "Instinct, or an involuntary stimulus of an innate unknown power," causing such action without any intervention of reason as the result of such actions.

I therefore think we may conclude that (1) colour, both in birds and their eggs, is intended as a means of preservation of their kind from natural enemies by the adaptation of their hues to the colour of their surrounding in their usual habitat; a most forcible instance of design, clearly pointing to the existence of an "omniscient great First Cause."

Mudie has beautifully illustrated it by comparing "the ptarmigan to lichen rock in summer, hoar frost in autumn, snow in winter; grouse are brown heather; black grouse are peat, bank, and shingle; partridge, clods and withered stalks all the year round."

(2) That any variation from the normal coloration is not due to any action of the birds themselves, but is caused by the amount of nutriment obtained, or some speciality in the soil or climate they may inhabit, such variation being often only slight and hardly ever permanent.

Alteration in colour is easily obtainable; the high colour in canaries produced by cayenne feeding, the dark bullfinches by hempseed, from which unnatural causes (such extreme cases not being found in nature) erroneous conclusions are drawn.

The most remarkable variations are those obtained in animals or birds in a state of confinement or domestication, consequently not proper or safe examples upon which to found theories.

(3) That in cases where the eggs are not protected by their colour, the plumage of the parent assimilates with the surroundings instead, and that in many cases, upon the old bird leaving the nest, the eggs are covered up.

The case of the wood pigeon and turtle dove is most puzzling, and I must confess that I am unable to solve the mystery, which I put down to my want of knowledge, but at the same time cannot accept the theory that having descended from hole-breeding ancestors, they have adopted the system of nesting in trees and hedges as an improvement; by the same argument, they ought to have adopted coloration as a means of protection by concealment, which they have not. That nests are not constructed by "imitation or memory," but from instinct inherent, or as it has been expressed, "an involuntary desire, acting on the mind without intervention of reason, motive, or deliberation, but tending uniformly and exclusively to the preservation of the individual or propagation of the race."

What I want to be shown are some of the so-called transition stages, or else positive proof that a given species formerly constructed its nests quite differently.

The subject I have addressed you upon is, I know, a very debatable one, and it is quite possible, with the mass of evidence. both for and against, to make a strong case for either side; but before I alter my views, I want more conclusive evidence, when I shall be quite willing to do so. I sincerely hope that others, with more time and ability than myself, will take this matter up, and endeavour to elucidate some of its mysteries. This must be my excuse for troubling you with what I fear has been a very uninteresting address and allow me to express my grateful thanks for the very courteous attention with which you have listened to me.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART IV.

The Middle Lias Considered as a Source of Water Supply.

(Continued from page 298, Vol. IX.)

There is, perhaps, no social question of greater importance at the present time than that of the supply of pure water to large towns; and since many people seem to have the idea that Water Companies or Corporations can always get abundance of water if they will only go to the trouble and expense of digging, or boring, or some such operation. I have thought it advisable, as a prelude to the scheme I have to propose for the water supply of Northampton and district, to consider the various possible sources of water and the reasons of their failure, or for or against their rejection as a supply to that district; an additional reason being that I shall endeavour to show later on how some of these inadequate sources may be made helpful to the Marlstone supply.

Under the heads of SPRINGS, RIVERS, and LAKES (natural or artificial), we might perhaps group all the various methods adopted for water supply in this country. Wherever it is possible to obtain a copious supply of drinkable water from a spring, that is undoubtedly the most desirable source for a town, because, if from a sufficient depth to yield good potable water, it will not fluctuate in quality, quantity, or temperature, as water from the other two sources would, and until recently Northampton was furnished with such water. This supply was obtained from the Marlstone, and, as has been pointed out before, this is the chief water-bearing bed of the county West and South-west of Northampton.

Although a deep seated water source may be exceedingly desirable, it cannot always be had, from a variety of causes, and it is remarkable that some of our largest towns are supplied partially or entirely otherwise. Probably no town uses such a large quantity of river water as London, for out of a daily supply of about 178,000,000 gallons (September, 1886), some 90,000,000 gallons are obtained from the Thames above Teddington Lock,* a fact which clearly shows the possibility of obtaining a satisfactory water from ordinary surface drainage by artificial filtration.

There seems to be a growing desire on the part of the governing bodies of our large towns to utilise the waters of existing *lakes*, or to construct artificial *reservoirs*. Some natural lakes have already been appropriated to the water supply of towns. I may particularly mention Loch Katrine and Thirlmere, the former by Glasgow and the latter by Manchester.

It is extremely doubtful whether it is a wise course for Parliament to allow of the monopoly of such supplies of water by any one town, and some very pertinent remarks were made on the subject by Mr. G. J. Symons, F.R.S., the Secretary to the Meteorological Society, in an address on "Water Economy," delivered before the Sanitary Institute of Great Britain in 1879.

It is not my intention to speak for or against any of these systems as applied to other districts, but having noticed the fact that they are applied, it will be necessary to consider only the reasons for or against their adoption in Northamptonshire.

* "Sanitary Progress during the Reign of the Queen," by Captain Douglas Galton, C.B., F.R.S. Address delivered at the opening of the Session of the Society of Arts.

The various springs of the county may, for present purposes, be classified as below:—

1.—River Gravel Springs.
2.—Drift Gravel Springs.
3.—Great Oolite Springs.
4.—Inferior Oolite Springs.
5.—Marlstone Springs.
6.—Trias Springs.

THE RIVER GRAVEL SPRINGS.—Along most river valleys there is on each side of, and below the present restricted water channel, an accumulation of matter newer than the river itself, and evidently owing its accumulation to that river. This alluvial matter, in the case of the Nen Valley, consists of a deposit of sand and gravel, covered in the lowest parts of the valley by a dirty looking mud or clay containing much vegetable matter.

The River gravel apparently dips below the present river and its alluvial clay bed, but rises some little distance above the ordinary level of the river on each side, forming low meadow lands, or in some cases, as for instance in the Cow Meadow at Northampton, a distinct *river terrace.* This bed is of *Palæolithic* age, and has yielded numerous remains of the Elephant (two species), Rhinoceros (two species), Hippopotamus, Ox, Horse, Wild Hog, and Red-deer, and also a few flint implements.

The bed is sometimes worked for gravel in Northampton, and an extensive bed of it between Barnwell and Oundle is worked by the railway company for ballast.

The *Alluvium* proper is practically impervious to water, and certainly more recent than the gravel. It contains the remains of the Ox, Red-deer, Horse, Wild-hog, and numerous freshwater gastropods, such as Anodonta, Physa, Planorbis, Limnea, &c.; also human remains. The thickness of the alluvium is very variable. The clay and gravel together may reach thirty feet or more in places, and where both are present they seem to have a thickness inversely to each other, though on this point I cannot speak very definitely.

The river gravel rests upon Upper Lias clay, and hence we have all the conditions for the formation of a *Land Spring*, and such a spring we find.

Some few wells in Northampton are fed by water from this river gravel, and it was even proposed to utilise it for the water supply of the town, but this scheme fortunately found little favour, as also a proposal to pump it into the same reservoir with water from other sources.

It is a characteristic of these *land springs* that they vary considerably with the seasons, both in quantity and quality, and in dry seasons frequently fail altogether, for the double reason that the accumulation of water is not large, and they are not without the influence of the evaporative power of the sun aided by capillarity and vegetation. The quality of the water from such springs is sometimes satisfactory, but much more often decidedly bad. In the particular case under consideration, this source of supply may be condemned for several reasons. (1.) The river gravel is either not at all, or only slightly, overlaid by impervious matter, and so the water is easily contaminated from the surface; besides this, one of the main sewers of the town passes through a portion of this bed, not very far from the situation once proposed for a pumping station, and so at any time the water might have become contaminated with the most dangerous of all impurities. (2.) The water is so near the surface and the bed so inconsiderable in thickness that it cannot itself yield water sufficiently well filtered for domestic use. The general character of the water will be seen from the following analysis, which must be taken as a mean of several:—

Solids	72 grains per gallon.		
Chlorine	6·2	do.	do.
Nitrites	A little.		
Nitrogen in nitrates and nitrites ...	2·5	do.	do.
Free ammonia	·31 parts per million.		
Albuminoid ammonia	·18	do.	do.

The solid residue charred a little on being heated, and during the operation emitted the disagreeable odour characteristic of ignited organic matter. (3.) The water is not sufficient in quantity for a town supply. I know of one instance in which rather continuous pumping at one well drained another about a quarter of a mile away in a very short time—a day or two—and, of course, any contamination would be all the more injurious because of its comparatively small dilution.

This water was for a time used for flushing purposes, and this was, of course, a very legitimate use for it when better water was very scarce.

It may be said in favour of this water that it is well clarified, and rather bright and sparkling in appearance. The bed seems to offer considerable facilities for the oxidation of organic matter, owing to the fact that there is considerable variation in the water level with the season, and each time the water level sinks air follows, which latter is again largely expelled and partly absorbed by the next influx, and so a rather good aëration is the result.

DRIFT GRAVEL SPRINGS.—A considerable portion of Northamptonshire is covered by *Boulder clay* or *gravel* deposited during the Glacial period, and the gravel furnishes very numerous springs of pretty good water, where it rests upon impervious beds. Besides this there are some rather extensive deposits of a fine sand or gravel, differing considerably from the ordinary drift gravel, though probably of the same age. These latter deposits appear to be very local, and to consist of redeposited Northampton sand, as none of the flints and pebbles, &c., so enormously abundant in the ordinary drift are present, whereas fragments of ironstone are very common. There is a tolerably extensive deposit of this form of drift within a few miles of Northampton, and during the discussion on the water supply of the town, Mr. Westley, of Kislingbury, several times urged the adoption of it as a source of water. The particulars which Mr. Westley gave were about as below:—"Catchment area about 12,000 acres, extending for about five miles through the parishes of Courteenhall, Collingtree, Milton, Rothersthorpe, Kislingbury, and Bugbrook, with a width varying from twenty to fifty chains (say an average of twenty-five chains), and a thickness of twenty to forty feet of sand, from which good and never-failing springs issue. Assuming fifteen inches of rainfall absorbed, it would yield a yearly supply of 408,000,000 gallons, or rather more than 1,000,000 gallons per day." This scheme was not entertained, and even supposing the amount of water estimated by Mr. Westley could have been realised, it is not a quantity adequate for the supply of Northampton; and being very superficial, it would be open to some of the objections urged against the River gravel springs. It is so situated that water could not be stored in it to any great extent, and so in times of drought it might fail altogether, I do, however, think that a supply of water like this might be made useful, and the particular feature of the scheme I have to propose is that such partial supplies could be used at comparatively little expense.

THE GREAT OOLITE SPRINGS.—Most of the high lands around Northampton — Kingsthorpe, Dallington, Duston, Wooton, Blisworth, Moulton Park, &c.—are capped by limestone of Great Oolite age, a rock which allows water to percolate through it; and alternating with the limestone are beds of clay—sometimes two, at other times three—which, owing to the resistance they offer to the passage of water through them, give rise to springs. Generally these springs are very inconsiderable, for these and possibly other reasons:—The intervening clay beds are more or less calcareous, and so do not offer as great resistance to the passage of water as the stiff clays of the Lias; also, they are comparatively thin, the greatest thickness of clay in one bed that I have myself recorded being 15 feet 1 inch; further, they are succeeded downwards by the Inferior Oolite, the whole of which is very porous.

The best springs occur near the top of the formation, at the junction of the Cornbrash with the Great Oolite clay, but all of these are far removed from Northampton, and so need not detain us.

The Inferior Oolite Springs.—Below the Great Oolite beds just referred to, we have another set of porous beds yielding a much larger supply of water. They belong to the lower part of the Inferior Oolite, and may be distinguished as below:—

$$\left.\begin{array}{l}\text{Lower Estuarine Series}\\ \text{Ironstone Beds}\end{array}\right\}\text{Northampton Sands.}$$

The Lower Estuarine is the upper bed of the Inferior Oolite in that part of Northamptonshire we are concerned with. It is nearly pure sand and very porous; vertical plant markings are plentiful, but it contains no fossils. The lower portion of the Northampton Sand is what is worked as an ironstone in the neighbourhood, but it sometimes becomes calcareous, and both it and the more indurated portions of the Lower Estuarine are at times used as building stones. They are both rather variable in character and in thickness, the maximum thickness being about eighty feet, and the lower one rests upon an eroded surface of Upper Lias clay.

The accumulation of water on the surface of this Upper Lias clay gives rise to many free springs, particularly as the Northampton Sand in the neighbourhood of Northampton generally forms a cap to the hills, the sides of the hills affording a ready vent for the water. Amongst the many well-known springs in and around Northampton having an origin of this nature, I may mention "*St. Thomas à Becket's Well*," "*Scarlet Well*"—now very properly closed—the "*Old Nine Springs Well*," which used to be on the Billing Road, opposite to what is now Victoria Road; the spring in *Gypsy Lane*, that on the *Race Course*, and "*Lumber Tubs Spring*," &c.

In addition to these freely running springs, there are many pumps in and around the town getting their supply of water from this same source, but the number is gradually diminishing.

From about 1400 to 1848 the town was supplied with this water; and from 1837, the date when the Water Company was formed, to 1848, this was the only source of supply the Water Company had, and it was obtained from a well near the Billing Road, where the present deep well is, and conveyed to a reservoir on The Mounts, near to the Borough Jail. The source of the Ise and one of the sources of the Nen are supplied from these Inferior Oolite springs.

There is a fairly abundant supply of water from the ironstone springs of this neighbourhood—altogether, probably sufficient for the use of Northampton if it could be collected and utilised; but this, I think, is impossible for several reasons; and, as so many people in the town still have a very high opinion of the quality of the water from these sources, I may as well point out the objections to it.

In the first case, there would be considerable difficulty in getting the supply from these beds, because the beds themselves are most frequently found in this neighbourhood only capping the hills, in which situation no considerable accumulation of water could take place in any one hill, the water can so easily discharge itself on the sides; and to collect the water from a number of hills would be a very expensive undertaking. Of course, the water running from these hills finds its way into channels—brooks and streams—and ultimately into the river; but then it has all the drawbacks of a river supply. During the great scarcity of water a year or two back, the water from these beds on a hill to the north-east of Northampton was utilised, and formed a very valuable addition to the rapidly diminishing Marlstone supply. By going further away from Northampton, some of the drawbacks above alluded to, and those to be alluded to, would be obviated; and at the present time, largely assisted by the Drift, the Northampton Sand does furnish Northampton with water.

Secondly: These springs are rather superficial; the water has not to pass through much sand—the filtering medium—either to get down to the clay or to find an exit; consequently, although it is an excellent filtering medium, water from this bed near to towns or villages must be regarded with suspicion. As a matter of fact, water from this bed in the town and some of the adjacent villages is not good. Most of the public springs and pumps in the town have been condemned and closed.

Thirdly: Since by far the greater part of Northampton is built upon the Inferior Oolite, nearly all the culverts are laid in it, also the cemetery and all the graveyards are in it, so that it is open to the most serious kind of contamination, and to my certain knowledge it has at times received a considerable amount of sewage matter. The water from Thomas à Becket's Well is distinctly deteriorated after the manuring of the gardens situated near it.

In speaking thus of the Inferior Oolite springs I do not wish to underrate their value, but only to condemn that water which is obtained from them in and near the town, and even more so that which is obtained from them in some few villages where proper drainage works do not exist.* As a matter of fact, very large quantities of good water are obtained from this formation; indeed, in some places in this and neighbouring counties it is the chief or only supply. Mr. De Rance says that "Unpolluted spring water from the Oolites is unsurpassed in its comparative freedom from all kinds of organic matter;" and "They are bright, sparkling, and palatable, and excellent for all domestic purposes except washing, but the hardness is mostly temporary, and so capable of being removed by Clarke's process."

(*To be continued.*)

ON THE CAUSES OF GLACIER MOTION.†

BY W. P. MARSHALL, M.I.C.E.

Glaciers have their origin in the snowfall above the line of perpetual snow. All the share of rain that is due to fall in the particular locality, instead of falling in a liquid state and at once passing away to the lower regions of the mountains and valleys as rivers, falls in a frozen state as snow, which remains where it falls, and accumulates in the higher regions of the mountains. At all places above the level where the annual snowfall exceeds the annual melting from the direct heat of the sun, combined with the evaporation from the surface, the mass of snow upon the mountain tops would receive a permanent addition every year, and the heights of the snow mountains would undergo continuous increase, rising higher and higher indefinitely if there were not some counteracting influence to prevent this rising. This counteracting influence is the "Glaciers," which are in reality

* One of the worst waters I ever analysed came from a village where these remarks would apply.

† Transactions of the Birmingham Natural History and Microscopical Society. November 23, 1886.

continuous descending streams, that as effectually drain and keep down the level of the great snowfields, as rivers drain and keep down the level of lakes. In consequence, however, of the glaciers being frozen water, their motion is very different to that of liquid water, and becomes complicated by several interfering causes.

The snow suffers compression and consolidation from the weight of the accumulated mass, and this pressure becomes so intense under the enormous masses that the snow crystals are ultimately welded together into a solid transparent block of ice in the same way as two blocks of ice can be united by sufficient pressure, the two blocks being united into a single undivided block as completely as two pieces of iron are welded into one when pressed together at the right temperature. The cementing together of the snow is further aided by the trickling down of the surface water from the partial melting of the snow that is caused by the heat of the sun's direct rays in the middle of each day.

The glaciers are irregular streams of this ice, extending to half a mile in width, 300ft. in thickness, and six miles in length, in Switzerland; but they are considerably larger in other countries, and especially in Greenland, where the largest known glaciers exist, one of which is as much as three miles in width and thirteen miles in length. These, however, appear quite insignificant when compared with the gigantic glaciers, of which there are distinct traces, from the "Great Ice Age," when the Rhone Glacier in Switzerland, for instance, must have been no less than 120 miles in length and 2,000ft. in thickness.

In the motion of glaciers, gravity, instead of being the sole moving cause as in the case of rivers, is only sufficient to account for a small portion of the work that is done. The velocity of motion of water in rivers bears direct relation to their rate of fall or inclination, but the velocity of motion of ice in glaciers bears no relation whatever to the inclination of the glacier. The most rapid moving glacier—the one in Greenland already referred to—is very flat, and has much less inclination than the slow moving glaciers. The Mer de Glace in Switzerland, with a slope of one in twelve, does not move faster than 3ft. per day; but the Greenland glacier, which has a slope of only about one in one hundred and twenty, has a motion of as much as 65ft. per day, or twenty-two times the velocity, with only one-tenth of the inclination.

Some other cause than gravity has, therefore, to be looked for, and various ingenious theories have been proposed to explain the motion of glaciers; but these have failed to satisfy the conditions that are observed. Ice has been looked upon as a "viscous" body, and having something of the properties of pitch, which, although brittle and fracturing like ice when cold, will, if a lump is left for some time, gradually sink down and flow outwards on all sides, or travel down an inclined base, the rapidity of motion depending upon the temperature to which it is exposed. But this theory is found to be not applicable to glaciers, because their motion is found to be independent of temperature to a great extent, and their rate of travel is nearly as great in winter as in summer, being about four-fifths as much in winter as in summer.

The only explanation that appears to fit all these circumstances is the one originally proposed by the late Canon Moseley, namely, that the motion is caused by the daily alteration of expansion and contraction in the ice from the exposure to the direct heat of the sun in the day and the intense cold of the night. The amount of this action will depend not on the *actual* temperature at any time, but upon the *difference* of temperature between mid-day and mid-night, which will not be much less in amount in winter than in summer. When the expansion of the ice takes place in the glacier it will have effect mainly in the direction where movement is easiest, that is, down the valley; but when the contraction subsequently takes place, as the expansion is *assisted* by gravity whilst the contraction is *opposed* by gravity, the movement upwards from contraction will be somewhat less in amount than the movement downwards from expansion, and the result will be that the mass will be permanently displaced a small distance down the valley. By the repetition of such alternate daily expansions and contractions the glacier is moved gradually from the top to the bottom of its course.

This action is directly analogous to what is well known as the creep in the lead covering of roofs; the lead is constantly endeavouring to creep down the slope of the roof, in consequence of being exposed to daily alternations of expansion and contraction from change of temperature, and any movement downwards is assisted by gravity, whilst the return movement upwards is opposed by gravity. That the total force available in this manner in the case of a glacier is very large in amount will be seen from a consideration of the circumstances. It happens that the rate of expansion and contraction of ice under changes of temperature is very high, being as much as 1—35,000th of the length for each degree of temperature Fahr. (which is three times as great as the rate of expansion in brass); and in the case of the Rhone Glacier, six miles in length, this amounts to about 1ft. for each degree, or for a difference of temperature of only twenty degrees between mid-day and mid-night there is as much as 20ft. change of length in the glacier daily, lengthening 20ft. every day and shortening again nearly, but not quite, 20ft. every night.

In the case of the Greenland glacier, which moves at the extraordinarily rapid rate of twenty-two times as fast as the Swiss glaciers, there is an enormously greater moving power if, as there seems good reason to assume, the entire surface of that large country, 700 miles in width and 1400 miles in length, is covered with a thick mass of snow, consolidated more or less throughout the whole extent to the condition of glacier ice. Then the whole of that immense area will expand daily from the centre on all sides towards the coast, and the only outlet for this expansion will be along the several valleys and ravines leading to the sea, producing a glacier along each of them. The distance from the centre of the country to the coast, 350 miles, gives a daily expansion of no less than 50ft. per degree of temperature, or a total of 1000ft. for the twenty degrees difference of temperature taken before, as occurring daily between mid-day and mid-night. The result of this would be a daily movement of advance and receding of 1000ft. all round the coast if there were a free exit all the way round; and when the exit is confined to the several valleys and ravines leading to the sea, through which the whole advancing mass of ice has to be crowded, it does not seem unreasonable that the actually observed result should be obtained, namely, an actual advance of 65ft. per day in the coast glacier.

When it is considered that this enormous propelling force is constantly forcing outwards the glaciers through the only outlets by which they can escape, and that this escape of the ice must take place, whether the glacier bed is at a great or a small inclination, though not at the same rate, it will be seen that a glacier may exist with a very small slope, such as the slope 1 in 120 named of the Greenland glacier, and that if the bed were to become level, or even turn upwards towards the outlet, the glacier motion could not be stopped. This latter case actually exists, and there is a glacier that really moves up hill in the latter part of its course, a circumstance that does not seem to admit of explanation by any other theory than the one described.

The transverse crevasses of glaciers are a marked feature; they are numerous irregular cracks of large dimensions, extending a great depth into the mass of ice, and have been suggested to be caused by a bending of the ice stream over the edge of an increased slope in the bed of the glacier. But this seems an insufficient cause to account for the circumstance, and the theory described above offers a very simple and sufficient explanation. In the daily contraction of a glacier, the small strength of cohesion of the ice, and the very great friction of the bed, will not only absolutely prevent the whole glacier being pulled back as one mass, but will necessarily result in its being pulled asunder transversely, and pulled to pieces, thus forming the transverse crevasses.

Another important point that has to be referred to is the scoring and grooving in longitudinal lines that takes place in the bed of glaciers, and that has left such remarkable records of the ancient glaciers of the "Great Ice Age." These are great scratches, amounting in many cases to definite grooves, that have been formed by the scraping along of hard stones under the enormous pressure of the great mass of glacier; but when the amount of force is considered that must have been employed in ploughing out such grooves in hard rock, it is seen that this cannot have been effected by the simple passage over it, once for all, of a stone embedded in the ice. If, however, the glacier descended by a long-continued series of oscillations, according to the theory here named, so that the stone passed a great many times over the same spot, backwards and forwards, the result becomes intelligible.

The above-named theory of glacier motion, which originated with Canon Moseley, was further developed after his death by the late Mr. Walter Browne, from whom I obtained most of the information given in this paper.

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Part IV., Chapters XII. and XIV.

BY F. J. CULLIS, F.G.S.

To the evolutionist all things are as they are, simply because the natural forces to which they are and have been subject have been and are, such as could produce just this and no other result.

Mr. Spencer, in the fourth part of his Biology, shows this to be true of organic forms, and those of his pages in which he applies the doctrine to the morphology of plants have been

* Birmingham Natural History and Microscopical Society, Sociological Section, March 18th, 1886.

already discussed for us by Professor Hillhouse. A similar review of animal forms and the mode of their production and modification forms the subject of the chapters before us, in which it is shown that, in addition to those forces which modify the forms of plants, we have an important new factor in the locomotion which is so prominent a characteristic of animate life.

It is further shown that in animals which are rooted or fixed, and therefore subject to much the same conditions as prevail in the vegetable kingdom, we have that well-known resemblance to plant forms which the Sea Anemone has made familiar to our children, and which is so much more strikingly displayed by many of the compound Coelenterata.

Mr. Spencer reminds us that among the Protozoa, where an average all-round equality of conditions obtains, we have many instances of spherical form, which may be regarded as the Protozoon ideal, from which, without good cause being shown, it never departs; while in animals whose environment supplies an average equality of forces about an axis, we find a cylindrical or radial symmetry; and where the incident forces are equal and opposite on the two sides of a median plane, and there only, we get that bilateral symmetry which is so constantly and beautifully developed in all higher animal forms.

The radial symmetry of the Echinodermata having been justified by the evolution hypothesis, we read (p. 178):—

"On watching the ways of the common Sea-urchin, we are similarly furnished with an explanation of its spherical, or rather its spheroidal figure. Here the habit is not to move over any one approximately flat surface; but the habit is to hold on by several surfaces on different sides at the same time. Frequenting crevices and the interstices among stones and weeds, the Sea-urchin protrudes the suckers arranged in meridional bands over its shell, laying hold of objects now on this side and now on that, now above and now below; the result being that it does not move in all directions over one plane, but in all directions through space. Hence, the approach in general form towards spherical symmetry—an approach which is, however, restrained by the relations of the mouth and vent, the conditions not being exactly the same at the two poles as at other parts of the surface."

Passing on to higher forms, Mr. Spencer, speaking of the Annulosa (p. 182), says:—"The common Earth-worm may be instanced as a member of this sub-kingdom that is among the least conspicuously bilateral. Though internally its parts have a two-sided arrangement, and though the positions of its orifices give it an external two-sidedness at the same time that they establish a difference between the two ends, yet its two-sidedness is not strongly marked. . . . On calling to mind the habits of the creatures . . . it will be seen that they explain these forms. The incidence of forces is the same all round the Earth-worm as it burrows through the compact ground."

The forms of the Mollusca are next surveyed from the same point of view, and then the forms of the Vertebrates are considered. Mr. Spencer here shows that, as the front and hinder parts, and also the upper and lower parts of the higher animals are differently formed, so the conditions to which these unlike parts are subject are different. Moreover, such unlike parts are found to be more unlike in proportion to the degree of unlikeness in the conditions affecting them. And an illustration (p. 188) is found in the Pleuronectidæ—"the order of distorted flat fishes to which the Sole and the Flounder belong. On the hypothesis of evolution, we must conclude that fishes of this order have arisen from an ordinary bilaterally symmetrical type of fish, which, feeding at the bottom of the sea, gained some advantage by placing itself with one of its sides downwards, instead of maintaining the vertical attitude. Besides the general reason, there are specific reasons for concluding this. In the first place, the young Sole or Flounder is bilaterally symmetrical—has its eyes on opposite sides of its head, and swims in the usual way. In the second place, the metamorphosis which produces the unsymmetrical structure sometimes does not take place—there are abnormal Flounders that swim vertically, like other fishes. In the third place, the transition from the symmetrical structure to the unsymmetrical structure may be traced. Almost incredible though it seems, one of the eyes is transferred from the under side of the head to the upper side (p. 189) . . . . besides this divergence from bilateral symmetry involved by the presence of both eyes upon the upper side, there is a further divergence from bilateral symmetry involved by the differentiation of the two sides."

In a last quotation from a summary of the evidence (p. 189), we read:—"Thus little as there seems in common between the shapes of plants and the shapes of animals, we yet find on analysis that the same general truths are displayed by both. The one ultimate principle, that in any organism equal amounts of growth take place in those directions in which the incident forces are equal, serves as a key to the phenomena of morphological differentiation. By it we are furnished with interpretations of those likenesses and unlikenesses of parts which are exhibited in the several kinds of symmetry; and when we take into account inherited effects, wrought under ancestral conditions contrasted in various ways with present conditions, we are enabled to comprehend, in a general way, the actions by which animals have been moulded into the shapes they possess."

Wayside Notes.

MIDLAND GEOLOGISTS are to be heartily congratulated on the award of the medals at the disposal of the Geological Society of London for the year 1887. Two of these have fallen to the lot of Birmingham men, the Bigsby medal, given biennially, being awarded to Professor Charles Lapworth, LL.D., of the Mason College, and the Lyell medal, awarded annually, being appropriated to Mr. Samuel Allport, F.G.S., of the same College. The Bigsby medal has a rather quaint foundation deed. It is awarded "as an acknowledgment of eminent services in any department of geology, irrespective of the receiver's country; but he must not be older than forty-five years at his last birthday, thus probably not too old for further work, and not too young to have done much." This latter sounds rather like a delicate paraphrase of "not too old to be lazy, nor too young to be foolish;" but really the limit of forty-five years, as that at which men are liable to cease doing good original work, is a striking expression of the opinion Dr. J. J. Bigsby, F.R.S., had of himself and the majority of his most eminent compeers, and one which probably neither he nor they would be willing to accept the application of. Man's intellectual powers rarely reach maturity before forty; their decline must evidently be phenomenally rapid. However, we believe that Dr. Lapworth will have many years of good work before him when he has reached the Bigsby limit of forty-five. By the way, the Lyell medal carries a money grant with it of at least £25.

MEN may come, and men may go, but the letters on Physiological Selection in the columns of "Nature" go on for ever.

WE FIND THAT WE HAVE to welcome another "local Naturalist." The Essex Field Club has converted its transactions and proceedings into a monthly periodical called "The Essex Naturalist." We heartily wish it success. One of the main considerations which has caused the change is the desire which the society has to encourage intercommunication amongst its members, by promoting the contribution of personal notes of things of interest which have come under their observation. Readers of the "Midland Naturalist" could effectively brighten our own columns in the same way.

MOTTO FOR A SPORTSMAN: "If you see a strange bird, shoot it." If you do not, probably someone else will, for this phase of the undying curiosity of man is well-nigh universal. How many rare birds, like the "hunting hawks," for instance, which have been seen with more frequency in recent years, would again settle down and become domiciled amongst us, could the gunners only be persuaded to leave them alone. But so deeply impressed is the principle that a bird in the cabinet is worth two dozen in the field, that protest seems hopeless. Will the time ever come when we can cease grieving over the needless destruction of rare birds, butterflies, or plants?

PETROLOGISTS will greatly miss the help of John Arthur Phillips, F.R.S., whose sudden death on January 5 removed one of their ablest thinkers. Mr. Phillips was more than a geologist; he could bring to bear upon geological problems chemical and mineralogical powers of the highest order. His work bore mainly on the practical side; amongst the mines of Cornwall or in the goldfields of California he was almost equally at home. But with, and above, all his scientific abilities, he showed kindliness, large-hearted sympathies, and simplicity in the most marked degree.

MR. HERBERT SPENCER.—Naturalists interested in the synthetic philosophy will be glad to hear that Mr. Herbert Spencer has just re-published, with additions, in a small 8vo volume (pages I.-IV., 1-76), the two important articles which appeared under the title of "The Factors of Organic Evolution" in the "Nineteenth Century" for April and May last. The preface, which is dated "Brighton, January, 1887," and shows that the distinguished author is still at work, states, *inter alia*:—"Though the direct bearings of the arguments contained in this essay are Biological, the argument contained in its first half has indirect bearings upon Psychology, Ethics, and Sociology. My belief in the profound importance of these indirect bearings was originally a chief prompter to set forth the argument, and it now prompts me to re-issue it in permanent form."

METEOROLOGICAL NOTES.—DECEMBER, 1886.

This month will be ever memorable in meteorological annals for the exceedingly low pressure on the 8th, when the mercury fell, at Loughborough, to 28·008 inches, and at Hodsock Priory to 27·861 inches. The fall was very rapid, the reading at Loughborough at six o'clock on the previous evening being 29·477 inches, and at six p.m. on the 10th it had risen to 29·392 inches. On the 31st, the reading at eight a.m. was 30·579 inches, giving a range which is seldom, if ever, attained in one month. Temperature was also very unequal. The mean was about five degrees below the average. The highest maxima were:—56·0° at Henley-in-Arden, 54·7° at Loughborough, 53·2° at Hodsock, and 52·5° at Coston Rectory, on the 6th. On the same date, in the rays of the sun, 88·1° was recorded at Hodsock, and 87·1° at Loughborough. The minimum readings showed an unusual degree of frost. The mercury fell to 12·0° at Coston Rectory, and to 17·4° at Hodsock, on the 18th; to 16·0° at Henley-in-Arden, on the 31st; and to 17·0° at Loughborough, on the 21st. At Hodsock, the thermometer on the grass registered 10·3° on the 18th, and at Loughborough 15·5°, on the same date. Rainfall was above the average. The amounts collected were 4·36 inches at Henley-in-Arden, 3·85 inches at Coston Rectory, 3·52 inches at Loughborough, and 3·51 inches at Hodsock. At Henley-in-Arden 1·20 inches was measured on the 26th. The number of "rainy days" varied from twenty-one to fourteen. Lightning was observed at Loughborough on the evening of the 18th, and lunar halos on the 3rd and 16th. Gales were of frequent occurrence during the month. Mock moons (*paraselenæ*) were observed at Coston Rectory, at five p.m., on the 1st.

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Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GENERAL MEETING, January 18th. Mr. R. W. Chase in the chair. Mr. J. B. Williams, Secretary of the Toronto Natural History Society, exhibited the following birds, which he had brought from Canada:—The cat-bird, white-crowned sparrow, towhee bunting, and the scarlet tanager. Mr. W. R. Hughes, F.L.S., exhibited for Mr. F. W. Sharpus, of London, a series of twelve slides showing the anatomy of the spiders, including specimens from Australia, South Africa, &c. While the specimens were under the microscopes, Mr. Hughes explained the more interesting features; Professor Hillhouse, M.A., Mr. Pumphrey, and others took part in the discussion. Mr. J. E. Bagnall, A.L.S. exhibited *Vicia lathyroides*, from Hart's Hill, new to North Warwick. He then read a paper describing the mosses, &c., collected by Mr. J. B. Stone, J.P., from the Trosachs, Riviera, and other localities. He exhibited a fine collection of beautifully mounted specimens, and explained some of their peculiarities, and displayed their delicate structure by sections under the microscope. Amongst the many exhibited were the following:—*Hypnum Crista-Castrensis*, *H. fluitans* var. *submersum*, *Neckera crispa*, *Mylia Taylori*, *Bozzania trilobata*, and *Hypnum dilatatum*.—Geological Section. January 25, 1887; twenty-five present. Mr. W. P. Marshall, M.I.C.E., in the chair. The special feature of interest was a paper on "The Processes of Crystallisation in Rocks," illustrated by rock sections under the microscope, by Mr. T. H. Waller, B.Sc., who described the various processes of crystallisation which take place in molten masses of silicates on cooling. Beginning with ill-defined granules and heaps of granules, there gradually are built up very minute bodies which are not recognisable as definite minerals, but which show crystalline structure by their action in polarised light. These in some cases are seen to be aggregated into definite crystalline minerals of known species. The process of crystallisation in a rock has frequently gone on in two stages—the one before eruption, producing large crystals, the other afterwards, producing smaller ones. An interesting discussion ensued. After the paper had been fully discussed, a very hearty vote of thanks was accorded to Mr. Waller. A very fine geological map, the property of the Birmingham Natural History and Microscopical Society (date 1815), by William Smith, the "Father of English Geology," was exhibited. In February, 1831, the Council of the Geological Society of London honoured Mr. Smith by awarding him the first Wollaston Medal, "in consideration of his being a great original discoverer in English geology; and especially for his having been the first in this country to discover and teach the identification of strata, and to determine their succession by means of their embedded fossils."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 20th. A meeting devoted to Geology. Mr. P. T. Deakin exhibited a somewhat large collection of fossils from the Lias and Inferior Oolite of Gloucestershire; Mr. Insley exhibited fossils from the Red Crag, and called attention to the conditions under which they were embedded; Mr. C. F. Beale, specimens of *Lepidodendron Sternbergii*, *L. selaginoides*, and *Lepidostrobus ornatus*; Mr. A. T. Evans, graptolites from the Lower Silurian; Mr. Madison, slates of Keuper marl, showing ripple marks and impressions of salt crystals; also specimens of *Helix labyrinthica* from Michigan. Under the microscope, Mr. J. W. Neville showed a section of coal-ball showing a sporangium with spores *in situ*.—January 3rd. Mr. H. Hawkes showed specimens of bramble brand, and remarked on the persistence of the fungus in the late severe weather; also the following fungi: *Agaricus fasiculatus* and *Auricularia mesenterica*; Mr. J. Madison, specimens of *Limnæa palustris*, *Bulimus hypnorum*, *Helix monodon*, and *H. alternata*, from America. Under the microscope, Mr. Hawkes showed *Œcidium thesii*; Mr. J. W. Neville, palate of *Zonites draparnaldi*.—Jan. 10th. Mr. C. Beale, C.E., read a paper on "The Stones of the Field." The writer referred to the great antiquity of the earth, the origin of language, and some of the earliest known references to stones. These references were made at a time when little was known concerning them, except their universality. Pretty and curious stones doubtless generated a desire in man to learn where such things came from. The writer described the manufactory of pebbles as the sea shore, and enlarged on the process of attrition by which they were brought to their rounded form. These forces were at work on every shore excepting those perpetually ice-bound. All pebbles were not, however, rounded in this way, for some owed their origin to mountain torrents. The writer described glacial action, and pointed out the difference in the deposits from those made by the agency of water. The wide distribution of stones was attributed to many causes—water, ice, and the agency of man—but the time necessary for it opened up a wide field for speculation, a period too vast for the mind of man to comprehend.—January 17th. Mr. J. W. Neville exhibited specimens of *Pelopæus fistularis*, a mason-wasp, from Constantinople; also, mouth organs of the same under the microscope; Mr. W. Tylar, a specimen of scorpion from Australia.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—January 11th, conversazione at Orton Hall, by the kind invitation of the Marchioness Dowager of Huntly. The magnificent billiard room was arranged as a concert hall, being prettily decorated with rare and interesting plants. A good musical programme had been arranged, and was well carried out by the various performers; while the Rev. E. Bradley, better known as "Cuthbert Bede," the author of "Verdant Green," &c., gave two excellent and highly amusing readings, and during the interval briefly alluded to Fotheringhay and Mary Queen of Scots, and the approaching tercentenary of her death. Refreshments, kindly provided by Lady Huntly, were served in the vestibule during the interval and at the close of the meeting, her ladyship, with her well-known kindness, doing her best to minister to the comfort and enjoyment of her guests. A magnificent collection of Roman, Saxon, and Early British vessels was exhibited by her ladyship, as also a collection of engravings of Mary Queen of Scots, and a part of the hangings, worked with the Scotch thistle, from the bed on which the Queen had slept. Mr. Bradley exhibited a miniature and contemporaneous painting of Mary Stuart; an impression from, and drawings of, the ring given by Darnley to the Scottish Queen, which was found at Fotheringhay a few years back, having, it is supposed, dropped from her finger on the morning of the murder, and been swept away in the bloody sawdust; also, several sketches and water-colour drawings made by himself of Fotheringhay and its neighbourhood, kindly presenting to the Society a pen-and-ink sketch of the chair preserved in Connington Church, from which Mary Queen of Scots is believed to have risen for execution; and water-colour drawings of a stone coffin *in situ*, found in the parish of Stilton, near to Folksworth, on December 24th, 1866. The length of the coffin lid was 6ft. 6in., breadth 2ft. 2in., with a thickness of 8 inches. Interior dimensions of coffin, length 6ft. 2in., depth 1ft. 5in., width of base 1ft. 2in., gradually increasing to a width of 2ft. There was also shown the (conjectured) route of Ermine Street; and Samian ware discovered on the site of the (presumed) Roman cemetery near Folksworth, one piece, the base of a patera, showing the potter's mark "BORILLIOFFIC;" and another picture showing ten fragments of pottery of different ware and markings, found in the field with the stone coffin recorded above. Hearty thanks were given to the Marchioness Dowager of Huntly, to Miss Goole, to the Rev. E. Bradley, and to other ladies and gentlemen who had assisted in the entertainment.—January 13th. Her Majesty the Queen presented to the Society, through Mr. C. Dack, copies of "Leaves from the Journal of our Life in the Highlands," and "More Leaves from the Journal of a Life in the Highlands." On the fly-leaf of each book appears, in Her Majesty's handwriting, the following inscription:—"Presented to the Peterborough Natural History, Scientific, and Archæological Society, January, 1887, Victoria R.I."

THE "MIDLAND NATURALIST."—At the meeting of the Management Committee of the Midland Union, held on the 24th of January, a letter from Mr. W. J. Harrison, F.G.S., was read, resigning the co-editorship of the "Midland Naturalist." Professor Hillhouse, M.A., F.L.S., was unanimously elected his successor. The hearty thanks of the Committee were given to Mr. Harrison for his past valuable services.

"CHANGE OF EDITORS.—During the past nine years it has been my pleasant though onerous duty to assist in issuing 108 numbers of the 'Midland Naturalist.' Since my coming to Birmingham, my associations have allowed me less and less time for the direct study of natural history, and I have more than once placed my resignation of the co-editorship of the 'Midland Naturalist' in the hands of the Council of the Midland Union, only withdrawing it at their assurance that I should be relieved as soon as a suitable man could be found to take my place.

"In now retiring from the post which I have held so long, it gives me special pleasure to know that Professor Hillhouse has consented to be my successor. To each and all of the supporters of this magazine I tender my hearty thanks for the consideration which I have always received at their hands. I shall always look back with pleasure at my connection with the 'Organ of the Scientific Societies of the Midlands,' and although no longer taking a direct part in its management, I shall still hope to contribute from time to time to its columns.

"W. JEROME HARRISON."

INDUCTION.

To the Readers of the "Midland Naturalist."

The Council of the "Midland Union of Natural History Societies" has asked me to undertake the responsibilities and duties of co-editorship, on its behalf, of the "Midland Naturalist." In acceding to its wishes I must at once candidly admit that I have been largely influenced by a desire to at least attempt to restore this magazine to its true position amongst scientific periodicals, by obtaining for it a larger amount of sympathetic assistance, whether in the form of contributions to its pages or of subscriptions, from the long list of Societies constituting the Union. It would be the merest affectation to assume that the present position of the "Midland Naturalist" is satisfactory, or that the journal itself is not susceptible of improvement. I hope its readers will not misunderstand me in saying that I should not have gone out of the way of my professorial duties merely for the purpose of preserving a *status quo*.

I believe that the "Midland Naturalist" has a real purpose in existence; that it does not more completely fulfil its purpose is not, however, the fault of its editors. What the "Midland Naturalist" offers to the societies constituting the Union is a means for the publication, the prompt publication, of such portions of their Transactions as it is desirable should be immediately published, or as are of interest sufficiently general to warrant publication. And this it offers without expense to the societies themselves. More than this, in its reports of meetings it gives an opportunity for local societies to publish such a diary of their proceedings as "Nature" gives to the learned societies of London, and this at a cost of no more labour than is involved in the secretary writing and sending the periodical notes.

No doubt the "Midland Naturalist" is small, and for its size perhaps some may think expensive. This again is a matter which can be rectified by others. Increase the number of the contributions, increase the number of subscribers, and the editors will gladly respond by increasing the size of the "Naturalist" to the extent the funds will allow. Indeed, if its pages were used by the societies constituting the Midland Union in the way in which they may and ought to be used, enlargement would become a necessity; though it need hardly be said that if both ends are to meet, as both ends must be made to meet, the members of the societies must help us by becoming subscribers in proportion as we help them by becoming publishers. It ought to be clearly and fully stated on behalf of the publishers, my co-editor, and myself, that there is no question of private profit in the ownership of the "Midland Naturalist." The only payments made on account of the magazine are towards the expenses of printing it; and an increase in the receipts from its publication would simply mean more money capable of being expended in the work of printing, illustrating, and distributing.

I would like local natural history societies to remember that they perform only one half of their functions if they live to themselves alone; that their labours to be of real value should also be communicated to others. A few of the societies constituting the Union, the more powerful and wealthy of them, recognise this, and are able to recognise this, by the publication of separate Transactions at more or less frequent intervals. The publication of Transactions is, however, an expensive matter, and the circulation very restricted; hence the great bulk of local societies, face to face as they are with small membership and low subscriptions, either do not publish at all, or publish at long intervals.

Now it is not too much to say that this tends strongly to kill local scientific activity. So long as a society is content to carry out the functions, very useful in their way, of a lecturing club, at which papers on general topics are read to such members as choose to attend the meetings, the method of non-publication will no doubt amply serve its purpose. But this alone is not the object with which local societies are founded. Nor is it fair to ask that labour of any value should be undertaken by a member for the very small return that the meeting can give him. With the judicious use of the columns of the "Midland Naturalist" the writer of a paper addresses himself to a far larger audience than could possibly come within the walls of a room many times exceeding the size of that in which the meetings of a society are usually held, and addresses them for the time future as well as the time present. I need hardly add that he does not thus in any way preclude, but rather facilitates, the subsequent publication of the paper, either in a separate form, or as part of the occasional Transactions of the society. Further, just as the publication of a paper enlarges the audience to which it is addressed, so the readers of the "Midland Naturalist," to whatever local society they may happen to belong, are placed upon a footing as it were of partial membership of all other societies from which contributions are received.

And even this is not all that the pages of the "Midland Naturalist" can do for its readers. It affords them a means, which it is earnestly hoped they will more freely avail themselves of, of recording natural history observations of local interest, and of the interchange of opinion, and of information, upon such scientific topics as come within its natural scope. For this purpose the editors will be glad to give admission to notes and queries, and to answers thereto.

These, then, are my own personal hopes in undertaking duties in connection with the "Midland Naturalist." They are hopes which are based upon a firm faith in the scientific and natural history resources of the Midland Counties; but it lies with others to demonstrate whether they are founded upon what is in itself a solid rock, or a shifting and unstable sand. If I cling to my faith in the rock, it is mainly because I am myself an outcome of a local natural history society; and it is impossible for me to think such dishonour of my scientific parentage as to believe that in the living present, and the yet unborn future, there are, and will be, in the ranks of the members of such societies less ardent lovers of scientific truth, than have existed in the past which daily fades from our touch. W. Hillhouse.

February 18th, 1887.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART IV.

The Middle Lias Considered as a Source of Water Supply.

(Continued from page 41.)

The Marlstone Springs.—The water which has supplied Northampton from 1848 to nearly the present time is derived from the Marlstone Rock-bed, and although satisfactory in quality, it is not so in quantity. I do not know what the average supply has been in recent years; but in 1871, when Northampton contained, according to the census, 45,080 people, the amount was 6·3 gallons per head per day (Haviland); and, although the available amount of water has been decreasing from the very first, still the supply to the town has once or twice been temporarily increased by deepening or making headings. Now, however, there is very little water left in the Marlstone. Many old wells are quite dry, and in all the water level is very low. As I shall have to refer to the Marlstone a good deal later on, it is scarcely necessary to say more here.

THE TRIAS SPRINGS.—After passing through the Upper, Middle, and Lower Lias in this district the upper part of the Trias is usually met with, and it has, in every case where it has been entered, yielded a supply of very salt water, the chief salts being the carbonates, sulphates, or chlorides of sodium, potassium, calcium, and magnesium. At the present time this salt water fills the old Kingsthorpe shaft to within 270 feet of the surface, which, assuming the pit has a depth of 967 feet, as the record gives it, means 697 feet of water. The nearest place where this water could find an inlet lies considerably to the north-west of the county, and well within Warwickshire, so that were it possible to use this supply, it seemed probable that it would be copious and fairly permanent. Pumping tests, however, showed that at Northampton it would only yield about 200,000 gallons per day, and at Gayton, where it stood twenty feet higher, less than 100,000 gallons.* The water at the Kettering Road well contained 1,200 grains of solid matter to the gallon, and the amount of Chlorine determined was 349·7 grains per gallon. That at Kingsthorpe and Gayton respectively was very similar, but each contained a rather larger percentage of solids.

The whole of the Trias has such frequent alternations of sand and marl that water may be obtained from it at very various horizons, and so it does not follow as a necessity that the water at Northampton and Gayton is from the same bed, though most likely it is.

It is known that the *Waterstones* of the Lower Keuper often yield an abundant supply of good water, and since the existence of the Trias had been proved by the trial shaft for coal at Kingsthorpe, about two miles to the N.N.E. of Northampton; when the Marlstone supply had got so low as to compel the Water Company to look for other sources, acting on the advice of their engineer, Mr. John Eunson, C.E., F.G.S., and after consultation with Mr. R. Etheridge, F.R.S. and Professor Judd, F.R.S., they decided to make a boring to reach, if possible, the Waterstones, which their advisers thought might perhaps be reached within a reasonable distance from the surface. The boring was commenced from the bottom of a well previously sunk into the Lower

* "The Range of the Palæozoic Rocks beneath Northampton," by Henry Jno. Eunson, Esq., F.G.S. Quarterly Journal of Geological Society, August, 1884.

Lias, at a spot about 1 mile N.E. from the centre of the town, near the Kettering Road. Although the boring added much valuable information to the science of Geology, as is well known, it entirely failed in its object. After passing through 738 feet of the Lias (Upper, Middle, and Lower), some abnormal sandstones, and conglomerates, occupying sixty-seven feet six inches, were passed through, and then twenty-five feet of Carboniferous dolomite, and then Lower Carboniferous limestone and shales for a depth of twenty feet six inches, the total depth being 851 feet. The Trias, Permian, and Coal Measures were absent, though it was pretty evident the Upper Trias existed not far away, on account of the considerable influx of salt water below 800 feet. Mr. H. J. Eunson says, in the paper from which most of these particulars are taken, that, without doubt, the saline water came from the beds above the dolomite.

This was a perfectly legitimate and well-conducted trial, and I thought conclusively settled the matter of a deep-seated water supply for Northampton; therefore, when the Gayton boring was broached, and before the work commenced, at my own request I was given the opportunity of explaining to the engineer of the Company the reasons why I felt sure the undertaking must fail, at the same time to suggest the alternative scheme, to be explained later on.

It has been well known for a long time that in the South Midland Counties of England a series of ridges or folds of the older Palæozoic rocks extended in an east and west direction across the country, and even into Belgium, and at no very great depth beneath the surface, and that in most cases these rocks were capped by the cretaceous or newer formations entirely cutting out the lower Mesozoic formations towards the east, and the lowest of them towards the west.*

As I understood it at the time, the idea in going to Gayton, five miles south-west of Northampton, was to endeavour to get at the Trias between the ridges of these old Palæozoic ranges of hills, or on the flanks of them, but as I pointed out at the interview referred to, it was possible they might get lower beds than they did at Northampton, but still they would be only the upper beds of the Trias, because the lower ones would be those most eliminated by deposition in an area which had to sink considerably before any deposit

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* More recent investigations show that "Oolitic" might be substituted for "Cretaceous." See "Nature and Relations of the Jurassic Deposits which underlie London, &c.;" by Prof. J. W. Judd, Q.J.G.S., November, 1884.

could take place on it. Thus the waterstones would not be present. These observations seem to be consistent with the result of the boring; the Rhætic shales were found, and some sixty feet of the Trias. They also seem necessary to explain the fact that further southwards at places where the Palæozoic ridge comes nearest to the sea level, newer and newer Mesozoic rocks rest upon it, showing that the ridge itself prevented the deposition of the earlier Mesozoic beds.

The anticipated thinning out of the Trias in the neighbourhood of Northampton, which was looked upon as an inducement to make a trial to reach the Lower Keuper waterstones, seems to offer no special advantages, but the reverse, because the thinning was only the result of an approach to a shore line of the early Trias sea.

It has been suggested that the carboniferous limestone met with at Northampton is an extension of the Pennine chain,* and I must admit that the finding of sixty feet of Trias at Gayton, five miles south-west of Northampton, and some 600 feet of Keuper marls at Rugby, some eighteen miles to the north-west, seem to favour the idea of a north and south extension of the carboniferous ridge, rather than an east and west one, in Northamptonshire. Still, the arguments made use of to account for the attenuation of the Trias, and the improbability of finding water, apply equally well; and the failure to reach the waterstones at Rugby constitutes a more powerful argument against success at Gayton.

Rivers.—With regard to a supply of water from the Nene, the water is not over-abundant, and is so polluted near the town, and the interference with mills and navigation likely to lead to such difficulties, that it was never seriously thought of.

Reservoirs.—At the present time a reservoir is being constructed in a valley near to the village of Ravensthorpe, for the supply of Northampton. It is situated about seven miles from the town, and is intended to hold 400,000,000 gallons of water. Before the reservoir was commenced, I did all I could to oppose its construction, both on account of its great cost and of the other drawbacks to such a supply for a town. I will not here make any specific charges against this scheme, because they might be misconstrued. I may even go so far as to say that if a reservoir there must be, then, providing there is enough water, the site selected could not be improved upon.

(To be continued.)

* "On the Range of the Palæozoic Rocks beneath Northampton." By H. J. Eunson, Esq., F.G.S. Quarterly Journal Geological Society, August, 1884.

THE DATA OF ETHICS.*

BY CONSTANCE C. W. NADEN.

"The Data of Ethics" forms the top-stone of Mr. Herbert Spencer's philosophy, or, at least, the highest stone yet placed; so that the Sociological Section of this Society, having but just completed the study of the "Principles of Biology," may seem unwarrantably to jump to a conclusion, by selecting this work for its next consideration. And yet, in making the leap, we do but follow the example set by Mr. Spencer himself. This book, which constitutes the first division of the work on the "Principles of Morality," with which the system ends, appears, the author tells us, out of its place, the second and third volumes of the "Principles of Sociology" being as yet unpublished. "The night cometh, wherein no man can work," is in substance the pathetic reason given for this departure from the natural order of precedence. This last part of the task it is to which the Synthesist regards all the preceding parts as subsidiary. "My ultimate purpose," he says, "lying behind all proximate purposes, has been that of finding for the principles of right and wrong in conduct at large, a scientific basis. To leave this purpose unfulfilled after making so extensive a preparation for fulfilling it would be a failure, the probability of which I do not like to contemplate, and I am anxious to preclude it, if not wholly, still partially. Hence the step I now take." Now, although as a section we may perhaps hope for that long life and strength which all of us must sincerely wish to Mr. Spencer, still it is natural that we should desire to touch and comprehend at an early stage of our studies what he regards as the vital point of his philosophy.

* An address delivered to the Sociological Section of the Birmingham Natural History and Microscopical Society, at the first meeting of the Section under the new laws of the Society, held at the Mason College, Birmingham, Tuesday, 22nd February, 1887. *(Transactions of the Society.)*

Having ascended the highest summit of the mountain range, we shall take our bearings, and shall be able to use the knowledge in subsequent ascents of the lower peaks or in excursions in the valleys.

That the problems which we are about to approach are important will be denied by none; but perhaps there are many who do not realise how transcendently important they are at the present stage of thought and belief. It is when the storms begin to beat, and the winds to blow, and the rains to fall, that it becomes foolish—nay, criminal—to be content with the very lordliest pleasure-house built on a shifting foundation. There is no time to be lost in looking out for a secure site; otherwise, great may be our fall. On this point I must again quote from the preface to the "Data of Ethics": "The establishment of rules of right conduct on a scientific basis is a pressing need. Now that moral injunctions are losing the authority given by their supposed sacred origin, the secularisation of morals is becoming imperative. Few things can happen more disastrous than the decay and death of a regulative system no longer fit, before another and fitter regulative system has grown up to replace it." This truth is strikingly illustrated by a passage from Ellis's "Polynesian Researches," quoted by Mr. Spencer in his work on "Ecclesiastical Institutions." It is as follows: "The sacrificing of human victims to the idols had been one of the most powerful engines in the hands of the government, the requisition for them being always made by the ruler. . . . An individual who had shown any marked disaffection towards the government, or incurred the displeasure of the king and chiefs, was usually chosen. The people knew this, and therefore rendered the most unhesitating obedience. Since the subversion of idolatry, this motive has ceased to operate, and many, free from the restraint it had imposed, seemed to refuse all lawful obedience and rightful support." Well, we are not South Sea savages, and our spiritual and temporal chiefs have not kept "the wretch in order" by condemning him to actual immolation at the shrine of an offended fetish. Still there have been modes always precarious, and now growing obsolete, of keeping the wretch who knew how to evade the laws in order, if not in very good order; and it is time to teach him that to be a wretch is bad evolutional policy. It is time for all of us to look to the basis of our moral creed, and to make sure that while beliefs may come and beliefs may go, morality must abide as an organic part of human nature.

It may at first appear a trifle incongruous that a Natural History and Microscopical Society should concern itself with Ethics. For surely the inhabitants of our ponds and hedgerows live "without a conscience," if not without "an aim;" surely the physiological conditions or concomitants of justice and mercy are not determinable by the most assiduous microscopist. Yet life in all its forms is the subject of Natural History; the simple conduct of the lowest organism is linked by a myriad gradations with the conduct of the highest; and until we understand those great biological generalisations, which are as true for the Amœba as for Man, we shall never truly comprehend any part of those sciences of mind and morals, which are themselves but sections of the science of life. "Just as, fully to understand the part of conduct which Ethics deals with, we must study human conduct as a whole; so, fully to understand human conduct as a whole, we must study it as a part of that larger whole, constituted by the conduct of animate beings in general."*

It is, indeed, chiefly in this breadth of foundation that Mr. Spencer's system differs from the empirical utilitarianism of Bentham and John Stuart Mill. All Utilitarians must, in the last analysis, estimate conduct by results. Conduct is good, if in the long run it promotes happiness; bad, if in the long run it decreases happiness. On this all are agreed; this is the common ground of Optimist and Pessimist; this, as Mr. Spencer shows, is virtually accepted even when verbally denied. Whether we estimate conduct by its relation to abstract virtue, to an ideal perfection of character, or to rectitude of motive; whether we invoke the Divine sanction, the legal sanction, or the sanction of conscience, our theory still involves an implicit reference to happiness as the ultimate end and aim. Theories differ by the varying degree in which they recognise the laws of natural sequence, and the interdependence of all departments of Nature. Empirical utilitarianism, for instance, takes no account of the established principles of biology, but seeks to confine itself to an induction which never can be complete. It is as though, declining to accept the law of gravitation, we were to insist on using Attwood's machine to prove experimentally the rate at which every apple falls to the ground. Attwood's machine is most useful for learners and as a means of verification, but there are a great many objects to which it cannot be applied, and physics certainly never would have become a science unless physicists had been willing to reason downward from law or

* "Data of Ethics," Ch. I., § 2

from hypothesis to phenomena, as well as upward from phenomena to law. This view is so important that I must quote Mr. Spencer's own words, contained in a letter to Mr. Mill :—" I conceive it to be the business of moral science to deduce, from the laws of life and the conditions of existence, what kinds of actions necessarily tend to produce happiness, and what kinds to produce unhappiness. Having done this, its deductions are to be recognised as laws of conduct, and are to be conformed to, irrespective of a direct estimation of happiness or misery. Perhaps an analogy will most clearly show my meaning. During its early stages, planetary astronomy consisted of nothing more than accumulated observations respecting the positions and motions of the sun and planets. . . . But the modern science of planetary astronomy consists of deductions from the law of gravitation —deductions showing why the celestial bodies necessarily occupy certain places at certain times. Now, the kind of relation which thus exists between ancient and modern astronomy is analogous to the kind of relation which I conceive exists between the expediency-morality, and moral science properly so-called."*

In this scientific and rational conception will be found the true answer to the objections so often and so forcibly urged against utilitarianism. It is repugnant to common sense and common feeling to assert that everyone is or ought to be at every moment consciously engaged in the pursuit of happiness, either for himself or for society. We know very well that many of our actions, although they may have pleasure as their impulse, yet have not pleasure as their conscious goal. " Every man acting voluntarily, does what he under all the circumstances prefers to do" is a perfectly true saying. But the seeming corollary, " he does it *because* he prefers to do it," is really ambiguous, and stealthily introduces a new and questionable idea. It is the seemingly innocent little word " because " which must bear the blame. For a confusion at once arises between the *final* cause and the *efficient* cause of the action; between the inclination which prompted it, and the object towards which that inclination was directed. My inclination prompts me to paint a picture or write a poem; but I do not take the inclination twice over, and make it into an object. My *object* is not satisfaction to myself, but the true expression of my thought. This expression will indeed bring me satisfaction, but I shall not work so well if I think very much about

* " Data of Ethics," Ch. IV., § 21.

the ultimate end. Not only are we apt to take the pleasure twice over, but we often take it three times over, confusing together the inclination, the object, and the results of the action. The results of my picture or poem, if it be good work, will be, let us say, beneficial to society; and yet benefit to society was not my object. In short, the *inclination* is always in the direction most pleasurable or least painful; the *results* of the action, if it be a moral one, are such as in the long run, and on a large scale, must increase happiness; but the *object* of the action need not be connected in the mind of the actor with any thought of happiness, personal or general.

Now it is the aim of rational utilitarianism to show, first, how inclination can be directed to an object not capable of gratifying any selfish desire; and second, how it comes that objects sought without any mental reference to general welfare are yet correlated with general welfare. Thus the way will be smoothed for a reconciliation of egoism, or care for self, with altruism, or care for others. I can but very briefly trace Mr. Spencer's solution of these problems.

(To be continued.)

THE RELATIONS BETWEEN EVERGREEN AND DECIDUOUS TREES AND SHRUBS.*

BY F. T. MOTT, F.R.G.S.

In the Highlands of Scotland there are four native trees which grow together nearly everywhere under similar conditions, of which two are evergreen—the Holly and the Scotch Fir, and two are deciduous—the Birch and the Rowan. What is the physiological difference? Why do the Holly and the Fir retain their leaves through the winter while the Birch and the Rowan drop them in the autumn? I do not know whether this question has ever been fully answered. I have not met with any satisfactory reply to it, and I offer the following notes as a contribution towards the solution of the problem.

* This paper originated from a discussion on the subject in Section D of the Leicester Literary and Philosophical Society, January 19th, 1887.

(1.)—Evergreen trees and shrubs are most abundant within the zone extending about 45° on either side of the equator, and having in no part of it, except on the mountains, a mean annual temperature of less than 50°. Within this zone, the evergreens form probably 80 per cent. of the total number of species, and in some parts of it a deciduous tree or shrub is scarcely to be found.

Deciduous trees and shrubs predominate in the zone, extending from about 45° to 60° of latitude, having a mean annual temperature of not less than 40°. Within this zone, they would constitute probably 80 per cent. of the total species if it were not for the Coniferæ, whose 200 evergreen species occur chiefly in this region.

(2.)—The whole of the Coniferæ are evergreen with the exception of the Larch, the Salisburia, and one or two others.

(3.)—A few species of trees and shrubs are evergreen in their native homes, but deciduous in more severe climates. as *Ligustrum Japonicum*, *Cotoneaster Simmonsii*, and some of the Cistuses.

(4.)—Certain orders, as Cornaceæ, contain some genera which are evergreen (*Aucuba*, *Garrya*, &c.), and others which are deciduous (*Cornus*). Many genera, as *Berberis*, *Viburnum*, &c., contain some species which are evergreen, and others which are deciduous; and some deciduous species produce evergreen varieties, as *Ligustrum vulgare*, var. *sempervirens*.

(5.)—There are about 3,600 known species of evergreen trees and shrubs, and about 1,200 deciduous species. About 75 per cent. of each bear showy flowers. Taking the whole 4,800 together, about 3,600 are shrubs and 1,200 trees.

(6.)—The hard cuticle of many evergreen leaves minimises evaporation, and their upper surfaces are often quite destitute of stomata.

(7.)—The young shoots of hardy evergreens in this country commonly remain green on one side, if not all round, throughout the winter, while those of deciduous species are mostly brown, plum-colour, or black.

(8.)—Professor Hillhouse, in a paper read before the British Association at Birmingham, has incidentally shown that deciduous leaves when they fall in autumn leave an accumulation of starch or other reserve food round the base of the dormant bud. This is not the case with evergreens. The chlorophyll-grains in evergreens leave the cell walls in winter and unite in central masses, but do not become decomposed as in deciduous leaves.

(9.)—Starch is only developed from chlorophyll under the influence of light. If it remains in contact with chlorophyll during prolonged darkness it is re-absorbed (*see* Sachs), but if it is stored away when formed in separate cells, as in seeds, tubers, &c., it continues unchanged.

Reviewing and collating these facts I suggest the following provisional theory :—

Whether any group or botanical order of trees or shrubs is normally evergreen or deciduous depends upon the climatal conditions under which it was evolved, differentiated and established as a distinct group; and the character then assumed is perpetuated by heredity through its later ramifications, although the climatal conditions may have changed considerably. But an order which was originally and is still normally evergreen may have evolved certain genera or species under later and much altered conditions, which assumed the deciduous character, and *vice versâ*.

An evergreen order is one which was evolved under a climate in which the change of seasons was but slightly marked. A deciduous order, on the contrary, originated under a climate in which the conditions of winter and summer differed widely.

The only extensive region of the earth, as it now is, in which the seasons are but slightly marked, is the tropical zone, and this state of things has existed probably for at least 100,000 years. But in earlier geological epochs, there is good reason to believe that the climate of the whole surface of the earth was much more equable than it is now, much more resembling the conditions of our present tropical zone. Evergreens, therefore, probably originated either in these early epochs, or else in the neighbourhood of the tropics. Of existing trees and shrubs, the oldest group is undoubtedly the *Coniferæ*. This order originated at least as far back as the Carboniferous period, and is normally evergreen, as might have been expected, with a few deciduous forms probably of late development. The earliest group of Angiosperms, the truly exogenous trees and shrubs, occurs in the Wealden formation, just before the opening of the great Tertiary epoch; and this group consists almost entirely of the curious evergreen order of *Proteaceæ*, now chiefly confined to the Cape of Good Hope and Australia.

In the lower Eocene strata are found, in addition to the Proteads, the evergreen Figs and Laurels; while the London clay yields also Anonas, Acacias, and Palms, all evergreen groups. Not till the Miocene period do such distinctly deciduous genera as the Willows, Poplars, Maples, Hazels, Birches, and Beeches make their appearance, and still these are in the minority, the forests evidently consisting mainly of evergreen forms. But from this period upwards the strata deposited in the temperate zone contain an increasing proportion of deciduous exogens, mixed with a few of the earlier evergreen forms, and the still persistent and evergreen *Coniferæ*.

The association of the deciduous habit with extreme variation of seasons is not difficult to explain. Leaves are the organs by which the functions of vegetable life are chiefly carried on. They are the principal organs of respiration, transpiration, assimilation, and secretion. By means of their form and position, large surfaces of sensitive tissue are brought into direct contact with air and light, but the necessary consequence is that they are, more than any other parts of the plant, liable to injury by violent changes of temperature, and especially by frost.

In regions whose mean annual temperature is above 55° snow does not lie and ice is rarely seen. The functions of vegetable life can be carried on throughout the year, although with diminished energy during the colder or drier periods, and the leaves of plants remain green and active until new ones take their place. But a mean temperature below 50° implies great depression in the winter months, and frequently severe frost such as the leaves of most plants are not able to bear. If they are killed while the cells are full of active chlorophyll, which has been providing daily food for the growth of the plant but has laid up no store, there will be nothing to support the fresh growth of spring, and the plant must dwindle or die. It would seem that by the law of natural selection and survival of the fittest, plants which were developed in climates gradually becoming more varied and more severe must have adapted themselves to these conditions by converting their chlorophyll into starch and storing it in special cells at the base of the buds as soon as the cold and comparative darkness of autumn began to check the vital functions. The leaves exhausted of chlorophyll would be of no further use and would be cast off, while the plant passed into a state of hibernation, withdrawing its remaining chlorophyll even from the surface of the young twigs, that it might be preserved for the time of re-awakening. This process is plainly analogous to the hibernation of animals in similar climates. Fattened by the abundant food obtainable in autumn, they are able to sleep through the season of cold and darkness. and to wake with a sufficient reserve to carry them on till fresh food is found. Deciduous plants are those which hibernate; and as some animals maintain themselves through the winter while others have acquired the habit of hibernation, so, even in the zone of frosts, some evergreen plants are mixed with the predominating deciduous flora; such species having perhaps been evolved in more moderate climatal conditions, but with organs and tissues so far differing from the majority as to be able to withstand some greater amount of seasonal variation.

A PROPOSED MIDLAND UNIVERSITY.

The English people are in the main so fully convinced that we have Universities galore, that the news that a movement has been seriously set on foot to further the foundation of a University for the Midland districts of England will probably come to most in the sense of a distinct shock. Why we think our supply of Universities should suffice fully for our needs, it is difficult to say. Seeing that Germany, with its unrivalled system of national education, has twenty-one such institutions, with over 22,000 students and nearly 2,000 professors and lecturers; seeing that Scotland, with its three and three-quarter millions of inhabitants (less than the population of London), has four Universities, with over 7,000 students, we can only conclude that if the English supply is sufficient for the English needs, it can only be because the English needs for University training are themselves small. But is this so? Have we not scattered over the length and breadth of the land local University and other Colleges, in which distinctly University training of a systematic kind is imparted to students counted by the thousand? And is not each of these a standing proof that there is a need in England for University training, and therefore there is a need, which the existing institutions do not fully supply, for English Universities? Perhaps it may be said that there is here a confusion of argument; that the grand upheaval of University Colleges which the last dozen years has seen is evidence of the need of University teaching, but no evidence of the need of University examination. This can hardly be; for in our methods of teaching the examination is an essential part, and every College recognises this in its own line of conduct, and every College gives, as the result of examination, certificates which only in degree differ from the examination certificate given by a University. The whole question, then, hinges on the power, not to examine, but to give some special distinction, as the result of examination, in the form of certain representative initial letters, B.A., M.A., and the like.

At the present time the bulk of these local Colleges send their candidates for these distinctive letters to the University of London. Why should they do this? Has the University of London any peculiar merits as an examining body which could not be possessed by any other body? This can hardly be, since the examiners of the University of London are themselves gathered from all quarters, and could become equally examiners in any other duly constituted examining body. Take the examiners of the University of London—and it must be distinctly understood that the University of London does nothing but examine—take the examiners of the University of London, and put them in another centre for examining purposes, and why should the result differ from that at present attained? London is not an educational Mecca.

I suppose the fear really is that if there are a number of degree-giving bodies, the standard of degrees may be lowered. Well, to start with, what is the standard at present existing? Of course, this is uniformly high! Every educationalist will at once tell you that it is impossible, or well-nigh impossible, to conceive a more diverse system than that at present appertaining in England. Institute a comparison between a high honour degree and a "poll" degree at Cambridge. Both equally result in B.A. Compare London, again, with Durham; and add to these the personal University powers of the Archbishop of Canterbury, and what, then, must be our opinion of the uniformly high quality of the English degree-giving examination, or want of examination? The cry of lowering the standard of a degree is a farce; but it serves its purpose of making the English public fear a multiplicity of degree-giving bodies. It is quite true that a diversity of standard could exist, and might result from increase of the number of degree-giving bodies; but such diversity exists now, and could hardly be greater. Personally I much regret it, and probably nineteen out of every twenty educationalists do likewise; but it is absurd to suppose that the present disparity could be intensified. Further, every practical educationalist knows the value of each degree, so that he at least is not deceived. Nor do I think that, with proper addition of at least an equal quantity of external examiners to any local degree-giving body, very great disparity need exist; it would not surprise me, indeed, to find uniformity much greater than it at present is.

The movement in favour of a Midland University was originated about a year ago amongst the professorial staff of the two Birmingham Colleges—Mason Science College and the Queen's College Medical School, with the addition of the well-known Midland Institute. It has culminated at present in a memorial to the Mayor of Birmingham, which is as follows:—

"To His Worship the Mayor. Sir,—Many propositions have recently been made respecting the way in which it is desirable to celebrate the Queen's Jubilee. We feel that none of these entirely appeal to our sympathy. On such a special occasion it is well to leave the beaten track and to accomplish some public act which will for ever emphatically recall and emphasise the present year of our town's history. Birmingham, with its well-organised system of primary and secondary education, is yet far behind many other towns in the way of higher University education. We form the centre of a population larger than that of Wales, and nearly as large as that of Scotland, yet our youths have to go elsewhere for their degrees, and often for their training in science, medicine, and arts. Manchester and Liverpool have already their University, and Leeds will shortly follow in their wake. Are we to remain stagnant and alone? In Birmingham students have been prepared for obtaining degrees at distant Universities; but the work has been arduous and heavily handicapped by the want of a local body exercising University functions. The three institutions which we possess—the Mason College, the Queen's College, and the Midland Institute—are the products of individual public spirit. Those who are aware of their individual fitness know how little, both in the way of funds and of organisation, would be sufficient to found by their co-ordination a great Midland University, where our people could obtain that knowledge which means bread at their very doors, without having to go for it to Germany, to Scotland, or to London. We would suggest that that portion of the town's Jubilee Fund which it is decided to use for local purposes shall be converted into a University Fund, as an expression of the desire of the town to see in its midst a University which shall be in sympathy with the wants and requirements of the inhabitants, and shall rival the Victoria University."

Amongst those who have signed this memorial are the following:—Messrs. Follett Osler, F.R.S.; Richard Chamberlain, M.P.; H. W. Crosskey, LL.D.; E. F. M. MacCarthy, M.A.; Osmund Airy, M.A.; Professors Bridge, Poynting, Lapworth, Hillhouse, Haycraft, Heath, Sonnenschein, Dammann, Smith, Windle, Loreille, and Woodward, together with some fifty others.

The memorial has produced no direct result with the Jubilee Committee; nor probably did any one of the memorialists greatly anticipate such result. But it has set a ball rolling which will probably never stop till the Midland Counties, with their own special genius, their own special wants, and their special racial characteristics, have an institution in their midst endowed with the degree-giving function. The three counties into which Birmingham and its suburbs extends have a population of nearly two and a quarter millions—much more than half the population of Scotland. The eight counties impinging on these three, and forming the outer circle, have a population of another three millions. Why should students derived from this dense mass of population, taught and trained in its midst, go elsewhere for those examinations which are to crown their student career?

Perhaps it will take years to fulfil the hopes of the initiators of this University scheme for the Midland Counties. The ball has, however, been started; and for those amongst the readers of the "Midland Naturalist" who take an interest, whether for or against the scheme, I can only ask that they should purchase for a spare penny the presidential address of the Rev. H. W. Crosskey, LL.D., to the Birmingham Philosophical Society (Cornish Bros., Birmingham, publishers), and read there, given with an eloquence peculiarly his own, the reasons of one of the leading Birmingham educationalists in favour of this topmost stone of the Midland system of universal education.

W. Hillhouse.

TWENTY-EIGHTH ANNUAL REPORT

OF THE

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY,

Presented by the Committee to the Annual Meeting, February 1st, 1887.

The committee in presenting the report for the year 1886 feel much pleasure in stating that the regular work of the Society has been well sustained. The communications made to the Society have been both numerous and valuable, and the specimens exhibited, whilst they have been very varied, have proved both interesting and instructive, many being very rare, and a goodly number being new to the district. This has been especially the case amongst the more minute forms of life, such as the micro-organisms shown from time to time by Mr. T. Bolton, F.R.M.S., the Society's assistant-curator; the micro-fungi by Mr. W. B. Grove, B.A.; to these must be added as a constant contributor, Mr. J. E. Bagnall, A.L.S., whose "Flora of Warwickshire" has won for him a high position amongst the local botanists of our country, and who from time to time has exhibited rare and interesting flowering plants, mosses, &c., with notes upon their geographical distribution. Still the committee believes that if a larger proportion of the members would bring specimens for exhibition, the interest of the Society's meetings would be yet further enhanced.

The committee are pleased to report that the diminution of members by withdrawal—owing to the increase in the subscription—has now practically ceased, and they look forward hopefully to an increase of membership in the early future.

On account of the visit of the British Association, no conversazione was held this year in the Town Hall; but each session was commenced by a soirée on a smaller scale, held in the examination hall of the Mason College, which was kindly placed at the disposal of the Society for that purpose.

The committee feel it an honour to point to the prominent part taken by many members of the Society, in the proceedings of the Meeting of the British Association in Birmingham in 1886, not only in the reading of papers before the various sections, and in their work on the different committees; but especially in connection with the Natural History portion of the Exhibition in Bingley Hall, and in their valuable help in the preparation of the "Hand-Book of Birmingham," which was published for the occasion. A resumé of the relations of the Society with the visit of the Association written by Professor W. Hillhouse, M.A., appeared in the "Midland Naturalist" for 1886, page 316; and the final report of the executive, presented to the general local committee, contains a generous and hearty recognition of the work of the Society in connection with the meeting of the Association.

The annual meeting of the Midland Union of Natural History Societies was held in Shrewsbury, on June 22nd and 23rd, when a conversazione was held in the Music Hall, and three excursions were made:—The geological to Norton and Stokesay Castle, the botanical to Ellesmere, and the archæological to Uriconium and Buildwas Abbey.

A whole-day excursion of the Society was made on Easter Monday, April 26th, to Chirk, when about fifty members attended. A fortnight's excursion was made to Tenby by a party of members of the Society, when the marine fauna and flora of the shore were examined, and botanical, geological, and ornithological rambles were made in the neighbourhood, and many interesting specimens found. Two excursions were made by the Sociological Section, and are referred to in the report of that section.

The committee deeply regret having to record the loss the Society has sustained by the death of Mr. John Morley, F.R.M.S., for ten years the active secretary of the Society, and to whose constant care it owes so much. His loss will be long felt by all who knew him, as his genial manner and readiness to help the members had won for him the esteem for all.

Another loss has also been sustained by the death of Mr. W. Southall, F.L.S., F.R.M.S., a former president of the Society, and one whose extensive botanical knowledge was often kindly placed at the service of the Society.

The committee have also to record the death of Professor T. Spencer Cobbold, M.D., F.R.S., an honorary vice-president, whose papers and exhibits on Helminthology have so frequently enriched the Society's Transactions; and of the Rev. W. W. Newbould, M.A., who has rendered very valuable service in the botany of this district, and whose specimens have occasionally been exhibited by Mr. J. E. Bagnall.

The total number of members is now 211, being a net decrease of 32. There are now six life members, 155 ordinary (guinea) members, twelve family (half-guinea) members, five honorary vice-presidents, thirty corresponding members, and three associates. The complete list of these will be separately published.

TRANSACTIONS.—During the year there have been twenty-two general meetings of the Society (with an average attendance of 18·5), at which the following communications have been made:—

February 16th.—An enumeration of specimens of organic life, both animal and vegetable, found in a swampy ditch in Sutton Park: T. BOLTON, F.R.M.S.

March 2nd.—Physical History of Great Britain from the Glacial epoch to the present day: Rev. H. W. CROSSKEY, LL.D., F.G.S.

March 16th.—Petrels and shearwaters of Great Britain: R. W. CHASE.

March 30th.—Notes on a tour in America, including geology and natural history: W. P. MARSHALL, M.I.C.E.

April 6th.—Hints on photo-micrography: J. EDMONDS.

April 20th.—A half day's ramble in the Arrow district: J. E. BAGNALL, A.L.S.

April 20th.—Some observations on the anatomical structure of the Royal fern (*Osmunda regalis*): Professor W. HILLHOUSE, M.A.

June 15th.—On the development and germination of the cocoanut (*Cocos nucifera*): Professor W. HILLHOUSE, M.A.

November 16th.—Photographs of flowers and plants, illustrated by the oxyhydrogen lantern: C. PUMPHREY.

November 30th.—Photo-micrography, illustrated by the oxyhydrogen lantern: J. EDMONDS.

December 7th.—A ramble amongst the lichens on the island of Bute: W. H. WILKINSON.

The following communication has been made to the Biological Section:—

On the mechanical structure of the hart's tongue fern (*Scolopendrium vulgare*): Professor W. HILLHOUSE, M.A.

The following communications have been made to the Geological Section:—

January 26th.—Fossil ornithology, with special reference to *Archæopteryx lithographic, macrura*: R. W. CHASE.

May 25th.—The quartzite pebbles of the Drift: A. T. EVANS.

July 27th.—On granites: T. H. WALLER, B. Sc.

September 28th.—On the geological specimens collected in the Shropshire excursion of the British Association: W. P. MARSHALL, M.I.C.E.

October 10th.—On a rock from New Zealand, and the dust from the recent eruption there: T. H. WALLER, B. Sc.

November 23rd.—The modern theory of glacier motion: W. P. MARSHALL, M.I.C.E.

The subjects of the meetings of the Sociological Section have been as follows:—

I.—THE PRINCIPLES OF BIOLOGY.

January 21st.—Morphological differentiation in plants: Exposition by Professor HILLHOUSE, M.A., F.L.S. (*concluded*).

March 18th.—Morphological differentiation of animals: Exposition by Mr. F. J. CULLIS, F.G.S.

April 1st.—The vertebrate skeleton: Exposition by Mr. F. J. CULLIS, F.G.S.

May 6th.—The problems of physiology: Exposition by Mr. W. K. PARKES.

May 20th.—Physiological integration in animals: Exposition by Professor HAYCRAFT, M.B., F.R.S.E.

July 1st.—The laws of multiplication of organisms: Exposition by Mr. W. B. GROVE, B.A.

October 7th.—The literature of Evolution published during the year: Address by Mr. W. R. HUGHES, F.L.S.

November 25th.—Genesis, development, expenditure, and nutrition: Exposition by Mr. W. R. HUGHES, F.L.S.

December 9th.—Special aspects of genesis: Exposition by Mr. F. J. CULLIS, F.G.S.

December 16th.—Multiplication of the human race, and human population in the future: Exposition by Dr. ALFRED HILL, F.I.C.

II.—THE STUDIES IN SOCIOLOGY have been continued by Mr. A. BROWETT, Mr. W. H. FRANCE, Mrs. BROWETT, Mr. W. R. HUGHES, F.L.S., Mr. F. J. CULLIS, F.G.S., and Miss NADEN.

BIOLOGICAL SECTION, (President, W. P. Marshall, M.I.C.E.; Secretary, J. E. Bagnall, A.L.S.)—During the year 1886, eight meetings of this section were held, with an average attendance of 14·25 members. The meetings have been mainly devoted to the exhibition of specimens, by which, and the discussions following thereon, their interest has been well sustained. Amongst the exhibitors, special mention has already been made of Mr. W. B. Grove, and Mr. J. E. Bagnall; the very beautiful ornithological specimens exhibited by Mr. Chase were made specially interesting by notes on habits, habitats, and other features of bird-life. Many specimens of North American plants, and mosses from various parts of Great Britain and the Continent have been exhibited from the collections of Mr. J. B. Stone, J.P., greatly enhancing the interest of the meetings. Mr. W. H. Wilkinson has exhibited many lichens and other plants; Mr. Fred. Enoch has exhibited and presented to the Society several beautifully prepared slides of insects and spiders; and other members have actively assisted in the work of the section.

Geological Section, (President, T. H. Waller, B. Sc.; Secretary, J. Udall).—Eight meetings of this section have been held during the year, with an average attendance of fifteen members. The section has to express its indebtedness to Mr. T. H. Waller, B. Sc., and Mr. Horace Pearce, F.L.S., F.G.S., for the exhibition of various rocks and volcanic dust from New Zealand, and of granites, and micro-sections of them, from Aberdeen and Peterhead; also to Mr. W. P. Marshall for the fine diagrams with which he illustrated his paper on "Glacier Motion," and to Mr. T. Evans for the exhibition of many beautiful specimens of fossils contained in the pebbles of the Drift.

Sociological Section (President, W. R. Hughes, F.L.S.; Secretary, A. Browett).—During the year twenty-one meetings of this section have been held, nineteen being ordinary meetings and two excursions. The average attendance at the former has been nine. The main subject of work has been the continuation, through Parts IV., V., and VI. of Mr. Herbert Spencer's "Principles of Biology." This important study was commenced by Dr. Alfred Hill, F.I.C., at a meeting of the section on October 4th, 1883, and was concluded by the same gentleman in an able and lucid address on the "Multiplication of the Human Race," and "Human Population in the Future" at the meeting on December 16th last. The exposition, discussion, and illustration of this division of Mr. Herbert Spencer's "Synthetic Philosophy" has given great gratification to those who have joined in it, and it is probably the first time that the systematic and combined study of a work on the principles of the doctrine of Evolution has been thus carried out by any Natural History Society. Eight chapters of the "Study of Sociology" of Mr. Spencer have also been read and discussed by the section during the year. The seventh excursion of the section was made on Saturday, July 24th, and under the leadership of Mr. A. Browett and Mr. W. Showell Rogers, LL.D., to "The Country of the Rev. Samuel Parr, LL.D.," Rector of Hatton, and to Temple Balsall, the ancient home of the Knights Templar and the Knights Hospitaller; and also to Wroxall Abbey, where the section was kindly received and entertained by Mr. J. B. Dugdale, J.P., and Dr. Rogers gave an address on "Dr. Parr: his literary works and influence." The eighth excursion was made to "The Country of Boulton and Watt," at Handsworth. The party first visited Soho House, where Matthew Boulton lived, and where the famous "Lunar Society" met. Mr. James Wilson, the present occupier, gave an account of the past and present history of the house. The party then visited Heathfield Hall, formerly the residence of James Watt, now of Mr. George Tangye, J.P., by whom the visitors were received and entertained. Here they examined the celebrated Watt Room, with its specially interesting contents; then after a visit to the parish church of Handsworth, the party was kindly received and entertained by Mr. and Mrs. J. B. Clarke, of Endwood Court, and a paper on the Watt Room was read by Mr. W. P. Marshall, M.I.C.E. The section regrets to report that Mr. Alfred Browett has resigned the office of secretary. The able, courteous, and energetic way in which he has carried out the duties of that office entitles him to the thanks, not only of the section, but also of the whole Society.

The Library.—(W. B. Grove, B.A., Librarian). The committee have great pleasure in announcing that in consequence of the publication on the monthly programmes of the Society of the list of books missing from the Library, several of the volumes have been found and returned. Two or three valuable works are, however, still missing. The issue of books during the past twelve months has been as follows: Botany, 40; Zoology, 19; Ornithology, 2; Entomology, 9; Geology, 15; Microscopy, 18; Philosophy and General, 47; total, 145. The number of persons borrowing books during the year has been 41. This does not fall far short of the number of 1885, and the Library is still frequently used during the day for the purpose of reference. The list of books added to the Library during the year will be separately published.

General Property.—The curators (G. M. Iliff and H. Miller), after a careful examination, have to report that the microscopes, &c., are in good condition. One of the oblique light diaphragms for the "Swift" sub-stage condenser is missing, also the paraboloid belonging to the same instrument, which latter they have been unable to trace since the opening meeting of the winter session in October last.

Finance.—The report and balance-sheet of the treasurer, (Chas. Pumphrey) which will be separately published, shows total receipts £172; total payments (including adverse balance of £37 17s. last year), £189 19s. 1½d.; balance due to the treasurer, £17 19s. 1½d. The total liabilities of the Society are about £83, the arrears of subscription being £15. Since 1861, upwards of £1,190 has been expended by the Society in books, furniture, and apparatus.

Review.

Florule Bryologique, ou Guide du Botaniste au Mont Blanc. Par Venance Payot. 8vo., pp. 78. Genève: Henri Trembley.

This little work, which gives the result of fourteen years' work and travel about Mont Blanc, the Pennine range, and circumjacent mountains, will be interesting and truly useful to those bryologists who have collected or intend to collect in this region of bryological wealth. Over 430 species and many varieties are recorded by the author, some of them new to science, and many of them rare. M. Payot had the advantage and honour of corresponding with that late great master of the science of bryology, Prof. W. P. Schimper, who examined the various species contained in his herbarium, and more recently the eminent botanists, M. L'Abbé Boulay, MM. Geheeb, G. Davies, Brotherus, Limpricht, etc., so that the nomenclature may be accepted as correct. The author's work is more than once alluded to in Schimper's Synopsis, and a rare moss, *Bryum Payoti*, was named in his honour by the author of that work, who says in commendation, "Unde oculatissimus *Payot* floræ m. Mont-Blanc investigator indefessus misit." The book is blemished by many typographical errors, some of which are corrected in the errata, but many still remain uncorrected; otherwise it is a valuable addition to our bryological literature.

J. E. B.

METEOROLOGICAL NOTES.—January, 1887.

Atmospheric pressure was very unsteady throughout the month. The mercury fell rapidly to 28·826 inches on the 5th, then rising quickly to the 13th (30·454 inches), after which it experienced various fluctuations. Its highest point was on the 21st. Temperature was above three degrees below the average. The means both of maximum and minimum were low. The highest readings were:—54·3° at Loughborough, on the 28th, and at Hodsock on the 29th; 54·0° at Henley-in-

Arden, on the 28th; 51·9° at Coston Rectory, on the 30th, in the rays of the sun; 93·0° at Loughborough on the 30th, and 92·9° at Hodsock, on the 29th. The lowest were:—10·0° at Henley-in-Arden, on the 17th; 10·5° at Coston Rectory, on the 1st; 12·3° at Hodsock, on the 7th; and 14·4° at Loughborough, on the 17th; on the grass, 4·0° at Hodsock, on the 7th; and 13·5° at Loughborough, on the 17th. The amount of rain or snow (melted) was about the average for the month. A heavy fall of snow occurred on the night of the 7th, the values of which were 0.71 inches at Loughborough; 0·60 inches at Henley-in-Arden; 0·52 inches at Hodsock; and 0·39 inches at Coston Rectory. The total fall for the month was, at Henley-in-Arden, 2·61 inches; at Loughborough, 2·44 inches; at Hodsock, 2·30 inches; and at Coston Rectory, 1·96 inches. A lunar halo was observed at Loughborough on the evening of the 10th. The last few days of the month were fine and warm. WM. BERRIDGE, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Wayside Notes.

WE HAVE TO RECORD the loss to science by the death of one of our veteran workers in bryology, William Curnow, who died January 24th, 1887, at his residence, Newlyn Cliff, Cornwall, aged 78. Although Mr. Curnow published little, his work in the mosses and hepatics has been extensive, and his name is one honoured not only in Britain, but also on the Continent. He contributed many specimens of the Hepaticæ to the "Fasciculi," issued by Carrington and Pearson, as well as to those issued by Continental botanists. Among his published works may be mentioned his paper on "The Hepatics of West Cornwall," by William Curnow, and "The Mosses of West Cornwall," by William Curnow and John Ralfs, M.R.C.S. These were both published in the Transactions of the Penzance Natural History and Antiquarian Society.

SOME new species of rotifers, twenty-four in number, are described and illustrated in the February number of the "Journal of the Royal Microscopical Society," by P. H. Gosse, F.R.S. Amongst these four came from the neighbourhood of Birmingham, collected by Mr. Thomas Bolton, the indefatigable Assistant Curator of the Birmingham Natural History and Microscopical Society. They are—(6) *Diaschiza (?) cupha*, a hunchbacked form described from a single dead specimen in water from Birmingham. (8) *Pterodina reflexa*, found abundantly in water from Smallheath. (12) *Notholca polygona*, characterised as a remarkable species, and found in Kingswood Pool; and (18), *Asplanchna eupoda*, a species with a remarkable foot, found in the canal at Small Heath. Next month we will copy Mr. Gosse's descriptions of these new local species.

A DEPOSIT of phosphatic nodules, the so-called "coprolites" of commerce, has been found in the Isle of Wight by two assistants in the Woodwardian Museum at Cambridge, Messrs. Keeping and Woods. They are in four beds, in distinct horizons, the lowest about 200 feet from the top of the lower greensand, and one of them thick enough to work, but for the fact that the beds dip at such a high angle that little could be profitably extracted. These pseudo-coprolites have been worked for many years at several places in Bedfordshire, *e.g.*, Leighton Buzzard, Woburn, Ampthill, Sandy, and Potton, going right across the country, and following the base of the upper neocomian greensand. There the beds range from six inches to two feet in thickness. In Cambridgeshire, where they are likewise worked extensively, they come either from the gault or the lower greensand. In Suffolk they are met with at the base of the Red Rag, and probably derived from the Coralline Crag. They are very interesting deposits, partly the débris of denuded beds, partly bones of dead saurians and fish, but all rolled about in shallow seas, till their identification becomes very difficult. True coprolites of fæcal origin were first found in the lias of Gloucestershire, but never occur in quantity sufficiently great to make them of value for agricultural purposes.

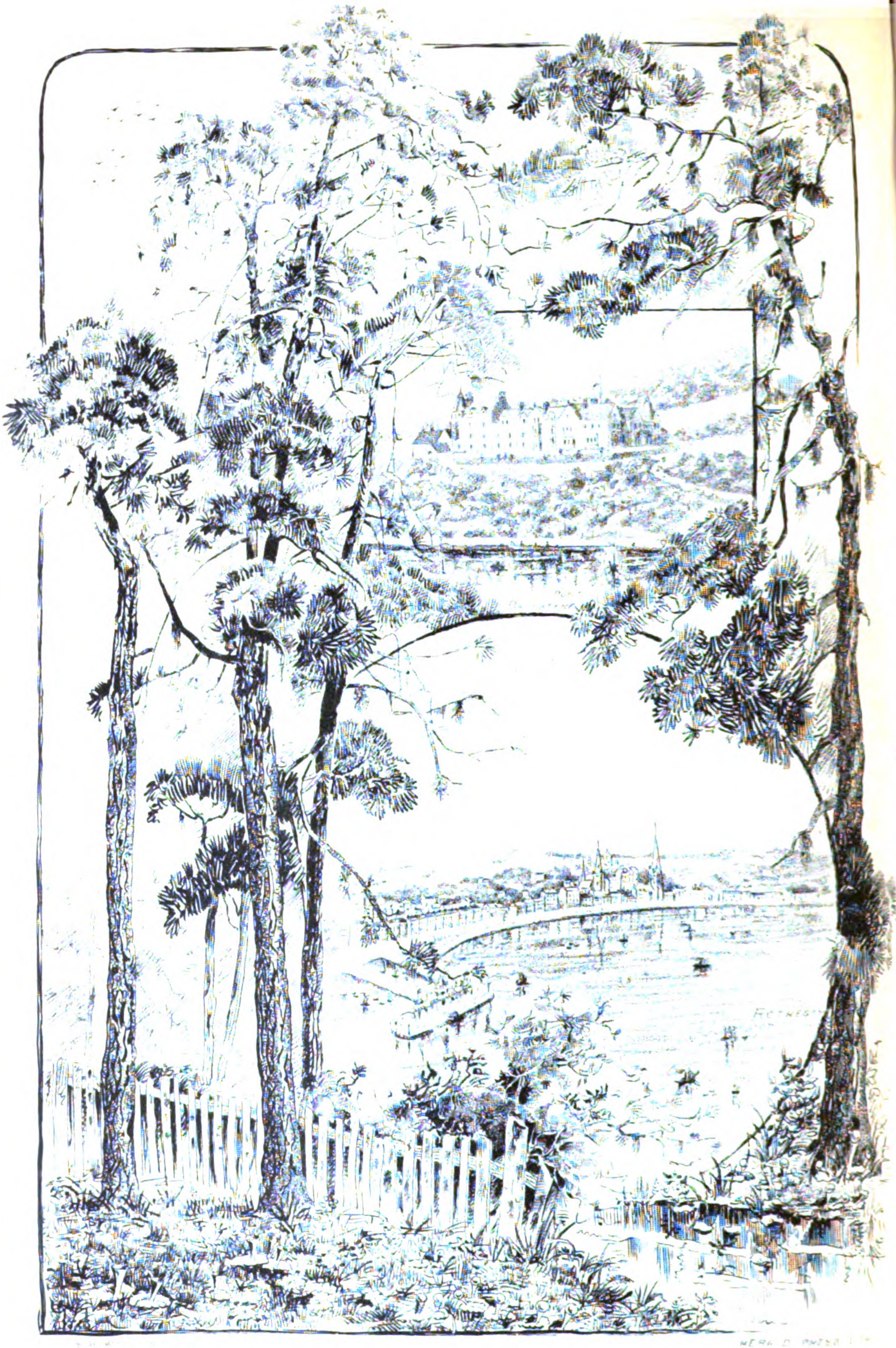
Pulicaria dysenterica, *Gaertn.*, var. *longiradiata.*—Last autumn I noticed on Bowar's Hill, Berkshire, a form of *P. dysenterica*, which differed considerably from the usual state in having the ray ligules narrow strap-shaped, half an inch long The flowers of the disc were normal and fertile, nor did the plant in habit differ from the type. This variety does not appear to have been noticed in our own or Continental floras. The figures of the plant, too, represent it as having a short contiguous ray. Sir J. D. Hooker considers it a handsome form. Should the character be constant in cultivation, it, however, would appear to be at least worth varietal distinction, and the above name, although rather uncouth, has at least the merit of describing its special feature. [G. C. Druce, Oxford.]

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—February 1st, Annual Meeting. Mr. R.W. Chase presided, and there was a good attendance of members. The report for the past year was read by the hon. secretary (Mr. W. H. Wilkinson), and an abstract of it appears at page 70. On the motion of Professor Hillhouse, seconded by Mr. W. R. Hughes, the best thanks of the society were cordially presented to the president (Mr. Chase) for his services during the past year. Similar votes were accorded to the officers and committee, and to the local press. Professor Hillhouse was elected president of the society for the forthcoming year; Mr. W. B. Grove and Professor Lapworth, vice-presidents, together with four ex-presidents; Mr. Pumphrey, treasurer; Mr. W. H. Wilkinson and Mr. W. P. Marshall, general secretaries; Mr. J. E. Bagnall, librarian. The committee was also appointed, and some changes were made in the society's laws. Professor Hillhouse, in taking the presidential chair, said he regarded it as a happy augury that that great scientific college in which they were assembled had now two of its professors occupying the presidential chairs of the two great scientific societies of Birmingham.—Biological Section, February 8th. Mr. R. W. Chase was elected president of the section, and Mr. W. P. Marshall was elected secretary for the ensuing year. Mr. J. E. Bagnall read a paper on "South American and European Mosses," describing several genera of South American mosses, and giving notes of their distribution in America and in Europe. The paper was illustrated by specimens, together with micro-preparations, to show their structure; also a series of Italian mosses was exhibited from Dr. Bottini, of Pisa, including *Hypnum Bottinii*, *Grimmia Lisæ*, and *Bryum juliforme*. Mr. T. Clarke exhibited specimens of silicified wood from Chalcedony Park, in Arizona, North America. It was arranged, on the proposal of Professor Hillhouse, to hold supplementary meetings of the section for the study of special biological subjects; the first series of these is to be devoted to the Mosses, and the first meeting will be held on Friday, 25th inst., when the subject will be taken by Professor Hillhouse of "Mosses and their Life History." This will be continued at a second meeting in March, after which Mr. J. E. Bagnall will undertake the "Classification of the Mosses." — SOCIOLOGICAL SECTION, February 22. There was a large attendance, including many ladies. Mr. W. R. Hughes, F.L.S., was unanimously re-elected president, and Mr. F. J. Cullis, F.G.S., hon. sec. Thanks were passed to Mr. A. Browett, the retiring hon. sec., for his able and courteous services. Miss Naden then delivered a most interesting address on Mr. Herbert Spencer's "Data of Ethics," the aim and scope of the work. The first portion of the address appears at p. 59 of this month's "Midland Naturalist." A cordial vote of thanks was unanimously passed to Miss Naden for her able and valuable address.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—January 24th. Mr. T. H. Waller delivered a lecture on "Inclusions in Crystals." The lecturer described the consolidation of igneous rocks, and how largely the resulting rocks depended on the rate of cooling. In a molten mass everything was ready to combine; as the temperature fell, oxides crystallised out first and silicates next, forming olivine. As the olivine was drawn together it often shut in magnetic grains and crystals, although it sometimes pushed them out, forming crowns of them on the outer sides. There did not always seem to be a definite order in crystallisation, for augite was sometimes included in felspar, at others felspar was included in the augite. The lecturer spoke of the curious arrangement of some crystals, and said that while some were readily determined, others, like quartz, were of an arbitrary character. A description of the manner in which air and water cavities found their way into rocks brought the lecture to a close. The subject was largely illustrated by rock sections under the microscopes.—January 31. Mr. A. T. Evans showed pebbles from the Moseley Drift, containing burrows of *Trachyderma serrata*, impression of spirifer, part of trilobite, calymene etc. Mr. P. T. Deakin, specimens of fossil wood from the lias of Dorsetshire.—February 7th. Mr. W. Dunn exhibited a curiously constructed nest of a species of weaver bird taken from an orange tree in India, also a scorpion from the same locality. Mr. J. Madison, specimens of *Pisidium amnicum*, from several localities in the neighbourhood, a shell said not to be found in the district; Mr. Deakin, a distorted specimen of *Unio pictorum*. Under the microscope, Mr. J. W. Neville showed striated muscles in *Pulex irritans*.—February 14th. Mr. A. T. Evans showed pebbles from the Drift, containing gena and tail of a trilobite and other fossils. Mr. W. Tylar then read a paper on "Photography as an adjunct to the study of Natural Science." The writer glanced at the early history of photography, and described many of the difficulties it passed through, and that it only rose to an art when Mr. Fox Talbot found out a method of fixing the pictures. The main portion of the paper was taken up in describing the many ways in which this art had rendered service to science. The paper was illustrated by a lantern exhibition of photographs, and comprised photo-micrographs and an assortment of other slides; a series of slides of orchids and of plants covered with hoar frost being specially deserving of mention.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Evening Meeting, January 19th; attendance, eleven (five ladies). The Chairman exhibited some charred wheat found by Mr. Ingram, of Belvoir Castle, in an ancient British granary dug in the ground near Belvoir, and read a short article by Mr. Worthington Smith, which appeared in the "Gardeners' Chronicle," comparing various examples of old British wheat found in similar granaries, with the wheat now sold in English markets, and concluding that in size of grain there was no conspicuous difference. The Chairman suggested that probably, however, there would be a considerable difference in the length of ear and number of grains, and pointed out that in the wild *Ægilops*, from which wheat was supposed to have descended, the number of grains was very small in each ear.—The subject for discussion was "The relations between evergreen and deciduous plants." The Chairman exhibited a number of twigs of each kind, showing that in evergreens these were usually more or less green even in winter, while in deciduous trees and shrubs they were mostly brown or blackish. He believed that the physiological difference related to the storage of reserve food material, and depended largely upon the climatal conditions under which each species had been evolved. Rev. T. A. Preston, M.A., gave an interesting account of the elaborate phenological observations which he had carried on at Marlborough for about twenty years, and exhibited several large and valuable diagrammatic tables, showing some of the remarkable results obtained by a comparison of the average temperature, rainfall, and sunshine, with the date of flowering of a number of wild plants.—Evening Meeting, Feb. 16. Attendance 10 (three ladies). The following objects were exhibited, viz., by Miss Sloane, two specimens of Leicestershire plants from districts in which they are not recorded in the new County Flora. By E. F. Cooper, F.L.S., a collection of the seeds of grasses and other plants neatly put up in glass tubes, labelled, and arranged in trays. By Rev. T. A. Preston, M.A., a valuable diagram showing the daily amount of sunshine for every day in the year 1882; also two curious hygrometric plants, a Selaginella and "The Rose of Jericho," from the desert districts of Asia, which although apparently dead and juiceless, opened out when placed in a dish of water. Also two specimens of the "Globe Conferva," *Conferva ægagropila*, each about 1½ inch diameter, and a ball of fir-leaves five inches in diameter, all from the famous Shropshire lakes. By the chairman, one of Baker's Dissecting Microscopes, with which several of the younger members had a little practice in dissecting vegetable tissues. The chairman then introduced a discussion on "The Biological Meaning and Action of a Stimulant," which was well maintained by Dr. Tomkins, Dr. Cooper, Rev. T. A. Preston, Mr. E. F. Cooper, Mr. Overton, and Mr. Garnar. The problem to be solved was whether organic "stimulation" implies the release of potential energy, or the imparting of kinetic energy, or a combination of both, or some action not referable to the known laws of energy. The phenomena of stimulation by mechanical blows or friction, by radiant or conducted heat, by the prick of a needle, by galvanism, by food, and by camphor, ginger, alcohol, and opium, were all considered. The discussion was interesting and instructive, and it was felt that the problem was at present by no means ripe for solution.



THE LEGENDS OF THE ISLAND OF BUTE

A RAMBLE AMONGST LICHENS IN THE ISLAND OF BUTE.*

BY W. H. WILKINSON,

HON. SEC. OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

In this paper your attention is invited to some of the results of a ramble amongst the lichens.

The flowering plants ever offer special attractions, with their beautiful forms and brilliant colours; the ferns have won for themselves a place in the garden and the home from their graceful fronds and their association with shady woods and holiday joys. The mosses, too, have a charm all their own, and although but seldom cultivated they, by their abundance in decorating every wall and tree and crowding over each space of unoccupied land, are familiar to every observant eye. The fungi also have received a good share of attention at the hands of the students of botany, which has yielded a rich harvest of interesting facts to the world at large.

But the lichens are so low down in the scale that they are generally overlooked, or meet with but scant attention. Yet they have a useful purpose to serve, and form a link without which the chain of Nature would not be complete.

The lichens are separated into two divisions—viz., the lower or crustaceous, and the higher, including the foliaceous, fruticulose, and filamentous.

The crustaceous generally grow on rocks and stones, and sometimes on trees, moss, &c. Starting from a central point they form somewhat circular or oval patches on the rocks, and year after year they not only extend outwards but they increase in thickness, and thus sometimes they live to a great age.

DESCRIPTION OF PLATE I.

View of the Kyles of Bute Hydropathic Establishment, Port Bannatyne.

View of Rothesay Bay.

The Lichens represented are—

- Usnea barbata on trees.
- Peltigera canina in foreground.
- Cladonia pyxidata, "The Cup Moss."
- Cladonia digitata, var. macilenta, scarlet fruited.

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* Transactions of the Birmingham Natural History and Microscopical Society. December 7th, 1886.

The higher lichens, on the other hand, grow into the form of miniature trees and shrubs, or spread into various leaf-like forms, and are found abundantly on trees, rocks, and walls; also on moss and on the ground. And it is to these (the higher lichens) we wish to confine attention for the present paper, so in order to give definiteness to our remarks we will endeavour to describe a real "ramble amongst the lichens," and that in one of our favourite haunts—viz., the western islands of Scotland.

An hour's ride by the fast train will take us from Glasgow to Wemyss Bay, where a pleasant-looking steamer is waiting to convey us on to Rothesay, the chief town on the Island of Bute. On the passage we notice the fine views of the coast line at the mouth of the Clyde and the Islands of Comrie and the sharp peaks of "Goat Fell" and other mountains on the Island of Arran.

After landing on the spacious pier at Rothesay we find a tram-car waiting, which takes us round the bay some two miles northwards to Port Bannatyne, where we stop for our head-quarters. The view from here is quite charming, as in clear weather the mountains across the Kyles of Bute appear in sharp outline, and the fleet of gentlemen's yachts at anchor in the bay below, with the sun lighting up their flapping sails against the deep blue water, altogether forms a beautiful picture.

Being prepared with tools to obtain and vasculum to carry our pretty plants, we set off for our ramble. The first part of our course is a walk round Kame's Bay, where our attention is at first caught by the fine scenery which surrounds us; but standing on the stones just above high-water mark to get a vantage point of view, we at length glance down to the stone on which we were standing and find its sides brilliant with the golden yellow of a lichen, and stooping down we find it to be *Physcia parietina*, the wall lichen, one of the brightest and commonest of them all, as it is found everywhere—on rocks and trees, on tile roofs, and wood palings. We notice plenty of it on the stone wall we are passing, and a little further on we come to a variety of it on a tree, called *P. polycarpa*, the thallus or leaf-like portion being green or greyish instead of yellow, while the little discs or apothecia are still of the same orange colour, and both kinds are white underneath.

Leaving the bay we enter a small "glen," winding up Kame's Hill, evidently worn out of the hill side by the tiny "burn" rippling pleasantly along our path. The glen is lined with trees, affording a pleasant shade from the sun and a shelter from the cold and stormy winds. We notice the grassy banks beneath the hedges or palings, and on stopping to look into it we find growing amongst the moist grass a rather larger lichen *Peltigera canina*, of a deep olive green above and almost white beneath, but we find it pretty firmly attached to the grass by a number of white rhizinæ or root-like appendages, which are not really roots, but are evidently only means of support, like the tendrils of climbing plants. From the edges of the thallus finger-like lobes may be seen standing upright, upon the ends of which are flat round discs of a dark brown colour. These are the apothecia, and bear the asci and spores. When dry the plant looks very different in colour; the olive green all disappears, and the thallus goes into a light brown or grey colour.

If we now notice the trunks of the trees we find them abundantly mantled with a whole galaxy of lichens. Let us look more closely at some of them.

There is the grey beard-like *Usnea barbata*, of a pale sea-green shade, with its long threads growing into tangled tufts; through the centre of each runs a white thread, being the medullary layer; a whitish powder, the soredia, is often scattered over the fine branches, which gives a very soft appearance to the plant, thus much heightening its effect in ornamenting the forest trees. Its fruit is terminal, and the disc is surrounded with a row of barbs; hence its name *barbata*.

Near it we find a somewhat similar lichen, but much firmer in texture, *i.e.*, cartilaginous. Its branches are flattened, and not so fine nor so intricate as in *Usnea*, but they, too, are often extensively covered with patches of mealy soredia, which give the name to it—*Ramalina farinacea*, and it is very rarely found in fruit.

Near it there is another of the same genus—*Ramalina fastigiata*—which is abundantly in fruit, and, as its name implies, it is a small variety with a number of short branches closely packed together.

Our attention is next arrested by a whole cluster of very pretty, though rather shaggy-looking lichens, almost covering the branches of a tree. This is *Evernia prunastri*. Its soft limp thallus is flat and cut into a number of branching lobes, called laciniæ. It is glaucous on one side and snowy white on the other, and is one of the most plentiful lichens on the trees of our woods and the palings of our country lanes.

There is another *Physcia* growing on the trees, but it is so near the colour of the bark and is so closely appressed that you will have to go close up to find it. The centre is often crowded with the little cup-like apothecia, while both they and the thallus are covered with a fine powder. Hence its name—*P. pulverulenta*.

On another tree we find *Physcia stellaris*, var. *tenella*; it is of a grey colour, and has long cilia from the edges of its laciniæ.

We now come to a whole group of parmelias, the most conspicuous of which is *P. caperata*, wrinkled in the centre, rounded lobes on the margins, closely oppressed, and of an ochroleucous colour. Then a patch of *P. perlata*, of a greyish glaucous colour above and brownish-black beneath. Next we find, quite close to the bark, a specimen of *P. olivacea*; as its name indicates, it is of a deep olive brown colour, but it is only found by close examination, as its dark colour so nearly assimilates to that of the tree.

We now come to *Parmelia physodes*, one of the commonest of all our British lichens. It grows nearly everywhere, but here we find it abundantly on the trunks of trees, and in places almost covering the wayside palings. It is of rather a stiffish texture, of a whitish glaucous colour, and pitch black below. It is very various in the shape of the lobes of its thallus, sometimes being rounded at the apices, at others inflated, and sometimes formed into little horns open at the mouth and marked with a white soredia at the extremities. The whole of this group of parmelias is very seldom found in fruit, but high up the glen we found this one, *P. physodes*, with its cup-like dark brown fruit, and some specimens thickly covered with the spermogones, which may be recognised as minute black points on the surface of the thallus.

And the last of this group is *Parmelia saxatilis*, which we find plentifully mixed with the preceding on trees and palings. It is of a greenish colour, and black fibrillose below; it may usually be distinguished by its surface being reticulated or marked by fine cracks. We also find here its two varieties—*sulcata*, in which the soredia appears in lines, with the edges of the ruptured thallus thrown up on each side of it; and *furfuracea*, in which the centre is covered with points, or, as it is called, isidiose; and on the rocks near we find a third variety of a dark olive colour, *P. saxatilis*, var. *omphalodes*.

We now emerge from the wooded glen on to the top of the hill, and the fresh mountain breeze is welcome and refreshing after our scramble up the valley; having admired the wide panorama that presents itself on all sides of us, we look amongst the grass and boggy ground, and find ourselves introduced into the group of Cladonias. Here is the familiar "cup moss," as it is called, *C. pyxidata*; then the beautiful scarlet fruited *C. digitata*, var. *macilenta*; then the quiet brown *C. cervicornis*; then we find the hollow tubes of *C. uncialis* opening out into four points at the tops of their stems.

Plentifully scattered all round us we find the *Cladina rangiferina* and *C. furcata* looking like miniature trees, but with hollow stems and bending over at the extremities, bearing the brown fruit, like tiny berries, hanging from their points.

We also notice amongst it portions of *Cetraria aculeata*, with its wire-like brown stems, angular, and often spinose on the margins. Then on the rocks which crop up here and there, amongst many old friends, we find *Platysma Fahlunense*, with its dark brown lobes often curling up on its edges, and sorediiferous. Then, lastly, as we must hasten homewards, we find on the earth, sheltered by the heather, *Bœomyces rufus*, a delicate green thallus, bearing on its white stipes the capitate reddish apothecia.

Thus, in one single ramble, we have met with most of the Common Lichens which enrich our hedge banks and ornament our trees. And it is these which the young student would first wish to know; the Crustaceous ones and the rarer species will form subjects for his future investigation.

We trust our introduction to this group of lowly plants will awaken an interest in their study in the minds of some, and be a slight help to enable us to know more of the variety, the beauty, and perfection in the manifold works of the Creator.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

The Authors of the best local Floras of modern date have deemed it a useful and honourable task to trace the history of the discovery of the indigenous vegetation of the districts upon which they have written, and to describe the successive contributions made by their predecessors to our knowledge of the present day. This task has not yet been adequately performed for the County of Worcester. I have ventured to attempt it and hope, by so doing, to lay the foundation for a new Flora of the County, whenever, and by whom, it may be undertaken.

A fairly complete list of the writers who have published records of Worcestershire plants is contained in the "*Botany of Worcestershire*" (Worcester, 1867), by my friend Mr. Edwin Lees, p. lxxxviii.—xci.; and also, under the head of Worcester, in the "*Botanical Bibliography of the British Counties,*" by Dr. Henry Trimen; Journal of Botany, 1874, Vol. XII., p. 155. It should further be mentioned that the late Rev. W. W.

Newbould, who was associated with Mr. J. G. Baker in the editorship of the second edition of Watson's "*Topographical Botany*" (London, 1883), searched, with characteristic industry, all the early Floras and made notes of the records referring to each county. These notes are contained in a number of manuscript books which are happily preserved in the Botanical department of the Natural History Museum at South Kensington. I have derived great assistance from them.

Our history may conveniently be divided into four periods. The first, from the date of the earliest records up to the middle of the 18th century; the second and third, the second half of the 18th and the first half of the 19th century; the fourth, from 1850 to the present date.

First Period. Up to 1750.

The first writer whose name has been mentioned in connection with Worcestershire Botany is John Leland, the Antiquary. His Itineraries began in or about the year 1538, and are described in a manuscript preserved in the Bodleian Library. A copy in black letter was published by Johan Bale in 1549. An edition in nine volumes was published from the original MS. by Thomas Hearne (Oxford, 1710—12), and a second edition of the same in 1744—5.*

At page 138 of Mr. Lees's Botany of Worcestershire is the following foot note :—

"*Leland, the Antiquary, who made his well-known Itinerary in the reign of Henry VIII., mentions the Juniper as covering Towbury Hill Camp, near Ripple, in the Severn Valley, but not a stray individual bush now remains there.*"

The passage referred to is, I presume, the following, which I quote from Hearne's 2nd Edition, Vol. VI., p. 71, Folio 80 :—

"Tetbyri Castelle"

"Is a. 2 miles from Theokesbyri, above it, in ripa læva Sabrinæ, apon a Cliv with double diches, in the Paroche of Twyning. It is now overgrown with trees and bushes of Juniper."

The record is interesting, the Juniper being now very rare in Worcestershire; but the interest is diminished by the fact that the locality referred to by Leland is in the County of Gloucester.

* See Lowndes "Bibliographers' Manual," Vol. II., p. 1,022; Vol. III., p. 1,338.

From the date of Wm. Turner's Libellus, the earliest English work on Botany, to the middle of the 17th century, the more important works relating to English Botany are the following:—

William Turner.

"Libellus de Re Herbaria novus." 1538.
"Herbal," 1548.
"New Herball." 1551 to 1568.

Lobelius, (Matthias de l'Obel).

"Stirpium adversaria."
"Plantarum seu stirpium historia."
"Icones."
Various dates. 1570 to 1605. Partly published in London, partly at Antwerp.

John Gerard.

"The Herball." 1597.
2nd Edition, by Thomas Johnson. 1633.

John Parkinson, Apothecary, London.

"Paradisus terrestris." 1629.
"Theatrum Botanicum." 1640.

I have not examined any of these works, but conclude from the manuscripts of the late Mr. Newbould that they contain no Worcester records.

These appear for the first time in the "*Phytologia Britannica*," 1660, the first British Flora. The full title of this book is "Phytologia Britannica Natales exhibens Indigenarum stirpium sponte emergentium." [Londini. Typis Ric Cotes. 1650.] The name of the author is not given, but it is known to have been written by William How, M.D. It contains many local records, and among them two relating to the County of Worcester. These are—

"**Chedidonium minus flore pleno nondum descriptum.** Pilewort with a large flower. In Worcestershire."

(*Ranunculus Ficaria L.*)

"**Consolida regalis Tab. Delphinium Gesn. Flos regius Dod. Larkesheele.** In a Cornfield by Pershire in Worcestershire and thereabout frequently."

(*Delphinium Ajacis, L.*)

The second record is a very interesting one. The Larkspur is quite extinct in Worcestershire, and has not been seen within the county by any living Botanist.

The next work to be mentioned is *Merrett's Pinax*, 1666. Its full title is "Pinax rerum naturalium Britannicarum

Authore Christophoro Merrett." [Londini. Cave Pulleyn. 1666.] It contains 8 Worcester records. Two are a cultivated Wheat and Barley; a third is the Larkspur, simply quoted from the Phytologia. The remaining five are—

"**Bellis flore herbaceo globoso.** In Mr. Selden's Cops neer his house in Worcestershire. Mr. Morgan."

(*Bellis perennis, L., probably a form without rays.*)

"**Gentiana autumnalis flore albo, foliis longis augustis.** In old Pastures on the north west of Church Lench, Wostershire, plentifully."

(*Gentiana Amarella, L.*)

"**Lactuca sylv. laciniata minima.** N. D. near Church Lench in Wostershire in great plenty."

(*Probably Lactuca saligna, L.*)

"**Rosa sylv. odore flore duplici, Double Eglantine, G. 1270,** invenitur duplici & triplici serie petalorum, in sepibus præsertim prope Wigorniam. Mr. Brown."

(*Double Sweet Briar, Rosa rubiginosa, L., perhaps cultivated.*)

"**Rosa pimpinellæ fol. fl. rubro.** In some barren fields near Worster. Mr. Brown, and in a barren field at Church-lench four miles beyond Evesham in great plenty."

(*Probably Rosa spinosissima, L.*)

The next step in the history introduces us to John Ray. This remarkable man was born at Black Notley, near Braintree, in Essex, in 1628, and died at the same place in 1705. He was educated at Braintree School, and at St. Catharine's and Trinity, Cambridge, of which latter College he became a Fellow, Lecturer and Dean. In 1660 he was ordained Deacon and Priest. In 1662 he was deprived of his Fellowship on his refusing to sign the declaration required by the Act of Uniformity. In 1667 he was made a Fellow of the Royal Society. Among his pupils at Trinity was Francis Willoughby, of Middleton Hall, Warwickshire, between Sutton Coldfield and Tamworth, whose second son was raised to the Peerage, by Queen Anne, under the title of Lord Middleton. Ray lived upon terms of close friendship with Francis Willoughby, was a frequent visitor at Middleton, and on Willoughby's death in 1672, was appointed one of his Executors and Tutor to his sons. From 1675, or 1676, to Michaelmas, 1677 Ray lived at Sutton Coldfield and then removed into Essex, where he continued to his death.*

Of Ray's numerous works in various departments of Natural History we need only concern ourselves with two, the

* "Memorials of John Ray." Ray Society, 1846.

"*Catalogus Plantarum Angliæ*," first edition 1670, second edition 1677; and the "*Synopsis Methodica Stirpium Britannicarum*," first edition 1690, second edition, 1696. Of the last named work, a third edition was published after Ray's death in 1724, under the Editorship of Dr. J. J. Dillenius, at that time Professor of Botany in the University of Oxford.

The "*Catalogus Plantarum Angliæ*, 1670, contains only one Worcester record, but it is one of special interest. At p. 90 we read—

"**Cynoglossa folio virenti, J. B.**
Cynoglossum minus folio virente, Ger.
Cynoglossum semper virens, G. B. Park.
The lesser Hounds-tongue.
. . . also in some shady lanes near Worcester"

The record occurs in the same words in the edition of 1677.

We must now leave Ray for a time, in order to make acquaintance with the earliest Worcester Botanist, in the person of Mr. Edmund Pitt, of that city, Apothecary and Alderman.

In the "*Philosophical Transactions*" for April, May, and June, 1678, No. 139, p. 978, we read as follows:—

"Extract of a letter from Mr. Edmund Pitt, Alderman of Worcester, a very knowing Botanist, concerning the Sorbus Pyriformis.

Last year I found a rarity growing wild in a forest of Worcester. It is described by L'Obelius under the name of Sorbus Pyriformis, also by Mathiolus upon Dioscorides, And by Bauhinus, under the name of Sorbus Procera. And they agree that in France, Germany and Italy, they are commonly found. But neither These nor any of our own countrymen as Gerard, Parkinson, Johnson, How, nor those Learned Authors Merret or Ray, have taken notice of its being a native of England. Nor have any of our English Writers so much as mentioned it. Saving that Mr. Lyte, in his translation of Dodonæus, describes it under the name of the Sorb Apple. But saith no more of the place, but that it groweth in Dutch-Land.

It resembles the Ornus or Quicken-Tree; only the Ornus bears the Flowers and Fruit at the end, This on the sides of the Branch. Next the sun the Fruit hath a dark red blush: and is about the bigness of a small Juneting Pear. In September so rough as to be ready to strangle one. But being then gathered and kept till October, they eat as well as any Medlar. Thus far the Letter.

Q. Whether a Verjuyce made of this Fruit, either ground with Crabs or Grapes, or if plentiful alone, would not, being kept for some time, prove one of the best acid-astringent Sawces that Nature affords."

This is the first notice of the celebrated Wyre Forest Sorb Tree, which, after having attracted the visits of many generations of Botanists, was destroyed by fire by some miscreant in 1862. A view of the tree, with a figure of the foliage and fruit, will be found in the plate opposite p. 10 of Nash's Worcestershire, (Vol. I., 1781,) and a full description in p. 11. A sketch of the tree in its last stage of decay is given by Mr. Lees, at p. 91 of the "Botany of Worcestershire." We have seen that Ray was elected a Fellow of the Royal Society in 1667. It is probable that Mr Pitt's letter was addressed to Ray, and contributed by him to the Philosophical Transactions.

The first edition of the Synopsis, 1690, gives very little further information relating to the County. At p. 75, we find a description of the Lesser green leaved Hounds-tongue, and the remark, "It hath also been observed in some shady lanes about Worcester, by Mr. Pitts." At p. 219, is a description of the Sorbus, with the note, that it is "said to grow wild in many places of the Morelands in Staffordshire, by Dr. Plot. Hist. Nat., Stafford, p. 208."

In 1695, Edward Gibson, of Queen's College, Oxford, subsequently Rector of Lambeth, Archdeacon of Surrey, Bishop of Lincoln, and finally Bishop of London, published his translation of Camden's Britannia. This book is of great interest to Botanists. At the end of the description of each County is a list of the rarer plants, contributed by Ray himself, the whole forming the first collection of County records published in this country. We learn from the preface that,

"The Catalogues of Plants at the end of each County were communicated by the great Botanist of our age, Mr. Ray. They are the effect of many years observation: and as that excellent Person was willing to take this opportunity of handing them to the publick, so were the Undertakers very ready to close with such a considerable Improvement tho' it exceedingly enhanced the expences of Printing, and they were no way ty'ed to it by their Proposals." The Worcestershire list is on page 528. It is a very meagre one and is worth quoting in full:—

"More rare plants growing wild in Worcestershire—

Colchicum vulgare seu Anglicum purpureum and album, Ger. Park. Common Meadow Saffron. I observed it growing most plentifully in the meadows of this County.

Cynoglossum folio virenti, J. B. Cynoglossum minus folio virente, Ger. Semper virens, C. B. Park. The lesser green leaved Hounds-tongue. It hath been observed in some shady lanes near Worcester by Mr. Pitts, an Apothecary and Alderman of that City.

Sorbus pyriformis, D. Pitts: which I suspect to be no other than the **Sorbus sativa, C. B. legitima, Park.** That is the true or manured Service or Sorb-tree. Found by the said Mr. Pitts in a forest of this County.

Triticum majus glumæ foliaceæ seu Triticum Polonicum, D. Bobert. An Triticum speciosum grano oblongo, J. B.? Polonian Wheat. It is found in the fields in this County, and as Dr. Plot tells us, in Staffordshire also."

These are the plants now known as *Colchicum autumnale, L.*, *Cynoglossum montanum, Lam.*, *Pyrus domestica, Sm.*, *Triticum Polonicum, L.* The latter is a cultivated wheat, and need not further engage our attention.

In 1722, Bishop Gibson published a second edition of his version of Camden but, in this, Ray's lists are simply reprinted verbatim.

The second edition of the Synopsis, published in 1696, contains no additional records; nor yet does the 3rd edition, published in 1724, 19 years after Ray's death. We read, however, in the latter, under the head of the Meadow Saffron, "*In the Parish of Mathon in the Meadows under the Malverne Hills in Worcestershire plentifully, Mr. Manningham.*"

It is remarkable that Ray should have passed over without notice the records of How and Merret, and annoying that he should leave us in doubt whether the Worcester Apothecary and Alderman spelt his name with or without the s.

The Botanical works of the first half of the eighteenth Century yield, so far as I can ascertain, a single addition only to the Worcester Census, but it is one of great interest. In the *Hortus Elthamensis* of Dillenius, 1732, is a plate (Tab. lviii.) of Campanula patula, with the record (fol. 69),

> "Sponte nascentem reperi inter dumeta collis cujusdam sylvosi prope Worcestriam, (in a wood called Elbury Hill, about a mile from Worcester)."

The discovery is referred to by Richard Pulteney, in his "*Account of some of the more rare English Plants observed in Leicestershire*," in the Phil. Trans. for the year 1756-57, see Vol. XLIX, Part II., p. 815; and again in his Catalogue of Leicestershire plants, contained in the first volume of the "*History and Antiquities of the County of Leicester*," by John Nichols, 1795. In the latter work, at p. clxxix, we read, under Campanula patula,

> "First discovered in England, by Mr. Brewer, in 1726, near Worcester, as recorded by Dr. Dillenius."

The history of this period is fitly concluded by the "*Specimen Botanicum*" of John Blackstone. Its complete title is "Specimen Botanicum Quo Plantarum Plurium Rariorum Angliæ Indigenarum Loci Natales Illustrantur, Authore J. Blackstone, Pharm., Lond." [Londini, 1746.] It is rich in local records, mostly belonging to the Metropolitan Counties, the neighbourhoods of Oxford and Cambridge, and the County of York. It does not contain a single Worcester reference.

The records of the first period may be summed up as under :—

				Species.
How,	*Phytologia*,	1650	...	2
Merrett,	*Pinax*,	1666	...	5
Ray,	*Catalogus*,	1670	...	1
Pitt,	*Phil. Trans.*	1678	...	1
Ray,	*Gibson's Camden*,	1695	...	1
Dillenius,	*Hort. Eltham.*,	1732	...	1
				11

We have now reached the end of what may be termed the pre-Linnæan era. The adoption of the Linnæan system of classification, and the introduction of the binomial nomenclature, due to the publication, in 1753, of the first edition of the "*Species Plantarum*," made an epoch in Botanical Science.

(To be continued.) p - 120

THE DATA OF ETHICS.

BY CONSTANCE C. W. NADEN.

(Continued from page 63.)

Evolution has been possible only by the correlation of pains with injuries, and of pleasures with benefits. For if an organism persistently preferred what was hurtful to it, and disliked what was beneficial, that organism would have a very small chance of surviving, and transmitting to offspring its suicidal peculiarity. You cannot, for instance, transmit liking for starvation as a family trait. To a certain extent, then, the simple sensations are true and safe guides. But the evolutional progress is towards increased length and breadth of life; and with every fresh adjustment to the environment, involving new developments both of structure and function, the mental and bodily activities grow more coherent, more definite, and more heterogeneous. That is, acts are no longer isolated, but are connected into series; they are more delicately adjusted to ends; and they are more varied in kind. In order to preserve this continuity, fitness, and variety, the simple and presentative feelings must be restrained by complex and representative feelings; foresight must be exercised, and many immediate pleasures renounced for a greater but more remote good. The savage will hurt or maim himself to avert the anger of his fetish; he will risk his life in battle in obedience to the command of his chief, or to win a reputation for courage.

And here, indeed, we are "tracing the genesis of the moral consciousness," the main feature of which is self-control. This self-control is evolved within and by the religious, political, and social controls; but it differs from them in referring to the *intrinsic*, while they refer to the *extrinsic* effects of actions. The three external controls co-operate primarily for securing success in war, and secondarily for restraining aggressions within the community; they seek to preserve the society from foes without and from foes within. But the savage obeys his chief's command, or sacrifices to his fetish, or to his primitive "Mrs. Grundy," not so much from any perception that the natural consequences of non-conformity will be disastrous, as from a fear of its incidental consequences. He refrains from hurting his neighbour, not because he is unwilling that his neighbour should be hurt, but because he does not want to be punished. In time, however, the united influence of the political, religious, and social controls engenders a type of character which does spontaneously what was at first done under compulsion. From accumulated racial experiences of utility, moral intuitions are developed, and the pain which was of old connected simply with the punishment now becomes connected with the action to be punished. From the principles of evolution, it is as clear that this *must* happen as that individual pleasures must be correlated with individual benefits, and *vice versa*; for if the being best fitted to the physical environment is the most likely to survive and to leave offspring which may inherit its endowments, not less is this true of the being best fitted to the social environment. There are laws which impose penalties on me if I rob, or maim, or kill. If I have a nature sufficiently sympathetic to make me shrink from the intrinsic as well as the extrinsic effects of robbing, maiming, or killing—not only from the pain I may probably suffer, but also from the pain I shall certainly cause—then I am less likely to subject myself to punishment, and, so far, more likely to live and prosper.

Duty is an abstract sentiment, deriving its authority from a sense of the usually superior guidance given by re-representative feelings, and its compulsiveness from racial experience of the three lower controls, aided by a recognition of natural penalties.

It is, then, already clear that to a certain extent, evolution tends to the growth of unselfish motives, and that, broadly speaking, "true self-love and social are the same." No society can exist unless internal aggressions be restrained; unless, further, there be co-operation among its members, involving approximate equity, and performance of contract; and it is difficult to imagine the existence of any society without some degree of beneficence or spontaneous effort on the part of some of its members to promote the welfare of others. All this may happen without any thought being expended on *universal* welfare, or "the greatest happiness of the greatest number," which must always remain an Ideal rather than a definite object of endeavour. Half-blindly, slowly, with no set purpose, mankind has already worked out the main conditions of happiness, and embodied them in its moral code—Be strong, be just, be kind. Rational utilitarianism takes these results; and aims, not straight at happiness, but at the essential conditions of happiness. It endeavours to conform "to certain principles which, in the nature of things, causally determine welfare," and which are generalisations from past racial experience, rectified by present intelligence. The law of justice, for example, is a statement of the most fundamental conditions of happiness. Equity must always be maintained, whatever may be the immediate consequences; because the permission of a seemingly beneficial injustice makes the foundations of happiness insecure, while seeming to adorn the superstructure. The evolutional moralist must therefore insist on conformity to principle as strongly and as sternly as any believer in the Categorical Imperative.

But still, we have not reached a complete reconciliation of the claims of egoism and altruism. It is very evident, "that a creature must live before it can act," and that "unless each duly cares for himself, his care for all others is ended by death; and if each thus dies, there remain no others to care for."* Survival of the fittest has been the law of evolution, and works for general, as well as for individual happiness, by ensuring the survival of the healthiest, and therefore of the happiest. It is our duty to be both healthy and happy; for our fitness or unfitness will be transmitted to

* Ch. XI., § 68.

future generations; and besides, excessive unselfishness not only fosters selfishness directly, by accustoming others to receive and expect undue sacrifices, but it also fosters selfishness indirectly, by tending towards the non-survival of the unselfish. A certain degree of egoism, then, is not only justifiable, but actually imperative. Try to imagine a state of things in which everyone cared for everyone else, and no one cared for himself; in which everyone, neglecting his own dinner, ran about with tit-bits for his neighbours, while they in turn besieged him with their own tit-bits. Clearly if all were purely altruistic, givers would be balked by finding no recipients; or else unwilling recipients must *pretend* to be pleased, in order to afford pleasure to the givers. Again, sympathy is only a representative feeling, and can never be quite so vivid as the original feeling which it represents; so that if egoistic pleasures and pain should fail, their sympathetic reflections must fade away and vanish. The image in the mirror will not remain when the imaged body is withdrawn. Then, although we may strip ourselves of happiness for the sake of others, we cannot give them all that we renounce. Bodily health, the joys of success, and all intimate and individual feelings, are as non-transferable as a railway ticket.

And yet altruism has been as necessary as egoism to the preservation of the race. Consider its earliest manifestation —parental love and care—which "in its simple physical form" is "absolutely necessary for the continuance of life from the beginning," and which developes in complexity and duration with the development of higher organic types. This parental care has become an instinct—an insistent, imperative instinct —often overpowering the strongest egoistic cravings. Where there is family altruism, social altruism has a chance of evolving; and we have seen that men living in society are obliged to be to some extent altruistic. Their individual welfare depends largely on the welfare of the community. To be just, to see justice done to others, to maintain and improve the agencies which administer justice; this is the true policy of every citizen. But to crown his joy, he must be spontaneously kind and beneficent, as well as just, for thus only can he know the pleasures of friendship and sympathy; thus only can he renew his youth when he is old, his strength when he is infirm, and feel all his lost delights by proxy.

But if egoism is essential, and altruism also essential, and yet the two conflict; what is our hope? Will the weary battle go on for ever? Is there no prospect of a final peace?

There is such a prospect. We have already seen that evolution works towards perfect adaptation to the environment. Pleasures and pains are not fixed and absolute; they are relative to structures and to the states of structures; and as organisms adjust themselves physically to the conditions of their life, they must at the same time adjust themselves psychically. That is, every mode of action demanded by social conditions must eventually become pleasurable to social beings, and as parental love is already an instinct, so the broader love, not only of country, but of the race, will in time become instinctive. Sympathy, hitherto stunted by adverse conditions, will develop; and as human nature improves, the natural language of feeling will be less restrained; looks, words, tones will all grow more expressive, and the power of interpreting them will strengthen and sharpen by use. As the sphere of sympathetic gratification widens, the sphere of self-sacrifice will diminish; for with growing efficiency and increasing welfare there will be fewer troubles to assuage, fewer pangs to partake. No one will be willing to accept benefits at the cost of pain or privation to others. It would be curious to speculate on what might happen if the balance began to descend on the altruistic side, and love for one's neighbour grew actually more potent than love for one's self. Then the moral dangers and hence the moral judgments of mankind would be reversed. The egoist would then possess a rare but desirable virtue, and so be counted a saint; self-seeking and self-assertion might be reckoned as attributes of holiness, and even the thief might be looked upon leniently, as endowed with an overplus of the unusual quality of acquisitiveness. The heaviest censure would be reserved for vicious excesses of generosity, humility, long-suffering, renunciation, charity.

But leaving this quaint possibility, there is certainly something inspiring in the contemplation of a future merging of generosity in equity; of a perfectly pleasurable altruism; of a state in which all actions should be "absolutely right." To-day, most actions are only relatively right; that is, are partially wrong; for most are attended with some degree of pain, either to self or to neighbours. An absolutely right action is one which produces pure, unadulterated pleasure; but this can happen only when evolution has perfectly adjusted desires to conditions. And at present, such perfect adjustments are possible only or chiefly in the lower part of our nature, which has been moulded to its environment before social evolution began. A healthy mother suckling her infant, a father playing with his boy, are not performing duties of a very high order; but what they are doing is in itself absolutely right, being a source of mutual pleasure. In time, the higher part of our nature will be similarly perfected; and a foreshadowing of this ultimate development may even now be seen in the almost or entirely unmixed pleasure afforded by certain æsthetic and benevolent activities. It is this conception of the completely adapted man in the completely evolved society with which moral science must deal, just as physics and astronomy must assume in the first place certain ideal conditions, making allowance subsequently for actual incidental conditions. The rigid and weightless lever is a fiction; the ideal man is a fiction; but both are fictions which have a direct and practical bearing on reality. Only, while the physicist's lever can never become a reality, the moralist's man may yet tread the earth in flesh and blood; ethically adult, having outgrown that sense of self-control and self-compulsion, which is so often painful to the best of us; no more conscious of the demands of duty than he is conscious of the beatings of his own heart. Here philosophy and poetry meet and clasp hands; for the picture drawn by Mr. Spencer cannot be distinguished from that drawn by Wordsworth in his "Ode to Duty."

"Serene will be our days and bright,
And happy will our nature be
When Love is an unerring light,
And joy its own security.
And they a blissful course may hold,
Even now, who not unwisely bold,
Live in the spirit of this creed,
Yet find that other strength, according to their need."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

General Failure of Deep Springs.

(Continued from page 58.)

The general failure of the water supply from deep-seated springs is becoming a most serious matter in England, and one which requires dealing with in a comprehensive manner. The falling off is probably most serious in the North of England, where large towns are common, and great quantities of water are required for manufacturing purposes; but it is not confined to these parts. Many Midland and Southern towns have felt the inconvenience of a short allowance, and paragraphs recording the falling-off of water supply are frequent in the newspapers. The history of the struggles, and successes, and failures in various parts may be read in numerous Reports, and there is a great similarity in them; spite of the deepening of wells, increase of pumping power, going to greater distances, etc., the available water is getting less.

At Northampton the same kind of thing has been taking place. In 1836 a shaft was sunk near to Kingsthorpe, at a point about 2¼ miles N.E. of Northampton, with the object of finding coal, and according to the account left of this sinking, when the Middle Lias was pierced, at a depth of 210 feet,* a large quantity of water was met with, which was estimated at 36,000 gallons per hour—that is, about 864,000 gallons per day. No use was made of the water, but the finding of it induced the Water Company of Northampton to sink a well into the Middle Lias about ten years afterwards. This well was made on a piece of ground near to the Billing Road, at a point about two miles South of the Kingsthorpe one; it was sunk to a depth of 150 feet, and then a bore hole, 21 inches in diameter, was made some 18 feet deeper. About 500,000 gallons a day was obtained, and the water rose to within 60 feet of the surface. This supply was made available in 1848. It very soon became evident that the water level was sinking; however, as there was an increased demand for water, a second well was sunk within 40 feet of the first in 1866, and with the aid of larger pipes and more powerful pumps, a yield of 860,000 gallons per day was obtained. This increased yield of course produced a more rapid fall in the water level, and in 1874 the amount of water that could be pumped had considerably diminished, and its head level in the well been reduced from 90 feet to 20 feet. About this time the well was deepened by divers, but the supply of water obtainable, and the level of that water, has been diminishing ever since, though the latter at a less rapid rate than the former. The water now (1884) does not rise above the Rock-bed, the top bed of the Middle Lias, I believe, and the quantity is totally inadequate to the supply of the town.

The reasons for this decline in water level and consequent yield of water are tolerably evident, for other wells in this district, and wells in different geological formations in other districts, have the same tale to tell:—(1) More water is being pumped from the pervious beds annually than would ever get in naturally in the like period. (2) Less water gets into these

* There are reasons for doubting the accuracy of this depth. The matter will be referred to later on.

beds now than formerly owing to excessive, and in some cases indiscriminate agricultural drainage. No doubt both of these causes have been in operation in Northamptonshire, but the former has had much more effect than the latter.

I tried to form an estimate of the amount of water that might reasonably be expected to get into the Middle Lias of the county annually, supposing no artificial impediments were interposed, and so to see what relation it bore to the amount actually extracted from the Marlstone wells at Northampton. Almost at the outset it became evident that any such estimate founded upon catchment area would be of little or no value, but the attempt considerably modified my ideas of the extent of catchment area in the direction of reducing it. On looking at a geological map of the district, it will be noticed that nowhere does the Middle Lias cover a very extensive uninterrupted surface area, owing to numerous Upper Lias hills rising above it, or to valleys cut through it, a natural consequence of its comparatively small thickness. Besides this, even where coloured as Marlstone in the maps, it is not unfrequently covered by the lowest beds of the *Upper Lias*,* and these by interposing one or more thin clay beds between the surface and the Rock-bed would materially reduce the intake of water, as would also the capping of *boulder clay* that is sometimes found similarly situated. The Middle Lias is still more often covered with *drift* in the form of thick beds of sand or gravel; indeed, so completely is the Middle Lias catchment area covered to the North-west of Northampton that the boundaries of its outcrop are only approximately indicated on the maps by dotted lines. This drift can scarcely be regarded as injurious, and may be very helpful, by, as it were, extending the catchment area of the Middle Lias.

The effect of streams in reducing the water-bearing capacity of the Middle Lias of Northamptonshire is no doubt greater than that of all of the other causes named, for not only do they destroy the continuity of the bed by cutting it up into outliers and peninsula-like masses of no great storage capacity, but they very considerably drain these and the escarpments of the main bed. Also the main mass of Middle Lias to the South-west of Northampton is well drained by streams.

The Nen, Cherwell, Leam, and Avon each receive considerable contributions from the Middle Lias.

* I have so frequently found fossils from the stone beds at the base of the Upper Lias in Northamptonshire, marked as Marlstone, that I think they must at one time have been regarded as Middle Lias.

In considering the area which can contribute to the water supply of Northampton itself, it will be necessary to pay much attention to the great Nen "fault," but that may be fairly left for the present.

I must say that I do not think AGRICULTURAL DRAINAGE has had much to do with the scarcity of water from the Marlstone, because the Marlstone area is well drained naturally, but that the diminution is chiefly owing to the quantity pumped annually being in excess of the annual impounded rainfall which is naturally available. When the Northampton Water Company noticed how rapidly the water level was sinking in their Billing Road well, they might have been sure of the fact that they were draining a reservoir of water more rapidly than it could be filled, and that consequently there was a limit to the time it would last. They adopted the plan pursued in so many other places, of making fresh wells and new headings, and so increasing the present supply with the fact before them that they were only the more rapidly exhausting the bed. The result was exceedingly manifest in the shortness of water, the supply being limited for a long time to three hours a day.

AGRICULTURAL DRAINAGE, by carrying away rapidly very much of the water which formerly found its way into the rocks below, has no doubt reduced the water-bearing capabilities of many beds, and at the same time helped to cause floods in the river valleys. As I said before, I do not think the diminution in the Marlstone supply is great on this account, but nevertheless it is a factor which must not be lost sight of, and there is little doubt that the excessive floods in the valleys of Northamptonshire are due in part to the excessive drainage of other strata forming the uplands. I have spoken of the drainage as excessive chiefly because the continuance of wet seasons has caused some people to drain as though wet seasons were always to be. These lands may correspondingly suffer if we have a succession of dry and hot seasons.

(To be continued.)

MIMICRY IN INSECTS.

The beetles and flies of Central America must have learned by experience to get out of the way of the nimble Central American lizards with great agility, cunning, and alertness. But green lizards are less easy to notice beforehand than brown or red ones ; and so the lizards of tropical countries are almost always bright green, with complementary shades of yellow, grey, and purple, just to fit them in with the foliage they lurk among. Everybody who has ever hunted the green tree-toads on the leaves of waterside plants on the Riviera must know how difficult it is to discriminate these brilliant leaf-coloured creatures from the almost identical background on which they rest. Now, just in proportion as the beetles and flies grow still more cautious, even the green lizards themselves fail to pick up a satisfactory livelihood; and so at last we get that most remarkable Nicaraguan form, decked all round with leaf-like expansions, and looking so like the foliage on which it rests that no beetle on earth can possibly detect it. The more cunning you get your detectives, the more cunning do the thieves become to outwit them. Look, again, at the curious life-history of the flies which dwell as unbidden guests or social parasites in the nests and hives of wild honey-bees. These burglarious flies are belted and bearded in the very selfsame pattern as the bumble-bees themselves; but their larvæ live upon the young grubs of the hive, and repay the unconscious hospitality of the busy workers by devouring the future hope of their unwilling hosts. Obviously, any fly which entered a bee-hive could only escape detection and extermination at the hands (or stings) of its outraged inhabitants, provided it so far resembled the real householders as to be mistaken at a first glance by the invaded community for one of its own numerous members. Thus any fly which showed the slightest superficial resemblance to a bee might at first be enabled to rob honey for a time with comparative impunity, and to lay its eggs among the cells of the helpless larvæ. But when once the vile attempt was fairly discovered, the burglars could only escape fatal detection from generation to generation just in proportion as they more and more closely approximated to the shape and colour of the bees themselves. For, as Mr. Belt has well pointed out, while the mimicking species would become naturally more numerous from age to age, the senses of the mimicked species would grow sharper and sharper by constant practice in detecting and punishing the unwelcome intruders. It is only in external matters, however, that the appearance of such mimetic species can ever be altered. Their underlying points of structure and formative detail always show to the very end (if only one happens to observe them) their proper place in a scientific classification. For instance, these same parasitic flies which so closely resemble bees in their shape and colour have only one pair of wings apiece, like all the rest of the fly order, while the bees, of course, have the full complement two pairs, an upper and an under, possessed by them in common with all other well-conducted members of the hymenopterous family. So, too, there is a certain curious American insect, belonging to the very unsavoury tribe which supplies London lodging-houses with one of their most familiar entomological specimens; and this cleverly disguised little creature is banded and striped in every part exactly like a local hornet, for whom it evidently wishes itself to be mistaken. If you were travelling in the wilder parts of Colorado you would find a close resemblance to Buffalo Bill was no mean personal protection. Hornets, in fact, are insects to which birds and other insectivorous animals prefer to give a very wide berth, and the reason why they should be imitated by a defenceless beetle must be obvious to the intelligent student.—*From the "Cornhill Magazine" for February.*

Review.

Catalogue of Canadian Plants. PARTS I., II., and III.; *Polypetalæ, Gamopetalæ*, and *Apetalæ.* By JOHN MACOUN, M.A., F.L.S., F.R.S.C. Dawson Bro., Montreal. Royal 8vo., pp. 623.

THIS important work, which is one of the publications of the Geological Survey of Canada, reflects the greatest credit upon the author, and no commendation can be more than sufficient for the admirable way in which the work has been compiled. Although the modest title of "Catalogue" is affixed to this work it is in fact a Flora, and a very valuable Flora, of that vast region, the Dominion of Canada, including also Newfoundland; and in the present Volume I. we have a full record, so far as this is known, of the botany of Canada from Ranunculaceæ to the end of the Exogens. The second volume, which is in a fairly complete form, will also consist of three parts. Part I. will contain all the Endogens; Part II., the Anophytes and Acrogens; Part III., the Thallogens.

The purpose of this work is to place in the hands of Canadian botanists, in a connected form, a full record of all that is known of the number and distribution of Canadian plants. That much and valuable work has been done is evidenced by the fact that although the present volume includes the Exogens only, 2,207 species belonging to 584 genera have been recorded, and their distribution traced more or less fully from Newfoundland to Vancouver Island.

In compiling this volume Professor Macoun has availed himself of all published records, such as Sir William Jackson Hooker's great work, the "Flora Boreali-Americana," which contained the records of the work of the early travellers and explorers; and also the splendid "Flora of North America," by Torrey and Gray, the first volume of which appeared in 1840, and the last published volume, which completes the Gamopetalæ, in 1878. In addition to these is the long experience of more than a quarter of a century of Professor Macoun, whose observations in the field extend from the eastern provinces to the Pacific, and whose industrious research includes not only his own personal observations, but also a careful examination of the various herbaria existing in the Dominion, and of the proceedings, reports, and lists that have from time to time emanated from the various natural history and scientific societies of the Dominion. The work which this volume records commenced considerably prior to the opening up of the country by modern enterprise, at a time when what are now flourishing communities were vast forests, prairie lands, and swamps, so that a true idea could be formed of the primitive flora; the gradual spread of alien weeds, the results of cultivation, reclamations, and the like could be watched and their presence accounted for. Hence this work will not only be a good foundation for a fuller and more perfect Flora of Canada, but a work of standard value for all future botanists. Comparing this "Catalogue" with Asa Gray's excellent "Manual of the Botany of the Northern United States," it will be found, as might be expected, that a great affinity exists between the Flora of the United States and that of the Dominion. What, however, appears to the writer most interesting is the great number of British plants to be found as either native, alien, or introduced plants in this region, some of them being wide spread and evidently of very ancient origin there. Out of the 2,201 species recorded, about 400 are found also in Britain. Of these about 235 are indigenous to Canada, and 161 aliens, being either introductions, casuals, or escapes. Many of these alien plants have established themselves, and are in some cases somewhat unwelcome visitors. A few instances may be given. *Ranunculus acris*, L., which is stated to be a pernicious weed in the eastern provinces and western part of Ontario. *Brassica Sinapistrum* Boiss., a vile weed in cultivated fields and waste grounds, from New Brunswick, throughout Quebec and Ontario. *Capsella Bursa-Pastoris*, Mœnch, found in profusion, wherever there is cultivation, from the Atlantic to the Pacific. *Raphanus raphanistrum*, Linn.; a troublesome weed in many parts. *Lychnis githago*, Lam.; wherever wheat is cultivated this weed is found abundant. *Stellaria media*, With; introduced into all garden ground from the Atlantic to the Pacific. *Spergula arvensis*, L.; troublesome in damp fields. *Chrysanthemum leucanthemum*, L.; an obnoxious weed in many sections of the eastern provinces and Ontario. *Polygonum aviculare*, L.; wherever the smallest settlement is made this weed is sure to appear. *Chenopodium album*, L., is rapidly taking possession of railway banks, ditches, and other places, and is used as a pot herb in many places. It is known in Canada by the common name of Lamb's quarters. Many others might be mentioned did space permit.

Of the British species also indigenous to Canada only a few of the more rare can be noticed. *Myosurus minimus*, L., which with us is a local cornfield plant, is found there in rocky pastures and arid spots occasionally, from Ontario to Vancouver Island. *Arabis petræa*, Lam.; an alpine plant in Wales and North Britain, is found throughout Canada, extending westward to the Rocky Mountains. *Cochlearia anglica* and *C. danica*, L., are plants of the arctic shores. *Silene acaulis*, L., is found on elevated parts of the Rocky Mountains, and throughout arctic and sub-arctic America from Labrador to Behring's Straits. *Cerastium alpinum*, L.; arctic America, and adjacent islands, Rocky Mountains, etc. *Linum perenne*, L., is very common throughout the prairie regions. *Astragalus hypoglottis*, L., is abundant in the eastern prairie region and north to Peace River, and east of the Rocky Mountains. *A. alpinus*, L., has a wide range from Newfoundland and Labrador to the Rocky Mountains and northern British Columbia. *Dryas octopetala*, L.; Rocky Mountains, and over a wide range to Behring's Straits. the islands of the Arctic Sea and Greenland. The beautiful *Parnassia palustris*, L., occurs throughout Canada as far north as the arctic circle, and on swamps on the Rocky Mountains; frequent also in British Columbia. *Ludwigia palustris*, L., is very common in ditches and dried-up ponds throughout Ontario, and over a wide range in Canada. *Linnæa borealis*, L., a very rare northern plant in Britain, is very abundant in cool mossy woods from the Atlantic to the Pacific. *Vaccinium uliginosum*, *V. Myrtillus*, *V. Vitis-Idæa*, *V. Oxycoccos*, *Arctostaphylos alpina*, *A. Uva-Ursi*, and *Loiseleuria procumbens* are all abundant and widely spread, whilst the whole of the Ericas are absent, and our common *Calluna vulgaris* is confined to a very limited district on the east coast of Newfoundland. Space will not allow of a further notice of these plants, enough having been given to show that whilst this work will be invaluable to the Canadian botanist it has also many points of interest to British botanists, and is a valuable addition to our knowledge of geographical botany. J. E. B.

METEOROLOGICAL NOTES.—February, 1887.

The mean of atmospheric pressure was above the average. The barometer rose, from the commencement of the month, to 30·767 inches on the 8th, its highest point, after which it fluctuated downwards till the 24th, and again rose rapidly. Temperature was slightly below the average. A few warm days were experienced at the beginning and end of the month. The highest readings were:—58·1° at Loughborough, on the 27th and 28th; 55·8° at Southwell, 55·6° at Hodsock Priory, 55·0° at Henley-in-Arden, and 54·3° at Coston Rectory, on the 27th; and 53·5° at Binley Vicarage (Coventry), on the 25th. In the rays of the sun, 103·8° at Hodsock, and 103·3° at Loughborough, on the 28th. The lowest minima were:—16·5° at Coston, on the 17th; 20·2° at Southwell, on the 8th; 20·6° at Hodsock, on the 9th; 21·0° at Henley, 21·8° at Binley, and 22·3° at Loughborough, on the 17th. On the grass, the thermometer recorded a minimum of 13·3° at Hodsock, on the 9th; 18·0° at Southwell, on the 8th; and 19·6° at Loughborough, on the 17th. The amount of rain-fall was decidedly below the average, though more than in February, 1885, and varied from 0·67 of an inch at Binley, to 0·52 of an inch at Southwell; the number of "rainy days" not exceeding 8. Sunshine was considerably in excess of the average for the month. A lunar halo was observed at Loughborough, on the 4th. The dry, frosty air was particularly favourable to agricultural operations. Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Wayside Notes.

The Entomologist's Monthly Magazine for March contains a note from a well-known local entomologist, Mr. W. G. Blatch. "On Christmas day last one of my sons found a small beetle walking on the outside of an orange in my house at Small Heath, Birmingham. Being in some uncertainty as to the species, I sent it to the Rev. A. Matthews, who pronounced it to be *Sacium pusillum*."

Owing to the Pressure on our space we are compelled to postpone the promised descriptions of Mr. Bolton's new rotifers, mentioned last month, until our next number.

The Mason College has lost one of its professors, and the Birmingham Natural History and Philosophical Societies an active working member, by the sudden removal of Dr. John B. Haycraft, the College Physiologist, to temporary duties as "professor-substitute" during the ill health of Dr. Rutherford, at Edinburgh, to be followed by a permanent appointment on the University staff. Abundance of good wishes for his future will go with him from his friends in the Midland Metropolis. We see that one of the Birmingham daily papers describes Professor Haycraft as having undertaken the duties of "Professor of Theology." Almost simultaneously with this delightful suggestion (worthy of Mark Twain's "English as she is taught"), we receive the card of a local supplier of gardener's materials in which, in praising the virtues of cocoa-nut fibre refuse, he ascribes to it "considerable antisceptic properties." We strongly urge upon Professor Haycraft the advisability of giving this substance a fair and free trial in his new avocation. We do not know whether one and the same Mrs. Malaprop was responsible for both of the above slips. In justice it ought to have been so, for there is a fine dual association of "antisceptic" and "theology" on the one hand, and "antiseptic" and "physiology" on the other.

In the Zoologist for January last some remarks were made, in an editorial, upon the "Horse-shoe Bats." Mr. J. E. Kelsall, in this month's issue, supplements this by some details as to the recorded distribution of the smaller species, *Rhinolophus hipposideros*, in Britain, from which we extract the following references to the Midland Counties:—Worcestershire. Dr. Hastings, in his "Illustrations of the Natural History of Worcestershire" (1834), includes (p. 62) "The large Horse-shoe," *R. ferro-equinum*, but not the lesser species.—Gloucestershire and Warwickshire were added by Mr. Tomes in the second edition of Bell's "British Quadrupeds" (1874), though it cannot be considered common in the latter county, since Mr. Tomes mentions only two localities for it—Welford and Ragley near Alcester. In the former county it is stated to be not rare at Cirencester.—Staffordshire. The lesser Horse-shoe Bat is not mentioned by Garner in his "Natural History of the County of Stafford," but Mr. J. R. Masefield, in a paper on "The existing Indigenous Mammalia of North Staffordshire," includes it as occurring near Burton, on the authority of Mr. Edwin Brown. It is remarkable that these counties appear to form the south-eastern limit of this Bat in England, for, although numerous other species have been met with, this one has never been recorded to the south-east of these counties. In Herefordshire it has been taken over the kitchens at Sufton Court, as recorded by Mr. R. M. Lingwood (Ann. and Mag. Nat. Hist., 1840, p. 185). From Derbyshire we have the evidence of Sir Oswald Mosley, in his "Natural History of Tutbury," that he received many specimens from "the calcareous caverns of Dovedale and Matlock," and believed it to be dispersed over the whole of the limestone districts of the county. In Nottinghamshire, Mr. Whitacre has not met with it, but Mr. J. Ray Hardy, of the Manchester Museum, informs me that he picked up a dead one from the ground at Edwinstowe, in Sherwood Forest, years ago, "too far gone to make a good specimen." In sending me two Irish specimens he observed that if these are rightly named (as they certainly are), the Nottinghamshire specimen was identical with them.

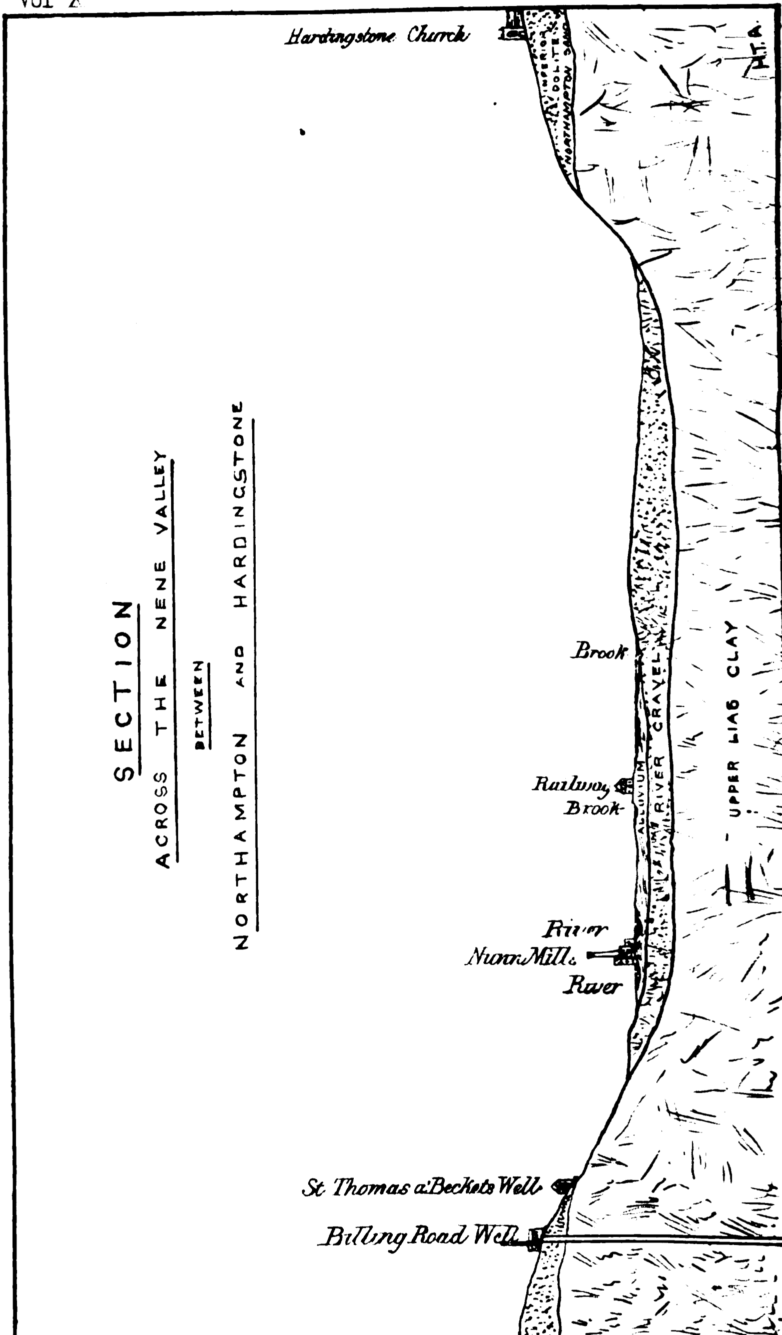
Caterpillars Incog.—The geometric moths have brown caterpillars, which generally stand erect when at rest on the branches of trees, and so resemble small twigs; and in order that the resemblance may be the more striking, they are often covered with tiny warts which look like buds or knots upon the surface. The larva of that familiar and much-dreaded insect, the death's-head hawk-moth, feeds as a rule on the foliage of the potato, and its very varied colouring, as Sir John Lubbock has pointed out, so beautifully harmonises with the brown of the earth, the yellow and green of the leaves, and the faint purplish blue of the lurid flowers, that it can only be distinguished when the eye happens accidentally to focus itself exactly upon the spot occupied by the unobtrusive caterpillar. Other larvæ which frequent pine trees have their bodies covered with tufts of green hairs that serve to imitate the peculiar pine foliage. One queer little caterpillar, which lives upon the hoary foliage of the sea-buckthorn, has a grey-green body, just like the buckthorn leaves, relieved by a very conspicuous red spot, which really represents in size and colour one of the berries that grow around it. Finally, the larva of the elephant hawk-moth, which grows to a very large size, has a pair of huge spots that seem like great eyes; and direct experiment establishes the fact that small birds mistake it for a young snake, and stand in terrible awe of it accordingly, though it is in reality a perfectly harmless insect, and also, as I am credibly informed (for I cannot speak upon the point from personal experience), a very tasty and well-flavoured insect, and "quite good to eat" too, says an eminent authority. One of these big snake-like caterpillars once frightened Mr. Bates himself on the banks of the Amazon.—*From "Strictly Incog." in the "Cornhill Magazine" for February.*

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, February 15th. Mr. T. H. Waller, B.A., B.Sc., chairman; thirty-five present. Mr. T. H. Waller was re-elected chairman, Mr. J. Udall was re-elected secretary of the section. The chairman announced the receipt of the "Proceedings of the Royal Physical Society, 1885-6," with a request that the Birmingham Natural History and Microscopical Society should make a regular exchange of its "Transactions" with the above society. A very interesting series of views in Switzerland (taken during a holiday ramble by Mr. C. J. Watson) was shown, with the aid of the oxyhydrogen lantern, by Mr. C. Pumphrey. Mr. C. J. Watson added much to the interest of the members by his description of each view, as it was projected on the screen. Professor Hillhouse, president of the society, promised a paper on the "Distribution of Plants in Geological Time," for the meeting on March 15th.—MICROSCOPICAL MEETING, March 1st. Prof. W. Hillhouse, M.A., the president, occupied the chair. This being the first meeting of the section under the new arrangement, he gave an introductory address explaining the work of the section. Mr. W. H. Wilkinson was elected secretary of the section. Two specimens of the glass coral sponges of Japan, *Hyalonema*, were exhibited by Mr. H. G. Young. Mr. W. P. Marshall, M.I.C.E., then gave his paper on the "Measurement of the Magnifying Power of Microscope Objectives," and exhibited his new 1-25 inch water immersion objective. He illustrated the paper by diagrams, and showed a series of diatoms as test objects under microscopes, thus affording a good opportunity of appreciating the great advantages of his new lens. He also made sketches from it by the camera lucida. Remarks were made upon its use and structure by Prof. Hillhouse, Messrs. W. R. Hughes, F.L.S., T. H. Waller, B.Sc., and J. Levick. The exhibition was much appreciated by the large attendance of members and friends.—BIOLOGICAL SECTION, March 8th. Mr. R. W. Chase in the chair. A paper was given by the Rev. H. Friend, of Worksop, on Micro-Fungi, describing the minute parasitic growths that infest various plants, as mildew, mould and rust, &c., causing extensive damage in some cases from their great rapidity of growth. The paper was illustrated by a series of interesting coloured slides, prepared by Mr. Friend, and exhibited in the lantern by Mr. C. Pumphrey.—GEOLOGICAL SECTION, March 15th: sixteen present. Mr. T. H. Waller, B.A., B.Sc., in the chair. Mr. John Farthing, Prescott House, Kenilworth, elected a member. Specimens: Mr. Blakemore, *Sagartia bellis*, the daisy anemone, from Shanklin; Mr. Cullis, mica schist with garnets, basalt containing olivine inclusions, both from Scandinavia. Notice given that at the next General Meeting it will be proposed that the word Committee (in the Laws) be changed to Council. Professor Hillhouse read a paper on the "Distribution of Plants in time"; a cordial vote of thanks was given to the Professor. It was resolved that the Publishing Committee be requested to have the above paper printed in the "Midland Naturalist" at an early date.—BIOLOGICAL SECTION. Supplementary Meeting, Friday, March 25th. Mr. R. W. Chase in the chair. Professor Hillhouse gave the conclusion of his address on the "Life History of Mosses," tracing the gradual development from the fertilised archegonium to the matured ripe capsule discharging its spores.—SOCIOLOGICAL SECTION, March 22nd. Mr. W. R. Hughes, F.L.S., in the chair. A paper was read by Mr. F. J. Cullis, F.G.S., on the first four chapters of Mr. Herbert Spencer's "Data of Ethics," in which the gradual development of moral conduct was considered from the naturalist's point of view.—At supplementary meetings, on March 3rd and March 17th, Mr. W. R. Hughes, F.L.S., in the chair, papers on the first portion of Mr. Spencer's "Factors of Organic Evolution" were read by Mr. Alfred Browett. At these two meetings tea was served at 5.30.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 21st. Mr. P. T. Deakin exhibited specimens of *Helix pygmæa*, *Zonites radiatulus*, and other shells from Solihull; Mr. J. Madison, *Mya truncatula*, with siphon and other marine shells. Under the microscopes Mr. Hawkes showed archegonia and gemmiparous conceptacles of *Marchantia polymorpha*; Mr. J. W. Neville, a slide of a series of jaws of Helices, mounted for comparison.—February 28th. Mr. C. P. Neville exhibited a specimen of sea fan (Gorgonia). Mr. A. T. Evans then read a paper on the "Geology of the Birmingham District." The writer spoke of rocks as being of two kinds, Archæan, in which all traces of life were held to be obliterated, and Fossiliferous. The former were divided into two sections, Huronian and Laurentian, which were reviewed with some theories of their formation. They were devoid of fossils with possibly one exception. From this point the writer described the rocks of the district. The Cambrian and Silurian were well represented, but we had then a great gap that brought us to the coal period. One of the most singular features in this formation is the 30ft. seam of coal in the Bilston district, thinning out and being separated by sandstone layers into 330ft. at Pelsall. The Permian and Trias were dealt with at some length, and some of the missing secondary rocks remarked upon. The writer concluded by recommending patient and diligent work in the Lickey quartzite and drift-beds, as fields likely to benefit local geological students. The paper was illustrated by diagrams and specimens.—March 7th. Mr. J. Madison showed specimens of Rhætic shale containing Avicula and Gryphæa; Mr. A. T. Evans, pebbles from the Drift, one of Caradoc sandstone containing cup corals and various shells. Mr. H. Insley showed, under the microscope, sections of a Lancashire coal ball, showing woody cylinder and bark of Lygenodendron, and medullary rays, &c., in *Amyelon ascis*; Mr. J. Madison, *Chelifer muscorum*; Mr. J. A. Grew, *Pulex vespertilionis*.—March 14th. Mr. J. Madison exhibited specimens of *Succinea oblonga*, *Vertigo angustior*, and *V. moulinsiana*. Mr. C. F. Beale then read a paper on the "Natural History of a Trilobite." The writer described the position occupied by Trilobites in the Animal Kingdom, and remarked that they were once supposed to be represented in modern seas by *Limulus polyphemus*, but that conjecture was now a theory of the past. The bibliography of the subject was traced from their earliest mention to the present time, and though the literature of the subject had grown voluminous of late years, still some species have been found that have not yet been described. The three divisions of a Trilobite, the head, thorax, and pygidium, and their component parts, were described. Their geological range was from the base of the Cambrians to the Carboniferous Limestone; their most abundant period being the Silurian age. The alleged predatory habits of these creatures were held to be without foundation, their food being found in the mud in which they were afterwards entombed. The paper was largely illustrated by specimens, diagrams, and plates.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D, Zoology and Botany. Chairman, F. T. Mott, F.R.G.S. Monthly meeting, Wednesday, March 16; attendance thirteen (five ladies). Mr. John Palmer, Waterloo Street, was elected a member. The following objects were exhibited, viz., by Mr. E. F. Cooper, F.L.S., a number of large, coloured, and very excellent German plates of grasses and other agricultural plants; by Mr. Grundy, a small tray of marine shells; by Mr. H. E. Quilter, a shell of *Nautilus Pompilius*, cut through and showing very perfectly the chambers and the syphon-channel; by Dr. Finch, an extraordinary example of the creeping root-stock of the nettle, *Urtica dioica*, about six feet long, very much branched, and in some parts three-quarters of an inch thick; also, a specimen of the rook, with the lower mandible broken, and the upper one grown abnormally to three inches in length, curved and hooked. The chairman introduced a discussion on the relations between univalve and bivalve shells, the question in dispute being whether the operculum of univalves is really a second valve or an organ which has no homologue in the bivalve. Gray argues that it is a second valve, because its structure is the same, with the same spiral character, and with the spiral turned the contrary way to the other valve; but the fact that it is secreted by the foot, and not by the mantle, is opposed to this theory, and the most recent writers seem to consider that it is not a true valve. The discussion was continued by Mr. Quilter, Dr. Tomkins, Dr. Cooper, and others. The chairman then read a short paper on "The Voices of Animals," showing that voice was only possible in the air-breathing vertebrates, and was in fact only developed to any important extent in the two classes of birds and mammals.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Nunn Mills
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St Thomas a'Beckets Well
Billing Road Well
ALLUVIUM
RIVER GRAVEL
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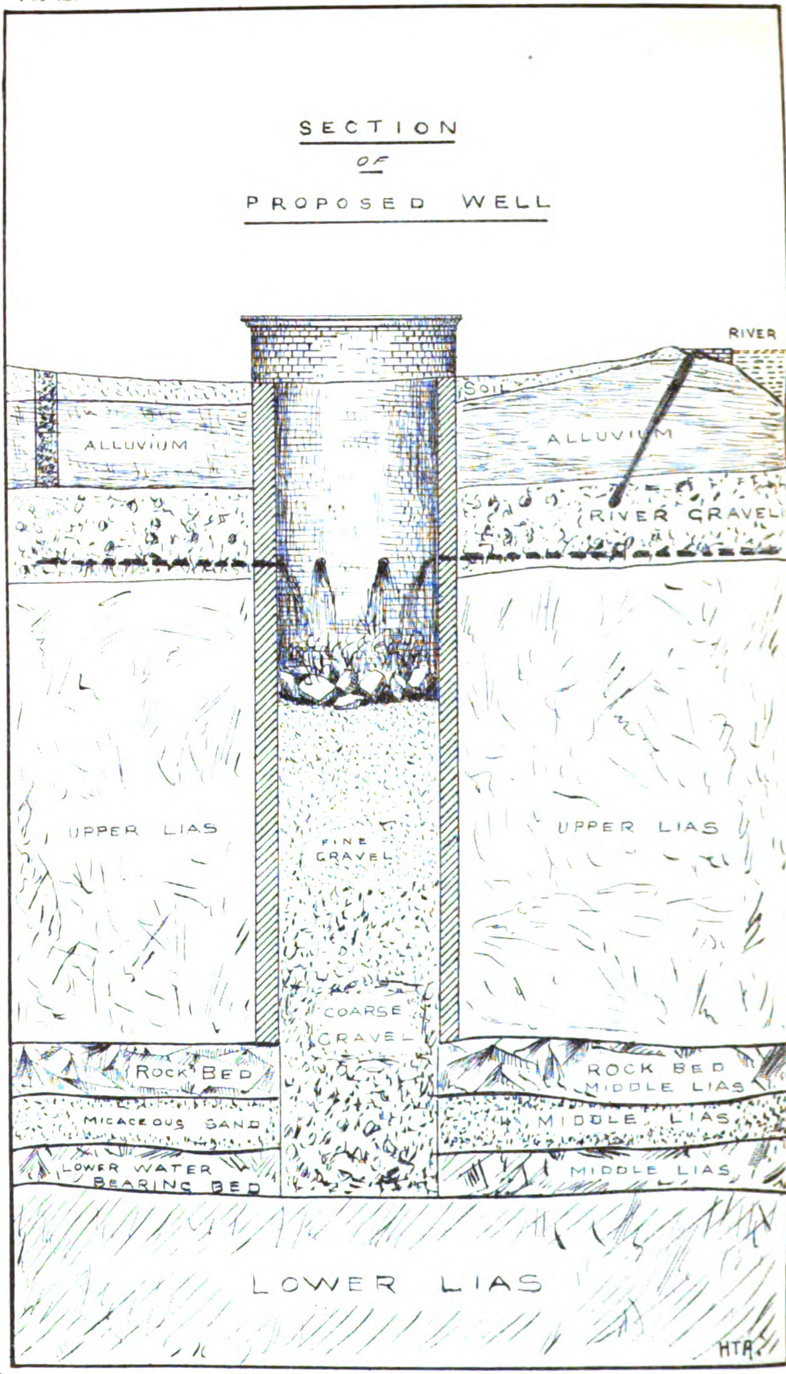
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THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

The Remedy.

(Continued from page 100).

There is no doubt whatever that the natural distribution of water in England has been considerably disturbed of late years by artificial means. Not being content with the quantity or purity of the water obtained from the hillside springs, or shallow wells, the deep-seated reservoirs have been tapped and pumped as though there could be no limit to the amount of water in them. Again, not being satisfied with the dryness of our fields we have artificially drained them, and so cut off some of the water which otherwise would have got into the porous beds below, and consequently at the same time helped to produce extensive and destructive floods. The particular object of the following pages is to endeavour to show how the equilibrium may be largely restored by putting into the porous beds of a district much of the water which is now naturally and artificially kept out of them, together with any additional surplus water that may be available. The details of the method proposed for the application of this in Northamptonshire are as follows:—In most of the valleys around Northampton there are times of the year when they are visited with considerable floods; many fields seem almost constantly under water in winter time, owing to the fact that they are lower than the water in the river when the river is high, and so they have nowhere to drain into. An artificial well or swallow-hole, about 100ft. in depth on the average, more to the east and less to the west, would enable this water to run away into the porous beds of the Middle Lias, where it is so much needed.

Description of Plates II. and III.

Plate II.

Section across the Nen Valley between Northampton and Harding-stone, showing the supposed arrangement of alluvium, river gravel, &c.

Plate III.

Diagramatic section, showing the general relation of proposed dumb wells to the surrounding strata.

These dumb wells would all be situated in the valleys, and would generally require to be cut through a little alluvium and river gravel, and through the Upper and Middle Lias. The wells might be lined with brick, and then filled up with coarse gravel, broken brick, or any good porous material to within 35ft. or 40ft. of the top, the material to get finer towards the top, in imitation of the filter beds of the London Water Companies. The depth of 35ft. to 40ft. not filled in with gravel is given to enable the water running in from the river gravel, as well as that from the surface, where such water is desirable, to have a good fall, whereby it may be effectually aerated before entering the chief filter bed. Some large stones might be placed at the top of the sand to prevent the latter from being much disturbed by the falling water. The river gravel is so commonly met with along the Nen Valley that very great use might be made of it in such a scheme as is here being described. Sometimes this gravel is capped by 12ft. to 14ft. of alluvium, an earthy kind of clay containing much organic matter, and very impervious to water; at other times the gravel comes nearly or quite to the surface, but there is every reason for believing it to be a fairly continuous bed. The flat land on each side of the River Nen eastward of Northampton gives almost the exact limits of the alluvium, or river gravel, or both—that is, the part which is so liable to floods has below it a porous bed which may be utilised for the mitigation of floods. The gravel frequently extends beyond and above the alluvium, and forms a kind of fringe to the valley, as described in a previous page. (See Plate II.) Since, then, we have a porous bed, several feet in thickness, existing very little below the ground which is now so commonly flooded, it would not be a difficult matter to make a number of artificial openings into it from the surface, and fill them up with gravel, so as to put the primary well into good communication with the source of its supply—flood-water. At the present time water obtained from the river gravel is clear, and free from suspended impurities, and would still be so if this plan were adopted, so that there would be little or no silting up of the dumb wells. In some places where it might be desirable to construct a dumb well the river gravel would not lend itself for the purpose; this would be the case in the northern branch of the Nen. The difficulty might be got over by making six or more radiating channels from the well to a slight depth, in which would be placed large drain pipes, these to be covered over with gravel and the turf replaced. The precautions here mentioned would secure the wells from any rapid silting up, although somewhat retard the flow of water, and consequently the amount that could be utilised, though at any time the upper layers of the filter bed in the well could be taken out and replaced if necessary.

As all these openings into the Marlstone would be near the river or some feeding stream, an additional and very important increase in the amount of water obtainable might be made by having a connection with the river, by means of a pipe, so placed as to draw water from this source when the river was sufficiently high for it to be well spared. It would indeed be an advantage to millers and others to be relieved of this water, and might somewhat prevent the injuries which arise to the banks from overflowing. The diagrams* will show the general nature of the proposed arrangements. The advantages which I claim for this scheme are these:— It would improve a large district now injured by floods; it would after the first season improve our water supply, and ultimately make it abundant; the water would be very pure, because it is filtered before entering the well, and filtered in the well itself before entering the most effectual filter, the bed itself; and what I consider a very important matter, the water would be well aerated by its fall; and it will be at once evident that no additional reservoir is required for the increasing amount of water, no pipes required to convey it to the pumping station, and no filtration required after pumping.

As indicating the objections that might be, and indeed have been, urged against this scheme, I propose to consider separately the following questions:—

1.—Would there be enough water?

2.—Would the water go into these beds?

3.—Would the water which goes in be available for our use?

4.—Would the water be pure?

5.—What would be the expense?

6.—Are there any special natural or legal difficulties in the matter?

I.—Would there be enough Water?

In the early part of 1885 the water supply of Northampton was estimated at 420,000 gallons per day from all sources, only about 315,000 gallons being from the Marlstone.

* The Diagram containing section of well must be regarded as one in which relative dimensions have been ignored, so that the particular features of the arrangement may be the better shown. I have to thank Mr. H. T. Armitt for preparing the drawings for me.

This supply for 60,000 inhabitants, it will be readily observed, was equal to 7 gallons per day per head; whereas not less than 20 gallons per head should be available. For Northampton alone, therefore, a daily supply of 1,200,000 gallons at least is required; and since the town is rapidly increasing, and a number of villages may also claim to be supplied by the town, owing to the character of an Act of Parliament applied for and obtained by the Water Company, certainly no less than 2,000,000 gallons per day ought to be aimed at.

The River Nen and its tributaries has a drainage area of 1,077 square miles, made up of 150 square miles of Lias, and 927 of oolite, much covered with alluvium. The drainage area above Higham Ferrers Bridge is 383 square miles.* Higham Ferrers Bridge is situated fourteen miles N.E. of Northampton, a distance not exceeding that of some portions of the Middle Lias which have in all probability acted as collecting grounds for the water supplied to Northampton in the past; for as I shall be able to show in a later section, the Marlstone area nearest Northampton has in no way contributed to the town water supply. It appears, therefore, that so far as the *average porosity of the Marlstone is concerned*, the whole of the catchment area, viz., 383 square miles, might be utilised for feeding the Middle Lias. As, however, many things might modify the available amount of water, and with any amount of care only a rough idea of the quantity could be obtained, I have tried to err on the side of caution by basing the following calculations on a supposed catchment area of 150 square miles.

The rainfall of Northamptonshire, taking an average of a good many years, is 23·1 inches per annum, and since 1 inch of rain = 22,687 gallons per acre, or 14,519,680 gallons per square mile, it follows that a rainfall of 23·1 inches over 150 square miles would give about 50,310 millions of gallons.

Of this water a good proportion is lost by evaporation from exposed surfaces, and from the leaves of plants. The amount of water evaporated in different seasons would vary considerably, and be greatest when the rainfall was most evenly distributed throughout the year; it would also be influenced by the character of the country as regards structure, hills and valleys, and the geological character of its surface. Taking these latter into account for the district under consideration, and by comparing with estimates given by more competent authorities for other districts, I think an allowance of 10 inches per annum on account of evaporation would be sufficient.

* "The Water Supply of England and Wales," by Chas. E. de Rance, F.G.S., &c.

A deduction of 10 inches of the rainfall over an area of 150 square miles would amount to about 21,779 millions of gallons.

A second loss is to be considered in the average flow of the river. According to Mr. Beardmore,* the Nen, at Peterborough, has drained 620 square miles, and its ordinary summer discharge at this place is 5,000 cubic feet per minute, which is equal to 8·06 cubic feet per minute for each square mile of area drained. This represents 1·82 inches of the rainfall, and so the contribution for the area under consideration is equal to 3,964 millions of gallons per annum.

The water which sinks into the ground and is not evaporated again need not be considered as a loss, because it all reappears as springs, feeders of the river, or accumulates in the Middle Lias, that being the lowest water-bearing bed of the district, where, of course, it is still available.

The remainder then, after deducting loss by evaporation and ordinary flow of the river, may be regarded as *flood water*, which is disposed of by the river, or along the river valley. So great is the discharge sometimes, that according to Mr. Shelford, C.E., the amount of water passing through Peterborough Bridge was on one occasion increased from the ordinary flow of 5,000 cubic feet per minute to 480,000 cubic feet per minute. All this water is to spare, and would be better disposed of in another way.

The quantity of water to spare, therefore, from the drainage of 150 square miles would be about as below :—

		Millions of Gallons.
Rainfall (23·1 inches per annum)		50,310
Loss by evaporation	21,779 millions	
,, ,, flow of river	3,964 ,,	
Total loss		25,743
		24,567

That is, a quantity of water equal to a daily supply of over 67 millions of gallons is to be had if we can only take it.

Of course I do not pretend that this amount could be impounded; indeed, a fraction of it would be ample, but the great magnitude of the surplus water must be evident to everyone.

* "Hydraulic Tables," by Nathaniel Beardmore, M. Inst. C.E. Weall, 1852. Quoted from Water Supply of England and Wales, by C. E. de Rance, Assoc. Inst. C.E., F.G.S.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENTIAL ADDRESS.*

BY R. W. CHASE.

The honour conferred in re-electing me President of this Society last year entails the duty of giving a retiring address for the second time. I can assure you I deeply felt having that important post again placed in my hands, as it assured me I still retained your confidence.

The successful career of a President is largely due to the assistance and support rendered by his colleagues on committee; I, therefore, take this opportunity to most heartily thank those members who have from time to time so kindly and cordially given me their help, thereby enabling me to complete satisfactorily—I hope—my year of office, which is one especially to be remembered on account of the meeting of the British Association, which passed off with so much éclat.

The Society is to be congratulated upon the active and important part taken by many of its members in the proceedings of that meeting, and the deservedly high eulogium passed upon their work cannot help encouraging members to continue their efforts in the hope of obtaining the same or greater results in the future.

Retrospect.

The Society during the year has lost by death two of its most valued members, and I cannot allow this occasion to pass without recording the deep regret felt, not only by myself, but by every member of the Society who knew them personally. I refer in the first instance to Mr. W. Southall, F.L.S., an ex-president, who, by his great abilities, his intimate and comprehensive knowledge of botany, his never-failing kindness in imparting that knowledge to others, his universal courtesy and geniality of manner, endeared himself to all his friends; and it was entirely owing to failing health that this Society of late years had not benefited on more occasions from his varied attainments. It is with difficulty that such a gap in any Society can be refilled; men of William Southall's character are rarely met with. The second loss was that of our honorary secretary, Mr. John Morley, F.R.M.S., who for many years past occupied that

* Transactions of the Birmingham Natural History and Microscopical Society. Read March 29th, 1887.

onerous and difficult post, in which he laboured throughout the whole period with indefatigable zeal for the welfare of the Society; in fact, he thoroughly assimilated himself with it, so that the interests of both became identical. It is probable that no one was better, or so well, known in the Society as he, on account of his general popularity and the number of years he had belonged to it. Botany was his special branch of study, and British Ferns were his especial delight. One of his chief characteristics was the courage with which he advocated his views, and however widely he might differ from his brother scientists, he was always friendly as soon as the controversy was over. His sterling good qualities caused his loss to be deeply felt by the Society, and his memory is not only respected now, but will be in years to come, as one who faithfully tried to do his best.

The work of the Society has been of a very satisfactory character during the past year, and an increased interest in the proceedings has been evinced by many members, which is most gratifying to those who labour in promoting the love of Natural Science. The financial position is slightly improved from the previous year, but to continue the usefulness of the Society it is absolutely imperative that the present income should be kept up, if not augmented, and to do this, new members are necessary to take the place of those lost to the Society, either by death or otherwise. I would, therefore, urge upon the members the desirability of bringing the advantages of the Society—which are great—before their friends as an inducement for them to join.

Popular Interest in Natural History.

The interest taken in what I may term general Natural History is, I think, more widely spread than is usually imagined. I do not refer to scientific study or systematic research, but the casual interest, or desire to know something of things, animate and inanimate, one meets with in our every-day life, without caring about the morphology and physiology of the object which attract attention. This class of interest was largely shown and exemplified by the majority of the visitors who inspected the Natural History Division of the Exhibition held in Bingley Hall, which section was of a necessity restricted, as the specimens exhibited only represented species that had been obtained in the immediate district, and consequently it was impossible to convey an adequate idea of the complete Fauna, Flora, and Geology of the Midlands. In making enquiries for the loan of specimens, I found that many rare mammals and birds obtained in this and adjoining counties were scattered about in all directions; often the solitary Natural History object possessed by the owner, which in its isolation was nearly valueless, but if forming part of a collection would be of some practical use and its individual worth greatly enhanced.

Need of a Local Natural History Museum.

From the foregoing observations I could not help lamenting that our town does not possess a Natural History Museum. In all other branches of education and improvement our town well acts up to its motto "Forward;" but as regards Natural History, I do not hesitate in saying, it neglects an important duty in not affording Nature a place wherein might be displayed and explained her wonders and beauty to the edification of the many.

It is greatly to be regretted that Natural History is not more recognised by teachers as a means of education, producing logical thought, training the mind to detect salient points, working out cause and effect, thereby showing an indisputable continuity of action connecting both. Such study cannot but be beneficial to the pupil, and in the Board Schools what an inestimable boon such lessons might become to a working man in after years, providing him with a healthy and elevating recreation. I consider myself fortunate in knowing many such instances, and could mention several in this town, who after a hard day's work devote their leisure to the pursuit of some branch of Natural History, Entomology or Geology being the favourite studies, and it is surprising what splendid results, what intimate and accurate knowledge, such men obtain, entirely by their own individual industry and perseverance, and often with little help from books. I wish such cases could be multiplied, which probably would be done if we possessed a good museum. For some time past a controversy has been going on as to the advisability of opening museums and similar institutions upon the Sunday. If I possessed the power as I have the will they should be thrown open at once, but at the same time, I advocate educating the masses so that they may intellectually enjoy, and understand a little of what they see and admire, so that all moths and butterflies should not be "Bob Howlers," and other sections of the animal kingdom be honoured with similar appellations.

The reason Birmingham is so behindhand with respect to the foundation of a Natural History Museum is rather incomprehensible. I am afraid that those who are in a position to assist in bringing about this desirable acquisition to our town associate such an institution with a collection of stuffed monstrosities or dummies placed on stands in glass cases, or perhaps the only Natural History collection they have ever taken the trouble to notice is the wretched display —although there are some good specimens interspersed amongst the others—at Aston Hall, which is nothing less than a disgrace to a community like ours. Let me assure those who may have gathered their opinions from such a display, that the Naturalists of the present day insist that specimens shall be exhibited naturally, and represented, as far as possible, as "Nature" herself ordains. I am now speaking of a public, or shall I say popular museum, not one solely for the use of students in scientific institutions, which would be formed upon quite a different basis.

This neglect of Natural History in our town is the more astonishing when we find it taken up so warmly and supported in many others; in fact, a Natural History Museum of some sort is to be found in almost every town of any size. Take for instance, Liverpool, Newcastle-on-Tyne, York, Durham, Chester, Leicester, Shrewsbury, Ludlow, Worcester, Warwick, Lichfield, Derby, Norwich, Salisbury, not to mention the Universities, and a host of other places. I grant many of them are antiquated, neglected, and useless to a Naturalist; but the reason of this is, I think, not far to seek.

Principle and Method of a Local Museum.

Provincial museums as a rule miss their purpose, owing in most instances to bad management, or, quite as often, by attempting too much — in endeavouring to illustrate the Zoology of the world instead of restricting their efforts to the immediate district; the consequence is, a miserable failure. In my opinion, such museums ought to most fully and perfectly represent the fauna, flora, and geology of their respective districts, each species that is indigenous being shown in all the metamorphoses that it passes through; in fact, giving a complete life history of both the animate and inanimate creation to be found in their neighbourhoods. Lack of material cannot be any excuse, as objects of interest are to be found almost at our very doors; only in those districts where there is a paucity of observers is there barrenness; even the very stones cry out for an opportunity to display their written pages of the world's history. If this could be carried out, local museums would occupy a much more important position than they do at present, and would attract specialists who might be engaged in studying any particular branch of Zoology or Geology, who, upon ascertaining that such a locality was prolific in those subjects of their research, would have only to visit the local museum to find a complete series of specimens illustrating such a family or genus more thoroughly than could be possibly done in our National Museum, both on account of the better facilities for obtaining specimens, and the additional amount of room that could well be assigned to each species. The reason so many local museums are the repositories of all sorts of heterogeneous matter is due to the reluctance of the governing body—generally a committee of estimable men, but who know nothing of Natural History—to refuse anything that may be offered for fear of giving offence and checking future donations. A private collector has generally to destroy his first, and sometimes his second collection, before experience teaches him what to save and how to store his treasures; but he has this advantage over a public museum: he can get rid of his duplicates and rubbish how and when he pleases, whereas the public body cannot. If the vast amount of rubbish, often an accumulation of years, could be swept away, and the collections begun *de novo*, with the good things left as a nucleus, a great improvement would soon be observable. Rarely does a museum possess a catalogue worthy of the name, and frequently the curator knows nothing and cares less about the objects placed under his care, and looks upon his office as a sort of comfortable retirement in which to end his days; and lastly, the want of funds is an always present calamity and effective stop to any progress in institutions of this kind. No doubt, you will ask, how can such a state of things be altered? Without much trouble, I think, by a committee annually elected by the local authorities, either Town Council or Local Board as the case may be, associated with, say, three naturalists nominated by the local Natural History Society or Field Club. This would enlist the sympathy and ensure the co-operation of many naturalists in obtaining specimens for the museum, at a great saving of cost; at the same time, by creating a personal interest, it would greatly assist in inducing specialists to undertake that their branch of study should be well and properly represented. This committee should be the governing body, to whom a grant should be annually made from the Museum and Free Library Rate; there should be no lavish expenditure allowed upon unnecessary glass cases and fittings; a carefully compiled catalogue, with reference number attached to each specimen, should be provided; the exhibits should be properly labelled so as to furnish general information to visitors as to habits, &c., and admission should be free. If I were called upon to arrange an ornithological collection of a district, I should only require a large room with top light, without any wall cases whatever; each species should be mounted in a box case, with dust-proof moveable back, glass front, with accessories showing the habitat of each species, the adult, ♂ and ♀, young in several stages, and summer and winter plumage should be illustrated. The cases would be made of various sizes, but capable of forming blocks when piled together, but with the lines of division level. Anyone who has seen Mr. Booth's splendid collection at Brighton cannot help being struck with the great difference between such a style as I have pointed out, and which, I am delighted to say, is fast being adopted at South Kensington, and the old-fashioned skin-and-bone sentinels placed in cases, generally so crowded as to frustrate the proper examination of any individual specimen.

Local Societies and Local Museums.

The one great reason why I advocate the formation of local Natural History Museums is, that a considerable portion of the labours of this and kindred societies may be of some practical service and lasting benefit, diffusing their knowledge for the public good, as well as leaving a legacy to the next generation of naturalists. Now most of the work undertaken at the present time is of a purely personal character, each pursuing his studies and observations for his own advancement and edification. I imagine that what delights the one will in all probability the many; and, as the results of such labours are now often lost, or scattered beyond recovery, it stands to reason that if these divided efforts could be preserved and systematically brought under the notice of the masses, a vast amount of good would be done both intellectually and morally, for few pursuits tend more to elevate the mind than Natural History.

Hugh Strickland on Local Societies.

I should like you to hear the opinions of one who sacrificed himself in the cause of Natural Science. I refer to Hugh Strickland. As to the duties incumbent upon local Natural History Societies, he says:—"The formation of clubs for the investigation of local Natural History also began to take up new ground. These are of much importance. The preservation of the condition of the present physical characters of our country will be far more dependent on them than at first sight appears. The last fifty years have made a great change in the surface of the country; population has increased; so has agricultural improvement, plantations, drainage, enclosure of waste lands, in short, artificial works of every kind. These have often completely altered the nature and aspect of the country, and, in consequence, the productions, both animal and vegetable. In parts of the North of Scotland, another cause—that great rage and fashion for "sporting," as it is termed, has influenced the distribution of the higher orders; the wild animals and birds have been reduced in numbers as 'vermin,' sometimes almost extirpated, and many will in a few years stand side by side in history with the bear and the wolf. It will be to these clubs that we shall be indebted for a record of what in their days did exist; and in the still untouched mountains and valleys we may have the discovery of insects and plants not known to our geographic range; and when the country shall have been mapped on the large scale by the Government surveyors, there is nothing that should prevent an active club to fill up in a few years a list of the productions within their beat, and so lead on to a complete and accurate Fauna and Flora of our own time and age; and generations succeeding would be able not only to mark the changes of the productions, but to judge and reason upon the effects which these now so-called improvements have produced on the climate and soil, and the fertility and increase of the latter. These clubs have yet to write the Natural History of Great Britain."

As this Jubilee Year seems to be full of germs of good intent, and the promise of spontaneous growth of all sorts of possible and impossible schemes, let us hope that it may contain one that will germinate and ultimately develop into a goodly edifice, to be the holder of a representative collection of the Natural History products of our district. I have little fear that, if only a small beginning were made, with continued efforts, our labours would eventually be crowned with success.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 92.)

Second Period, 1751 to 1800.

The history of this Period commences with the celebrated "*Flora Anglica*" of William Hudson, the first English Flora on the Linnæan system. Hudson was born at Kendal in 1730, and practised as an Apothecary in London, where he died in

1793. The first edition of the Flora Anglica, in one vol., appeared in 1762, the second, in two vols., in 1778. Two other editions were published after his death.

The first edition contains many local records; the second is much more copious in this respect; it yields, nevertheless, two only relating to the County of Worcester, viz.:—

"**Scirpus romanus**," pp. 19—20. "Habitat in palustribus juxta Throgmorton in agro Worcesterensi. Revd. D. Sheffield."

* "**Campanula patula**," pp. 95—96. "Prope Worcester."

As I shall often have occasion to repeat the names of plants previously recorded it will be convenient to mark such names with an asterisk (*), in order that they may be distinguished from new County records. I shall also mark with a dagger (†) records which, in my judgment, are undeserving of credit.

The discovery of Scirpus romanus, a small form of S. Holoschœnus, L., at Throckmorton near Fladbury, by Dr. Sheffield, has been discredited by the late Hewett C. Watson,* but, as it seems to me, without sufficient reason. Its discoverer, the Revd. William Sheffield, D.D., was Keeper of the Ashmolean Museum from 1772 to 1795, and Provost of Worcester College, Oxford, from 1777 to 1795. It is most unlikely that Hudson would have recorded so rare a plant unless he had been convinced of its identity, either by the sight of an actual specimen or from knowing that he could trust his correspondent.

We now pass to the honoured name of William Withering, one of the most eminent of British Botanists. From his time Botany became the study of the Physician rather than of the Apothecary. He was born at Wellington in Shropshire in 1741, passed the greater part of his life in Birmingham, where he was the principal physician, and died there in 1799. He lived for many years at Edgbaston Hall, a residence still situated in a well-timbered and picturesque park, close to the edge of the town. The first edition of his well-known "*Botanical arrangement of British Plants*," in two vols., was published in 1776, the second, in three vols., in 1787, the third in four vols., in 1796. It passed through five further editions, in four vols., after his death. The edition of 1776 contains few local records, and none relating to Worcester, and we might at once pass to the second edition were it not necessary, for the preservation of chronological sequence, to introduce the name of another author.

* Cybele Britannica, Vol. III., p. 71.

In 1781 and 1782 Dr. Treadway Nash published his two ponderous Folios, entitled "*Collections for the History of Worcestershire.*" The first vol., 1781, contains (Introduction p. lxxxix.) a list of 43 rare plants. As this is the first Worcester List of any extent I shall quote it entire, arranging the species in the order now usually adopted, and omitting for the sake of brevity the English names, times of flowering, and other remarks.

"A catalogue of some rare plants in Worcestershire, the Latin generic and specific names of which are taken from the 13th edition of the Systema Vegetabilium of Linnæus, published at Göttingen by Andrew Murray, A.D. 1774."

28. **Fumaria claviculata, L.** In rough stony places by the side of Malvern Hill above Great Malvern Town.

24. **Cardamine amara, L.** On the banks of the Avon below Great Comberton, plentifully.

25. **Cardamine hirsuta, L.** In the same place with the foregoing.

23. **Iberis nudicaulis, L.** In some old stone or gravel pits by the side of Pensham field, in the foot way.

18. **Dianthus Armeria, L.** Upon banks under hedges in a clayey soil, about Pershore, Eckington, Great Comberton, and many other places.

34. **Hypericum montanum, L.** Upon banks under hedges and by woodsides about Pershore, and on Breedon Hill.

26. **Geranium pratense, L.** Frequent in moist meadows, and amongst bushes in rough grounds.

27. **Malva moschata, L.** In like places with the foregoing.

29. **Lathyrus Nissolia, L.** On banks by the sides of woods between Pershore and Eckington.

30. **Lathyrus sylvestris, L.** By a woodside going from Pershore to Eckington.

31. **Vicia sylvatica, L.** In a thicket on the north side of Breedon Hill.

32. **Hippocrepis comosa, L.** On the south side of Breedon Hill, below the Camp.

33. **Astragalus arenarius, L.** On the south side of Breedon Hill, near the Hippocrepis above mentioned. (*This is now known as Astragalus Hypoglottis, L.*)

20. **Spiræa Filipendula, L.** On Breedon Hill above Overbury, plentifully.

21. **Comarum palustre, L.** In boggy places on the Lickey, near Bromsgrove.

19. **Sedum album, L.** On the rocks by the side of Malvern Hill, above Great Malvern town.

11. **Parnassia palustris, L.** In some low boggy meadows on the south side of Breedon Hill and eastward of Overbury.

8. **Œnanthe pimpinelloides, L.** By the sides of rills ascending the north side of Breedon Hill.

9. **Œnanthe crocata, L.** Frequent in ditches and by river sides in many parts of this county.

10. **Smyrnium Olusatrum, L.** Between Great Comberton and Woollershill, under the hedges of some enclosures near the Avon's side.

4. **Scabiosa Columbaria, L.** On Breedon Hill.

35. **Hyoseris minima, L.** In Pensham field, near Pershore, in the most barren and gravelly places. *(Now known as Arnoseris pusilla, Gaert.)*

36. **Hypochœris glabra, L.** In Pensham field with the foregoing.

37. **Carduus eriophorus, L.** On Breedon Hill.

38. **Gnaphalium sylvaticum, L.** Plentifully in rough pastures near Fladbury.

39. **Inula Helenium, L.** In great abundance on the side of Breedon Hill, in the ascent from Great Comberton.

* 7. **Campanula patula, L.** In hedges and by roadsides about Worcester, Malvern, and various other parts of the county.

14. **Vaccinium Oxycoccos, L.** In the boggy parts of the Lickey, near Bromsgrove.

16. **Chlora perfoliata, L.** In rough pastures of a stiff clayey soil about Great Comberton and elsewhere.

22. **Melissa Calamintha, L.** In woods and thickets near Malvern and elsewhere, not unfrequent.

* 5. **Cynoglossum officinale, L.**, var. **B. folio virente.** Near the three mile stone going from Worcester to Pershore.

6. **Anagallis arvensis, L.**, var. **flore cæruleo.** Upon Breedon Hill in a corn field at the top of Overbury Wood.

15. **Daphne Laureola, L.** In woods and hedges near Pershore, frequent.

40. **Satyrium viride, L.** In meadows and pastures about Great Comberton and Pershore, abundantly.

41. **Ophrys insectifera, L.**, var. **apifera.** In rough pastures of a clayey soil on the south side of Great Comberton, towards Woollershill, frequent.

1. **Iris fœtidissima, L.** This grows plentifully in woods and thickets and by waysides about Great Comberton, and other places in the neighbourhood of Pershore.

43. **Iris Xiphium, L.** By the river's side near Fladbury, and some other places in this county; just discovered by the Duchess Dowager of Portland, that great admirer of Natural History.

12. **Galanthus nivalis, L.** At the foot of Malvern Hills.

17. **Paris quadrifolia, L.** In woods and thickets on the side of Breedon Hill.

* 13. **Colchicum autumnale, L.** In pastures and low meadows frequent about Great Comberton, Great Malvern, and many other places of this county.

* 2. **Scirpus romanus.** In marshy places near Throgmorton.
3. **Bromus pinnatus, L.** Abundantly in almost every rough pasture of a clayey soil in the neighbourhood of Great Comberton and Pershore.
42. **Osmunda Lunaria, L.** On the north side of Breedon Hill in several places, particularly above Woollershill in rough ground amongst the Pteris aquilina or Common Brakes.

It is not known who supplied Nash with the above list. which appears to be the work of a perfectly competent hand. Omitting the Blue Iris as a casual introduction, omitting also four plants previously noted, and including the Common Brake, it furnishes 39 new County records. It anticipated by six years the second edition of Withering to which we must now recur.

This, of which the first two volumes appeared in 1787, was edited by Dr. Jonathan Stokes, a Physician residing at Kidderminster. We learn from Mr. Edwin Lees (*Bot. of Worc.*, p. lxxxix.) that Dr. Stokes subsequently removed to Chesterfield where he died in 1831, in his 77th year. Dr. Stokes has enriched this edition with many records for the Counties of Worcester, Warwick, and Stafford, partly supplied from his own observations, partly from those of Withering, and partly by numerous correspondents, among whom Mr. Ballard, Surgeon, residing near Malvern Wells, appears to have been the most serviceable. I have abstracted those relating to Worcester and give the following list of them omitting those previously given by Ray, Hudson, and Nash, which are all included by Stokes. It must be remembered that the large Parish of Halesowen, which was in Salop in Withering's time, is now in Worcester.

(To be continued.) p 150

SOME NEW LOCAL ROTIFERS.

By P. H. Gosse, F.R.S., Hon. F.R.M.S.

From the Transactions of the Royal Microscopical Society, December 8th, 1886.

The following species of Rotifera were discovered either too late to be included in Dr. Hudson's work, or since that work was published. They are described with brevity, but, I hope, with precision sufficient for identification and differentiation.

6. *Diaschiza* (?) *cupha*. Much compressed; dorsum squarely gibbous: foot short, scarcely protruding; toes long, blade-shaped, slightly recurved, with claws abruptly shouldered. Length $\frac{1}{124}$ in. Lacustrine.

This hunch-backed form needs fuller examination. I describe it from a single example, just dead, but not decomposed, in water sent from Birmingham. The depth, compared with the width, of the animal is remarkable. The trophi were very long, but ill-defined: in the occiput is a short brain, carrying a flat, lens-shaped red eye on its inner surface. The peculiar shape of the toes is shown at *e*. I affix a mark of doubt to the *generic* position, because I could not be *quite* sure of the dorsal cleft. (Fig. 6.*)

8. *Pterodina reflexa*. Lorica elliptical in outline, the two longitudinal halves bent upward and backward, at a considerable angle; the dorsal surface being evenly furrowed, the ventral rounded. Length of lorica $\frac{1}{220}$ in. Lacustrine.

The angular character is not noticed on a dorsal view, but becomes conspicuous in the act of turning. *P. valvata* bends its leaves *downward*, on hinges, at will. *P. reflexa* bends its halves *upward*, on a medial line which is not hinged, but permanent. It is somewhat like a butterfly, sitting, with half-opened wings, on a flower in an autumn noon. The internal structure is normal. I have found it abundant in water from Smallheath, Birmingham. (Fig. 8.)

12. *Notholca polygona*. Lorica roundly pear-shaped, truncate in front; the central pair of the occipital spines stout, the other two pairs almost obsolete: ventral plate forming a square box, with sloping, many-angled sides. Length $\frac{1}{160}$ in. Lacustrine.

A remarkable form. The dorsal plate is a half-oval, the ventral nearly flat. The latter is very peculiar: a kind of sub-cubic box, open at the summit, runs down to about three-fourths' length, and then proceeds, in pyramidal form, to a point at bottom; and this appears to contain the viscera. Each side is covered-in by a plate of two planes, but appears to be empty. On those parts of the arched dorsal plate which answer to these empty lateral chambers, run down very delicate flutings, while the broad medial part is quite clear and smooth. All the angles are distinct. The only example seen was dead, but showed a crimson eye and a normal mastax. From Kingswood Pool, near Birmingham. (Fig. 12.)

* Reference to figures in J.R.M.S., Feb., 1887, Pl. I. and II.

18. *Asplanchna eupoda.* Body globose, with a stout foot, retractile at will: rami of incus long, each armed on its inner edge with four widely-severed teeth. Length, moderately extended, $\frac{1}{32}$ in., width $\frac{1}{118}$ in. Lacustrine.

The most remarkable feature is the foot, which is, proportionally, much larger than in *A. myrmeleo.* The pincer-like rami are those of a normal *Asplanchna*, having a close resemblance to those of *A. priodonta*, save that their inner edges are not cut into saw-teeth, but beset with three distant spinous teeth, while each curved point is double. I have examined eight or ten examples, all from the canal, Small-heath, Birmingam. (Fig. 18.)

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Part IV., Chapter XV., and Appendix B.

The Vertebrate Skeleton.

BY F. J. CULLIS, F.G.S.

[ABSTRACT.]

When a little maiden, who is learning to sew, pricks a finger with her needle, so that just one drop of blood oozes out, she knows not that in that shed blood there are millions of living organisms doomed to a premature death, through so small an accident. Still less does she know that her dainty little body is a vast aggregate of beings equivalent to these, and that they are grouped, as it were, in families, and societies, and nations, all of which are compacted into the marvellous kingdom, of which she is the queen. But this multiplex nature alike of every human form and of every tree is fast becoming part of that common knowledge at which the multitude ceases to wonder.

Though not so much a matter of popular knowledge, it is very well known to the naturalist, that in many organisms there is not only a compounding of cells into tissues, and of tissues into organs, and an integration of these into the one greater and more manifest individual; but there is also a more or less perfect joining of several or many such semi-independent individuals into one larger whole. The study of the compound cœlenterates, of worms, or crustaceans, shows that

* Birmingham Natural History and Microscopical Society, Sociological Section, April 1st, 1886.

each more obvious individual is composed of twenty, or fewer, or, it may be, of very many more such less-independent though highly complex individuals, these being more or less perfectly fused into the greater unity. And probably no student of these forms has ever comprehended the structure of an earthworm, without asking himself if the jointed chain of his own backbone does not point to a like doubly-compound origin of his body, in common with those of all other vertebrates. This interesting question of "Morphological Composition" Mr. Spencer has considered in the early part of this volume, and the chapter on the vertebrate skeleton, as well as the appendix relating to the same subject, are practically continuations of that discussion.

To the great English osteologist—Sir Richard Owen—as to the famous Goethe and others, this theory of the serial origin of every vertebrate animal, commended itself as being indicated by the long succession of somewhat similar bones, and sets of bones, which constitute the principal portion of their skeletons. He taught that each member of this worm-like chain of segments is but a modification of one "archetypal" pattern, from which all the many existing varieties have been derived. The classical works of Sir Richard are dominated by this conception; and on this ground Mr. Spencer bases an adverse criticism.* At the same time he pays a willing tribute to the unrivalled knowledge, and great abilities of this most celebrated of osteologists, and acknowledges his own indebtedness both to his writings and lectures.

In opposition to this theory of the multiplex origin of the vertebrates, Mr. Spencer advances his own view, that the jointing of the backbone is not a remnant of an original compound individuality; but that it is due to later changes, which have been produced in the originally continuous cartilaginous notochord, as by ossification it became too rigid to admit of the necessary flexures without jointing.

The statement of this latter theory is prefaced by a discussion of the distribution of the strains in a beam. First, when it is depressed in the ordinary way by a load acting in one direction only; secondly, when the bending force acts alternately in opposite directions. It is shown that by these alternate bendings both the upper and lower parts of the beam are alike subject first to compression and then to tension; while there is a portion along the middle of the beam which is never stretched, but always compressed, let the bending come from which side it may.

* "Principles of Biology," Vol. II., Appendix B.

The case of a fish with its alternate bendings from side to side, as it propels itself through the water, is seen to present a sufficiently parallel case. In the animal's body, as in the beam, a central part is compressed by every movement; and this part is advantageously composed of a comparatively unyielding substance. In older types this appears as the notochord, rigid enough to resist the compressions which occur, while retaining a considerable amount of flexibility. But as size, or activity, or both increase, a more resistent fulcrum is needed; and the deposition of bone becomes gradually manifest, both in passing from lower to higher forms, and also in the course of the embryological development of the latter.

To continue in Mr. Spencer's own words (p. 204): "If, as facts warrant us in supposing, a formation of denser substance occurs at those parts of the notochord where the strain is greatest, it is clear that this formation cannot so go on as to produce a continuous mass; the perpetual flexions must prevent this. If matter that will not yield at each bend is deposited while the bendings are continually taking place, the bendings will maintain certain places of discontinuity in the deposit—places at which the whole of the stretching consequent on each bend will be concentrated. And thus the tendency will be to form segments of hard tissue capable of great resistance to compression, with intervals filled by elastic tissue capable of great resistance to extension—a vertebral column."

And in conclusion we read again (p. 208):—"Of course, the foregoing synthesis is to be taken simply as an adumbration of the process by which the vertebrate structure may have arisen through the continued actions of known agencies. The motive for attempting it has been twofold. Having, as before said, given reasons for concluding that the segments of a vertebrate animal are not homologous in the same sense as those of an annulose animal, or a phænogamic axis, it seemed desirable to do something towards showing how they are otherwise to be accounted for. . . ."

"Leaving out all that is hypothetical, the general argument may be briefly presented thus:—The evolution from the simplest known vertebrate animal, of a powerful and active vertebrate animal, implies the development of a stronger fulcrum. The internal fulcrum cannot be made stronger without becoming more dense. And it cannot become more dense while retaining its lateral flexibility without becoming divided into segments. Further, in conformity with the general principles thus far traced, these segments must be alike in proportion as the forces to which they are exposed are alike, and unlike in proportion as these forces are unlike; and so there necessarily results, that unity in variety by which the vertebral column is from the beginning characterised."

THE FLORA OF LEICESTERSHIRE.*

This year witnesses the publication of another of our County Floras, the Leicestershire Flora having been compiled by Messrs. F. T. Mott, F.R.G.S.; E. F. Cooper, F.L.S.; Thos. Carter, LL.B.; J. E. M. Finch, M.D.; and C. W. Cooper, M.B.

The last Flora of the County was that written by Miss Mary Kirby in 1850. Since that time the Rev. W. H. Coleman worked at the county, and prepared a manuscript flora, which forms the basis of the present book.

The plan of the Flora is as follows:—The first line gives the generic and specific name, with the authority for the name, followed by the census number of the species, and then by the English name. The second line gives its estimated relation to the indigenous Flora of the County, *i.e.*, Native, Denizen, Colonist, Alien, Casual, followed by its known distribution through the twelve botanical districts of the county, the records being divided into three periods—the old, which terminates with the year 1820; the middle, ending with the year 1850; and lastly, the recent period. A capital letter indicates whether the plant is Annual, Biennial, etc., and then the time of flowering is given.

The third line gives its usual habitats, the colour of its flowers, and its estimated frequency.

The following lines give the localities, such synonyms as seem important, and editorial remarks.

The Introduction consists of an account of the Botanical divisions and districts, with the recorded number of the species for each district. A geological map is appended. Then follows the Flora proper. This is printed in clear bold type—very refreshing to eyes weary with glancing over the older Floras—and with few misprints. Notwithstanding the amount of labour spent upon the county, the results, however, appear rather meagre. Leicestershire, like Northamptonshire, is probably too well cultivated to yield many treasures. The

* The Flora of Leicestershire, including the Cryptogams. By F. T. Mott, F.R.G.S.; E. F. Cooper, F.L.S.; Thos. Carter, LL.B.; J. E. M. Finch, M.D.; and C. W. Cooper, M.B. London: Williams and Norgate. Price 15s.

nomenclature followed is that of the "Student's Flora." No attempt has been made to utilise the corrections of that work which have from time to time appeared in the "Journal of Botany." A few matters may be worth alluding to. *R. Drouetii* is placed as a variety of *R. trichophyllus*; it appears worthy specific rank as much as *R. penicillatus*, Dumort., which is given as a species apart from *peltatus*, Fries.

Corydalis claviculata, DC. Here Persoon is the authority.

Barbarea intermedia is given as a variety of *vulgaris*.

B. præcox has specific rank.

Arabis hirsuta, Br. Scopoli has priority over Brown.

Sisymbrium Thaliana, Hook. It should be *Thalianum*, Gay: and *Alyssum calycinum*, Linn., should be of Jacquin. There is only one locality given for *Polygala depressa*, Wender, which would be more correctly written *P. serpyllacea*, Weihe. In the neighbouring county, Northamptonshire, it is much the commoner form. Linnæus wrote *Arenaria trinerva*, not *trinervis*, Smith being accountable for the latter word. The small flowered Lime is called *T. parvifolia*, Linn., but it should be *T. cordata*, Mill. *Sagina apetala*, Linn., should be described as of Arduini.

Radiola linoides, Gmel., should be Roth.

The name of *Geranium perenne*, Huds., is antedated by that of *G. pyrenaicum*, Burm. f. Burman also is the authority for the name *G. pusillum*. Our British *Euonymus* is much more correctly described as *Euonymus vulgaris*, Scop. The Linnæan *europæus* was made up of two species. *Medicago maculata*, Sibth., is antedated by Allione's name of *M. arabica*, if, indeed, it should not stand as of Curtis, who has beautifully figured and described it in the "Flora Londinensis" under the same name, which, by-the-bye, Sibthorp quotes as a synonym. *Trifolium medium* is of Hudson. The old *Lotus major*, Sm., stands as *L. uliginosus*, Schk.; but, as already pointed out in the "Journal of Botany," *L. pilosus*, Beeke, is the proper name.

Vicia angustifolia, Roth., is rather Reichard, and *Lathyrus macrorhizus*, Wimm., should be *L. montanus*, Bernh. *Prunus communis*, Huds., as a name for the Sloe is incorrect, if applied to the restricted plant. Hudson in his second edition so called the combined *insititia* and *spinosa*, and as such it is correctly given in the "Student's Flora;" but when the three plants, *spinosa*, *insititia*, and *domestica*, are treated as separate species, then the Sloe must be called *P. spinosa*, Linn. Ed. I. *Potentilla Comarum*, Nestl., should be *P. palustris*, Scop., Scopoli also being the authority for *Alchemilla arvensis*.

Callitriche verna, L., is described as a species apart from *platycarpa* and *hamulata*, and is said to be common. This may be so if the aggregate species be intended, but if the restricted plant *vernalis*, Kuetz, be meant, then Leicestershire must differ from every other British county. There is no record of the occurrence of *C. obtusangula*, Le Gall, which the writer has seen in the county, and which is probably not uncommon in it.

Bupleurum rotundifolium, L., is described as a chalk plant. This, although undoubtedly more frequent on limestone and chalk, is not as a cornfield weed restricted to such formations. My venerable friend the Rev. M. J. Berkeley found it in Northamptonshire, on limestone, and I believe considered it to have good claims to nativity there. *Apium graveolens* is said to be a sea-side plant, which is quite true, but there are also undoubtedly native localities inland, as in Oxon and Berks.

Apium nodiflorum, L.; Reichb. fil. is the authority, not Linnæus. Koch's variety *repens* is quoted for four localities; but it is extremely improbable that this very rare British plant should occur in all of them. It is more likely to be the var. *ochreatum*.

It is not quite correct to say that Coleman first distinguished *Œnanthe fluviatilis* from *Œ. Phellandrium*. Dillenius described and figured it in Ray's Synopsis, and in the 3rd edition of Withering it was described as var. 2. Coleman was the first botanist to give it a binomial term.

The record of *Galium sylvestre*, Poll., if the plant be correctly identified, is very interesting. *Valerianella olitoria*, Mœnch, was first described as a *Valerianella* by Pollich. Hudson, not Linnæus, is the authority for *Dipsacus sylvestris*. *Symphytum tuberosum*, L., if native, is an interesting record. *Mentha piperita*, Huds., was first described by Linnæus in Ed. I. Spec. Plant. *Calamintha officinalis*, Mœnch, should be *C. montana*, Lamk., as *C. Nepeta*, Clairv., should be *C. parvifolia*, Lamk., and *C. Acinos*, Clairv., *C. arvensis*, Lamk., all these being described in Flor. Franc. by Lamarck previously to the names above quoted. *Prunella* is rather pedantically changed to *Brunella*, but, as Mr. Daydon Jackson points out, *Prunella* is the name we should use.

Lamium intermedium, Fries, is recorded for one locality. Has this plant been verified by competent authority? It is a great extension of the geographical range of the plant.

Specific rank might as well have been given to *Atriplex deltoidea*, Bab., as to a hybrid thistle. *Alnus glutinosa*, L., was described by Linnæus as a *Betula*; Gærtner was the first to call it an *Alnus*.

Is the identity of the Linnæan *Salix incubacea* with Ehrhart's *ambigua* satisfactorily made out?

No notice is taken of Mr. Beeby's *Sparganium*, and Hudson is quoted as the author of the species. The writer has seen *S. ramosum*, Curtis, in the county.

Brown wrote *Eleocharis*, not *Heleocharis*.

Scirpus carinatus, Sm. This, if authentic, is a peculiar extension of the range of the plant.

Alopecurus agrestis, Linn., was originally named *A. myosuroides*, by Hudson in the 1st edit. of "Flora Anglica." *Trisetum flavescens*, Beauv., is rather *T. pratense*, Pers.

Under *Glyceria distans* there is no notice of the var. *obtusa* mentioned in Babington's "Manual" as found in Leicestershire, although more than two pages are occupied with the description of the forms of *Capsella Bursa-pastoris*. The records in the Record Club reports also have not all been worked into the text.

It is stated that the *var. loliacea*, Curt., of *F. pratensis*, Huds., is now considered to be a hybrid. This is the form which has the honour to be included in two places in the edition of the London Catalogue, *i.e.*, under *Festuca pratensis*, where it is described as of Huds., and also under Lolium as a hybrid of that species with Festuca, *i.e.*, *L. festucaceum*, Link. The Leicester Flora asserts that Hudson's *Festuca loliacea* is a shore plant with shorter spikes, which is certainly not the case, for in the first edition of Hudson it is described as occurring in fields near London, and is the hybrid already alluded to. Hudson's *Poa loliacea* is the shore plant, and has been confused in the London Catalogue with the *Festuca*. The proper name for the maritime grass, as a glance at the "Enumeration" of Kunthe will show, is *Festuca rottboelloides*. Since Hudson's time it has been shifted about from *Poa* to *Triticum*, to *Glyceria*, to *Sclerochloa*, and now to *Festuca*. The old genus *Triticum* should be spelled *Agropyron*, not *Agropyrum*.

After the Flowering plants and Ferns come the Cellular Acrogens, the Mosses numbering 179 species. Oxford has 193 species on record.

A large number of Fungi, Lichens, and Algæ are enumerated.

About thirty Phanerogams and Ferns are stated to have become extinct.

In the summary the Flora of Leicestershire is compared with the Flora of Warwick, and with that of the British Isles. It shows that of Flowering plants, and Ferns and their Allies, Warwick has 1,017 species, Hampshire 1,136, and Leicestershire 891, the British Isles having 1,610. The latter number is decidedly underestimated. Warwick and Hants are quoted as if they had no Cellular Acrogens and Thallogens. The statement that Leicester is richer in proportion to its area than Warwick, and very much richer than Hampshire, is rather misleading. As a county it cannot compare favourably with Warwickshire, and is not to be mentioned in the same page as Hampshire, which is peculiarly rich not only in the number of its species but in the rarity of so many of them.

On the whole the compilers of the Flora are to be congratulated upon producing the County Flora; many of the editorial notes are suggestive, and the table of plant distribution through the county is distinctly useful. With respect to the colour of the flowers being given, it may in some instances prove of service; but the statement that the flowers of *Veronica hederæfolia* and *V. arvensis*, are both *pale blue* is not likely to assist in the diagnosis of those species. *Galeopsis speciosa*, Miller, is said to be pink and white, which leads one to suppose the true plant (the *versicolor* of Curtis and the *cannabina* of Pollich) has not been seen in the fresh state by the recorder. Nor does bluish white quite convey to the mind's eye the colour of *Nepeta Cataria*. *Galeopsis Tetrahit*, in Northants, is as frequently found with pink or white flowers as with "yellowish."

G. Claridge Druce.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Annual Meeting is arranged to be held at Malvern on Wednesday and Thursday, the 6th and 7th of July. The meeting will be held on the 6th, and the 7th will be devoted to Excursions in various directions, of which further particulars will be shortly communicated to the Societies in the Union.

Thos. H. Waller, Hon. Sec.

METEOROLOGICAL NOTES.—March, 1887.

The barometer was high at the commencement of the month, reading 30·592 inches on the 2nd, but there was a gradual, though interrupted, diminution of pressure till the 19th, when a rapid fall took place, and on the 23rd the reading was 28·869 inches (the lowest). A rise ensued, and another fall at the close of the month. The mean temperature was above two degrees below the average, both the maxima and minima being lower than usual for the month. The highest readings occurred on the last few days. On the 29th, 59·4° was registered at Loughborough, 58·5° at Henley-in-Arden, 57·4° at Hodsock, 56·9° at Southwell, and 55·3° at Coston Rectory; on the

27th, 56·0° at Binley Vicarage. In the rays of the sun, 121·2° at Hodsock, on the 12th; 109.3° at Loughborough and 104·5° at Southwell, on the 27th. The lowest readings were 16·3° at Coston, 20·0° at Binley Vicarage, on the 13th; 18·8° at Hodsock, 20·7° at Southwell, on the 20th; 21·0° at Henley-in-Arden, on the 13th, 14th, and 19th; and 21·5° at Loughborough, on the 21st. On the grass, 11·3° at Hodsock, on the 18th; 16·3° at Southwell and 16·6° at Loughborough, on the 17th. Rainfall was about half an inch below the average, the amounts measured being 1·61 inches at Coston Rectory, 1·59 inches at Binley Vicarage, 1·54 inches at Henley-in-Arden, 1·44 inches at Southwell, 1·30 inches at Loughborough, and 1·29 inches at Hodsock. The values in twenty-four hours in no case exceeded half an inch. The number of "rainy days" varied from sixteen to twelve. Snow fell at Loughborough on seven days. The customary March gales were rather "conspicuous by their absence" till the end of the month. Sunshine about the average. WM. BERRIDGE, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Wayside Notes.

VISITORS TO THE BRITISH ASSOCIATION MEETING last year will remember the excitement over Mr. E. B. Poulton's five-toed cats, while his far more interesting communication on the gilding of chrysalids did not attract nearly so much attention. This latter series of investigations he has since been continuing, broadening out into experiments on the protective value of colour and markings in insects, especially in Lepidopterous larvæ, in their relations to vertebrata. He has found that conspicuous insects are nearly always refused by birds and lizards, but that they are eaten in extreme hunger; hence the unpleasant taste which conspicuously-coloured insects possess failed as a protection under the circumstances. Further, conspicuous and unpalatable insects, although widely separated, tended to converge in colour and pattern, being thus more easily seen and remembered by their enemies. In the insects protected by resembling their surroundings it was observed that mere size might prevent the attacks of small enemies. Some such insects were unpalatable, but could not be distinguished from the others. In tracing the inedibility through the stages, he found that no inedible imago was edible in the larval stage; the unpleasant taste arises therefore in this latter stage.

AT A RECENT MEETING OF THE PHYSIOLOGICAL SOCIETY OF BERLIN (March 25) Prof. Falk gave an account of some recent investigations into the influence of extremes of temperature upon the colour of the blood. In persons either burnt or frozen to death the *post mortem* patches present a strikingly bright red colour. He has found that temperatures of 0° C. (freezing point) and below lead to the colour of the blood becoming bright red by causing the oxygen of the air to be more readily fixed and more stably retained by the blood corpuscles than is the case at ordinary temperatures. If, however, the blood has stood exposed to the air until putrefactive changes have set in, in this case the action of cold no longer makes the blood brighter in colour. Other experiments have shown that in animals killed by low temperatures the blood is bright red, not only in the peripheral parts but also in the heart and great vessels. Also in human beings frozen to death the blood even in the heart is sometimes observed to be bright red, although in most cases only the blood in the peripheral parts presents this appearance; probably death has ensued from freezing only in the first of these two appearances. These researches may not improbably have some future bearing in medical jurisprudence.

BOTANISTS EVERYWHERE will watch with some interest the progress of an experiment upon which the Corporation of the city of Glasgow has just entered in assuming control of the grand botanical gardens at Kelvinside. These gardens, which were started in 1816, were the property of the shareholders in the Royal Botanic Institution, by whom they have been maintained, with the assistance of occasional grants from different sources for special considerations. They include twenty-three acres of ground, and have a collection of glass structures second perhaps only to Kew. The society has been, however, financially overweighted by them for many years, and now, in liquidation of a debt to the Corporation of £46,000, has handed the property over without any reserve or conditions to the Corporation. Fortunately the city of Glasgow is governed by a body of eminent public spirit, far removed from that mercantile littleness which is the bane of many corporations, and there seems little doubt that the Corporation will preserve in its entirety their new property. A curious difficulty has, however, cropped up, in that the gardens are situated in a suburb which is outside the municipal boundary, and a bill to annex which, though practically unopposed, has been thrown out by a committee of the House of Lords. It is unlikely that this will affect the result, especially bearing in mind that a botanical garden is an essential appendage to a university, and the whole weight of the university influence of Glasgow is thrown into the scale in favour of retention.

STILL ANOTHER "NATURALIST," and this time connected in name as well as in fact with a religious body. The "Wesley Naturalist," with the Rev. W. H. Dallinger, F.R.S., Rev. W. Spiers, M.A., and Rev. H. Friend, F.L.S., as editors, has been started as the monthly organ of the Wesley Scientific Society. In his editorial Dr. Dallinger tells us that a study of Nature may, under certain circumstances, become a moral obligation. Perhaps we should ourselves be inclined to go a step further and mention that the study of Nature is, under all circumstances, excepting the absence of the various sensory organs, a moral obligation. At least, that is our reading of the parable of the talents.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL MEETING, April 5th. The president, Prof. W. Hillhouse, M.A., in the chair. Mr. Walliker sent for exhibition, *Oxytheria stictica*, Linn., a beetle found amongst flowers from France. Mr. W. B. Grove, B.A., exhibited for Mr. Hanson a number of specimens, prepared by Mr. English's process for preservation of fungi, by powdered plaster of Paris, dry, and some preservative solution washed over; also, on behalf of Mr. Westwood, a double orange, one growing within the other. Mr. W. H. Wilkinson then read a paper on "Colour Re-action: its use to the microscopist and biologist." After pointing out the great advantages to the biologist, by the use of colour re-action, in studying the continuation of a given tissue, or tracing the course of a vascular bundle, or in revealing the structure of otherwise too transparent tissue, he illustrated the effects by placing under a series of microscopes specimens, plain and stained in several different ways. He then referred to the value of colour re-action in lichenology, both in showing the structure and in assisting in classification, and then showed the effect by causing three lichens to become three different colours, viz., yellow, red, and purple, by touching them with the chemical reagents. He further illustrated the paper by carefully prepared and coloured drawings.—BIOLOGICAL SECTION, April 15. Mr. R. W. Chase in the chair. A paper was read by Mr. A. Bernard Badger, of New College, Oxford, on "Phosphorescence in the Animal Kingdom." illustrated by an extensive series of coloured slides which were exhibited in the lantern by Mr. C. Pumphrey. The display of phosphorescent light in living animals was described and illustrated, from the minute marine infusoria (*Noctiluca*) that cause the luminous appearance of the surface of the sea, the sea-pens (*Pennatula*), and many other marine animals, to the glow-worms and fire-flies of this country and tropical climates. The emission of the light appeared to be the result in all cases of some external excitement or irritation; and it was considered to be produced either by a slow oxidation or combustion of some fatty or oily matter, or some conversion of nervous energy into light energy. The latter hypothesis appeared very questionable; but the former one was supported to a remarkable extent by the discovery from microscopical examination in the majority of cases of special phosphorescent organs containing stores of minute fatty or oil globules.—GEOLOGICAL SECTION MEETING, April 19. Mr. T. H. Waller, B.A., B.Sc., in the chair. Exhibition of specimens: Mr. Bolton, the plasmodium of a myxomycete in active motion, in form, like a very large amœba from three to four inches long, from near Sutton; Mr. W. B. Grove, the three earliest leaf fungi of Spring, viz., *Œcidium ficariæ*, *Uromyces ficariæ* (both, in some instances, on the same leaf), and *Puccinia adoxæ*, all from Water Orton, gathered on Easter Tuesday; on behalf of Mr. Iliff, *Daldinia concentrica*, from Aldwinckle, Northants. Mr. John H. Lloyd, M.A., exhibited specimens of gold ore from Australia and New Zealand. Mr. Waller, B.A., B.Sc., read a note on the occurrence of gold at Mount Morgan, near Rockhampton, Queensland. Votes of thanks were accorded to both the above gentlemen for their interesting specimens and notes thereon. The secretary, on behalf of Mr. W. R. Hughes, read a paper (by Mr. A. H. Cocks), on "Chillingham Wild Cattle;" the paper was illustrated by photographs. The secretary was directed to convey to Mr. Cocks the thanks of the section for his note and illustrations.—SOCIOLOGICAL SECTION, April 26th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. J. H. Salter, of Queen's College, was unanimously elected a member of the Society, and a paper was read by Mr. Hughes on the fifth and sixth chapters of Mr. Herbert Spencer's "Data of Ethics," treating of the physical and biological aspects of conduct. At supplementary meetings on April 7th and 21st, papers were read by Miss Byett and Mr. F. J. Cullis, F.G.S., on the second portion of Mr. Spencer's "Factors of Organic Evolution."

CARADOC FIELD CLUB.—The Annual Meeting was held at Shrewsbury, on Tuesday, March 29. In the unavoidable absence of the president the chair was occupied by T. P. Blunt, Esq., one of the vice-presidents. The minutes of the last annual meeting having been confirmed and the treasurer's accounts approved, the Rev. J. D. La Touche was re-elected president, and G. R. Jebb. Esq., was elected a vice-president, in place of W. E. Beckwith, Esq., who retired by rotation. The Rev. P. B. Brodie, president of the Warwickshire Field Club, was also elected an honorary member. Field meetings for the ensuing season were fixed as follows: Larden Ditches (Wenlock Edge), May 27; Malvern (long meeting), at the date of the meeting there of the Midland Union of Natural History and Scientific Societies; The Breidden, August 10; and Pulverbach (for Cryptogamic Botany), September 23.

Fig 1. Jet from 10 Lead Discs.

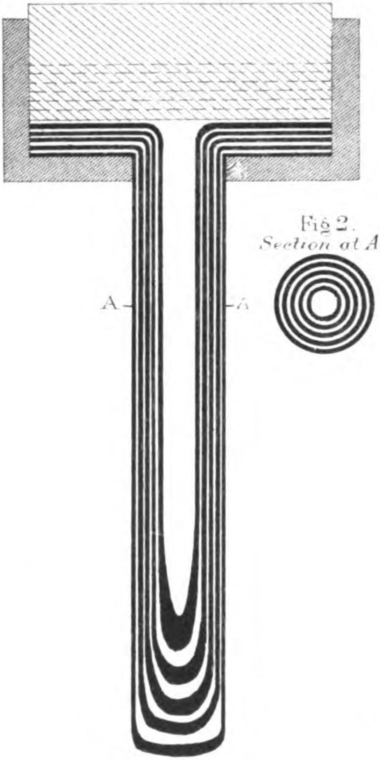

Fig 2.
Section at AA.

Fig 3. Jet from 4 Lead Discs.

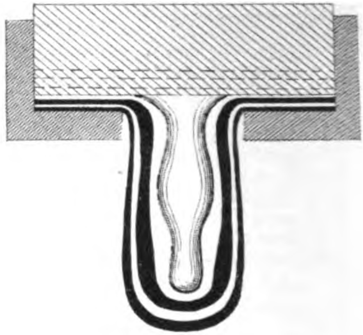

Fig 4. Jet from Shallow Water.

Fig 5. Compression of 20 Lead Discs.

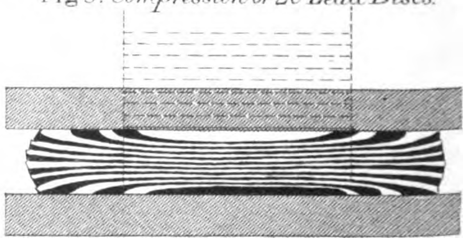

Fig 6. Double Jet.

Fig 7.

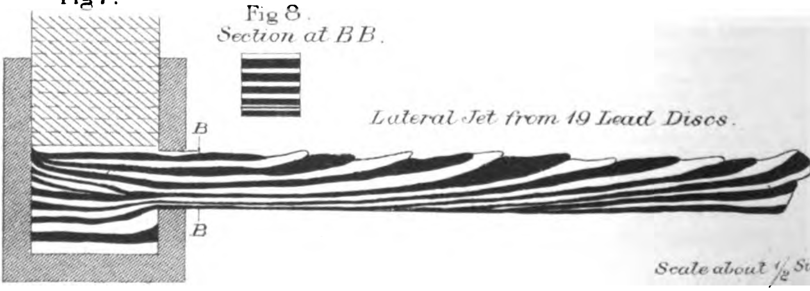

Fig 8.
Section at BB.

Lateral Jet from 19 Lead Discs.

Scale about 1/2 Size

W. P. Marshall del.

FLOW OF SOLIDS.

Herald Press Lith.

ON TRESCA'S REMARKABLE INVESTIGATIONS INTO THE FLOW OF SOLIDS UNDER GREAT PRESSURES.*

BY W. P. MARSHALL, M.I.C.E.

The application of pressure to solid bodies is ordinarily looked upon as producing simply consolidation in the body under pressure, making it more dense and hard; but this is only true within the limits of ordinary pressures, and when sufficiently high pressures are applied such bodies become plastic and yielding, and with an extremely high pressure the harder metals and even steel itself can be squeezed into new forms, and made to behave similarly to a lump of clay. We are indebted for the knowledge of these facts to the remarkable investigations of the late M. Tresca, the talented director of the "Conservatoire des Arts et Métiers," at Paris, who made a long series of experiments in many very ingenious forms for the investigation of this subject, and carried out important practical applications of the results in improvements in the mode of making sound iron forgings.

The first series of these experiments was made upon lead, as the softest and most ductile of the metals; the lead to be compressed was placed in a circular metal cylinder, shown in Fig. 1, Plate IV., which had a round hole in the centre of the bottom, and a circular ram, fitting the cylinder closely, was then gradually forced down upon the lead in the cylinder, by placing the whole in a hydraulic press, exerting a very great pressure uniformly over the upper surface of the lead. The lead being rigidly supported by the sides and bottom of the cylinder everywhere excepting opposite the hole in the bottom, that hole was the only point in which it could yield to the pressure; and it was found that as the pressure was increased the lead began to bulge outwards at the hole, and presently protruded through the hole, forming ultimately a continuous cylinder the same diameter as the hole, and several times longer than the original mass of lead in the cylinder. In fact, the metal was made to *flow* through the hole by the application of a sufficient amount of pressure, forming a solid jet, just as a soft body such as clay would flow through the hole under a moderate pressure, or a liquid would flow through under the pressure of gravity alone. An extreme case that was tried was a set of discs

* Transactions of the Birmingham Natural History and Microscopical Society, June 24th, 1884.

2in. diameter that were forced through a hole only ⅛in. diameter, which made a continuous jet of as much as 23ft. length, consisting entirely of concentric tubes.

In order to examine the process of the flow amongst the different particles of the lead, the ingenious plan was devised of making the original mass of lead in a series of thin flat discs, all of the same dimensions (like a pile of penny pieces), their touching surfaces being dusted with chalk to prevent the discs adhering together when under the severe pressure of the experiment, so that they could be taken apart again for examination at the close. The result was found to be that each of the original discs preserved its separate individuality throughout the severe ordeal of forming the long jet; and the jet was found to be composed of a series of successive layers or coats, each one fitting over the following one like a glove over a finger, and the whole showing a beautifully symmetrical figure when cut open longitudinally along the centre line of the jet. This is illustrated in Fig. 1; the successive layers being shown alternately black and white; and in Fig. 2 is shown a transverse section of the jet taken at the point A A in Fig. 1.

When this process comes to be examined, it is seen that no other result could indeed have occurred, because a uniform force applied simultaneously to all the discs must produce a uniform result in all of them, and they have really no alternative but to follow one another regularly through the hole, as the only escape possible from the overpowering force that is urging them forward.

Another form in which the experiment was tried was by having a *square hole* in the *side* of the pressure cylinder at a little distance from the bottom, as shown in Fig. 7; instead of a *round* hole in the centre of the *bottom* of the cylinder. The result found was that instead of a cylindrical jet being formed as before, consisting of a series of concentric envelopes, a square lateral jet was formed, composed of a series of flat horizontal layers of different lengths, overlapping one another; the discs directly opposite the orifice being caused to flow out at once in a continuous flat ribbon, and the discs that were originally above the orifice then following on successively in the same course, as they became one after another brought down to the level of the orifice by the gradual compression of the whole mass. In Fig. 8 is shown a transverse section of the jet taken close to the orifice at the point B B in Fig. 7.

An interesting point to notice is the behaviour of the different discs according to the position in which they happened to be situated as regards the lateral orifice at the time that the pressure was first brought to bear upon them. The effect of the pressure showed most at the bottom edge of the orifice, and the several discs that were originally situated between the top and bottom of the orifice became at last reduced down to very thin layers at the bottom edge of the orifice, by the crowding of the upper discs as they were successively brought down and caused to flow out at the orifice. This action taking place only at the front, or the point of escape, those discs that are so excessively reduced there in thickness retain much more of their original thickness at the back of the cylinder, whilst on the contrary the uppermost discs have their back edges left thinner than at the front, by the compressing ram causing the top surface of the last disc to be kept level throughout.

Another point of interest is that although the pressure at the bottom of the cylinder is uniform over the whole surface of the lowest discs that are below the level of the orifice, the effect produced upon them is modified by the circumstance of the discs above them being in a condition of flow towards the orifice, and the front edges of the lower discs are deflected upwards towards the general line of flow, in consequence of the pressure lessening gradually towards the point of escape.

A remarkable modification of the result obtained in the first experiment, Fig. 1, with the central orifice in the bottom of the cylinder, was shown when the total supply of lead discs was reduced in number, as in Fig. 3, so far that the quantity of material present under compression in the cylinder was not sufficient to fill up the jet solid. The singular result was then obtained of a jet that neither filled up the orifice close on the outside, nor was solid in the inside; and in the flow of the lead through the orifice there was obtained a central hollow and a *contracted jet* on the outside. This bears a striking analogy to the well-known *contracted vein* that occurs when a liquid flows out through a similar central aperture, as in Fig. 4; and the flow of the jet of lead has to be looked upon as differing from the flow of a jet of liquid only in the degree of pressure that is required to produce this flow, for which gravity is sufficient in the case of a liquid, but a very high pressure is required in the case of the metal.

From the circumstance of the metal jet being composed of a series of successive concentric layers, a valuable opportunity is afforded by the separate examination of these layers for ascertaining the relative motions and lines of flow of the different particles composing the jet, and of studying the action of the forces controlling their flow and their mutual interferences with one another; such an examination being impracticable in the case of a liquid jet. It will be noticed that all the particles of the material under pressure have a tendency to move towards the orifice, for the purpose of yielding to the pressure, but only those particles that are actually opposite the orifice are able to flow directly outwards, whilst the others beyond that region and surrounding the orifice have first to move laterally in a radial direction towards the orifice, before they can get a chance of escaping. These lateral movements of the particles interfere with one another, and those from opposite sides of the orifice are directly opposed to each other, whilst the particles from higher levels move in oblique funnel-shaped directions towards the centre of the orifice. The result is that a general oblique direction is given to the particles in passing through the opening, forming a funnel-shaped centre to the hollow jet in the case where the total supply of material was not sufficient for maintaining a solid jet. This is exactly what occurs, as is constantly seen, in the case of a liquid flowing through a centre orifice (such as out of the plug opening at the bottom of a basin); when the depth of the liquid gets so low that the head or pressure is not sufficient to maintain a solid jet, a funnel-shaped hollow gets formed in the centre, as in Fig. 4, which increases in diameter as the depth and pressure become less. The liquid jet is also contracted round the outside, in a similar manner to the metal jet, and it cannot be got to fill up the entire diameter of the orifice through which it flows.

This is a very interesting point, showing that a *loss of pressure* takes place, whenever the matter is put in motion and caused to flow; and this loss of pressure may be carried so far under special circumstances of deficiency in supply of material for following up the flow, as to actually become *negative* pressure and produce a hollow.

When the orifice in the lead jet experiment was *not central*, but eccentric, there was found to be a circular displacement added that gave a torsional movement to the jet; uniform equilibrium being disturbed by the preponderance of metal that had to flow towards the jet on the thick side. An analogous effect in water jets is shown by the spiral movement that is set up in water flowing out of an orifice in the bottom of a vessel, which has the central effect of its position upset by some lateral disturbance of the surface of the liquid.

A *double orifice* in the bottom, namely, two orifices of different sizes side by side, gave very interesting results; the smaller orifice yielded a shorter jet, on account of the greater freedom of flow through the larger orifice, and the concentric layers of each jet were distorted towards the side facing the other jet, and drawn towards that side, as shown in the sections of the two jets in Fig. 6.

Further, a centre large orifice was tried with *six smaller orifices* arranged round the centre one in the position of the six angles of a hexagon; and the result was that instead of circular central jet, one of hexagonal character was obtained, having hollow grooved sides with projecting rounded angles towards each of the surrounding six holes, showing the disturbing effect of the simultaneous flow of material from the centre of the mass towards each of those six holes.

The experiments that have been described were all made in *closed* cylinders, and the compressed material had consequently no means of escape except through the special orifice provided; and experiments were also tried in an *open* unconfined space, with a similar pile of lead discs compressed between two flat surfaces, as shown in Fig. 5, leaving the edges of the disc free to expand laterally. The middle discs of the whole pile flowed outwards the most freely, and became consequently the thinnest at their centre; and the extreme top and bottom discs, being retarded in their flow by the friction against the compressing surfaces over which they had to flow, became curved and distorted in their form by the pressure of the other discs, this distortion gradually diminishing symmetrically towards the middle discs.

The above experiments were then repeated with harder metals than lead, and it was found that with all of these, and even with steel itself, the same law of flowing under pressure applied, provided that the pressure was sufficiently increased in proportion to their hardness.

I had the opportunity of witnessing some of Tresca's experiments that have been described; and the drawings from which the Figs. in Plate IV. have been copied I made direct from the several experimental pieces described; otherwise I should have hesitated to give full credence to the extraordinary results obtained.

The special practical application that was made by Tresca of these results was in improvements in the modes of forging and working iron; by so arranging the dies and tools that the metal was enabled to flow in a continuous solid stream during the process of changing its form under the hammer or press, so as to produce thoroughly sound work. It was known before from general experience that unsound forgings are liable to be made from want of care and skill on the part of the workmen, and these defects sometimes proved very inconvenient and uncertain, and involving a dangerous risk of subsequent breakage; but the matter was not properly understood till Tresca showed the real action that produced this unsoundness, and consequently the means of preventing its occurrence. The force of the blows in forging iron (that is, both the weight and the velocity of the hammer) must be proportionate to the mass operated upon; if this force is too light, the exterior portion gets drawn more than the core, leaving the ends of the forging concave, and causing unsound places or even hollows in the heart of the forging, such as a hole or "piping" extending many inches up the centre of an axle from each end. On the other hand, if the blows are too heavy, the opposite effect is produced, and the central portion is elongated more than the exterior; the unsupported material in the centre being squeezed out at the ends in a convex form, whilst the surface is held back by the hold of the hammer and anvil faces, as in the experiments of discs compressed without supporting walls, shown in Fig. 8.

It will be seen that these valuable experiments have an important bearing also upon other investigations, such as the geological changes that may have taken place in the underlying portions of the earth's crust, from the enormous pressure of the mass above them, or the lateral thrust produced by the contraction of the earth's crust—a pressure so enormous that it may possibly have been sufficient, if only a few miles, depth of superincumbent rock is considered, to reduce to a plastic and flowing state even the hardest of the rocks of which the earth's crust is composed; and the ingeniously varied forms in which Tresca's experiments were carried out may assist in understanding the phenomena that are observed in some of the remarkable contortions of the strata forming the earth's surface.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENTIAL ADDRESS.

BY R. W. CHASE.

(Continued from page 120).

CHANGES IN LOCAL FAUNAS.

A strong reason for the formation of Natural History Museums without delay is that in the course of a few years many of the forms of animal life which are now common will either become very rare or quite extinct in some districts, making the obtaining of specimens almost impossible. This is not to be wondered at when we consider the invasion of bricks and mortar which has been carried on for so many years, obliterating and absorbing so large an extent of our rural tracts that, instead of country lanes and hedgerows resounding with the song of birds and hum of insect life, we now have paved streets and rows of houses, still resonant, but with a music of a totally different kind—a change, in many respects, not for the better. Again, the improved communication between place and place consequent upon the enormous growth of our railway system, far and away greater than the loftiest conceptions our forefathers had the slightest idea of, has been the means of opening up many quiet haunts, dear to the heart of mammal and bird, but also delightful to the overworked man of science or artisan of our towns, which previously for generations were left unmolested and uncared for; but this intrusion has been the cause of driving the original denizens further afield to regions still more remote. From various sources, such as household books, bills of fare of ancient banquets, and the like antiquarian records of a bygone age, we find that many birds, now extremely rare, or conspicuous by their absence, were formerly common.

I purpose, therefore, making a few remarks as to the probable causes of the decrease of many of our native birds. That such is the case, I think no one will dispute; species that formerly were abundant, and bred regularly in suitable localities, are now only met with as occasional stragglers to our shores. It is worthy of remark that those birds whose habitat is swampy marsh lands or dense reed beds are the least adapted, or at all events give one that impression, to accommodate themselves to any altered conditions of life; consequent upon the draining of the fens, many were driven from this country and betook themselves to the Dutch marshes, where they still remain. It is highly probable that our indigenous birds were always being supplemented more or less from the opposite coast, therefore it was natural for them to leave our uncongenial land for that better suited to their requirements, possessing, as many of them would, an inherent predisposition to return hither. No one who is conversant with the physical geography of our Eastern counties could help noticing the alteration that is even now going on in still further reducing the area of marsh and fen. Two causes are at work to effect this: the increase of pumping mills, and the "existence of the fittest" in the botanical arena—first reed, then bullrush, afterwards the common rush, and eventually grass, which is used for herbage, and, I am told, possesses extraordinary feeding qualities. The different style of farming adopted of late years has had a material influence upon many species of birds. The transformation of arable land into permanent pasture has been carried out to a very large extent in some parts, in the anticipation and hope that producing meat and dairy products will prove more profitable to the agriculturist than growing corn—hence the granivorous genera have been compelled to partially migrate to obtain necessary food, their place being occupied by soft-billed or insectivorous species; hence we find the sudden and abnormal increase of a certain species in one locality and decrease in another. I have often noticed that the country seems mapped out into districts or divisions, and that each has its complement of birds allotted to it. In case one of these divisions become depopulated from some cause or another, the void is immediately filled by some adjacent species, consequently we find the geographical range of a particular species often altered without any very definite reason, unless the hypothesis I have just given solves the problem. Again, the undue felling of timber throughout the country has a very great tendency to prevent the increase of bird life, as destroying means of shelter; also the laying or grubbing up of hedgerows. A good old-fashioned hedge of hazel or thorn, often yards through, with thick bottom of undergrowth—sacred spots to a sportsman—are objects of the past on a scientifically worked farm; but such afforded excellent cover for birds to construct their nests in, and gave every chance of successfully rearing their brood without discovery by their various enemies. The reclaiming and enclosing of common, or so called waste land, has also helped to bring about this decrease. The natural enemies of birds are strong and numerous. I have seen them enumerated somewhat as follows:—Their own brethren, polecats, stoats, rats, cats, and hooded crows, to say nothing about boys, collectors, and the *genus homo* generally. Undoubtedly the vicissitudes of bird life are many, and at frequent periods the struggle for existence is both sharp and severe. The elements are important factors to be considered and taken into account whencalculating destruction of life, as severe cold, continued frost, wind, or excessive wet, will deal death wholesale, especially if such calamitous conditions occur during the breeding season or migration. Last spring I had two instances brought most vividly under my notice. The first was the flooding of Rockcliffe Marsh, near Carlisle, where Skylarks, Meadow Pipits, and Dunlins breed in very considerable numbers. I saw dozens of nests, many on the point of hatching, that had been covered with water and totally destroyed. The result was that many birds forsook the place, and only very few young were reared by those who nested the second time. The other instance was the destruction of Swallows, Martins, and Sandmartins by a gale of wind in April last, which killed thousands, and was pretty general throughout the country, as reports all testified to the same result; in many instances dashing them against walls and buildings. An eye-witness informed me that at the foot of an engine-house wall at one of the reservoirs you might have filled a bushel measure with these dead birds. There is little doubt that, owing to the cold weather, food was scarce. These Hirundines were therefore weak, and unable to cope with a gale of this magnitude; some I examined were in a most emaciated condition, and had every appearance of being starved.

Enormous loss of life occurs during migration from various causes; the lanterns of lighthouses claim their tale of victims, many being attracted by the light, and striking the glass, kill themselves. Telegraph wires are often the means of destruction, and very effectually they do the work; I have seen birds, some of large size, nearly cut in two by a wire. The improvement in guns has had a material effect in reducing the number of birds, especially since the introduction of breech-loaders; but this case would apply chiefly to the slaughter committed at our marine breeding stations, where such birds as the Guillemot and Razor Bill abound, who in ages past were practically unmolested by man, and simply had to provide for the larders of a few Peregrine Falcons that might occupy the same cliff. I think it can safely be said that in Great Britain at all events, for many years past, circumstances hostile to the increase of birds have greatly increased. Not only are birds at the present time compelled to combat against those evils that naturally exist, and always have co-existed with themselves, but they have also the inventions and scientific adjuncts of this civilized age to contend with, which leaves the bird beaten in every encounter and at all points. To remedy this state of affairs, several Acts of Parliament have been passed at various times for the protection of birds, but before touching upon them I should like to refer to one or two species whose extermination in this country can be traced directly to the actions of man and to him alone. Notably, the Great Auk comes first, which became extinct about 1845, and the last British specimen, according to Yarrell's "British Birds," Vol. iv., p. 64, "was taken alive at the mouth of Waterford Harbour in May, 1834, and is now preserved in the museum of Trinity College, Dublin." This bird was never common on our coasts, but would possibly have continued to exist until the present, if not interfered with by man, because its large size and breeding stations inaccessible to any animal likely to prey upon it, combined with its powers of diving and swimming, gave it a good chance of holding its place in our avi fauna; but on the other hand, laying only one egg, the reproduction of the species was consequently slow, and could not long withstand any serious slaughter or destruction of eggs, without a diminution in numbers and eventual extermination, which has been accomplished. The final extinction of the indigenous race the Great Bustard is not a mere matter of history, for men are now living who well recollect seeing flocks of these handsome birds frequenting the sandy waters of Norfolk and Suffolk; the date when the last of the Norfolk birds was killed is given by Stevenson in his excellent work, the "Birds of Norfolk," as 1838, but it is likely that one or two continued to exist in that county until 1845. Anyone interested in this species cannot do better than read the article I have referred to, as the details of their being done to death by swivel guns and others placed like artillery in position to sweep a certain spot, where tempting food was laid, is fully set forth by the author in a most circumstantial and comprehensive manner; a pattern to all ornithologists who attempt to write a biographical account of local bird life.

The decrease in "Birds of Prey" is certainly attributable to man, as, on account of game preservation, any of the Hawk tribe are lucky if they rear their young without being detected by the vigilant eye of a keeper, who would soon make short work of what he would term "vermin." It is rather curious that in olden times laws were made to protect the different Falcons adapted for "Hawking," a pastime for kings and nobles, whereas at the present time the order is reversed, and game laws are enforced to protect what formerly fed the Falcons.

The Protection of Wild Birds.

Owing to the decrease of Wild Fowl, which constituted an important article of food and of some commercial value, an Act for the Protection of certain Wild Birds during the breeding was passed in 1872, fixing as close time from March 15th to August 1st for the species included in the schedule attached. The compilation of this list is a masterpiece, and certainly gives one the idea that lots were drawn whether a name should be included or not. This Act proved of little use, so an Act for the Preservation of Wild Fowl was passed in 1876, the schedule of which, I think, was framed from an edible point of view, as few species were included that were not of some gastronomic value. This Act, as well as that of 1872, and the Sea Birds Act of 1869, were repealed in 1880 by an Act entitled "The Wild Birds Protection Act," and I cannot do better than quote the brief summary from the "Zoologist," 1880, p. 487: "A close time is provided *for all birds* between the 1st of March and the 1st of August. Those species which are mentioned in the schedule may not be killed during the close time, under a penalty not exceeding £1; those not mentioned in the schedule may not be killed under a penalty (for the second offence) of a sum not exceeding 5s. and costs. In the case of the latter class the Act does not apply to the owner or occupier of the land on which any of these birds may be killed, or to any person authorized by owner or occupier. In other words, if any owner or occupier deems it desirable to keep down Sparrows, Hawks, Jays, Hooded Crows, Wood Pigeons, or any other bird which he may consider destructive he may destroy them on his own land, or authorize some one else to do so." That this Act has done an infinite amount of good in affording protection to many birds during the breeding season is no doubt the case, as the increased number of Blackbirds and Thrushes in the suburbs of the town will testify, for before the passing of the Act, any one might see numbers of nests containing young exposed for sale during the season in the Market Hall—a sale now stopped. It is a very debatable question whether it is desirable to allow such genera as Gulls, Gannets, Auks, Terns, &c., to increase and multiply to the extent permitted by nature, for while many fishermen affirm they are even now too numerous, and that the destruction of fish by such birds seriously affects their industry, others advocate the birds being protected, as they render good service in pointing out the shoals of fish, and also devour much fry of those species who would in their turn prey upon the herring; they also give notice by their cries when a boat approaches the rock, which at once tells the crew to sheer off.

The amount of good done by insectivorous birds, which form the most numerous class, to vegetation in keeping within due bounds insect life is incalculable, and, as Brehm put it, "to permit the insect world to make undue headway would amount to destroying Nature, for, in that case, the plant world on which her existence depends would cease to exist. The whole remaining creation combined would not be able to arrest the destruction caused by insect life so effectually as birds."

The Protection of Birds' Eggs.

That the decreasing number of birds is an important subject is duly testified by the attention that has been bestowed upon it by various Legislatures, not in this country only, but in our colonies; also in America and Germany. The protection that was intended to be provided by the Act of 1880 is minimised by the omission of a most important and essential feature—the protection of the eggs. I venture to affirm that it is from the taking of eggs that birds are more likely to be reduced than by the adults being shot—the gun tax was the best bird protection act ever passed and ought to be more rigidly enforced—as it stands to reason that a visitor to a breeding station of Gulls, for example, could, if so disposed, easily take 100 eggs. It is argued they will lay again, and that in the neighbourhood of these breeding stations the eggs are used as an article of food, and that the gathering of them finds work for several men. No doubt the birds will lay again after being robbed, to have the operation repeated the second time, and when any young are afterwards hatched the period is too short for them to be able to fly before the close time expires, when indiscriminate and brutal slaughter takes place, answering no legitimate purpose whatever.

The Bearded Tit, of quite different habits to the gulls, is fast becoming exterminated, entirely through the undue taking of the eggs. One marshman will take in the restricted area this species now occupies in Norfolk 200 eggs in one season, whereas I am certain from my own experience he would not be able to shoot 25 in a twelvemonth; besides, it would not pay him to give so much time in obtaining them, as no bird is more difficult to put up from the thick reed beds to obtain a shot, and the chances are you cannot find the bird when down.

The importance of taking eggs as a means of reducing the numerical strength of a species, relative to the time that species would cease to exist, is obvious, because, supposing a bird lays 100 eggs during its natural life, producing on an average five at a clutch, and if two broods were reared annually, the producing powers of the bird would last ten years, but if compelled to lay three clutches per annum instead of two, by the taking of the eggs her period of reproduction would be reduced to about seven years; therefore, the time of the extinction of a species simply resolves itself into a sum of the rule of three. It is well known that as often as eggs are taken the parent will continue laying until her strength is exhausted, so strong is her maternal desire and innate impulse to perpetuate her race.

Those species which benefit man by the destruction of insect life and are of some importance in the economy of Nature mostly migrate to our shores for the purpose of rearing their progeny, and as young birds should be hatched simultaneously with the supply of caterpillars and other larvæ to sustain them, it is obvious if the first lots of eggs are taken the time of hatching is delayed—if it takes place at all—and the outcome is that insect life obtains the chance of multiplying abnormally. Moreover, it is absolutely necessary that the young should be hatched at the appointed time to enable them to get full grown and sufficiently robust to withstand the perils of a long sea flight to their winter quarters. The like remarks, of course, apply to those species that winter here, and it is quite as desirable that they should have protection extended to them in their far-off homes likewise, to enable a strong contingent to migrate here, after their breeding season is over.

I fear that to an unusual number of eggs being taken in Norway and Sweden we must attribute the diminished numbers of Fieldfares and Redwings of late years. Of course, in a thinly-populated country birds have a much better opportunity of escaping molestation than in one so densely crowded as ours, but the increased facilities for travel, and the "Briton's" propensity for bringing back some trophy of his excursion, has somewhat equalised the apparent advantages formerly enjoyed in those countries where Nature reigned supreme.

I think I have clearly demonstrated that it is important that eggs should have the same protection afforded them as the birds themselves; an egg to appearance is dead, but it contains the elements of a future life, which lies dormant until stimulated to action and growth by the application of the proper degree of warmth, which quickly produces evidence of existing life; and, if I may be allowed such an expression, I might say eggs are simply birds held in suspense.

If I have made out a case I ask those members who may have the leisure and opportunity to take notes during the coming season, and judge whether I am right in advocating the protection of eggs; if so, then what more fitting duty could a Natural History Society perform than in urging upon those who are in a position to further such an alteration in the law as would tend to save from final extermination, or at all events lighten considerably the present struggle for existence. Without some such help many of those species will become fewer and fewer which now assist so materially in adding to the charm and delight of forest, moor, hedgerow, and field, to say nothing of how bird life contributes to make the desolate sea shore interesting.

Such restriction would in no way interfere with the student of Ornithology if our Government would follow the example of Canada, and grant licenses to those who are *bona fide* Naturalists and could produce credentials that they were engaged in making a collection for the purpose of study or science. Ornithology is the only branch of Natural History that is hampered by legal restriction of any kind. If an International Conference of Naturalists could be arranged to take into consideration the whole question of bird protection, its deliberations would be of immense assistance in arriving at some definite and uniform action, although the various issues to be discussed cover so large an area; still, whatever decision might be arrived at, it could not be otherwise than reciprocal to those who took part therein, and prove beneficial to them individually.

I regret that I have not been able to bring before your notice an address more in accord with your tastes, but the subject I have introduced is not necessarily confined to ornithologists, but should be of some interest to every lover of Nature. Thanking you for the patience with which you have listened to me, I must now leave the solution of the problems of a Natural History Museum and the Protection of Eggs to the future.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 124.)

SECOND PERIOD, 1751 TO 1800.

Stokes in Withering. Edit. 2., Vols. 1 and 2, 1787.

N.B.—The explanatory remarks in italics are by the present writer.

Myosurus minimus, p. 336. Malvern Chace. Ballard.

Ranunculus aquatilis, δ, 578. In shoals in the Severn. St.

This is the plant now known as R. fluitans, L.

Ranunculus Lingua, 572. Bogs on Malvern Chace. Ballard.

R. parviflorus, 577. Malvern Hill. Ballard. Worcester. St.

Helleborus viridis, 581. Orchard near Mr. Ballard's, Robinson's End, Malvern Chace. Mr. Welles. Ballard.

Aquilegia vulgaris, 562. Souston's Rock, near Shelsley. Ballard. St.

Nymphæa lutea, 554. River Avon at Pershore. Ballard. Mr. Waldron Hill.

* **Fumaria claviculata**, 753. Rough stony places above Great Malvern Tower. Nash. Ballard.

Lepidium ruderale, 672. Rubbish on the side of the Severn above Worcester. St.

"Tower" must be a misprint for "Town." See the record in Nash.

Cardamine impatiens, 685. On loose earth thrown up from a quarry above Lench Ford, nearly opposite Shrawley, and in Cliffy Wood near Hanley. St.

* **Cardamine amara**, 689. About Worcester. St.

Sisymbrium sylvestre, 691. On the banks of the Severn near Worcester. St.

S. amphibium, 692. Side of the Severn near Worcester. St.

Sinapis nigra, 714. Banks of the Severn. St.

Reseda Luteola, 492. About the ruins of Dudley Castle. With.

Viola tricolor, β. 957. Blossoms blue, blue and yellow or blue and white. About Stourbridge. St.

Drosera rotundifolia, 331. Malvern Chace on the side of the rivulet flowing from the Spa. Ballard.

Saponaria officinalis, 438. Hedges near Hanley. Ballard. St.

* **Dianthus Armeria**, 440. Clarkton Leap, near Worcester. St.

D. prolifer, 441. In a marle pit, Landridge Hill, Hanley Castle. Ballard.

Stellaria uliginosa, 457. Rivulets on the side of Malvern Hills, and on the side of the Hill at W. end of Powick's Ham, near Worcester. St.

Arenaria tenuifolia, 461. Malvern Hill. Ballard.

Alsine media, 324. Form with 10 stamens. In hedges near Worcester. St. (*Stellaria media. With.*)

Sagina apetala, 170. On a wall belonging to the Almshouse near St. Oswald's, Worcester. St.

Hypericum Androsæmum, 812. Lanes at the foot of Malvern Hill. St.

H. humifusum, 814. Ronk's Wood, near Worcester. St. Malvern Common. Ballard.

Geranium moschatum, 725. Near Stourbridge. St.

G. maritimum, 725. Sandy commons between Enville and Bewdley, Worcestershire. Mr. J. A. Hunter.

G. sylvaticum, 727. Near Halesowen. With.

Malva sylvestris, 739. Vars. 2 and 3. Near Worcester. St.

Rhamnus catharticus, 239. Side of a brook near Hanley Castle. Ballard. Near Worcester. St.

Anthyllis Vulneraria, 765. Limestone Pits, Cradley, near Malvern Hill, Worcestershire. Ballard.

Cradley is in Hereford, but it is quite possible that the Limestone pits may have been in Worcester, where (in Mathon parish) the Anthyllis may now be found.

Trifolium repens, var. **proliferum**, 793. Worcestershire. St.

Lotus corniculatus, var. **tenuissimus**, 805. In the neighbourhood of Worcester. St. *(Lotus tenuis. Kit.)*

Vicia sylvatica, 774. Woods about Clifton-on-Teme, in moist places. St.

V. bithynica, 779. Woods near Clifton-on-Teme. St.

Lathyrus latifolius, 772. Severn Stoke Copse. Ballard.

* **Sorbus domestica**, 514. In the middle of a thick wood in the Forest of Wire, near Bewdley, Worcestershire. One mile from Mopson's Cross, between that and Dowles Brook, found by Mr. Pitts, Alderman of Worcester. Ray, Nash, St.

* **Spiræa Filipendula**, 518. Near Madresfield. Ballard. Frequent in the neighbourhood of Worcester. St.

Potentilla argentea, 532. Side of the Turnpike road in the Parish of Holt Castle. Ballard.

* **Rosa rubiginosa**, 520. Between Dudley and Tipton. St. In Mr. Terne's garden, Worcester, from a gravel pit near Claines Church. St.

* **Rosa spinosissima**, 522. Hedges and ditch banks about Worcester. St.

Sedum Telephium, 465. Fields about Robinson's End, Malvern Chace. Ballard.

S. reflexum, 466. Malvern Hill. Ballard.

Cotyledon Umbilicus, 464. Malvern Hill. Ballard. In the clefts of rocks above Great Malvern. St.

Saxifraga granulata, 434. Bevere, near Worcester. St.

Chrysosplenium alternifolium, 404. Purlieu Lane, leading from the Wych to Mathon. Ballard.

* **Parnassia palustris**, 325. In Worcestershire. St.

Apium graveolens, 316. Moors, Samsom Fields, Worcester. St.

Pimpinella magna, 314. Worcestershire. Ballard, St. "In marle." St.

Anethum Fœniculum, 311. Near Spetchley. St. *(**Fœniculum** officinale, All.)*

Sium latifolium, 292. In the Moors, near Pitchcroft, Worcester. Dr. Thompson, junr.

Sison inundatum, 295. Sides of rivulets on Malvern Chace. Ballard.

* **Œnanthe crocata**, 297. Meadows near Hanley Hall. Ballard.

Phellandrium aquaticum, 298. Clifton, near Severn Stoke. Ballard. St.

Scandix odorata, 303. In an orchard at the top of Souston's Roche, near Shelsley Walsh. Ballard. St. *(Myrrhis odorata, Scop.)*

S. Cerefolium, 304. Found near Worcester in considerable plenty on the south-east side of the Bristol Road, just beyond the Turnpike, May, 1775. And in the hedges in Upper and Lower Old Swinford, though not to be discovered in any of the neighbouring gardens. St. *(Chærophyllum sativum, Lam.)*

Smyrnium Olusatrum, 310. Found by the Rev. Mr. Welles at Hill Croome. Ballard. St. And Pirton plentifully, Mr. Hollefear.

Viscum album, 1112. Worcestershire, on Apple trees, sometimes on Limes, and in one instance on a Plane tree, near Lord Coventry's menagerie, Croome. St.

Adoxa Moschatellina, 417. Purlieu Lane, Mathon. Ballard. Between Stone and Mitton. St.

Viburnum Lantana, 318. Ripple Field. Ballard.

Galium Mollugo, 155. Malvern Hills. St.

G. scabrum St., 155. Hedge row in a marly soil on the side of Red House Lane, near Worcester. St. *(A var. of the preceding.)*

Asperula odorata, 158. At the Leasows near Halesowen. With.

Dipsacus pilosus, 138. Abbey Lane, Evesham. Ballard.

Hieracium sabaudum, var. 4, 850. Perry Wood, near Worcester. St. *(H. boreale Fr.)*

* **Carduus eriophorus**, 875. Hill End Bank in Longdon Parish. Ballard. On the footway between Clarkton Leap and Kemsey. St.

C. pratensis, 877. Swampy meadows near Robinson's End, Malvern Chace. Ballard. St.

Anthemis arvensis, 937. Pastures about Asscote and the Stewponey, near Stourbridge, Worcestershire. St.

The Stewponey is in Stafford, but the plant is frequent on the Worcester side the county boundary.

Vaccinium Myrtillus, 394. Rocks above Great Malvern. Ballard.

Erica Tetralix, 398. Hartlebury Common. Ballard. Worcestershire. St.

E. cinerea, 399. In the N. of Worcestershire. St.

Chironia Centaurium, 237, var. 3. Blossoms white. Upper Battenhall, near Worcester. St. *(Erythræa Centaurium, Pers.)*

* **Chlora perfoliata**, 392. Side of Malvern Chace. Ballard. Edge of the Ridd Cliff. St.

Atropa Belladonna, 233. Dudley Castle. With. St.

Verbascum Lychnitis, 225. Kinver, Stafford, near the Rock-houses. St.

I have inserted this record as the plant grows in Worcestershire very near this locality.

V. virgatum, 228. First shown me by my late worthy friend, Mr. Waldron Hill, of Worcester, in a field on the S. side of a lane leading from Gregory's mill to the Turnpike road near that town. The side of the Turnpike road from Worcester to Ombersley, opposite to the lane leading to Beverley. St.

Digitalis purpurea, 655. Blossoms white. Shenstone Lane, near Hartlebury. St.

Antirrhinum Orontium, 650. Worcestershire. Ballard. St.

Veronica montana, 13. Wood at the west end of Powick Ham, near Worcester. St.

Orobanche major, 658. Shrawley Wood. Ballard. On a dry bank near Clifton-on-Teme. St.

Mentha Pulegium, 602. Side of a pool at Robert's End, near Hanley Castle. Ballard.

Galeobdolon luteum, 611. Hedges near Malvern Chace. Ballard. Woods near Worcester. St.

Anchusa sempervivens, 192. Near Birmingham on the Alcester road. With. Near the Blanketts, Worcester. Ballard. St.

Pinguicula vulgaris, 16. Broadmoor, about 3 miles S.W. of Birmingham. Mr. Brunton. On the N.W. side of the Malvern Hills, but not on the S. or S.E. sides. Ballard.

Lysimachia vulgaris, 208. By the side of the Avon, at Pershore. Ballard.

Samolus Valerandi, 221. Side of the brook running from the brine pit on Defford Common. Messrs. Ballard and Hollefear.

Plantago media, 143, var. 2. Leaves with straw-coloured stripes. Hawford Bridge in Worcestershire. St.

Rumex maritimus, 371, var. aureus. Severn Stoke. Ballard. St.

Rumex Hydrolapathum, 374. About Clifton. Ballard. St.

Polygonum Bistorta, 406. Ham Green, near Mathon, and Martley. Ballard.

P. Hydropiper, 408. Malvern Chace. St. (*See under P. minus, p. 210.*)

P. minus, 410. Gravel Pit on Malvern Chace. St.

P. pensylvanicum, var. **petechiale**, 412. In a ditch on Stourbridge Common. St.

P. pallidum, var. 3. Curtis. With., 3rd Edit., 381.

Quercus Robur, 1084, β. Acorns on long fruit stalks, 1086. Little Shelsley. Mr. Hollefear. (*Q. pedunculata, Ehrh.*)

Taxus baccata, 1130. Numbers scattered over the country between Stourport and Abberley. Clearly an indigenous tree. St.

Zanichellia palustris, var. β., St., 1014. Brooks and Pools near Worcester. St.

Lemna gibba, 1020. Lower Bishop's Pool, Northwick, near Worcester, and in a Pool near the East side of Malvern Chace. St.

Acorus Calamus, 357. River Avon, near Pershore. Ballard.

* **Paris quadrifolia**, 416. Wood near the Devil's Den, Clifton-on-Teme. Ballard. About Frankley. With.

Butomus umbellatus, 420. Side of the River Avon at Evesham. Ballard.

* **Galanthus nivalis**, 340. At the foot of the Malvern Hills on the right side of the road running below the camp, where no traces of any buildings or gardens are to be found. Ballard in Bot. Arr., Ed. 1. Finstall near Bromsgrove. St.

Narcissus Pseudo-Narcissus, 342. In Orchards, Hanley Castle. Ballard.

Allium vineale, β. with a double head of bulbs, 344. Near Worcester. St.

Hyacinthus non-scriptus, 356. Var. 2. Blossoms white. Near Worcester. St.

* **Colchicum autumnale**, 379. In orchards on the borders of Malvern Chace. Ballard. On the Meadows bordering the Severn. St. Halesowen. With.

Orchis latifolia, 976. Between Battenhall and Worcester. St.

* **Ophrys apifera**, 994. Tedstone near Whitbourne, Worcestershire. Ballard.

Tedstone itself is in Hereford, but very near the county boundary.

Serapias longifolia, 998. Swampy Meadows, Robinson's Street, on the borders of Malvern Chace. Ballard. (*Epipactis palustris. Sw.*)

S. grandiflora, 1000. Mr. Knight's Walks, Wolverley. St.

Juncus sylvaticus, 364. Witchery Hole near Clifton upon Teme. Ballard. St. (*Luzula sylvatica, Bichen.*)

Scirpus palustris, var. β., 46. Severn Stoke. St.

Scirpus acicularis, 47. Malvern Chace. St.

Carex pulicaris, 1026. Malvern Chace. Ballard. St.

C. disticha, 1028. Boggy Meadows on the side of Malvern Chace. Ballard. St.

C. pendula, 1046. Witchery Hole near Ham Castle. St.

Nardus stricta, 54. Malvern Chace. Ballard.

Phalaris canariensis, 65. New's Wood adjoining to Malvern. Ballard.

Poa cristata, 91. On the edge of a Marle Rock, Clarkton Leap, near Worcester. St. (*Kœleria cristata, Pers.*)

Festuca ovina, 97. Malvern Hill and Chace. Ballard.

F. sylvatica, 102. Worcestershire. St. (*Brachypodium sylvaticum, R. and S.*)

Bromus secalinus, var. 3, **hordeaceus**, 104. Near Kempsey and Ridd Green. St. *Now considered a var. of B. mollis. See Eng. Bot., 3rd Ed., Vol. XI., p. 170.*

B. mollis, 106. Var 2, nanus. Barren soil near Stourbridge.

B. madritensis, 107. Severn Stoke. St.

124 plants are enumerated in the above list. Of these, 15 are repetitions of species previously recorded; 2 are varieties of other species; and 2, Anthemis arvensis and Verbascum Lychnitis, cannot be claimed as Worcester records. After making these deductions we have 105 new records to the credit of Dr. Stokes.

(To be continued.) k 164

Reviews.

A Junior Course of Practical Zoology. By A. Milnes Marshall, M.D., D.Sc., M.A., F.R.S., assisted by C. Herbert Hurst. London: Smith, Elder, and Co.

The want of such a work as this has long been felt both by teachers and students, as the well-known "Elementary Biology" of Huxley and Martin does not treat of several animals, the structure of which it is important that a beginner in Zoology should know thoroughly well. Its appearance, therefore, will be heartily welcomed by Zoologists.

The book opens with some very valuable instructions on methods of study, which ought to be well taken to heart by every beginner; those on dissection, in particular, being extremely good and to the point. The remarks in this and the last chapters on the preparation and use of reagents are also very useful.

The body of the book is composed of directions for the examination and dissection of the following animals: Amœba, Paramœcium, Opalina, Vorticella, the freshwater Hydra, Liverfluke, Leech, Earthworm, fresh-water Mussel, Snail, Crayfish, Cockroach, Lancelet, Dogfish, Rabbit, and Fowl. This list, it will be seen, contains the types which it is most important a beginner should understand, with the exception of that of the Frog; Professor Marshall has, however, previously described this animal in a former work which it would be advantageous to have incorporated with the present volume. The treatment is admirable: full directions are first given as to the dissection necessary to expose an organ, and then follows a description of the latter and of its relation to neighbouring structures. In order to attract attention to them, the directions are printed in italics, whilst a system of indentation has been used to render the subdivisions of the descriptions more distinct. Some structures which present special difficulties have been treated at great but not undue length, whilst others, such as the muscular system, which the author regards as of subordinate educational value, have, owing to the short time usually available for laboratory work, been almost entirely omitted.

Although the book is essentially practical, yet the "morphological salt" of which Professor Michael Foster speaks has been plentifully scattered throughout its pages. This is a valuable feature, and the explanations of anatomical details will be of great use to the student in enabling him to gain a connected view of the various facts which he learns from his dissections.

There are some forty-eight illustrations; more have not been introduced, as it is strongly and rightly insisted that the student should make them for himself from his own preparations. Many of those given are new and have been specially drawn for the book. They are for the most part very good, but exception must be taken to those of *Vorticella*, and of the section through the body-wall of *Hydra viridis*, the former being greatly wanting in detail, and the latter being crude in execution. Those, however, of sections through the *Crayfish*, *Mussel*, *Snail*, and *Amphioxus* are exceedingly good and useful. Last, but not least, comes a very full and accurate index, while the printing and paper are all that can be desired.

There seems to us to be only one point in which this work is wanting, and that is in the absence of any bibliography of standard monographs on the various animals considered. The author may perhaps fear that students would copy the illustrations given in such works, instead of drawing their own preparations; that difficulty, however, could be easily obviated by the teacher, while the advantage of having good illustrations to which to refer, especially of the histology of the animals—a subject somewhat slightly treated by Dr. Marshall—is very great.

In conclusion, we heartily recommend this book to all teachers and students of Zoology, and hope that it will have the wide sale it undoubtedly deserves.

British Fungi (Hymenomycetes). REV. JOHN STEVENSON. *Vol. II., Cortinarius—Dacrymyces.* Wm. Blackwood and Sons, Edinburgh. Pages 1—336.

THIS is the completion of the work which has been so long looked forward to by British mycologists. Armed with this volume and its predecessor, the student of our larger Fungi is in a position to face the coming Autumn campaign with an assurance of success such as few in this country can have ever felt before. Especially will this volume be useful in regard to the difficult genus Cortinarius, for as all know, it is in this group that we find so many species which ordinary fungus collectors are totally unable to refer to their proper names. Still, with the full and faithful descriptions here afforded, this hitherto almost hopeless task can be satisfactorily accomplished.

But it must be confessed that the moment we leave the Agaricini and travel beyond the limits of Fries's "Monographia," from which work our author has translated these descriptions, we have to fall back upon the bald, deceptive, and irritating diagnoses of older days. A more serious complaint, however, can be founded on the fact that the present volume does not contain, as an appendix, the descriptions of those species which have been discovered as British since the author despatched his manuscript to the printers. In these fast-living days the number of new discoveries rapidly increases, and it has already amounted to about three score among the Hymenomycetes alone, since that apparently rather distant period. Are the mycologists of the north so far removed that they receive no tidings of what is being done by their brethren of the south?

The illustrations of this volume are as good as in the last, but the glossary, from which so much was expected, is meagre and decidedly disappointing. It seems to have been framed on the principle of leaving all the hardest words unexplained, while those which, of course, a student of the Hymenomycetes would necessarily be acquainted with, such as "gills," "cæspitose," "annular," "crenate," "obovate," "mycelium," and "zoned," are here most carefully embalmed.

W. B. Grove.

METEOROLOGICAL NOTES.—April, 1887.

Atmospheric pressure was variable during the month, and its range considerable. The highest reading of the barometer was on the 17th, 30·691 inches; the lowest, on the 24th, 29·281. Temperature was about three degrees below the average, the deficiency being especially noticeable in the minimum readings. The highest observed were 68·0° at Henley-in-Arden, on the 18th and 19th; 63·6° at Loughborough, on the 12th; 63·1° at Hodsock, and 60·8° at Coston Rectory, on the 18th. In the rays of the sun, 121·7° at Loughborough, on the 6th, and 119·4° at Hodsock, on the 24th. The lowest readings were 24·5° at Coston Rectory, on the 17th and 30th; 24·6° at Hodsock, on the 18th; 26·0° at Henley-in-Arden, on the 15th; and 28·1° at Loughborough, on the 30th. On the grass, 16·4° at Hodsock, on the 17th, and 22·1° at Loughborough, on the 15th and 17th. Rainfall was below the average, and at some stations the largest portion fell on the 26th. The total amounts collected were: Henley-in-Arden, 1·30 inches; Loughborough, 1·15 inches; Hodsock, 1·01 inches; Coston Rectory, 0·88 inches. The number of "rainy days" varied from 8 to 13. Sunshine above the average. North-easterly winds were prevalent. There was a slight thunderstorm at Loughborough, in the afternoon of the 23rd, and snow fell on the night of the 26th.

Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

[Mr. Berridge, we regret to say, informs us that he will not in future be able to continue the monthly "Meteorological Notes," which for so long have appeared in the "Midland Naturalist." We take this opportunity of thanking Mr. Berridge for his valuable services, which we can assure him have been very heartily appreciated by ourselves and our readers.—Eds. "Mid. Nat."]

Wayside Notes.

The Memorial to the late Thomas Edward, the Banff Naturalist, has, we much regret to learn, received so little support that the proposal is temporarily in abeyance, and the Committee are seriously contemplating the desirability of returning the subscriptions they have already received. The amount that Edward accomplished for natural science was simply enormous, even if considered independently of the bright example of devotion that he has left for younger generations to imitate,—if they can. We cannot understand why a memorial of this kind should fall so flat, although we recognise fully that the tendency of the day is to sound the praises of technical education, and to sneer at such impractical things as mere sciences of observation. When the pendulum comes back in its swing, and the old-fashioned word "naturalist" comes once more into favour, we shall probably be heartily ashamed of the neglect with which the proposed memorial to Thomas Edward has been received.

Dr. Junker gave the Royal Geographical Society a field day of the first water on the 9th ult., when he told a crowded and admiring audience his story of that region of the "dark continent" which lies between the Upper Nile, the Congo, and Lake Chad. Rather, we ought to say, when he was expected to tell his story to the Society, for in truth the famous traveller said very little about his own work, and devoted himself mainly to the Mahdist rebellion, and his gallant friend Emin Pasha, to whose aid another renowned African traveller, Mr. H. M. Stanley, has recently started. Probably Dr. Junker felt his task too complicated for a single meeting of a society, and indeed it may well be supposed to be difficult to compress even the baldest account of six years' continuous exploration into a portion of an evening. Dr. Junker has shown, just as other travellers have, that Central Africa contains the most perfect system of inland water communication in existence, the term "network," as applied to its rivers, being literally, and not metaphorically true.

Mummy wheat is responsible for a great many troubles. It would be an interesting investigation to find out how many good men have gone astray, or have been led astray by the Arab who has learned to measure all things by their capacity for extracting backsheesh. Prof. Judd is the latest addition to this noble army of martyrs to a disposition over-endowed with faith. Botanists, who above all men are interested in the prolonged vitality of seeds, have over and over again protested against the loose way in which seeds, asserted to have been taken from some Egyptian mummy case, have been used to demonstrate the possibility of enormous vitality, and it is really hard for them to be told by Prof. Judd that "competent botanists have cited the case of the germination of seeds taken from ancient Egyptian tombs as authentic." Pray, Prof. Judd, do not be so chary in taking us into your confidence. Either let us know everything or nothing. Who are these certifiers to the character of mummy wheat? As, in our small way, earnest enquirers after scientific truth, pray let some light in upon the Egyptian darkness with which we are enshrouded.

General scientific education will, we hope, receive decided assistance from the recently printed report of the Select Committee on Endowed Schools. It is not yet twenty years since the Endowed Schools Commission cleared away the dust which for, in some cases, centuries had accumulated upon the work of the great public schools of England. Much valuable work there was shown to have been done, but as a whole it might be plainly stated to be altogether disproportionate to the amount at the disposal of the then existing governing bodies. In some cases all the worst vices of close corporations were seen to be reproduced. The broom the Commission then applied no doubt swept clean for the time, but there is no finality in educational systems. That the public has largely profited by the changes few will now deny; many will, however, no doubt be found to deny the value of the new changes proposed by the Select Committee, just as, at the time, blood ran pretty warmly over the recommendations of the old Commission. These briefly are to the effect that, amongst other needed reforms, these schools should be more largely used than heretofore for the promotion of scientific and technical education, and that local authorities should be authorised to employ local rates for founding or contributing to laboratories and workshops in such schools in order to promote practical scientific education. This latter recommendation, by the way, opens some dubious points. The actual value of a scientific education is probably on the whole realised in proportion to possession of it. Hence popular constituencies may not perhaps be the best custodians of the funds for the promotion at any rate of pure, as distinguished from technical, scientific training.

A Semi-aquatic Myxomycete.—The common habitats of the Myxomycetes or Slime-Fungi are damp surfaces such as rotten wood, earth, grass, moss, etc. A few species, belonging to a group allied to these, are, indeed, found in water. Such are most of the Monadineæ, many of the species of which are parasitic, as indicated by their names. *Vampyrella spirogyræ*, *Leptophrys vorax*, etc. To this group also belong the famous *Protomyxa aurantiaca*, so well known to all readers of Haeckel, and *Plasmodiophora brassicæ*, which is now considered (one may say demonstrated) to be the cause of clubbing in the roots of the cabbage tribe. But the Eumycetozoa, or true Myxomycetes, though their spores require to germinate in a small quantity of water, are rarely found therein when the plasmodium has attained any considerable size. It was, therefore, a pleasure to me when Mr. Bolton called my attention to the long plasmodial strings of a Myxomycete which he had found in the water of a little aquarium, containing organisms collected by him about ten days before in a gravel pit at Hill Oak, near Sutton Coldfield. These strings passed among the Spirogyra threads, and formed a network which here and there reached the sides of the vessel; some of them were nearly five inches in length. They were of a semi-opaque, sub-hyaline appearance, and if a part was carefully placed in a trough or cell, under the microscope, the motion of the protoplasm could be clearly perceived, exactly resembling that of an Amœba, except that it reversed its direction at tolerably regular intervals (about every half minute, according to my observations). A day or two afterwards some of the plasmodium was elevated into the air by the raising of the Spirogyra-mass to the surface, owing to the bubbles of oxygen entangled in it. At these points, and also where a small portion of the plasmodium had crawled up the surface of the glass vessel, sporangia were formed—white at first, but soon dusky brown, and finally bluish-grey; the last appearance arose from the formation of star-like crystals of carbonate of lime on the darker surface of the spore-mass. The species was seen on a microscopical examination of the capillitium to be *Physarum nutans*. W. B. Grove, B.A.

The Leicester Flora—note on the review of.—Mr. Bagnall points out an error in my article which appeared under *Œnanthe fluviatilis*: there is no *figure* of it in the Dillenian Ray, only a description. I had in my memory, which, alas, was defective, an old drawing of it. This, of course, does not alter the point of the sentence. Nyman was my authority for the statement that *Corydalis claviculata* was first described by Persoon in the Synopsis. It is true Persoon describes it there as a *Corydalis*, and gives no reference to De Candolle, who, however, had previously described it in the Flore Française. *Alyssum* *calycinum*, described in ed. ii. of the Spec. Plantarum by Linnæus, is referred by him to Jacq. Hort. Vind. in error, as it is not included in that early work of Jacquin's. In the name *Arenaria trinerva* a letter has dropped out; it should, of course, be *trinervia*. Withering points out that the Linnæan *Mentha piperita* was a form of *hirsuta*.

It appears necessary to make considerable changes in our nomenclature. For instance, the *Dentaria bulbifera* of Linnæus has been placed with the *Cardamines* by Syme, and in the Genera Plantarum the genus *Dentaria* is merged in that of *Cardamine*. It has been quoted in Lond. Cat. of Syme, but long ago Crantz called it *Cardamine bulbifera*. *Linaria purpurea*, which in the Flora is quoted of Linnæus, appears to have been first called a Linaria by Miller. In the Spec. Plant. it was given as an *Antirrhinum*. The varieties of *Montia fontana* were alluded to as *minor* and *major* in the Flor. Ped. by Allione, but more fully described under the same names by Roth in Tent. Germ. *Hypericum Elodes*, as pointed out long ago by my friend Mr. R. C. Pryor, should be quoted of Grufberg, as should *Cochlearia anglica*, and several other species at present attributed to Linnæus. G. C. Druce.

Shamming Vegetable.—An Indian mantis or praying insect, a little less wicked, though no less cruel than the spiders, deceives the flies who come to his arms under the false pretence of being a quiet leaf, upon which they may light in safety for rest and refreshment. Yet another abandoned member of the same family, relying boldly upon the resources of tropical nature, gets itself up as a complete orchid, the head and fangs being moulded in the exact image of the beautiful blossom, and the arms folding treacherously around the unhappy insect which ventures to seek for honey in its deceptive jaws. Happily, however, the tyrants and murderers do not always have things all their own way. Sometimes the inoffensive prey turn the tables upon their torturers with distinguished success. For example, Mr. Wallace noticed a kind of sand-wasp, in Borneo, much given to devouring crickets; but there was one species of cricket which exactly reproduced the features of the sand-wasps, and mixed among them on equal terms without fear of detection. Mr. Belt saw a green leaf-like locust in Nicaragua, overrun by foraging ants in search of meat for dinner, but remaining perfectly motionless all the time, and evidently mistaken by the hungry foragers for a real piece of the foliage it mimicked. So thoroughly did this innocent locust understand the necessity of remaining still, and pretending to be a leaf under all advances, that even when Mr. Belt took it up in his hands it never budged an inch, but strenuously preserved its rigid leaf-like attitude. As other insects "sham dead," this ingenious creature shammed vegetable.—"*Cornhill Magazine*" *for February*.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Biological Section, April 29. Professor Hillhouse in the chair. Mr. Bagnall gave an introductory address on the "Classification of Mosses." He traced the history of the classification of mosses, with a fuller account of Schimper's system, which he considered the best to be adopted. He then described the two main series, namely, Acrocarpæ, with terminal fruit, and Pleurocarpæ, with lateral fruit, into which all the true mosses are divided; and then Bryineæ anomalæ, or the anomalous mosses, illustrating each with an extensive series of specimens and microscopic preparations.—

MICROSCOPICAL SECTION, May 3. Professor Hillhouse in the chair. Specimens were exhibited of different kinds of rice from Eastern Bengal, by Mr. Walliker; and a series of specimens as exhibited by Mr. Bolton of photographs, taken at fifteen minutes' interval, under the microscope, of a Slime Fungus (*Physarum nutans*), showing its constantly changing network form. A paper was read by Mr. Bolton on the "Anatomy of Rotifers," illustrated by a series of living specimens in microscopes, and of coloured drawings of a rotifer (*Brachionus rubens*) that was selected as a typical specimen of this group of animalcula.—BIOLOGICAL SECTION, May 10. Mr. R. W. Chase in the chair. Mr. H. J. Carter gave a paper, read by Mr. W. R. Hughes, on the "Third Eye of *Anguis fragilis* (the common slow-worm)," that had been found to have a central median eye, imperfectly developed, in addition to the perfect pair of lateral eyes. This had a special interest in relation to a newly discovered three-eyed reptile, *Hatteria punctata*, in New Zealand, that was described by Mr. A. B. Badger in the "Midland Naturalist" for 1886, page 257; having a central median eye lying upon the surface of the brain but covered externally by the skin. This was of particular interest as suggesting in explanation of the doubtful pineal-gland or epiphysis found in a similar position upon the surface of the brain in vertebrates, a survival from some ancestral type common with the ascidians, which retain a single median eye. Mr. Hughes also gave an account of some unusually large specimens of sea-anemones (*Tealia crassicornis*) that he had recently seen in the Brighton Aquarium, several of which had seized and were in course of swallowing a herring as large as about seven inches in length. Mr. Burgess, of London, presented to the Society a type slide of 100 species of Foraminifera, from the Friendly Islands in the Pacific. Mr. Chase exhibited specimens of the Natterjack toad (*Bufo calamita*), from the Norfolk Broads. Mr. Bagnall exhibited *Tolypella glomerata*, one of the Characeæ, found at Whimpstone, near Stratford, and not previously recorded in the Midlands. Mr. Grove exhibited *Onygena apus*, from Newcastle-on-Tyne, a fungus found on dead hoofs of cows and other similar animal substances.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 21st. Mr. Dunn exhibited under the microscope a freshwater worm, *Nephelis;* Mr. Hawkes, specimens of *Vaucheria racemosa* and *V. sessilis*, and explained their modes of reproduction; Mr. H. Insley, a section of a Lancashire coal-ball through rootlets of Stigmaria. — March 28th. Mr. J. Collins read a paper on "Low Forms of Vegetable Life." The writer said the morphology and physiology of the lower classes of vegetable life were but little understood, even by many advanced students of botany, and until very recently they had not been popular branches of the vegetable kingdom, though this fact alone was sufficient to commend them to practical naturalists. The division between the algæ and fungi was described as an artificial one. This interesting paper was illustrated by diagrams, and slides under the microscopes. —April 4th. Mr. H. Insley showed part of the spinal column of an Ichthyosaurus, from the Lias; Mr. Hopkins, specimens of *Vertigo edentula*, from Solihull; Mr. J. W. Neville, a Gorgonia, from Australia, and spicules of the same under the microscope.—April 18th. Mr. H. Insley exhibited some sketches of the auditory organs of insects; Mr. A. T. Evans, pebbles from the Drift containing specimens of *Orthis elegantula*, Modiolopsis and other fossils; Mr. J. Collins (under the microscope), *Draparnaldia glomerata;* Mr. J. W. Neville, palate of *Testacella haliotidea*. Mr. J. Madison then read a paper on "A Visit to Loch Skein." The writer described the journey as a conchological one. The route taken was through Moffat Dale, where a waterfall, "The Grey Mare's Tail," was visited. When Loch Skein was reached, though the 13th of June, the mountains had twelve inches of snow on their summits. The Loch was worked as one of the two recorded habitats of *Limnæa peregra* var. *Burnetti*, the other one being in Carmarthenshire. Many specimens were taken, though the mature ones were much eroded. The writer described a ramble by St. Mary's Loch, and through Selkirk and Melrose to Edinburgh, from whence the return was made. At the close of the paper the collection of shells was exhibited.—April 25th. An evening devoted mainly to conchology. Mr. C. P. Neville exhibited a series of specimens of Conus from the Magellan Straits; Mr. P. T. Deakin, a collection of land shells made in Somerset and Dorsetshire; Mr. J. Madison, a large collection of *Helix aspersa*, showing 180 variations from the type specimen; Mr. Moore, a collection, chiefly of the neighbourhood; Mr. A. T. Evans, *Terebratula caput-serpentis;* Mr. H. Insley, fossil shells from the Chalk and Greensand; Mr. H. Hawkes, a specimen of *Empetrum nigrum*, and (under the microscope) capsules of Jungermannia, showing elaters scattering gemmæ and spores.—May 2nd. Mr. J. Moore showed specimens of the Black Ant. *Formica nigra*, and gizzard of the same under the microscope; Mr. F. Shrive, living specimens of the common ring snake; Mr. J. W. Neville, a slide of selected foraminifera from sponge sand; Mr. H. Hawkes, twin female flowers of *Taxus baccata*.—May 9th. Mr. Mulliss exhibited a fœtus two months old; Mr. A. T. Evans, part of a trilobite in a quartzite pebble from the Drift. A paper written by Mr. Thoms, F.R.M.S., on "The Origin of Leaven," was then read by Mr. Hutchinson. The writer took exception to the accepted views of M. Pasteur and others that life only proceeded from life germs in the atmosphere, quoting the fact of his having found bacilli, etc., in cells having no apparent inlet through which germs from the atmosphere could be conveyed. The writer concluded that the organisms in such cells were the result of disintegrated cell contents becoming functional.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Evening meeting, Wednesday, April 20th. Attendance nine (one lady). The chairman thanked the members for their confidence and assistance during his three years of office. He thought it was undesirable to make the post a permanent one; that a change of leadership would tend to freshness and vigour, and that all the active members of the Section should occupy the chair in turn; he wished, therefore, to resign the post, and moved that Dr. Tomkins, Officer of Health for the Borough, be elected chairman for the ensuing year from June next, and that Dr. C. W. Cooper be re-elected hon. secretary. The motion was carried unanimously. The chairman reported that at the Field Day Excursion on the 9th, the first of the season, six members visited the Old Ansty Lane. The day was cold and dull, but they collected nine species of mosses, among them being *Brachythecium glareosum*, new to the county; two species of Hepaticæ, one being *Lophocolea heterophylla* in full fruit; and five species of land shells, among them a single specimen of the rather rare *Bulimus obscurus*, and a whole community of the pretty *Helix rotundata* under the bark of an old stump. The following objects were exhibited, viz:—By Mr. E. F. Cooper, F.L.S., a flowering branch of a *Eucalyptus*, probably *globulus*, received with other cut flowers from the Riviera. By Rev. T. A. Preston, M.A., specimens in spirit of the floating sea-weed, *Sargassum* *bacciferum*, and of a number of small marine animals taken among the living weed in the Sargasso Sea, including *Medusæ*, several small fish and crustaceans, the trigger fish, a small cephalopod, &c.; also a specimen of the curious fungus, *Geaster fornicatus*, the "vaulted earth-star." By Mr. W. A. Vice, specimens of three interesting fungi collected at Blaby, *Hypoxylon concentricum*, a solid black mass two inches long, new to the county; *Nectria pulicaris*, and *Podisoma Sabinæ*, neither of them recorded in the Leicester district. The chairman introduced a discussion on cleistogamous flowers, pointing out that whereas Darwin had shown the importance of cross fertilisation and the many remarkable contrivances among plants for securing it, it was found that a considerable number of plants bore, in addition to their ordinary flowers with open coloured corolla, other flowers generally without corolla and never opening at all, which seemed purposely formed for securing self-fertilisation, and which generally perfected seed while many of the open flowers were barren. These closed and inconspicuous flowers were called cleistogamous; what was their real purpose? Mr. E. F. Cooper showed fresh and dried specimens of *Viola odorata*, *V. hirta* and *V. Riviniana*, bearing flowers of both kinds. Darwin suggests that the closed flowers are degraded organs for securing ripe seed at the least possible cost of energy to the plant. The chairman suggested that they might be survivals of an early form of the reproductive organs before the corolla-bearing epoch was reached.—Evening Meeting, Wednesday, May 18. Attendance 14 (three ladies). Chairman, F. T. Mott, F.R.G.S. The chairman reported that the field-day excursion last week was attended by six members, who visited the gardens at Belvoir Castle, under the guidance of Mr. Ingram, and were delighted with the beauty of the Spring flowers. Camellias and the Himalayan rhododendrons, which have remained in the open air without protection for many years, were in full bloom, and a number of rare and beautiful hardy herbaceous plants were seen, with a fine collection of varieties of *Narcissus*. The following objects were exhibited, viz., by Mr. W. A. Vice, specimens of ripe loquats (*Eriobotrya Japonica*), sold in the streets of London, and several fungi; Rev. T. A. Preston, a beautiful microscopic slide of the *Amphioxus*, with several other examples of it in spirits, and a specimen of the curious fungus *Cordyceps entomorrhiza*, growing on a caterpillar from Norfolk; by the chairman, Dr. Cooke's work on the British Myxomycetes, translated from the Polish. Mr. Thos. Carter, LL.B., introduced a discussion on "A Botanical Garden for Leicester." He said that in France there was a system of such gardens in the principal provincial towns, all in connection with the central gardens at Paris, a system which dated from the great revolution; that while travelling in France he had found these gardens very useful, and that such a garden in Leicester would greatly facilitate the study of botany. The discussion was interesting and lively. The chairman produced a rough design which he had sketched for a very complete botanical garden of ten acres, in which visitors would pass successively through arctic, temperate, sub-tropical, and tropical floras, and in which there would be special departments also for the local flora, medical plants, hardy fruits and vegetables, agricultural plants, with experimental grounds, and a type series illustrating the botanical orders. It was finally determined that Mr. Byrne, of the Abbey Park, should be consulted as to the possibility of some small beginning being made there, and that, if it seemed possible, the Park Committee should be approached on the subject. Mr. J. H. Garnar read a short paper on "the Entomostraca," describing some personal observations confirming the published views of Dr. Baird, and illustrated by living specimens exhibited under the microscope as well as by a number of mounted slides.

RAGNAROK.*

BY G. DEANE, D.SC.

Whether this book should be regarded as a *jeu d'esprit*, or subjected to calm and judicial criticism, is a matter not easy to decide. To those unacquainted with the course of patient and careful investigation by which the present knowledge on the subjects here treated of has been gained, some of the arguments adduced will appear to possess a certain amount of plausibility, especially to readers predisposed to accept with slight or no proof the catastrophic and marvellous. Also the general character of the book makes it interesting reading. But, as a serious treatment of the subjects dealt with, it will certainly fail to commend itself to the judgment of experts either in Physical Science, Mythology, or Biblical Exegesis.

The author advances a novel and ingenious but unsatisfactory theory as to the origin of the so-called Glacial or Drift deposits of Europe, Africa, and America. After examining the character of the Drift, and the various theories now held by leading geologists as being concerned in its production, he makes the astounding suggestion that all these deposits have been caused by a collision with a comet; and, inasmuch as they are said to occur only on the hemisphere of the earth which includes Europe, Africa, and Eastern America, the presumption is that the comet in whirling at enormous velocity round the sun lashed that hemisphere and that only with its tail. The result was an immense development of heat which vaporized the oceans, destroyed all life except a few men who obtained safety in caverns, melted rocks, vaporized metals, and burnt and hardened the underlying Till or Lowest Boulder Clay, whilst the immense impact of dust, sand, pebbles, and boulders forming the comet's tail furrowed and scratched the earth's surface, produced chasms and crumpling in the rocks, and caused the fiords of the sea coast. After this delightful catastrophe condensation occurred accompanied by extreme cold, and immense torrents of primeval rain which partially re-arranged the boulders, stones, and clay, left by the comet's tail. After this the few saved men came forth from their caverns to inhabit the mythical island of Atlantis in the centre of the Atlantic Ocean; and from this point they radiated again to overspread

* Ragnarok: the Age of Fire and Gravel. By Ignatius Donnelly, Author of "Atlantis: the Antediluvian World." London: Sampson Low and Co.

the earth. For a theory like this we must go back to the mythical age of Geology, and even the explosive caverns of De Luc are less astounding.

The book then examines the nature and growth of myths and legends, gives a long and interesting account of the legends of various nations, and maintains that these are not only explicable by but actually point to the theory of a comet collision. In this part of the book we find the origin of its curious title. Ragnarok, meaning either "the darkness of the gods" or "the rain of dust and ashes," is the word used in some Scandinavian legends which record the coming of the comet. Then follow discursive discussions on the Book of Job and the Genesis narratives, wherein the comet is identified with the Satan of the former and the Serpent of the latter; and in treating the Arabian myths two lovely pictorial illustrations of the gentleman are given. The author continues with an account of Biela's comet, which he suggests was the cause of the great American fires in 1871; maintains that the earth has been struck by comets many times, thus causing the Appalachian Range of America, the Cambrian and Old Red conglomerates, the Lower Silurian boulders of Scotland, and sundry other specified strata; and concludes by a highly religious epilogue on "The After World," which he especially commends to the consideration of the "Dives" of the present.

It is impossible, within the limits of a brief review, to discuss the whole of these statements and reasonings, but the more important may with advantage be noted. The quotations from the numerous authors referred to are as jumbled and intermixed, without any regard to locality or time, as the Drift deposits themselves, and this fact does not tend to clearness of discussion. The authors quoted would, in some cases, certainly be surprised at the inferences drawn, or rather suggested, from their words. Concerning the four theories by which it has been attempted to explain the Drift, and which this book rejects, the first, viz., the Diluvial, may be put out of the question. There remain the action of icebergs, of glaciers, and of a continental ice sheet. Now each of these is undoubtedly a *vera causa* in actual operation on the earth's surface at present, producing phenomena and results analogous to those found in the Drift deposits. There now is a continental ice sheet in Greenland and in the Antarctic regions, from which icebergs invade the northern and southern oceans. Most high mountains above the snow line are snow capped, and their glaciers descend into the valleys, carrying with them the materials of their moraines. To these three true causes might be added another in the known phenomena of shore and river ice. These four causes are undoubtedly at work now in different districts of the earth's surface. How they were combined, and in what manner they were enlarged and intensified so as to produce the glacial deposits, is a matter for fair discussion and fuller research.

But can the same in any sense whatever be said of a comet? In other words, can a comet be said to be a *vera causa* at all? The physics of the cometary system have become much better known in late years than formerly; but still much remains to be known. What is known, however, utterly negatives the idea that one of these erratic visitors caused the Drift. This book speaks of a comet "many times larger than the mass of the earth" (p. 264); and again (p. 399) of "the attractive power of the comet great enough to hold its gigantic mass* in place through the long reaches of the fields of space." Whereas it is perfectly well known that the mass of existing and recorded comets must be very small compared with that of other bodies in the Solar system. Otherwise the perturbations caused in planetary motions must necessarily have been observed by astronomers. Indeed, our author quotes from the "Edinburgh Review" that "In the years 1767 and 1779 Lexell's comet passed through the midst of Jupiter's satellites and became entangled temporarily among them. But not one of the satellites altered its movements to the extent of a hair's breadth, or the tenth of an instant." This shows that the mass of this particular comet must have been very small. Moreover, the extreme tenuity of cometary matter is shown by other things; the writer of these lines himself saw the star Arcturus shining brilliantly through Donati's comet in 1858; and it is a well-known fact that a star of the fifth magnitude was clearly seen, with no abatement of its light, through the centre of the nucleus of the comet discovered by Miss Mitchell in 1847.

Nor, indeed, does the now commonly received hypothesis that some comets are attended in their orbits by meteoric masses, which occasion displays of shooting stars, in any degree support the idea that a comet caused the glacial deposits. Meteors and aerolites are very different things from boulders.

It may of course be urged that known comets of modern days can be no measure of the gigantic results which accrued from them ages ago. But, surely, if they were of such gigantic mass as Ragnarok represents, they would have been

* Is it possible that the author here has confounded the word 'mass' with 'magnitude'? Magnitude may be immense when mass is small.

reduced to orderly conduct by mutual attractions with other bodies of the Solar system, or dispatched again into space.

For these and other reasons we decline to receive, as a *vera causa* of the Drift deposits, the impact of a comet. Whilst at least four true causes are known to be at work on the earth's surface now, whose combination can explain the facts, there is no need to journey to a hypothetical comet for an explanation ; nor is it probable that such a comet will journey to us, and if it should the results would be anything but glacial.

A word or two must be said concerning the origin of the boulders and erratic blocks, and also concerning the absence of evidence of life from the deposits. As to the former it is well known that in our own Midland district the boulders are identical in composition and appearance with local rocks, and also with rocks occurring *in situ* in Wales, the Lake district, and Scotland. The phenomena are similar in character in other districts. There is no need to go to a comet to account for these. Concerning the absence of evidence of life the author appears to have somewhat misunderstood the statements he quotes from sundry geologists. These refer simply and solely to contemporary life, not to fossil evidence of life from other formations. In our own district the boulders and Drift pebbles contain abundance of well-known fossils derived from Palæozoic and other rocks, as the collection in the Midland Institute, and that exhibited in Bingley Hall last September, clearly demonstrate. The material of the Drift came from previous formations. There is no need to go to a comet when such rocks occur within 100 miles, and also at no great distance beneath our feet.

Passing now for a moment to the Biblical Exegesis, though that scarcely belongs to a scientific journal, it is even more startling than the science. The writers of the books of Job and Genesis would certainly be appalled if they saw the explanations of Ragnarok. Its author has re-arranged, excised, and explained in such a way as to produce a tessellated mosaic of the Mosaic narrative, at which even the most advanced of modern critics would stare in amazement.

Now, finally, for one or two brief illustrations of quaint sayings and reasonings. Page 405 states "In the age of man's declension he moved eastward. In the age of his redemption he moves westward." If this statement be true it is good for America but bad for Britain. On page 366 is found "The negro race, it seems probable, may have separated from our own stock in pre-glacial times, and survived, in fragments, somewhere in the land of torrid heats, probably in some region on which the Drift did not fall. We are told by Ovid that it was the tremendous heat of the comet age that baked the negro black; in this Ovid doubtless spoke the opinion of antiquity. Whether or not that period of almost insufferable temperature produced any effect upon the colour of the race I shall not undertake to say, nor shall I dare to assert that the white race was bleached to its present complexion by the long absence of the sun during the Age of Darkness."

In treating of Biela's comet it is written:—"In the year 1871, on Sunday, the 8th of October, at half-past nine in the evening, events occurred which attracted the attention of the whole world, which caused the death of hundreds of human beings, and the destruction of millions of property, and which involved three different States of the Union in the wildest alarm and terror." Then follows a detailed account of the immense fires which broke out at the time stated, "*at apparently the same moment*, at points hundreds of miles apart, in three different States, Wisconsin, Michigan, and Illinois." And these the author connects directly with the impact of Biela's comet, which is stated to have occurred on the 27th of November, 1872. This is going rather too far. How could a comet's impact, on the 27th of November, 1872, cause fires, at Chicago and other places, on the 8th of October, 1871? Moreover, Biela's comet, or its tail, did strike the earth on 27th November, 1872, and was seen from Madras, some days afterwards, on two consecutive mornings—"circular, bright, with a decided nucleus but no tail, and about forty-five seconds in diameter" (see Edin. Rev., Oct. 1874, p. 414). The presumption clearly is that the tail was partially burnt up in the earth's atmosphere, causing the magnificent meteoric shower of that date.*

Surely the book must be a *jeu d'esprit* after all. It is amusing reading, but as a serious contribution to the literature of the subject is highly unsatisfactory.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 156.)

SECOND PERIOD, 1751 TO 1800.

The third volume of the second edition of Withering was published in two parts. Part I., containing additions to the first two volumes, errata, index, and other matter, is undated.

* The reader will find the full story of Biela's comet narrated in "Nature," vol. xxxiii, pp. 392, 418.

Part II., containing the Cryptogams, with title page to the whole volume, bears date 1792. The only references in Vol. 3, germane to this history, are the following :—

Stokes in Withering. Edit. 2, Vol. 3, 1792.

Trifolium flexuosum, Jacq., p. cxxvi. Worcestershire. St. (*T. medium, L.*)

Ophrys ovata, cxxvii. Hurcot Wood. St. (*Listera ovata, R. Br.*)

Ophioglossum vulgatum, p. 45. Broadmoore, near Birmingham. With.

* **Osmunda Lunaria**, 46. Coal Pit Banks, near Stourbridge. Mr. Waldron Hill. *Whether in Worcester or Stafford is not stated.*

Polypodium vulgare, 55. *β*. Wings doubly serrated. Worcestershire. St.

Adding the 4 new records in this list to the 105 in the previous one, it appears that Dr. Stokes contributed 109 species to the Worcester Census, chiefly on the authority of Mr. Ballard, besides publishing new localities for plants previously noted. If he had also recorded the commoner species he would have laid the foundation for a complete Flora of the County.

I find that the Snowdrop, Galanthus nivalis, was first recorded by Withering in the first edition of his Bot. Arr., 1776, appendix, p. 783 *(bis)*, as "growing plentifully at the foot of Malvern Hills, Worcestershire," on the authority, as we learn from Stokes, of Mr. Ballard. My friend Mr. Towndrow informs me that the locality is in the County of Hereford, and that the plant still grows there.

The names of the localities in Dr. Stokes's list differ somewhat from those by which the same places are now known. Robinson's End is Robert's End, and the cluster of houses there Robert's End Street. Clarkton Leap is Clerkenleap, near Kempsey. The Ridd should be the Rhydd, and the Blankets the Blanquettes.

In the year 1789 a new edition of Camden's Britannia, by Richard Gough, was published, in 3 vols. fol. This work is cited by Dr. Trimen, in the article previously referred to, among "the Botanical Bibliography of the British Counties." The Editor states in the preface, p. v., that the want of "*a formal catalogue of plants peculiar to each County*" . . . . "*has, I trust, been in some measure supplied by the help of some young friends who have exerted their utmost diligence in collecting the plants peculiar to each County from books and from the researches of themselves and other Botanists, who have multiplied since Ray in the same proportion that science has improved.*" The curious inquirer, who turns to the Worcester list, in

Vol. II., p. 874, will be surprised to find that it is simply an appropriation, without acknowledgment, of the list published by Dr. Nash, re-arranged in alphabetical order, with one of the species omitted, probably by accident, and that Stokes's work is ignored. We may, therefore, dismiss Mr. Richard Gough and his diligent young friends from further notice in these pages.

The third edition of the "*Arrangement of British plants*" was published in 1796, three years before the death of the Author. It appears to have been edited by Withering himself; at any rate, I find no trace of the hand of Dr. Stokes. It contains many new County records, and names of new correspondents, among whom may be mentioned the Rev. Mr. Baker, of Stouts Hill, Gloucestershire; Miss Read, probably of Bromsgrove; and Mr. Wm. Pitt, the author of a series of Reports on the Agriculture of the English Counties. The following is a list of the new records contained in these volumes, and of new localities of species previously recorded, where they are of sufficient interest to republish:—

Withering, 3rd Edition, 1796.

* **Hypericum Androsæmum**, p. 663. In a deep holloway in a marly soil between Worcester and Tewkesbury.

H. dubium, 665. Discovered first as an English plant by Dr. Seward, of Worcester, growing plentifully about Sapey in that county.

Geranium phæum, 605. Near Cradley, Worcestershire.

N.B.—The Worcestershire Cradley is between Halesowen and Stourbridge and must not be confounded with the Herefordshire Cradley, near Malvern.

Genista anglica, 625. Broadmoore, near Birmingham.

* **Lathyrus Nissolia**, 632. Hadsor Wood, near Droitwich. Mr. Baker.

* **Rosa spinosissima**, 465. Frequent in the sandy Country about Bewdley.

Galium Cruciata, 187. Plentiful from Newcastle to within a few miles of Worcester, but further south it is scarce. Mr. Baker.

Onopordum Acanthium, 704. Road from Worcester to Droitwich near Henlip. Mr. Baker. "*Henlip" should be Hindlip.*

* **Campanula patula**, 242. Near Hagley on the Kidderminster Road, plentiful.

C. Rapunculus, 242. Hindlip, Worcester.

C. latifolia, 243. On the road from Halesowen Abbey to Birmingham, a mile from the former, on a shivery sand rock.

* **Vaccinium Myrtillus**, 370. Lightwoods, near Birmingham.

Veronica scutellata, 16. Broadmoor, near Halesowen.

Euphrasia Odontites, 543. Var. 2. Flowers white. Sent to me by Mr. Bourne, who gathered it on Northington Farm, Grimley, near Worcester.

Melampyrum pratense, 545. In the woods near the road from Birmingham to Halesowen.

Nepeta Cataria, 519. Dudley Castle.

* **Melissa Calamintha**, 538. Dudley Castle.

* **Polygonum pallidum**, 381. Var. 3. Stems spotted with red. In a ditch on Stourbridge Common. St.

This is the P. pensylvanicum, var. petechiale, of Stokes. In later editions of Withering it appears as a variety of P. lapathifolium. It is almost certainly P. maculatum, Dyer.

Ulmus campestris, 278. Plentiful in Worcestershire.

Carex ampullacea, 110. Mill below Droitwich. Mr. Baker.

Poa maritima, 147. Near the Canal from Droitwich to the Severn. Mr. Baker.

This is the first record of a maritime plant in the saline waters of Droitwich.

Festuca duriuscula, 153. Walls of Dudley Castle.

Asplenium Ruta-muraria, 769. Walls at Bewdley.

Polypodium Oreopteris, 775. In a wood at Old Foot's Well near Bromsgrove. Miss Read.

"Old Foots" Well is doubtless a misnomer for Offad's Well, between "the Valley" and Dodford.

P. aculeatum, 777. In a ditch in a meadow in the Valley near Bromsgrove. Miss Read.

P. fragile, 779. Road from Bourn Heath to Worms Ash near Bromsgrove, Miss Read.

The above list yields 19 new County records in addition to those previously published by Dr. Stokes.

I have failed to identify the locality called Broadmoor. As it is described by Stokes as "3 miles S.W. of Birmingham," and by Withering as "near Halesowen," I conclude it to be in the County of Worcester.

In 1799, Nash published a supplement to his History. This contains, at p. 96, an additional list, as to which Nash states that "*The following plants were observed in Worcestershire by my ingenious friend Dr. Sheward, whose untimely death was a great loss to the Infirmary, to the science of medicine, and to the public in general.*" Forty-seven species are enumerated in the list. Of these, two are Fungi—the Morell and the Truffle; seventeen are new or independent records of plants previously noted by Stokes. The remaining twenty-eight are as follows:—

Sheward in Nash's Supplement, 1799.

Dianthus deltoides. Blackstone Rock, near Bewdley.

* **Hypericum dubium.** First found in Worcestershire about Sapey; found since in many other places, as Witley and Martley, growing plentifully by the road side; often mixed with H. perforatum.

* **Geranium phæum.** Well Meadow, below Abberley Village.

Ornithopus perpusillus. Abberley Hill.

Astragalus glycyphyllus. On a marle bank near Gregory's Mill.

Geum rivale. Near a flight of steps leading from the Hope Farm to Sapey Church.

Epilobium tetragonum. Foot of Malvern Hill.

*Chrysosplenium oppositifolium.** With **C. alternifolium.** Near Sapey Brook, in many places.

Sium angustifolium. Ditches near Perry Wood.

Sison Segetum. On a marle bank near Gregory's Mill.

* **Apium graveolens.** Brook side, Salwarpe.

* **Adoxa Moschatellina.** Shady places, Sapey Brook, abundantly.

Asperula cynanchica. Broadway Hill.

Carduus acaulis. Dry Pastures, Sapey.

Erigeron acre. Tops of Walls about the Cathedral.

* **Campanula latifolia.** Hedges below Malvern Hill.

Pyrola rotundifolia. In a wood on the Witley side of Abberley Hill.

Vinca minor. Side of the road to Martley opposite Kemsey Mill.

Vinca major. Roadside. Little Witley and Clifton Hill.

Gentiana campestris. Bewdley Forest between Furniss Mill and the Eagle's Nest Inn.

It is doubtful if this is a Worcester record. Furnace Mill is in Salop.

Verbascum Blattaria. Roadside, Holt.

* **V. minus, flore luteo, foliis acutis.** At the end of the Green Lane in the Parish of Claines. (*Possibly V. virgatum.*)

Mentha rotundifolia. Several places near Sapey Brook.

Triglochin palustre. Boggy Meadows near Sapey Brook.

Convallaria majalis. Shrawley Wood.

Ophrys spiralis. Dry Pastures, Sapey.

Serapias ensifolia. In a wood on the Witley side of Abberley Hill.

* **Scirpus culmo tereti, nudo, capitulo laterali, conglobato.** Single-headed club rush. Found at Throckmorton in the Parish of Fladbury. (*S. romanus.*)

Deducting 7 plants previously noted, giving Dr. Sheward credit for Gentiana campestris and Verbascum Blattaria, his list yields 21 new County records, or, if we include Hypericum perforatum, 22. The following caution of Dr. Stokes (Bot. Arr., 2nd Edit., p. 229), should be borne in mind respecting Verbascum Blattaria :—"*My specimens from gardens, and having never seen it growing wild, I have been sometimes induced to suspect my Virgatum to have been taken for the true V. Blattaria.*" Mr. Towndrow, however, assures me that he has seen V. Blattaria at West Malvern, and, he believes, also at Madresfield, so that there is no reason to doubt its being a Worcester plant. The Scirpus is obviously S. romanus and has the appearance of an independent record, 21 years after its first publication by Hudson in the "*Flora Anglica.*"

The records to the end of the 18th century may be summed up as under:—

First Period, to 1750			11
Second Period, 1751 to 1800—			
Hudson, *Flora Anglica, 2nd Ed.*, 1778 ...		1	
*Nash, *Coll. Hist. Worc.*, 1781		39	
Stokes, *With. Bot. Arr., 2nd Edition* ...	1787—1792 ...	109	
Withering, *Bot. Arr.*, 3rd Ed., 1796 ...		19	
Sheward, *Nash, Suppt.*, 1799		22	
			190
			201

The close of the 18th century is notable for the appearance, in 1790, of the first of the 36 volumes of the celebrated "*English Botany,*" the figures by James Sowerby, the descriptions by Sir J. E. Smith. We learn from the latter that Dr. Stokes was one of his most valued contributors. He writes of him (Vol. I., No. 19) "*whose accuracy and extensive information none can doubt.*"

It will be interesting to mention, in this place, that in the description opposite to the plate of Verbascum virgatum, No. 550, Vol. 8, 1799, Sir James Smith writes as follows:— "*Dr. Stokes first clearly ascertained this species.*" "*Our worthy friend, the Rev. Mr. Baker, took this individual plant, when a seedling, from one of the spots near Worcester mentioned by Withering, and it flowered in his garden. He informs us this Mullein was first observed growing plentifully in a field near Wrexham, by Mrs. Nash, who planted it in her garden at Bevere, from whence probably its seeds got to the neighbouring Turnpike road to Ombersley, and from thence to the lane leading to Gregory's Mill.*" The plant now grows in several spots in the north of the County, where it is difficult to imagine that it can have spread from Bevere.

In Vol. 23, 1806, No. 1,612, Smith writes, under Scirpus Holoschœnus, "*The last-named Botanist (Hudson) mentions the Scirpus romanus, which I am convinced is a small variety of this, as growing in marshes near Throgmorton, Worcestershire.*"

* I have allowed the Snowdrop to remain in Nash's record. But if his locality was in Hereford the first record of this species as a Worcester plant must be transferred from Nash to Stokes.

(To be continued.)

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THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 113.)

II.—Would the Water go into the Middle Lias Beds?

At the commencement of the discussion which this scheme for water supply provoked, at Northampton, I was asked for proofs that the surface water would go into the beds of the Middle Lias, from which the town supply was then obtained. It was asserted that the Marlstone Rock-bed yielded no water at the Spinney Well near Northampton because of the closeness of the rock, and that the beds below were all clays and did not carry water, and it was suggested that like conditions might exist in those parts where I proposed to place feeding wells. I had no personal knowledge of the condition of the Middle Lias beds at the Spinney Well, and the descriptions that have appeared of the Spinney Well in my own papers and those of Mr. Eunson were given by the sinkers of the well, and so are not very exact in the description of the beds. Such being the case, I think I may be permitted to doubt the adequacy of the reason assigned for getting no water, and to assign another, as I do later on. The fact that no water was obtained, however, induced me to consider the matter much more fully than I should otherwise have thought necessary, although this stands out as an isolated instance of finding the Marlstone of the county without water, amongst hundreds of others in which water has been found. In Part I. numerous sections are described, from which a good idea of the character of the Middle Lias beds in Northamptonshire can be obtained, and it will have been noticed that there are two sets of springs—the first being thrown out near the top, by the clays just below the Rock-bed; the second near the base of the Middle Lias.

There is no one place where the whole of the Middle Lias beds can be seen, but on the whole, perhaps the best section is at Staverton, thirteen miles west of Northampton (see Part I., p. 211, Vol. VIII.), and anyone visiting this place will, I am sure, be quite convinced that there are two sets of springs in the Middle Lias of this part of the county, and that the sandy micaceous beds of the "*Margaritatus*" *Zone* are pervious to water.

It is several years since I first suggested that these porous beds of the "*Margaritatus*" *Zone* might be used as reservoirs for surplus water. I believe they now act in much the same way as the chalk, *i.e.*, absorb large quantities of water and slowly deliver it to the water-bearing bed at their base, and thus tend to equalise the flow throughout the year. If the lower water-bearing bed were more frequently used, and the water pumped from it at points situated some distance from its outcrop, there is little doubt that the sandy beds of the "*Margaritatus*" *Zone* would absorb and allow to pass through them much more water than they do now.

At only one place—DODFORD—have I seen water actually flow from these soft beds, and there it might have been from a fissure communicating with the lower spring, as it was most certainly within a few feet of the latter. The general dryness of Middle Lias lands, of these beds as seen in a section, and the readiness with which a specimen will absorb water, combined with the fact that nearly all the fossils found in them are casts only, show that water has a fairly ready passage through them. Now, although the success of the scheme for water supply that I am discussing does not depend upon these beds retaining the characters they have in the western parts of the county as far as Northampton, nor, indeed, upon their existence there, still a demonstration of their presence, and of the lower spring, so far eastward, would favour any project for the utilisation of the Middle Lias as a reservoir for surplus water.

On the first occasion when this scheme was presented to the Water Committee of the Town Council of Northampton, I spoke of the sandy micaceous clays and the second spring as existing at Northampton, but the existence of either was denied, I presume from a consideration of the results obtained at the Spinney Well. Considering that I put a different interpretation on the results of this boring, I also retained my opinion on the two points referred to above.

With regard to the porous beds of the "*Margaritatus*" *Zone* I may have been partly wrong; that is, they may be less sandy, and consequently less porous under Northampton than further westward, as they are thinner, but this is not certain; what little evidence there is will be given presently. So far as these beds can be traced by superficial sections, they vary very little. At STAVERTON, BADBY, NEWNHAM, and on the north side of the great Nen fault, near to WEEDON (new railway cutting), they have nearly the same characters. The evidence as to the lower spring has accumulated until it is quite conclusive. It must be borne in mind, that in making wells in the Middle Lias, water is, practically, always found in the Rock-bed, and until recent years the water so found would generally rise to a considerable height in the wells, so that further sinking would be somewhat difficult and quite unnecessary ; hence the second spring was never found.

In the summer of 1884, this lower spring was tapped within about four miles of Northampton under the following circumstances. In the village of MILTON there are some fifteen or twenty wells in the Middle Lias, from which plenty of water was obtained until the last few years. One of these wells, probably a hundred years old, is in the house used as an inn —The Greyhound—and occupied by Mr. East, who is also a brewer. The supply of water being inadequate, the well was opened, and it was found that the rock was only just broken into, as though an inrush of water had stopped further operations. To get more water it was necessary to deepen this well or dig another outside the house ; the latter plan being decided upon, it was commenced, and water had been found before I heard of the work. The water came chiefly from the lower part of the rock, and did not quite cover the bed. Mr. East asked my advice as to going deeper, in order to make a reservoir for storing the water, which did not flow in as fast as they at times wanted to pump it. I ventured to recommend him to go deeper with the object of tapping the lower spring, which, if present, would certainly be met with within 40 feet. It was decided to deepen the well, and when they had got down 10 feet lower, a hard nodular bed was met with ; this was only just broken into when a jet of water burst out to a height of a yard, and the influx of water was sufficient to stop further sinking. The section of this well has been already given (Part I., p. 75, Vol. IX.) After stopping the Rock-bed supply and bricking the well down to the lower water-bearing rock, the water rose and stood in the well 10 feet; that is, to almost the same level as did the Rock-bed supply previously, although its source was 10 feet lower. It shows no tendency to sink lower, and by their present pumping power (900 gallons per hour) they can only reduce the water level 4 feet. Thus it will be seen a difference of head of 4 feet between the water level in the well and the adjacent strata gives a flow of about 21,600 gallons per day.

The discovery of this second spring in the Middle Lias so near to Northampton I considered rather important, because from its position, almost south of Northampton, it furnished almost conclusive evidence that the same bed existed at Northampton itself, and therefore made it more probable that the sandy micaceous beds also existed, as one or more of them certainly did at Milton. Here, however, is the little piece of adverse evidence referred to a page or two back. The micaceous clay—see Section, p. 75, Vol IX. —out of the well seemed about as I expected to find it, but quite dry, whereas the bed just below yielded water under considerable pressure. From the condition of the fossils, too, I do not think much water had passed through this bed.

About this time attention was directed by the opponents of this scheme to a fresh instance of the Marlstone being found without water. It was a well sunk at Messrs. P. Phipps and Co.'s Brewery. On investigation I was surprised to find that a large amount of water was being obtained from the well; it issued from cracks in the rock along two headings, and the amount of water was increasing rather than diminishing, owing probably to the development of more definite channels. I was still more surprised to find that the rock was not the *Rock-bed*, but the lower water-bearing bed. The evidence on this latter point was quite definite, the common Rock-bed fossils were entirely absent, and those characteristic of lower beds present; furthermore, Mr. T. Phipps informed me that the water was quite different to that supplied to them by the town waterworks.

This same spring was also met with at Gayton (see p. 74, Vol. IX.)

It seems, therefore, practically certain that the lower spring might have been found at the Billing Road Well had it been sought for, and from its position, on the northern side of the Nen fault, it might be expected to yield a supply of water greater than that of any of the other places where it had been tapped in the neighbourhood. The expense connected with deepening the well, probably less than 25 feet, would have been much less than that incurred in obtaining other small temporary supplies.

It must at least then be conceded that the lower part of the Middle Lias under Northampton is not impervious, although it may not be as porous as the Rock-bed.

It must be borne in mind that when water gets into a porous bed in which there are no open fissures, there immediately commences a struggle between capillarity and gravity, and no water will flow till the capillary-holding power of the rock is satisfied; afterwards the flow of water depends upon the size of the interspaces between the particles, which interspaces are, of course, proportional to the size of the particles. A stiff clay consists of such small particles that the interspaces are minute enough to retain all the water that can get in, consequently, when a clay is once thoroughly wetted, no more water can pass downwards through it.

Clay, although impermeable, will often contain 10 per cent. of water by weight, and when apparently quite dry, often more than half that amount. I have made these remarks because it seems to be rather a common belief that water only travels in the Middle Lias by means of open fissures, whereas the great mass of the rock is engaged in supplying these fissures with water.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

PART V.—"PHYSIOLOGICAL DEVELOPMENT."

EXPOSITION OF CHAPTERS I. TO V.

BY KINETON PARKES.

In discussing the problems of physiology generally Mr. Spencer reminds us that we must use the word "physiology" in a sense co-extensive with the sense in which the word "morphology" was used in the previous part.

The various processes of animal and plant life must be considered in a way analogous to that in which their structures were considered. So that in this consideration the words have a far greater significance than is generally attributed to them. They are used to include respectively "All the general phenomena . . . . which illustrate the processes of integration and differentiation characterising evolution in general," and "the evidences of those differentiations and integrations of organic functions which have simultaneously arisen."

The enquiry pursued in these chapters is "How heterogeneities of *action* have progressed along with heterogeneities of *structure*," in them are traced out the various differentiations which have taken place in the life processes, and how these differentiations have been the accompaniment of the changes which have taken place in the bodies of the various organisms that are known to us. At the end of this enquiry we shall realise how fully life itself consists of "a definite combination of heterogeneous changes, both simultaneous and successive."

One of the first facts that is noticed, in a practical acquaintance with vegetable forms, is the difference between their external and internal parts. However lowly the organism may be, there is a clear distinction between the parts exposed to view and the parts enclosed by them. The plant "presents a contrast between its peripheral substance and its central substance." This difference may, indeed, be but slight, but it is inevitable. In whatever way the organism is viewed this fact appears first and prominently. The differences in the various species are naturally varied and numerous, but however unlike some of them may be they all agree in this one important particular, "a strong distinction between the parts in contact with the environment and the parts not in contact with the environment." It is to this fact, simple as it may seem, that differentiation of function is due.

In the consideration of the "differentiations among the outer tissues of plants," Mr. Spencer instances two forms of plant life, the *Protococcus* and *Volvox Globator*, two free forms. The *Volvox* is a complete sphere, and, consequently, no part of its outer surface is different to another, and forces act equally upon the whole of its exterior substance. This is anticipated by the hypothesis "If differentiations are occasioned by differences in the incidence of forces, then there will be no such differentiations where there are no such differences." On the other hand, considerable differences are noticeable where one end of any organism is attached to some object; then the differentiation is very great, because the difference in the incidence of the forces has been great also.

In the case of the Phanerogams, the environments of the fixed part and the free part of the plant are entirely different. The root is buried in the ground; that is, its environment is the earth. The environment of the stem, branches, and leaves is the air.

It is needless to point out the differences between the roots of a tree and its stem and branches: they are obvious; but the question is, How came these differences to exist? If we take a cutting from a tree and place a portion of it in the earth, that part, if all conditions are favourable, speedily develops rootlets and root fibres; in fact, part of a stem has assumed the characteristics and the functions of a root. And to what is this change due? To the altered environment, and to the incidence of different forces. But, as Mr. Spencer says, "the most conclusive evidence is furnished by the actual substitutions of surface-structures and functions that occur in aërial organs, which have taken to growing permanently under ground, and in underground organs which have taken to growing permanently in the air. On the one hand, there is the *Rhizoma*, exemplified by ginger. . . . . On the other hand, there are the aerial roots of certain orchids." We have here an answer to the question; an explanation of those causes which bring about the changed conditions.

A most important matter is such differentiation of tissues as shall form organs for the production of seed, in order to perpetuate the species. The consideration of many facts in the study of vegetable physiology leads to the conclusion that the process of "gamogenesis commences where the forces that conduce to growth are nearly equilibrated by the forces that resist growth; and the induction that in plants, fertilised germs are produced at places where there is an approach towards this balance" is found "to be in harmony with the deduction that an advantage to the species must be gained by sending off migrating progeny from points where nutrition is failing."

The agency of insects in the propagation of seed has been pointed out by Darwin, and its importance fully illustrated. Since Mr. Spencer wrote "The Principles of Biology" much has been done in this fascinating branch of study, by many of our most eminent naturalists. Fertilisation of flowers, by means of bees and butterflies, is the most popular form of looking at the subject, but there are many insects other than these whose importance in this respect is quite as great. Whatever results have been obtained from these studies have, more or less directly, added proof to the things Mr. Spencer has said.

Having dealt with the differentiations among the *outer* tissues of plants, we come to the consideration of "The differentiations among the *inner* tissues of plants." As we pass from plants of low organisation to those of a more complex structure, it is noticeable that the inner tissues begin to differentiate. The parts which were at one time homogeneous now begin to assume a heterogeneity of structure, and this change may be noted increasingly as we ascend from low to high forms. In the lower forms, where, as an instance, the organism may grow in a vertical position, but to no great height, the differentiations in the inner tissues do not require to be very extensive. A spiral vessel will answer the purpose very well as in a fern, or other similar vessels as in the flower-stem of the blue-bell or tulip. When, however, a higher stage is reached, as the stem of an endogenous or exogenous tree, in order to keep it vertical, and in order to keep its branches in the right positions, considerable differentiation must have taken place.

The function of circulation, and the formation of vessels, are matters which are part of this consideration. If at a certain place in a plant a large amount of sap is being consumed, it seems natural that a flow of sap should set in in the direction of that part. This includes circulation and the formation of vessels. But, as regards the latter process, two questions arise. Is a vessel a distinct formation? or is it a number of cells which have coalesced (their partitions being removed) to form a vessel? The second method seems to be the more probable way. The contents of one cell would burst through its walls at the weakest point and enter the next cell, and this process would be continued till, at length, it resulted in the formation of the vessel. These are the more important subjects involved in the consideration of the inner tissues of the plant. In Chapter V. the "Physiological Integration of Plants" is dealt with, and we find that an increase of differentiation implies a corresponding increase of integration. In the lower forms of plant life there is little integration observable, but as higher forms are studied and physiological division of labour takes place, then integration is the accompaniment. "Always the gain of power to discharge a special function involves a loss of power to perform other functions," and, therefore, integration must take place in order to keep pace with differentiation.

"Thus, that which the general doctrine of Evolution leads us to anticipate, we find implied by facts. The physiological division of labour, among parts, can go on only in proportion to the mutual dependence of parts; and the mutual dependence of parts can progress only as fast as there arise structures by which the parts are efficiently combined, and the mutual utilisation of their actions made easy."

NEW BRITISH MOSS.

I am pleased to report that *Dicranum undulatum*, Ehrhart, was found, for the first time as a British plant, near Great Wolford, Warwickshire, May 31st of this year. This I picked up whilst hurrying to catch a train, and as I did not recognise it until I reached home, I was unable to form an opinion as to whether it was abundant or otherwise. At the end of last week, however, I paid another visit to the locality, and found that the tropical heat of the last week or so had so shrivelled up the mosses that I had some difficulty in again finding my plant; but so far as a two hours' search would reveal, I think it must be recorded as very sparse in quantity. Possibly in the autumn and spring months of the year it may have been more abundant. Having unearthed it in this locality, I have great hopes of being able to find it in other parts of the same district, and have no doubt that it will be found on damp heathy spots in the Valley of the Evenlode, in Oxfordshire, and probably in the adjacent portions of Gloucester and Worcestershire. I at once forwarded specimens to Dr. Braithwaite, and the plant is fully and ably described in Part X., supplement, page 299, of "The British Moss Flora," and Dr. Braithwaite promises an illustration in the supplement of Vol. II. of the same work. The following is the condensed description of the moss:—"*Dicranum undulatum*, Ehrh. Dioicous; robust, densely tomentose. Leaves from a broad base, lineal-lanceolate, *strongly undulate, coarsely serrate at margin, and in two rows at back of nerve;* caps. aggregate, oblong-cylindric, arcuate; lid with a long subulate beak." "Brit. Moss Flora," page 299. The Wolford plant is barren. I think it will probably be found in other British stations, as it may have been overlooked as merely a barren state of *Dic. scoparium* or *Dic. palustre.*

J. E. BAGNALL.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

EXCURSION TO OXFORD.

On Whit Monday, May 30, an excursion of the members and their friends was taken to Oxford, by the 10.5 a.m. train from Snow Hill, arriving at Oxford at 12 noon, where the party were met by Mr. G. C. Druce, F.L.S., and Mr. G. Simms, of Oxford, who conducted them over the various places of interest in the city, and had made special arrangements for the reception of the party. After a light luncheon at the George Hotel, the party were conducted along Market Street into the Turl, seeing Lincoln, Exeter, and Jesus College fronts; and into the Broad, seeing Trinity and Balliol Colleges, and opposite Balliol the spot of the martyrdom, in 1555, of Bishops Ridley and Latimer, and Archbishop Cranmer; then along St. Giles', past the Martyrs' Memorial into Parks Road, where the Ashmolean Museum was visited, containing a very interesting collection of antiquities and relics; and then the Natural History Museum and Ethnological Museum. In the Natural History Museum, amongst the fine series of specimens illustrating Zoology and Geology, there was particularly noticed the attempt to give a perfect sequence of the evolution of life in different classes of the animal kingdom, especially in the Cephalopoda, which were present as they flourished on that very spot as the Ammonites of the Lias, and as the still living forms of Argo, Nautilus, and Octopus. The corals were lovely, and the models of these, and of the Actinoids, and of the development of the Echinoderms, were especially interesting. The glory of the collection was, however, the magnificent

Pentacrinus asteria, a stalked crinoid, from the West Indies, nearly two feet in height. Keble, the most recent college, founded in 1868, was then visited, where the party were courteously conducted by Canon Moore over the richly decorated chapel, the hall, and the library; and were shown Holman Hunt's celebrated picture, the "Light of the World," which has been presented to Keble College. Trinity and Wadham College Gardens were then seen, containing fine groups of large trees, including horse chestnuts in blossom; and the party proceeded to the Radcliffe Library, with its fine collection of modern English and foreign scientific literature; passing St. Mary's Church and Hertford College to New College, dating from as early as 1380 A.D., with its very fine chapel and cloisters, and large hall. In the gardens was seen the remaining portion of the ancient city wall, with its projecting bastions, and a picturesque view of Magdalen tower between the trees of the garden. High Street was then reached, and its grand sweep of fine buildings, terminating with the beautiful tower of Magdalen College; and the party were conducted by Mr. H. E. Garnsey, M.A., over the college, and its chapel, cloisters, and the pleasing water walks on the banks of the Cherwell. The Botanic Gardens were then visited, where the party were received by Professor Balfour, and shown by him over the houses, containing fine specimens of tropical plants, the museum, and botanical laboratory, and the library containing rare old books and the original drawings of standard botanical works, such as Sibthorp's "Flora Græca," and one of the two or three existing copies of the engravings of Dioscorides' plants, both of these left by Dr. Sibthorp to the University. The party then proceeded by Christchurch Meadow, along the Cherwell, to see the university barges on the Isis; and from thence by New Walk to the Cathedral, Christchurch College, the great Quad, and the celebrated "Tom" tower. After a substantial meal at the George Hotel, the party visited the beautiful and extensive gardens of St. John's and Worcester Colleges, with fine groups of trees and extensive shrubbery walks. Amongst the trees noticed during the day was a very fine cut-leaved alder, *Alnus incisa*, in New College Gardens; and in Christchurch Meadows were seen the last relics of *Fritillaria meleagris*. On the limestone walls the Oxford ragwort, *Senecio squalidus*, was seen, and the ivy-leaved toad flax, *Linaria cymbalaria*, was very abundant. The party then proceeded to the station, leaving by train at 8.12 p.m., and arriving at Birmingham at ten o'clock, having greatly enjoyed the visit, and been favoured with fine weather throughout.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT MALVERN.

We beg to point out that the Annual Meeting for this year, at Malvern, is to be held on the 6th and 7th of July, being Wednesday and Thursday instead of the usual days of the week.

The Meeting of the Council is to be held at 12, and the General Annual Meeting at 3 p.m., in the Drill Hall, Albert Road.

At the Conversazione in the evening there will be various exhibitions of scientific interest and short addresses on points connected with the local Natural History and Antiquities.

The excursions on Thursday, the 7th of July, will be three in number, so arranged as to specially meet the requirements of Geologists, Botanists, and Archæologists, respectively.

The Geologists will visit various points of interest in the Malvern chain of Hills and the vicinity, including the very fine collection of local fossils made by Mr. Piper, of Ledbury.

For the Botanists, Twining Fleet and Bredon Hill will no doubt furnish a rich harvest of uncommon plants, while the Abbey at Tewkesbury, the almost unique Saxon Church at Deerhurst, and the ancient houses of Payn's Place and Birtsmorton will afford plenty of interesting material for the Archæological excursion.

Review.

A Modern Apostle, etc. By CONSTANCE C. W. NADEN, Author of "Songs and Sonnets of Springtime." London:—Kegan Paul, Trench, & Co., 1887.

THE pages of the "Midland Naturalist" are not usually open for the criticism of works of a purely literary character, and therefore the indulgence of its editors and readers is craved for this departure from precedent. But, on the other hand, the reviewer is of opinion that a perusal of the dainty volume of poems above mentioned, will not only justify the present notice, but will call forth the gratitude of readers for being introduced to it, especially as the contents of the volume are written on a sound scientific basis, such as that laid down by Mr. Herbert Spencer in his famous "Essays on Education," wherein, speaking of poetry, he says:—"Like music, poetry has its root in those "natural modes of expression which accompany deep feeling. Its "rhythm, its strong and numerous metaphors, its hyperboles, its "violent inversions, are simply exaggerations of the traits of excited "speech. To be good, therefore, poetry must pay attention to those "laws of nervous action which excited speech obeys. In intensifying "and combining the traits of excited speech, it must have due regard "to proportion—must not use its appliances without restriction; but, "where the ideas are least emotional, must use the forms of poetical "expression sparingly; must use them more freely as the emotion "rises; and must carry them to their greatest extent, only where the "emotion reaches a climax. The entire contravention of these "principles results in bombast or doggerel. The insufficient respect "for them is seen in didactic poetry. And it is because they are rarely "fully obeyed that so much poetry is inartistic."

It is not too much to say that throughout her present work the accomplished authoress has fully and faithfully followed the scientific canons of the distinguished author of the Synthetic philosophy. The writings of Miss Naden are not unknown in the pages of this Journal, and her able expositions of some of the cardinal points of the doctrine of evolution in addresses delivered before the Sociological Section of the Birmingham Natural History and Microscopical Society on "Special Creation and Evolution," and on "The Data of Ethics," have had a wider circle of admirers. Thoroughly schooled in the domain of evolutionary teaching—a psychologist of a very high order—and a poet by nature, with large sympathies in favour of progress and beliefs in its indefinite "survival," Miss Naden has, in this volume, presented her ripest and richest experience.

"A Modern Apostle" is, of course, the principal subject in the work, and it is a poem of great power and beauty, following a noble model—the "Isabella" of Keats. "The Story of Clarice" is a sweetly tender and touching lyric, absolutely true to the life of womanhood:—

> "When pain and anguish wring the brow,
> "A ministering angel thou!"

The "Evolutional Erotics," one of the lesser but not unimportant divisions of the book, include some brilliant touches of humour and satire, mingled with wisdom. The following splendid example will specially commend itself to the acceptance of all Darwinians.

We hail with gratitude the appearance of this beautiful volume as an addition to Miss Naden's laurels, and we confidently predict further triumphs for her both in poetry and philosophy.

SOLOMON REDIVIVUS, 1886.

What am I? Ah, you know it,
  I am the modern Sage,
Seer, savant, merchant, poet—
  I am, in brief, the Age.

Look not upon my glory
  Of gold and sandal wood,
But sit and hear a story
  From Darwin and from Buddh.

Count not my Indian treasures,
  All wrought in curious shapes,
My labours and my pleasures,
  My peacocks and my apes;

For when you ask me riddles,
  And when I answer each,
Until my fifes and fiddles
  Burst in and drown our speech,

Oh then your soul astonished
  Must surely faint and fail,
Unless, by me admonished,
  You hear our wondrous tale.

We were a soft Amœba
  In ages past and gone,
Ere you were Queen of Sheba,
  And I King Solomon.

Unorganed, undivided,
  We lived in happy sloth,
And all that you did I did,
  One dinner nourished both:

Till you incurred the odium
  Of fission and divorce—
A severed pseudopodium
  You strayed your lonely course.

When next we met together
  Our cycles to fulfil,
Each was a bag of leather,
  With stomach and with gill.

But our Ascidian morals
  Recalled that old mischance,
And we avoided quarrels
  By separate maintenance.

Long ages passed—our wishes
  Were fetterless and free,
For we were jolly fishes,
  A-swimming in the sea.

We roamed by groves of coral,
  We watched the youngsters play—
The memory and the moral
  Had vanished quite away.

Next, each became a reptile,
  With fangs to sting and slay;
No wiser ever crept, I'll
  Assert, deny who may.

But now, disdaining trammels
  Of scale and limbless coil,
Through every grade of mammals
  We passed with upward toil.

Till, anthropoid and wary
  Appeared the parent ape,
And soon we grew less hairy
  And soon began to drape.

So, from that soft Amœba,
  In ages past and gone,
You've grown the Queen of Sheba,
  And I, King Solomon.

W. R. H.

Wayside Notes.

SIGNS OF THE TIMES.—In the sermon preached by Dr. Boyd Carpenter, Bishop of Ripon, in St. Margaret's Church, Westminster, in relation to Her Majesty's Jubilee, before the Members of the House of Commons, on Sunday, 22nd May last, after referring generally to the progress of knowledge during the last fifty years, he said:—"The age was not prosaic which had given us enlargement of knowledge and power, which had witnessed three discoveries, any of them equal to the discovery of the laws of motion—the discovery, he meant, of the doctrine of evolution, of the conservation of energy, and of the subtle molecular movement in the physical world, and which had given us Darwin and Spencer, Huxley and Tyndall, M'Clintock, Stanley, Baker, and Speke; he did not call that age prosaic which had drawn men together in closer bonds, extended its enfranchising hand to every creed, stood with tenderer care to the needy and the unfortunate, cherished the fallen, provided for the insane, abolished duelling, and mitigated war; which was the age of Florence Nightingale, of Sister Dora, of Agnes Jones, and Octavia Hill; which had shown us martyrs of science like Brewster and Professor Palmer; martyrs and heroes of the faith like Livingstone, Paterson, Hannington, and Moffat; heroes, too, of the battlefield that had left us records great and heart stirring, like the marches in Afghanistan, in Egypt, and the stories of Balaclava and Rorke's Drift." The above extract is taken from the "Times" newspaper of 23rd May last, the editor of which characterised the sermon as being "remarkable for its power, its brilliancy, and its sustained eloquence."

THE DEATH OF BERNARD STUDER, of Berne, the Swiss geologist, at the ripe old age of ninety-three years, carries back our thoughts almost into the pre-historic period of geological theories. Ninety-three years ago the war between the Vulcanists and Neptunists, as the advocates respectively of universal volcanic and universal aqueous origin of rocks were known, still raged with hardly diminished fury, though the names themselves had hardly as yet become terms of reproach. Hutton had as yet only published in preliminary form his views, now known as the Huttonian theory of the earth, declaring that "the ruins of an older world are visible in the structure of our planet; and the strata, which now compose our continents, have been once beneath the sea, and were formed out of the waste of pre-existing continents," variously modified by forces either mechanical or chemical, igneous or aqueous, and which forces are still existing and acting. Even William Smith, with whom British classificatory geology practically begins, had only two or three years before published his "Tabular View of the British Strata" (1790), and his great map was not published till more than a score of years after. Studer seems to have been the William Smith of Swiss geology, and his greatest work was the publication, in conjunction with A. Escher von der Linth, of a geological map of Switzerland. Perhaps an equally high distinction is, however, to indicate him as one of the very first to study physical geography from the geological point of view.

LOCAL READERS will probably be much interested in a series of articles, entitled "A Review of Lighthouse Work and Economy in the United Kingdom during the past Fifty Years," which Mr. J. Kenward, well known and highly honoured in Birmingham scientific circles, is contributing to the columns of "Nature," the first of which appeared on June 2.

THE PRESERVATION of Alpine plants has entered into a new phase. In spite of the strenuous efforts of M. Correvon, and the society which he founded, many of the beautiful Alpine flowers, especially the edelweiss and the Alpine rose, are in danger of becoming extinct. The government of Valais and the Monte Rosa section of the Alpine Club have caused gardens to be laid out and inclosures to be made for the cultivation and protection of these plants. The station on the Tête du Mouton, near Vissoye, in the Einsicht Valley (Valais), situated at the height of 2,300 metres, cultivates not only plants belonging to the Alps, but some from the Pyrenees, the Himalayas, and the Caucasus.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, May 17. Mr. T. H. Waller, B.A., B.Sc., chairman. The secretary reported the receipt of the annual volume of "Proceedings of the Palæontological Society" in exchange. Mr. Bagnall (on behalf of Mrs. Coker Beck, President of Chiltern Natural History Society) exhibited *Hypnum Kneiffii* (Wimpstone Fields), *Cerastium tetrandum*, *Taraxacum erythrospermum*, *Trifolium subterraneum*, *&c.*, from Bournemouth. A paper of considerable interest was read by Mr. W. P. Marshall, M.I.C.E., on "The recent Riviera Earthquake, with particulars from eye-witnesses." At the close of the paper an interesting discussion was opened by Mr. Evans, a visitor introduced by Mr. Walliker, who was present at Mentone during the earthquake and subsequently. Mr. Evans complimented Mr. Marshall upon the faithfulness of his description of the earthquake phenomena, and gave a graphic and dramatic account of his experience of the earthquake and its effects. A cordial vote of thanks was given to Messrs. Marshall and Evans.—MICROSCOPICAL SECTION, June 7. The president (Prof. W. Hillhouse, M.A.) in the chair. A letter was read from Prof. P. H. Gosse, F.R.S., in which he said the following species of Rotifera (all, till then, undescribed) were sent him, within the last year or two, by Mr. T. Bolton, F.R.M.S., from Birmingham :—*Philodina tuberculata*, *Copeus labiatus*, *Furcularia micropus*, *Rattulus helminthodes*, *Pterodina reflexa*, *Asplanchna eupoda*, *Distyla eupoda*, *Pedetes Saltator*, *Furcularia Boltoni*, *Mastigocerca Lophoessa*, *Diaschiza eupha*, *Notholca polygona*, *Diglena polygona*, *Anuræa polygona*. The last three are not yet published. Mr. Horace Pearce, F.L.S., F.G.S., exhibited rock from Place Fell, Ulleswater, specimens of granite from Shap Fell, rocks from near the summit of Scafell Pike, and volcanic rock from the summit of the Great Gable, Cumberland. Mr. J. Udall exhibited a selection of banded slates, breccias, and hornstones from Charnwood Forest. Miss Taunton exhibited a collection of photographs of countries round the Mediterranean, also some interesting specimens of plants from the same localities. Mr. W. B. Grove, B.A., exhibited the following fungi, from North Wales:—*Œcidium leucospermum*, *Œ. lapsanæ*, *Puccinia anemones*, *P. umbilici*, *Trichobasis Scillarum*, *Uromyces ficariæ*, and *Entyloma ficariæ* from the neighbourhood of Dolgelly; and *Œcidium grossulariæ*, from Menai Bridge. Mr. W. P. Marshall, M.I.C.E., read the report of the Oxford excursion on Whit Monday. Mr. T. H. Waller, B.A., B.Sc., gave an exhibition of rock sections, illustrating the process of devitrification of volcanic glasses, which he described and further explained by thin sections under a series of microscopes.—BIOLOGICAL SECTION, June 14. Mr. R. W. Chase in the chair. Professor Hillhouse gave a paper on "Investigations into the Function of Tannin in the Vegetable Kingdom," describing an extensive series of several hundred experiments that he had made in the investigation of the subject. The conclusions arrived at are that tannin is an intermediate product between glucose or sugar and starch, and is left as a bye-product in the formation of starch, and remains inert without being used up in the process of growth. In the fallen leaves of winter the starch is found to have been all transferred, but the tannin that has been formed remains in them without diminution.—A specimen was exhibited by Mr. Bagnall of a wall-flower with abnormal flowers, in which the petals and stamens were absent, and the calyx and pistil were doubled. Mr. Edmonds exhibited an abnormal tulip flower, which had one of the petals displaced and situated 1½ inches below the others. Mr. Marshall exhibited *Sagitta bipunctata*, dredged in the Menai Straits, a very transparent object of much interest, allied to the nematode worms; also, *Hippolyte varians*, a small stalk-eyed crustacean, dredged at Colwyn Bay. Mr. Chase exhibited *Phormium tenax*, the New Zealand flax; and Mr. Bolton exhibited a specimen of the cowberry, *Vaccinum vitis-idæa*, from Cannock Chase.---SOCIOLOGICAL SECTION, May 5. "On the Effect of Complexion in the Constitution of Offspring," by by Mr. W. H. France.—May 19. On Mr. Herbert Spencer's essays on "Beauty" and "Use and Beauty," by Mrs. Alfred Browett.—May 24. On "Data of Ethics (Psychological and Sociological Views of Conduct)," by Mr. W. R. Hughes, F.L.S. An interesting discussion followed the reading of each of the above papers.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Evening Meeting, June 15; attendance twelve (three ladies). A vote of thanks to the retiring chairman was moved by Dr. Cooper, and carried unanimously. The chairman reported that at the Field Day last week five members went to Swanningham Bog, and collected a good many of the less common plants, among them *Scirpus pauciflorus*, *Eriophorum polystachion*, and the fine moss *Hypnum commutatum*; all of them recorded previously for this station, but for very few other places in the county. The following objects were exhibited, viz.: by Dr. Finch, three distinct forms of the purple lilac, and a number of other garden plants; by Dr. Cooper, specimens of *Claytonia perfoliata* and *alsinifolia*, and of *Potentilla verna* from Wales; by Rev. T. A. Preston, *Asarum Asarabacca* in flower, and several abnormal cabbage leaves, some funnel-shaped and one pair grown together along the mid-rib. Mr. Carter reported that Miss Ridger, of Ashley, had found *Vaccinium* *vitis-Idæa* in flower, on Charnwood Forest, a plant never yet recorded in this county. Rev. T. A. Preston, M.A., opened a discussion on the zero temperature of vegetation. He said it was now an accepted doctrine that about 42° Fahr. was the temperature below which vegetable growth could not take place; that as soon as the temperature rose above that point cell-formation began; that the amount of growth depended mainly upon the length of time during which a plant was exposed to such higher temperature, and the total number of degrees above 42 by which it was affected during that time; and that different plants required different numbers of such degrees to bring them to maturity. He was not himself quite satisfied with this theory. He had collected and recorded phenological observations for a long series of years, and he thought the theory would require some modification. The discussion was continued for some time. The Rev. T. A. Preston then read a short paper on "*Carduus tuberosus*, a rare British Thistle," which was illustrated by a number of dried specimens of this species and of its nearest allies, *C. pratensis* and *C. acaulis*. This thistle appeared only to exist in England in the county of Wilts, and the early records of its appearance there were curiously inconsistent. It now grew at Avebury, and, possibly, in one or two other localities. Some supposed it to be a hybrid between *pratensis* and *acaulis*. It had the habits of the first, and the divided and serrated leaves of the second, but was distinguished by the fusiform tubers of the root.

CARADOC FIELD CLUB (SHROPSHIRE).—The first meeting of the season was held on Friday, May 27th, in conjunction with the Severn Valley Club. The locality chosen was Wenlock Edge, and the special point of rendezvous was Larden Ditches, a large encampment, probably of British origin, and still showing a triple entrenchment. On their route the members of the party paid a visit to no less than three fine specimens of sixteenth century manor houses—Wilderhope, the ancient seat of the Smalman family, and Shipton and Larden Halls, which belonged respectively to the Myttons and the Mores, and are now both the property of Mr. Jasper More, M.P., who, in company with Sir Charles Rouse Boughton, kindly acted as guides on the occasion. The characteristic geology of the neighbourhood was pointed out by the Rev. J. D. La Touche, the president of the Caradoc Club, and several exposures of Upper Ludlow Shale furnished many characteristic fossils. A few plants of some rarity were found, but the day was marred by a succession of cold showers, which were more favourable to the development of mud than the pursuit of science.

DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY.—This Society held their second meeting for this season on Tuesday, 14th June, at the Abberley Hills. The party, consisting of upwards of thirty members and friends, with Mr. H. Pearce, F.G.S., president, drove from Kidderminster to Witley, and were conducted through Witley Court and grounds by Canon Melville. They then visited an interesting outlier of Wenlock Limestone in the grounds of Abberley Hall, where a number of fossils were found, among which may be mentioned *Heliolites Murchisoni*, *Favosites Forbesi*, *F. Gothlandica*, *Monticulipora*, *Cyathophyllum*, *Rhynchonella cuneata*, *Strophomena rhomboidalis*, &c. The party then walked to a quarry of

Aymestry Limestone on the Bromyard Road, where the lie of the beds is reversed, and the Upper Ludlow Rocks rest on Old Red Sandstone, which is inclined uncomformably against the vertical beds of the Aymestry Limestone. The Abberley Hills form the northern end of that long axial line of disturbance which extends along the Malvern Range, and the contrast of the scenery on the east and west sides of the hills is very remarkable, as showing plainly that this is caused by the difference in the geological formations. On the east stretch the flat sandy plains of the Severn Valley, consisting of New Red Sandstones and Marls, whilst on the west the eye is delighted with well-wooded hills and undulating ground of Old Red age. The party afterwards ascended Abberley Hill, and obtained a pretty fair view of the surrounding country. Mr. H. Pearce exhibited *Ranunculus parvus*, from Broome, Worcestershire, and the following plants from the Lake district:—*Asplenium viride*, *Alchemilla alpina*, from Mardale, and *Antennaria dioica*, from Long Street Mountain.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 16th. Mr. H. Insley referred to the loss the Society had sustained by the death of the late Mr. J. H. Baxter (one of the first members of the Society), which took place on the 3rd instant. Mr. J. W. Neville, in moving a vote of sympathy with his family and friends, spoke of the genial manners and devoted zeal that endeared him to all fellow-workers—a zeal that was manifested through a protracted illness, and only terminated by death. Mr. J. Madison exhibited a curiously-spotted frog, taken from an elevated part of Snowdon; Mr. J. W. Neville, a specimen of the rose of Jericho, *Anastatica hierochuntica;* Mr. H. Insley, fasciation of wallflower, comprising sixteen stems; Mr. Hawkes, *Œcidium tragopogonis* and specimens of *Claytonia perfoliata;* Mr. F. Shrive, skin of cobra di capello.—May 23rd. Mr. J. Moore exhibited specimens of *Planorbis dilatatus;* Mr. Hopkins, pupa of *Chœrocampa elpenor;* Mr. J. Madison, rock specimens from Snowdon; Mr. A. T. Evans, a rock specimen, showing the junction of granite and basalt, from Charnwood Forest. Under the microscope, Mr. H. Insley showed a series of slides of marine algæ, and described their methods of fructification; Mr. Dunn, organs of locomotion of earthworm.—June 6th. Mr. J. Collins was elected a Vice-President in the place of Mr. C. F. Beale, who resigned on account of his removal from the district. Mr. H. Insley exhibited a spray of American cotton plant; Mr. J. Madison, a series of specimens of *Limnæa peregra* from Llyn-y-fan-fach, Caermarthenshire; Mr. J. W. Neville, a specimen of sea mouse. Under the microscope Mr. F. Holden showed a slide containing fifty-six species of desmids.—June 13th. Mr. H. Hawkes showed a number of micro-fungi, including specimens of *Œcidium allii*, *Trichobasis petroselini*, and *Entyloma ungerianum;* Mr. J. Madison, the following shells: *Succinea putris*, *S. virescens*, *Ancylus fluviatilis* var. *gibbosa*, and *Limnæa truncatula*, all from Caermarthenshire. Mr. P. T. Deakin, fourteen species of land shells collected between Caermarthen and the Black Mountain. Mr. C. P. Neville then read a paper, "Notes on the Butterflies of Cardiganshire," in which the writer gave the results of his collecting during many summer visits. The district was not rich in varieties, about twelve species only being commonly met with. A small collection of butterflies and moths was exhibited.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Tenth Annual Meeting of the Midland Union of Natural History Societies was held on July 6th and 7th at Malvern. The Meeting was a fortnight later than has been usual, owing to the Jubilee celebrations, which rendered the earlier date unsuitable. To this circumstance must be partly ascribed the small attendance, as several who would otherwise have been present were away from home.

The Council met in the Drill Hall, Albert Road, at 12 noon, and after receiving the usual reports adopted the Annual Report for presentation to the General Meeting.

The report on the subject of the Darwin Medal stated that only one paper in the specified subject (Archæology) had been submitted, but the Adjudicators unanimously considered it worthy of the prize, and the Council accordingly awarded the medal to Mr. E. W. Badger, M.A., for his paper on "The Monumental Brasses of Warwickshire."

A notification was received from the Secretary of the British Association that the Midland Union has been retained upon the list of the Corresponding Societies of the Association, and requesting that a delegate to the Manchester Meeting should be appointed; and the Council appointed H. Wilson, Esq., the Secretary of the Malvern Field Club, as delegate.

Mr. H. J. Eunson, the delegate from Northampton, invited the Union to meet in Northampton in 1888, and it was resolved to recommend the General Meeting to accept the invitation.

The attention of the Council was called to the very small use which the Societies composing the Union make of the *Midland Naturalist* for the publication of their proceedings, and the Hon. Sec. was directed to send a circular to the Societies on the subject, and to urge them to a more general subscription to it. The numbers taken by most of the Societies are extremely small, and the Council believes that the journal is worthy of much more support from our various Clubs and Societies than it at present obtains.

The Annual General Meeting

was held in the Drill Hall at 3 p.m. After the minutes of the Shrewsbury Meeting had been read and confirmed, the President, Rev. G. E. Mackie, M.A., delivered an address on the "Difficulties of Field Clubs," with suggestions as to how these may best be met, especially urging that the fundamental idea that the meetings are really for the prosecution of

Natural History work, and for mutual help of the members, should be adhered to as strictly as possible, and that the social element, which is so apt to overpower the scientific, should be kept in its right (subordinate) place.

Several members spoke on the topics touched upon by the President, and a hearty vote of thanks was accorded to him for his address.

The report from the Council was then read, as follows:—

Societies in the Union.

One Society, that by whose invitation we are holding the present Meeting, has joined the Union during the year, and the list of the Societies now composing it will be as follows:—

Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Evesham Field Naturalists' Club.
Leicester Literary and Philosophical Society.
Malvern Field Club.
Northamptonshire Natural History Society.
Nottingham Working Men's Naturalists' Society.
Oswestry and Welshpool Naturalists' Field Club.
Peterborough Natural History and Scientific Society.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.
Tamworth Natural History, Geological, and Antiquarian Society.

The Council, however, regrets to report that the Peterborough Natural History and Scientific Society has given notice that the considerable distance at which their city lies from the other towns at which meetings are held, and some changes in the circumstances of the Society, will compel them to withdraw after this year.

Darwin Medal.

The subject for the present year is Archæology, and the following gentlemen kindly undertook to act as adjudicators, viz., The Very Rev. J. J. Stewart Perowne, D.D., Dean of Peterborough; M. H. Bloxam, Esq.; Jno. Amphlett, Esq.; W. H. Duignan, Esq.; and J. A. Cossins, Esq. The reports received from them all speak in high terms of the value and interest of the only paper which was submitted to their consideration as complying with the conditions of the prize, and they comment upon the care and ability evidenced in the preparation of it. The Council have therefore awarded the Darwin Medal for this year to Mr. E. W. Badger, M.A., for his paper on "The Monumental Brasses of Warwickshire."

"Midland Naturalist."

The "Midland Naturalist" has, we consider, maintained a high standard of excellence in the character and value of the papers published. During the year there has been a change in the Editorship. We still retain the valuable services of Mr. E. W. Badger, to whom, as in the past, our most hearty thanks are due for his exertions in the work; but Mr. W. J. Harrison, to whom we have from the very beginning been so much indebted for the success which has been attained by the "Naturalist," who has given to the editing of it so much of his time, in writing, collecting materials, and the various duties of the office, has frequently during the last few years, as will be remembered by the Union, expressed his desire to be relieved of the post. Early in this year the opportunity occurred of securing the services of Professor W. Hillhouse, M.A., F.L.S., of the Mason College, the President for this year of the Birmingham Natural History and Microscopical Society, and Mr. Harrison again tendered his resignation, which the Committee accepted, passing at the same time the following resolution:—"That this Committee desires to express its most hearty thanks and those of the Midland Union for Mr. W. J. Harrison's services as co-editor of the 'Midland Naturalist' since its beginning in 1877, and to record its feeling of the value of those services in connection with it."

Professor Hillhouse entered upon his duties with the number for March, and the Council is confident that the high character of the journal will be perfectly safe in his hands.

The papers which have been published since the last meeting have been fully equal in interest and importance to any which have appeared of late years. The following are the titles of some of the principal:—

The Monumental Brasses of Warwickshire, by E. W. Badger, M.A.; A Three-eyed Reptile, by A. B. Badger; A Proposed Midland University, by Professor W. Hillhouse, M.A., F.L.S.; The Relations between Evergreen and Deciduous Trees, by F. T. Mott; Micro-organisms in a Swampy Ditch in Sutton Park, by T. Bolton; Fungus Hunting in Spring, Leafing of Oak and Ash, The Boleti of the Birmingham District, by W. B. Grove, B.A.; An Excursion to Tenby, Notes on an American Tour, The Causes of Glacial Motion, and Tresca's Investigations into the Flow of Solids under Great Pressure, by W. P. Marshall, M.I.C.E.; History of the County Botany of Worcester, by Wm. Mathews, M.A.; Ragnarok, by G. Deane, D.Sc.; various expositions and discussions of Herbert Spencer's Works, by Miss C. Naden, C. H. Allison, F. J. Cullis, F.G.S., W. B. Grove, B.A., Professor W. Hillhouse, and W. R. Hughes, F.L.S. B. Thompson, F.G.S., has continued his paper on the Middle Lias of Northamptonshire, with special reference in the more lately published parts to the water supply of Northampton. The address delivered to the Birmingham Natural History and Microscopical Society by the retiring President, R. W. Chase, of the British Ornithological Union, well deserves a careful study from all our members, dealing as it does with subjects so suitable for the consideration both of the Union as a whole and of the separate Societies as the proper principles and limits of Local Museums and their relation to Local Natural History Societies, and the preservation of our English birds by some properly considered scheme of egg protection.

The list of papers given above, however, by no means adequately represents the work done by the component Societies during the past year. Some of them publish Transactions separately, and to this number the Leicester Literary and Philosophical Society has recently been added. The three quarterly numbers already published contain many very interesting and valuable papers on Biology, Geology, Archæology, &c., and the Society has published by a sub-committee a

Flora of Leicestershire, which will no doubt be welcomed by botanists, and is an example of the useful work which enthusiastic naturalists may undertake in many branches of knowledge.

The Meeting of the British Association in Birmingham last year was naturally attended by many of our members, and several papers on the local Natural History were contributed by them both to the Handbook to the Birmingham district, which was prepared for the use of the Association, and to the Sectional Meetings. Among these, we may mention the papers on Heredity in Cats with an extra number of toes, and on the Artificial Production of a Gilded Appearance in certain Lepidopterous Pupæ, by E. B. Poulton, M.A.; Preliminary Notes on the Autumnal Fall of Leaves, by Professor W. Hillhouse, M.A., F.L.S.; on the Geology of the Birmingham District, by Professor Charles Lapworth, LL.D., F.G.S.; on a Deep Boring for Water in the New Red Marls, near Birmingham, by W. J. Harrison, F.G.S.; The Rocks between the Thick Coal and Trias, North of Birmingham, and the old South Staffordshire Coalfield, by Frederick G. Meacham, M.E., and H. Insley; on the Halesowen Coalfield, by W. Mathews, M.A., F.G.S.; and A Report on the Erratics of the Midlands, by Rev. H. W. Crosskey, LL.D.; the Fossiliferous Bunter Pebbles contained in the Drift at Moseley, &c., by A. T. Evans; the Extension and Probable Duration of the South Staffordshire Coalfield, by H. Johnson; the Ordovician Rocks of Shropshire, by Prof. C. Lapworth, LL.D.; Provincial Museums: their Work and Value, by F. T. Mott.

The Societies of the Union were also invited by the Secretaries of the various Committees of the British Association to render to these Committees any help which they might find in their power, and, we believe, a considerable number of our members responded to the request.

During the winter a beginning was made, though in a very tentative manner, with a scheme for the delivery of lectures, or the reading of papers among the Societies of the Union by visitors from other towns. A few visits were thus arranged for, but the season was already too far advanced when the subject was brought before the notice of the members, and the replies which did come in were in several cases too late to do anything with for the present. We believe that such an inter-visiting of members of the various Societies in the Union would be found to stir up an interest in Natural History among the younger members, to whom we must look to take the places of those who, as the years go by, must in the course of nature pass away, whose removal in so many cases so seriously cripples the work of local Societies, especially where these are small.

In reviewing the whole course of the Union for the year, we are confident that there is no need for despondency as to the work that is being done. There is abundant evidence that in spite of the heavy pressure on mind and body, which is so increasingly exerted by business engagements at the present day, possibly even in some cases as a relief from this pressure, many turn to the study of Nature with eagerness, and find still as ever that "Nature never doth betray the heart that loves her." Our office as a Union is to make it easier for anyone who is attracted to such study to discover what has been and is being done in the same field; to place, as far as possible, the knowledge and experience of all at the disposal of each one.

The Treasurer's report showed a balance in hand of £22 0s. 9d., as against £18 2s. 2d. last year, so that the financial position of the Union was considered very satisfactory.

The invitation to meet in Northampton in 1888 was then considered, and it was unanimously resolved that the invitation be accepted; the exact date to be fixed later on.

Mr. E. de Hamel was re-elected as Treasurer, and Messrs. T. H. Waller and H. J. Eunson as the Secretaries for the coming year.

Votes of thanks to the Malvern Society, to the officers of the Union, and to the President for presiding, concluded the proceedings.

Owing to a very unfortunate concurrence of circumstances the usual Conversazione was not held, and it was agreed at the General Meeting to substitute for it a drive round the North end of the Hills, partly to inspect a very interesting find of the Black Cambrian Shales, with characteristic fossils, which has recently been made in sinking a well.

The arrangements having been unfortunately upset, owing to the absence from home of the local Secretary, and a regrettable misunderstanding as to what was required in the way of preparation from the local Society, it was suggested at the General Meeting that it would be well to have a clearly defined account prepared and printed of what was really needed in the case of any Society preparing for a Meeting of the Union, and that the Executive Committee might appoint a small Committee to have the general care of the preliminary arrangements.

Excursion.

It had been arranged that on Thursday, July 7th, the members of the Midland Union assembled at Malvern should divide themselves in three directions; one party to botanise on Bredon Hill, an outlier of lias and oolite midway between the Malverns and the Cotswolds; another to "archæologise" at Tewkesbury and the Saxon church of Deerhurst; and the third to study the Geology of the Hills. However, from various causes the last-named Excursion only was carried out, about forty members uniting under the guidance of the local President.

A portion of the programme had been anticipated on the previous evening by a visit to the Syenitic Quarries of the North Hill, and to the Cambrian Shales recently found at the extreme northern end of the range. These shales have long been known at the south end of the Hills, where they are altered and upheaved by trappean intrusions of (probably) lower Silurian age; but they had not previously been found further north. The patch now found in sinking a well at North Malvern seems to have been preserved in a gully of the gneiss from the general denudation effected by the northerly currents of the Silurian Seas. The Section is as follows, in descending order:—

1.—Surface gravel	12 ft.
2.—Red crumbling marl, with small pebbles ...	24 ft.
3.—Coarse grey and red sandstones and conglomerates	16 ft.
4.—A very hard breccia of quartz pebbles in a red and yellow matrix	6 ft.
No fossils have been found in these three beds, which seem to be all of Permian age.	
5.—Black Cambrian shales, with Olenus, Conocoryphe, Lingulella, &c.	9 ft.

The beds dipped at an uniform angle of about 50°.

It is to be regretted that the well was not dug deeper; for the boring rod, which was carried 22 ft. further, penetrated through nine more feet of shale and thirteen feet of red rocks, apparently a repetition of beds (2) and (3) above. In any case the discovery is one of considerable interest. It is to be hoped that some attempt will be made to correlate these and the other Cambrian beds of Malvern with those recently discovered near Nuneaton, which appear greatly to resemble them.

Thursday's work for the members of the Union began about ten o'clock, with an inspection of the patch of Trias still clinging to the eastern side of the Hills, where, behind the Belle Vue Hotel stables, members noted the bright red Bromesberrow (Bunter) Sandstone, with characteristic stains of manganese, the rest of which is thrown down many hundred feet under the Keuper marls, which now cover the whole eastern plain.

The whole party then drove in two brakes to Mr. Canning's house at The Wyche, where, on the other or western side of the Hills, a similar relic of Upper Llandovery Sandstone, with Pentamerus and Petraia, was pointed out to them, adhering to the syenitic gneiss.

The next halt was made at the Camp Inn, where the great British Camp of the Herefordshire Beacon was visited. Close to here is the residence of Madame Goldschmidt (Jenny Lind), in whose grounds is a remarkable quarry shewing the foliation of the gneiss, and also a capping of Upper Llandovery Rock.

From here a long drive down the beautiful crest of Wenlock rock called the Ridgway, where members had pointed out to them a misletoe-bearing oak, led to Eastnor Castle and thence to Ledbury. Lunch was served at the Feathers at two o'clock. After the usual congratulatory speeches, an adjournment was made to the museum of G. H. Piper, Esq., Vice-President of the Malvern Field Club, who exhibited his splendid collection of Silurian and Old Red remains. Some specimens of Auchenaspis, with the body complete, are, we believe, unmatched.

The party then divided; some going under the guidance of the Rev. T. Auden to visit Ledbury Church, a Norman nave with Early English and Decorated additions, and a fine detached tower; while a few of the keener geologists accompanied Mr. Piper to the tunnel near the railway station, where he read a paper on the remarkable series there shown of Downton Sandstones, and passage beds between the Silurian and Old Red. These beds extend outside and above the tunnel in an unbroken section of over 900 feet, and show most completely the alternations of Silurian shales and limestones (containing trilobites, pterygotus, etc.), with Old Red marls and sandstones, containing Cephalaspis and other fish remains. Mr. Piper carefully measured these beds some years ago, before they began to be weathered and grass-grown; even yet they present a history of the transition between two great systems which cannot be surpassed anywhere.

The members were not fortunate enough to find any of the rarer fossils, but in the Ludlow and Aymestry rocks of the quarry just above, which form a downward continuation of the previous beds, many of the usual fossils were obtained. But the sound of the horn soon recalled all to the brakes, and after visiting Eastnor Church, they returned home by seven o'clock, after a very hot but most pleasant day.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 174.)

Third Period, 1801 to 1850.

It is not until the commencement of the present century that "*English Botany*" furnishes any new record for the County of Worcester. The period opens with the discovery
* of Festuca Calamaria (*F. sylvatica, Vill.*), as related in Vol. 14 of that work, 1802, where, under No. 1,005, Sir James Smith writes, "*Mr. Moseley, of Glasshampton, favoured us lately with living plants from the ledges of a lofty red sandstone rock in*

Shrawley Wood near his residence." The plant has been diligently searched for in this locality, but has not been seen there for upwards of 40 years.

Turner and Dillwyn's well-known "*Botanists' Guide*," in two volumes, with lists for each county in England and Wales, was published in 1805. The Worcestershire list, Vol. II., p. 656, contains 70 species only, mainly on the authorities of Merrett, Hudson, Nash, Withering, Stokes, and Ballard. Dr. Sheward's Catalogue in Nash's Supplement, 1799, seems to have escaped notice. It yields only the following new records:—

Turritis glabra. Near Stourbridge. Rev. W. Wood.

Epilobium angustifolium. Near Bewdley. Mr. Dyer.

Gnaphalium margaritaceum. By a rivulet in the heart of Wire Forest. Rev. Mr. Butt.

Alisma natans. Near Tenbury. Mr. A. Aikin.

A passing reference must now be made to a work mentioned by Mr. Lees, at p. 116 of his Botany of Worcestershire. This is the "*Agriculture of Bromsgrove*," by J. Carpenter, of Chadwick Manor, near Bromsgrove, Vol. I., 1803, Vol. II., 1805. I have not seen this book, but Mr. Lees informs me that it contains an engraving of two plants, described as very injurious to cattle. One is the Meadow Saffron; the other, which Carpenter calls "*Stavesacre*," appears from the plate to be the Larkspur. Of the latter he writes, "*This plant grows in some parts of this county, but wherever seen, care should be taken to prevent its future growth.*"

It may be well to insert here a correction for which I am indebted to my excellent friend, the Rev. J. H. Thompson, of Cradley. He tells me that I was in error in writing that "the Larkspur has not been seen within the County by any living Botanist." He has furnished me with the following records of specimens gathered by himself and now in his herbarium:—

1844. Holt.
1852. September 3rd. Cornfield at east end of Craycombe Hill; apparently wild.
1871. August 5th. East side of Hartlebury Common.
1885. July 23rd. Near Churchill Viaduct.

He adds that in every case except the second the plants were probably escapes from cultivation.

From Carpenter we pass naturally to William Pitt and his "*General View of the Agriculture of the County of Worcester*," one of the series of reports previously mentioned, published by order of the "*Board of Agriculture.*" Pitt lived at Pendeford, about 4 miles north of Wolverhampton, and subsequently in Birmingham. His Survey of the County of Worcester was made in the years 1805, 1807; the published volume bears the date 1810. At page 317 is "*a list of the most remarkable vegetable productions of the county of Worcester, observed in a tour through the county in September and October, 1805, with a few from other authorities.*" It is refreshing to find at last, from an independent observer, records of agrarian weeds and other common plants. Even of these the list is very incomplete, probably owing to the time of year at which the tour was made, and our trust in the botanical knowledge of the author is somewhat shaken by the occurrence of such entries as "*Epilobiums, of sorts,*" "*Polygonums,*" and the like. It will therefore be necessary to examine some of the records in a more sceptical spirit than if they were from the pen of Withering or Stokes. Omitting Nash's plants, most of which are repeated, and a few others previously noticed in these pages, Pitt's list yields the following materials for our history:—

Clematis Vitalba. Hedges near Malvern, and north of Evesham.

Thalictrum flavum. Meadows and banks of rivers; meadows on Severn. Marshall.

Ranunculus repens.

Papaver Rhœas.

P. dubium.

† **P. hybridum.**

The last three plants are followed by the note "Poppies of sorts in cornfields." *P. hybridum, for which no locality is given, is a very doubtful record.*

Chelidonium majus. Hedges in Shrawley.

Sinapis alba. On the bank of the Leominster Canal, by the road side near Tenbury.

S. arvensis. Cornfields and turnip grounds.

"Three distinct plants are called chadlock by the farmers; which are wild mustard, wild radish, and wild rape. I found them all amongst turnips, in the common fields around Bredon Hill."

We must therefore add the two following species:—

Raphanus Raphanistrum.

Brassica Napus.

Sisymbrium Nasturtium. Watercress. Vale of Severn. Marshall

* **S. amphibium.** Water radish. Marshall.

* **Reseda Luteola.** On banks and rubbish.

Malva parviflora. Road sides and often near buildings.

Doubtless a misnomer for Malva rotundifolia, L.

Rhamnus Frangula. In hedges north of Evesham.

Ononis spinosa. Road sides, heaths, and rough ground.

Trifolium arvense. On sand, in the neighbourhood of Kidderminster, Mitton, and Stourport.

Agrimonia Eupatoria. Road sides.

Sanguisorba officinalis. In meadows.

Poterium Sanguisorba. On Bredon Hill; on very barren waste land near Church Lench; on rich red loam near Inkborough, and in a meadow near Tenbury; not yet common to be found in the county.

* **Rosa spinosissima.** Hedge near Worcester, on the Kempsey Road; also on barren waste ground near Church Lench, north of Evesham.

The latter description confirms the identification of Merrett's species.

Lythrum Salicaria. Moist places.

Bryonia dioica. Hedges on sandy or gravelly soil, in the north of the county.

Sedum acre. Roofs and walls.

* **Saxifraga granulata.** Hedge bank near Kidderminster; dry pastures, Wolverley.

Peucedanum Silaus. A meadow plant.

Angelica sylvestris. Moist hedges.

Conium maculatum. Hedges.

Chærophyllum sylvestre. Pastures.

* **Smyrnium Olusatrum.** Hedges near Avon side, formerly cultivated, but its place now supplied by Celery.

* **Viscum.** On fruit trees; a bad orchard weed.

* **Galium Mollugo.** Hedges.

G. verum. In pastures.

† **G. spurium.** Corn galium or hairough. Cornfields.

Possibly an error for G. tricorne.

Valeriana dioica. In moist meadows, hedge sides, &c.

V. officinalis. In moist meadows, hedge sides, &c.

Dipsacus sylvestris. Moist hedges.

* **D. pilosus.** Moist hedge sides near Droitwich.

Scabiosa succisa. Rough pastures.

Tragopogon pratensis. Vale of Severn.

Cichorium Intybus. At Pinvin, north of Pershore. Introduced into cultivation by Mr. Arthur Young.

Tanacetum vulgare. Abundant near the Stour and other rivers.

† **Senecio paludosus.** Bird's tongue groundsel. Near Malvern Well by the road side and on the road thence to Upton.

An incredible record.

Inula dysenterica. Road side, on moist ground; common.

Chrysanthemum segetum. Cultivated ground.

Matricaria Parthenium. Hedge sides, Shrawley.

† **Anthemis arvensis.** Corn chamomile. A common corn weed.

The plant probably intended is Matricaria inodora. A. arvensis is very local.

Convolvulus arvensis. Corn fields.

Convolvulus sepium. In hedges.

Solanum Dulcamara. Hedges.

S. nigrum. Road sides and on dung hills in most parts of the County.

Hyoscyamus niger. Road sides and amongst rubbish.

Verbascum Thapsus. Road side on sandy ground north of Kidderminster.

* † **V. Blattaria.** In the same situations with the last.

I suspect an error.

Scrophularia aquatica. Watery places.

Antirrhinum Linaria. In hedges.

Euphrasias, two sorts. Corn fields and pastures.

These may be accepted as records for E. officinalis, L., and E. Odontites, L. The latter is noted in a previous List.

Veronica hederifolia. Amongst wheat very early in the Spring.

V. serpyllifolia. Hedges in Summer.

V. Chamædrys. Hedges in Summer.

V. Beccabunga. In shallow streams.

Verbena officinalis. Road side, Powick; amongst rubbish in the town of Evesham in great profusion.

Mentha arvensis. Corn fields and moist ground.

Glechoma hederacea. Hedge banks.

Scutellaria galericulata. Side of the canal between Wolverley and Stourport, in many places.

Marrubium vulgare. Road sides, on sandy and gravelly soils at Shrawley.

Ballota nigra. Hedges in the Vale of Evesham. Marshall.

Teucrium Scorodonia. On hedge banks.

Echium vulgare. Road side in the north of the County.

Symphytum officinale. In great plenty upon the Stour near Kidderminster.

Cynoglossum officinale. Hedge sides, Shrawley, and other places, in the town of Evesham on rubbish.

Primula vulgaris. Ditch banks.

P. veris. Meadows.

Plantago major. Road sides.

P. lanceolata. In pastures

Chenopodium Bonus-Henricus. Banks on road side near Bromsgrove.

C. rubrum. Road sides.

Atriplex patula. Road sides and on rubbish.

Euphorbia amygdaloides. Hedges near Worcester, on the Bewdley Road.

Mercurialis perennis. In hedges between Bromsgrove and Fockbury.

Juniperus communis. On barren waste land between Evesham and Church Lench.

Arum maculatum. On ditch banks. Common.

Tamus communis. Hedges in the Vale of Evesham.

Allium vineale. Vale of Severn. Marshall.

Avena fatua. In hard tilled corn fields.

Hordeum murinum. Dry banks on road sides.

Equisetum arvense. In corn fields.

E. palnstre. In bogs.

If, from the 90 plants in the above list, we deduct 14 for repetitions of previous records and for obvious errors, we have remaining 76 species to be placed to Mr. Pitt's credit on account of the Worcester census.

(To be continued.) p 220

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 179.)

The following proofs of the free circulation of water, and, consequently, the continuity and capacity to receive and store water, refer particularly to the Rock-bed:—

1.—All the water which is found in the Middle Lias, whether at Northampton or elsewhere, must have got in from the surface somewhere, and since the water in the Billing Road Well at one time rose 90 feet above the water-bearing rock, it is clear that the catchment area must have been *more* than that height above the rock which supplied the water, and so some considerable distance away.

2.—It is no local condition of the Marlstone to be porous, and to yield water. In Northampton itself, at least five wells have been made reaching to the Marlstone and yielding water. Two were made by the Waterworks Company—one at their chief pumping station, and the other near their reservoir; one at the County Jail; a fourth at Messrs. Brettell's Foundry; and a fifth at the Barracks. Besides these, in the districts west and south-west of Northampton there are probably some hundreds of such wells; there may be ten or twelve in a moderately-sized village where the Marlstone is not deep.

3.—Northampton has been taking more than its share of the Middle Lias water; hence, many of the near wells, not quite so deep, have ceased to yield water. This is the case with three out of the five wells mentioned above as formerly existing in Northampton. I believe, too, that without exception the water level in the Marlstone wells of the county has been gradually sinking—an absolute proof of the general continuity and porous nature of the bed.

4.—I believe it is rare for a single well in any formation to yield more than 1,000,000 gallons per day, unless aided by headings, or supplied by more than one spring. Without these aids the Middle Lias at both Northampton and Kingsthorpe has yielded water at the rate of 800,000 gallons per day, an amount, it will be seen, approximating to the maximum supposed to be obtainable from a single well. Such being the case, and bearing in mind the distance away of the Middle Lias catchment area, it must be pretty evident that some of the nearer dumb-wells would be able to impound something like 1,000,000 gallons per day, supposing that amount of water to be available, and the head of water at the pumping station to be kept low. Direct experiment confirms this.

5.—It is extremely improbable that definite underground channels for water primarily exist in porous beds like the Marlstone, or the sinking for water would be a very precarious operation; yet, in the neighbourhood of springs and wells such channels are gradually developed, because water will flow most freely in the direction of least resistance, and in doing so will gradually reduce that resistance if there is anything capable of being dissolved by water.

A rock which is continuously used as a water-bearing one gets more porous, for all the water which comes from such a bed is charged with mineral matter dissolved out of it. As an instance, our Marlstone water contains rather more than 50 grains of solid matter to the gallon. Supposing that for thirty years an average of 500,000 gallons per day has been pumped, this would give a total of over 17,456 tons of solid matter removed. The rock-bed has a specific gravity varying from 2·5 to 2·8, say 2·7 on the average, then 17,456 tons of it would occupy a space of nearly 232,000 cubic feet, and the matter actually dissolved probably more than this amount, because of a lower average specific gravity. After making large allowances for solid matter derived from superficial sources—soil or gravel—and possible shrinkage of the bed, it must be evident that it is made more porous by use. Wells do often improve considerably with use.

It may be demonstrated that water flows from one point to another in a saturated porous bed with a head due to the difference of vertical level of area of outcrop to that of area of discharge, less the frictional resistance; also that increase in the carrying power of a bed is almost in direct proportion to the water pressure.*

Through the kindness of Sir George Bannerman, Bart., I am able to offer some direct evidence of the porosity of the Marlstone in the neighbourhood of Brackley. Brackley Town Well was commenced in 1874 under the advice of my late friend Mr. S. Sharp, F.G.S., F.S.A., and reached a depth of 177 feet 6 inches.† The water then rested at 100 feet from the surface; that is, there was a head of water of 77 feet 6 inches. In 1882 this head was reduced to 41 feet; May, 1884, to 39 feet 6 inches; September 17th, 1884, to 36 feet 6 inches. When this last depth was taken the pump had been stopped from Saturday at noon to Monday afternoon, so that the natural water level might be ascertained. The pump used at Brackley discharges 6,000 gallons per hour, and after six hours' continuous pumping, on September 17th, the water level was reduced 11 feet 6 inches, leaving 25 feet in the well, and below this the pump could not bring it. In a few hours after the pumping was stopped, the water stood at the same level as before it was commenced, rising 2 feet in the first fifteen minutes. Here an increase of the difference between the water level inside the well and in the bed, of 11½ feet, produced a flow of water of 6,000 gallons per hour, or 144,000 gallons per day. A simple

* Mr. De Rance quotes some experiments made with New Red Sandstone blocks, which gave the following results:—With a pressure of 10lbs. to the square inch, 4½ gallons of water passed; with 20lbs., 7½ gallons; and with 46lbs., 19 gallons.

† I may say that the depth of well and height of water at first were originally given to me by Mr. Sharp, and differ a little from those afterwards given me by Sir Geo. Bannerman, and quoted above.

calculation based on the assumption before referred to, that flow of water is nearly proportional to the pressure, shows that a head of 100 feet acting through the same amount of rock would yield upwards of 1,250,000 gallons per day. If instead of reducing the water level in the well by 11½ feet, the head of water in the bed had been increased by a like amount, a yield of water only a little less than that actually obtained would have resulted, the reduction being due to the increased amount of rock through which the water pressure would be exerted. The receptive capabilities of such a well might fairly be put down at about 1,000,000 gallons per day, if the water could be put into it fast enough to maintain a head of 100 feet above the rest-level, a result agreeing with that arrived at in another way.

(To be continued.)

NOTES ON A ROCK FROM NEW ZEALAND, AND ON THE DUST EJECTED IN THE ERUPTION OF TARAWERA, IN JUNE, 1886.*

BY THOS. H. WALLER, B.A., B.SC.

The specimen which forms the subject of the following description was collected by my friend, John H. Lloyd, Esq., some three years ago, at Wairoa, on Lake Tarawera. On his return to this country he very kindly gave me a slice from it, but I found that it was so full of cracks, and, therefore, so readily disintegrated that I put it aside despairing of making a successful section. When, however, in June of this year the great volcanic eruption occurred in New Zealand, and buried in the ejected ashes and mud the village of Wairoa, the interest added to the specimen mentioned induced me to make an attempt to grind it thin.

Thanks to some practice which I had lately had with vesicular and friable rocks I was able to obtain a fair section.

The specimen is a grey glassy rock with very numerous cracks. It shows also many crystals and spherulites, many of the latter being hollow. On microscopic examination the ground mass is found to be perfectly glassy but to contain a very large number of minute crystals of a pale green or greenish yellow colour. They are about four to six times as long as they are thick and a good proportion of them are

* Transactions of the Birmingham Natural History and Microscopical Society, Geological Section, October 26th, 1886.

slightly thicker at the ends. They evidence by the positions in which they lie in the rock the motion which was taking place in the mass after they separated out. They form bands and streams heaped up where they encounter a larger crystal and are occasionally perfectly irregular in their distribution.

In addition to these microliths there are minute roundish bodies which in many cases seem to be the transverse sections of the first named bodies, but in others they appear as if they were strung together on a fine string forming the so-called Margarites. These are frequently of considerable length and are curved in various directions through the section.

The mineral nature of these minute bodies is very uncertain; they do not appear to show any definite crystal shape, and the points of the longer microliths show no signs of planes. They are not doubly refracting but remain quite dark between crossed Nicols.

In many places several strings of minute granules are attached at one end to an opaque grain, probably of magnetite.

The spherulites are mostly hollow, and though probably this is due in a few cases to the central parts having broken out in grinding, a good many are apparently hollow in the rock itself. They are rather imperfectly seen in my section, as this is somewhat thick, but appear to be composed of threads of doubly refracting substance roughly radial in position, but not so regularly as to show any black cross between crossed Nicols. The polarisation is irregular and not very marked.

The spherules are in many cases surrounded by a clear yellow margin, which, however, is seen, when a high power is used, to be fibrous and doubly refracting in character, and to be the ground, so to speak, in which the more opaque elements of the spherulite are imbedded. The microliths of the glassy base seem in some cases to be visible within the spherule, but in other cases they appear heaped up on its outer edge as if they had been driven against it by the flow of the lava.

The larger crystals which occur porphyritically are felspar, hornblende, and the strongly dichroic rhombic pyroxene which is usually called hypersthene.

The hornblende occurs sparingly and is of the normal olive brown colour. The crystalline fragments occasionally show the cross section of the prism, with the cleavage traces intersecting at the usual angle. The long and narrow sections extinguish at varying angles with the cleavage traces.

The rhombic pyroxene also occurs only sparingly. It is distinguished at once from the hornblende by its extinguishing when the traces of the prismatic cleavage in approximately longitudinal section are parallel to the axes of the Nicols, by the nearly right-angled prism which is shown by the cleavage in cross sections, and by the different dichroism, the colour of the vertical sections varying from a reddish brown to green during a rotation when the polarising prism only is used.

The felspar is both orthoclase and plagioclase, but I have not been able to determine the exact character of the latter. The chief point of interest is that the crystals are frequently mere skeletons of felspar substance enclosing a perfect swarm of glass inclusions. These are of most irregular shapes, sometimes very large at other times of but small size. They almost always appear slightly brownish in colour and with but few exceptions are provided with a spherical cavity.

Seeing that these cavities obviously vary a good deal in the proportion they bear to the size of the inclusions which contain them, it seems reasonable to conclude that they are at any rate in part air bubbles, and it is quite possible that their presence may have determined the formation of the inclusions. As is so usual, it is frequently noticed that the outer zone of one of a felspar crystal is much more clear and continuous than the central parts, as if the crystallisation went on more quietly and regularly towards the end of the cooling process.

A few instances of strain polarisation may be observed in the glassy base, and occasionally cracks closely surround crystals of the rhombic pyroxene, but the phenomenon is not very striking.

As all present will no doubt remember the terrific explosive eruption of Mount Tarawera, last June, I need not spend much time on a description of the damage done by it.

It may be interesting, however, to note that the usual linear character of the volcanic action was well shown. If a map of the volcanic region of the North Island is consulted and a line drawn from Mount Tongariro, in the S.W., to White Island, in the Bay of Plenty—both of them active volcanoes in a small measure—there will be found lying on it both Mount Tarawera and Lake Rotomahana, into which the lovely white and pink terraces, the result of the deposition of silica from boiling springs on the hillside, descended.

These, alas, have been utterly destroyed. The hot springs were evidences of a weak place, and when the explosion occurred it was among those which gave way.

Mount Tarawera is described by travellers as presenting the appearance of a glassy dome, no doubt a rock such as that just described and the mountain was one of the most strictly tabooed of all the district, for on its summit were exposed the bodies of the chief men of one of the most powerful of the tribes. It had been their cemetery for the whole of their traditional history, and it is certain that it had never been in eruption since the Maoris entered New Zealand. Whether this furious outburst has exhausted the forces below, or whether, as in the case of Vesuvius, in 79 A.D., it is but the re-establishment of an active crater, must be left for the future to determine. The celebrated Dr. Hochstetter, who made a geological survey of New Zealand in 1859, expressed his opinion that the whole country was so completely undermined by the decomposing and removing action of the hot springs, that eventually an explosion would occur by the falling in of the crust. It is probable that something of this sort happened. So far as any accounts which I have seen relate, there was no flow of any lava. Showers of stones and mud have done the damage, and dust has been so distributed over the district as to completely cover the vegetation and in many places destroy even the trees.

A microscopical examination of a specimen of the dust collected on the steamer "Southern Cross," in the Bay of Plenty, which has been placed at my disposal by my friend, J. E. Clark, B.A., of York, shows the same relation of things. There are very few portions which can be referred to the ejection of a fluid lava, and probably these are really fragments of a pumice which has been shattered by the explosion. There are glass fragments of all degrees of porosity —in some the pores are approximately spherical, while others again are drawn out into mere threads and twisted about most confusedly. Other pieces of glass contain microliths similar to those previously mentioned as occurring in the Tarawera obsidian, and also the globulites, both singly and in strings. The felspar is mostly orthoclase, but one cleavage fragment which is well twinned gives the extinction of oligoclase. This fragment also contains some inclusions of a brownish glass, which have apparently the same crystalline shape as the enclosing crystals—so-called negative crystals. I have found no hornblende, but there are a few grains of the rhombic pyroxene, with strong dichroism.

There are also a number of fragments of a lightest brown almost opaque substance, which when quite thin can be examined in polarised light and shows a doubly refracting composition, but very indefinite and confused. It has some similarity with the spherulites before mentioned, but occurs in too great quantity for this explanation to be probable.

On the whole it is evident that a solid rock, which, however, varied from a pumice to such an obsidian as we have considered in the early portion of this paper, has been blown into small fragments by the explosion.

Unfortunately my specimen was far too small to permit of an analysis, and I have not seen any in the New Zealand papers which have reached me.*

It may be worth while to mention that at the time of the disturbance Tongariro became somewhat explosive, and even the snow-clad Ruapehu began to emit smoke. At the other end of the line of fissure White Island had been unusually active for some time. It is worked for sulphur, and the workmen had been unable to get to it on account of increased violence in its eruptions. Since June it has been in eruption to an extent sufficient to be reported in the English papers.

As the country all round Auckland is volcanic and many of the hills are craters—Mount Eden, for instance, which closely overlooks the city and forms, in fact, a suburb of it—there has naturally been some anxiety felt as to the probability of another outbreak of these hills. This set of volcanoes, however, is much older than the Taupo series—indeed, we may consider it likely that the latter replace the former as safety valves. The fissure has opened in a slightly different position, as is not unfrequent.

* Since this note was communicated to the Society I have been able, through the kindness of Mr. W. J. Harrison, F.G.S., to make an analysis of another specimen of the dust, with the following result:—

	I.	II.
Silica	61·9	58·07
Titanic acid	1·0	
Alumina	12·9	13·22
Ferrous oxide	3·8	10·10
Ferric oxide	2·8	
Lime	7·1	7·04
Magnesia	2·7	4·46
Potash	2·0	1·58
Soda	3·8	2·59
Loss on ignition	2·2	1·50
	100·2	98·56

In column II. I have copied for purposes of comparison an analysis of the Armathwaite dyke as given by Mr. Teall in his paper on "Some North of England Dykes," Q.J.G.S. for May, 1884, p. 224, from which it will be seen that the principal difference consists in the much larger proportion of iron present in the English rock from which the darker character and more basaltic look follow.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

PART V.—PHYSIOLOGICAL DEVELOPMENT. CHAPTERS VI. TO X.

These were expounded by Professor Haycraft, F.R.S.E., then Professor of Physiology at the Mason College. The Professor gave a detailed explanation of the course of the Physiological Development of Animals, as narrated by Mr. Herbert Spencer, and increased the interest of the narrative by many apt and striking illustrations.

PART VI.—THE LAWS OF MULTIPLICATION. CHAPTERS I. TO VIII.

BY W. B. GROVE, B.A.

"If organisms have been evolved, their respective powers of multiplication must have been determined by natural causes." The adaptation of the reproductive activity of an organism to its conditions of existence has been determined by the same means—the action and reaction between it and its environment—by which its other adaptations have been effected.

We speak here only of organisms which maintain their ground. Those species which are dying out are excluded from the present argument. If a species is flourishing, it is so because of a certain relation established between the forces which tend to preserve it and the forces which tend to destroy it; and Mr. Spencer's enquiry is directed to the purpose of ascertaining if this relation is capable of being expressed in a definite numerical form—as indeed the laws of *multiplication* should be.

If the forces destructive of race, when once in excess, had nothing to prevent them from remaining in excess, the race would disappear; and if the forces preservative of race, when once in excess, had nothing to prevent them from remaining in excess, the race would go on increasing to infinity. There must be some way by which the excess of either of the conflicting forces is automatically adjusted; for the only alternative is to call in that perpetual meddling with the world on the part of its Creator which the older theologies postulated, but which hardly anyone would now seriously maintain.

There must thus be here, as wherever antagonistic forces are in action in the world, a rhythmic movement, an alternate predominance of each, and each by its very excess must call into play certain counter forces which eventually out-balance it and initiate a movement in the opposite direction. The dangers* which a species has to combat, and its ability to combat them, must each on the average remain at a constant level.

If the reproduction of a Hydra be imagined to proceed as slowly as that of Man, the race would immediately die out. On the other hand, did Oxen propagate as fast as Infusoria, they would all die of starvation in a week. As the ability of a species to meet the forces which tend to destruction is a constant quantity, and this comprises two factors—power to maintain individual life, and power to multiply—these must vary inversely as one another; one must increase as the other decreases. In other words, as high organisation implies great capacity for self-preservation, a correspondingly low degree of fertility will suffice to maintain the numbers; and in a lowly organised creature, whose power to contend against the adverse forces of the environment is small, great fertility must exist to compensate for the increased mortality.

But not only is this so: it is possible to see why it is so. Each organism having, on the average, a fixed power of obtaining nutriment—that is, of acquiring energy; the more it uses up this stock of energy for its own processes of life, the less will it have to spare for producing new individuals. For, as has been shown in previous chapters, Genesis, by whatever mode it may be carried on, is a process of disintegration, and is thereby essentially opposed to that integration which is one of the elements of Evolution. The other element, differentiation—or the division of labour between the parts of an organism—implies a transfer and transformation of food which also requires the expenditure of energy. Both elements tend to prolong the individual life, but only at the cost of the store of energy which can be reserved for Genesis. Individuation, therefore, and Genesis must necessarily vary in an inverse ratio—*i.e.*, $I \propto \frac{1}{G}$ or $IG = \text{constant}$.

This relation, however, though nearly true, is not exactly so. Each advance in Evolution implies economy, and thus the product of I and G, instead of remaining exactly constant, increases slightly with each advance in organisation, and this surplus becomes an admirable self-acting tendency to further the supremacy of the most developed types.

* Under this head natural death is included, for this only differs from what is called accidental death in the *smallness* of the cause which proximately induces the effect. I may note that I have, as far as possible, used Mr. Spencer's own words in stating his opinions.

The remaining chapters contain a summary of the evidence with which the detailed study of nature supplies us, in proof that the result which we have thus theoretically arrived at is that which actually exists. Allowing for the difficulties of inductive verification, which are many, the evidence adduced shows that not only is the antagonism between Individuation and Genesis true (as it obviously is) in the gross, and when comparison is made between organisms so unlike as Infusoria and Man, but it is also in most cases true in detail, between organisms closely allied, and from every conceivable point of view. For this evidence, however, reference must be made to the original, in Chapters V. to VIII. For the strength of such an induction depends upon the collective instances, and cannot be still further summarised without losing all its force.

Wayside Notes.

At the Meeting of the Midland Union of Natural History Societies at Malvern someone clearly blundered, and the blunder went a long way towards spoiling what might have been one of the most successful, as it was one of the most enjoyable, of these annual meetings. Everyone sympathised with the President, the Rev. G. E. Mackie, in the discouraging part he had to play, and admired the brave way in which he bore his load of anxiety. He even plucked up courage enough in his address to venture upon a few jokes, one of which is too good to let pass, as probably it will not be embalmed in the "Presidential Address." It was the answer of a boy, presumably at the College, to the question: "What do you know about Titus?" "Titus was a man in the Bible," penned this ingenious youth. "He wrote a book. His other name was Oates!"

It was a happy thought to give up a Conversazione, which was unprepared for and bound to fail, in favour of an open-air drive round the northern hills. The evening was delightful, and the ride was a most enjoyable departure from an impossible programme.

Not the least interesting feature of the drive was a well at North Malvern, which is being sunk by a poor fellow on a small piece of land he has bought for the purpose of erecting a cottage. Within a very short distance his neighbours have water within twenty feet or thereabouts of the surface. This well has been sunk through sixty-seven feet of strata, a description of which will be found upon another page, while the boring has proceeded twenty-two feet further, but no water has been found. The breccia is a really remarkable rock, and requires considerable study. The whole section is deeply interesting to the students of local geology, but it means ruin to the unfortunate cottager.

The Meeting at Northampton next year will be looked forward to with no little pleasure by the old stagers of the Union, who remember with much relish the capital meeting there in 1880. That meeting will take a great deal of beating, but the local Secretary says they mean to try.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, July 5. Mr. W. B. Grove, B.A., in the chair. Mr. W. Madeley exhibited a specimen of British sponge, probably *Chalina oculata* (Bowerbank), from Colwyn Bay; Mr. W. B. Grove, B.A., exhibited *Barbarea stricta* and *Alopecurus bulbosus*, two rather rare plants, from Clifton Ings, Yorkshire; Mr. W. H. Wilkinson, specimens of small spiral snail shells (*Clausilia nigricans*, var. *dubia*), from a stone wall in Scotland; also, *Salix fragilis* (Lin.), a willow, often called the "Cotton" tree, the seeds of which, last month, caused a shower of down through the streets of Staines, on the Thames; also a collection of interesting plants from Clent, amongst which were the following: *Viburnum opulus*, *Tragopogon pratensis*, *Genista tinctoria*, and *Briza media*.—BIOLOGICAL SECTION, July 12th. Mr. Horace Pearce, F.L.S., F.G.S., exhibited a collection of freshly-cut specimens from his British wild-flower garden. For some years Mr. Pearce has grown native wild flowers in a portion of his garden set apart for their special cultivation, and by supplying, as far as possible, the conditions essential to the healthy growth of the various plants, he has succeeded in getting together a good collection of many of our choice and rare native plants. He has maritime plants from our coasts, limestone-loving plants, and others from Alpine and rocky situations, and some requiring shade and shelter; all these conditions he seeks to supply, and a large share of success has rewarded his efforts, with both ferns and flowering plants. The following were the plants exhibited and described:—

Viola lutea, var. amœna	from	St. John's Vale, Keswick.
Silene maritima	,,	Pwllheli.
Carduus eriophorus......	,,	Abberley, Worcestershire.
Geranium sanguineum ..	,,	Great Orme's Head.
,, sylvaticum....	,,	Thirlspot, Keswick.
,, pratense	,,	Castleton, Derbyshire.
,, pyrenaicum ..	,,	Wrockwardine, Shropshire.
,, lucidum	,,	Chepstow.
Erodium maritimum	,,	Habberley Valley, Kidderminster.
Genista tinctoria........	,,	Near Enville.
Agrimonia Eupatoria....	,,	Ludlow.
Sedum Rhodiola	,,	Snowdon.
Campanula Trachelium..	,,	Milson, Shropshire.
Armeria vulgaris	,,	Pwllheli.
Echium vulgare	,,	Kinver Edge.
Verbascum Lychnitis....	,,	Whittington, Staffordshire.
Asplenium viride........	,,	Mountain, near Mardale, Cumberland.
Aspidium Lonchitis	,,	Snowdon.
Polypodium Robertianum	,,	Miller's Dale, Derbyshire.
Osmunda regalis	,,	Mountains east of Harlech.

Mr. W. H. Wilkinson exhibited the following lichens collected by Mr. W. B. Grove, B.A., in the neighbourhood of Barmouth:—*Usnea barbata*, *Ramalina fraxinea*, *Peltigera canina*, *Parmelia saxatilis*, *Stereocaulon denudatum*, *Stictina fuliginosa*, *Lecanora subfusca*, *Ramalina farinacea*, *Ramalina fastigiata*, *Peltigera rufescens*, *Parmelia perlata*, *Sphærophoron coralloides*, *Cladonia cervicornis*, and *Lecidea disciformis*.—GEOLOGICAL SECTION MEETING, Tuesday, July 19. Mr. Waller in the chair. Mr. Caswell exhibited a specimen of cabbage leaf in which the midrib, having left the surface of the leaf, had developed a cup upon a stalk. Mr. Grove exhibited two specimens, *Ornithopus perpusillus*, from the Lickey, and a fungus, *Polyporus dryadeus*, from Kingswood.

Mr. Bolton exhibited *Anuræa serrulata*, a rotifer, from a pool within the borough. Mr. Marshall exhibited specimens of plants from the island of Skye, including *Drosera anglica* and *Sedum Rhodiola*; also. geological specimens of rocks from the Black Cuillins and the Red Cuillins of Skye. Mr. Waller gave some interesting particulars of the remarkable and unique geology of Skye and the surrounding district. —SOCIOLOGICAL SECTION, July 26. The President, Mr. W. R. Hughes, in the chair. Mr. W. H. Wilkinson exhibited *Pimpinella magna*, *Carex remota*, and the following lichens, all from Hartshill:—*Physcia parietina* and *Lecidea canescens*. Mr. T. Bolton exhibited a fine display of rotifers from a pool near Hartshill Castle, including the rare one, *Asplanchna intermedia*, male and female; also *Brachionus amphiceros*, *B angularis*, *Polyarthra platyptera*, *Triarthra mystacina*, and *Anuræa brevispina*. The President read a series of letters relating to the work of the Section, and the Hon. Secretary reported that the excursion to Hartshill on the previous Saturday had passed off very pleasantly.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION.—The ninth excursion of the Section was made on Saturday, July 23rd, to Hartshill, near Atherstone, the country of Michael Drayton, by a party numbering twenty-nine members and friends. The remains of Hartshill Castle were visited, and the house in which Drayton is said to have lived. In this and some of the neighbouring cottages the manufacture of silk ribbons in homely wooden machines, cleverly actuated by hand and foot, excited much interest among the visitors. By the kindness of the Vicar and other governors tea was served in the Hartshill Schools, the President of the Section, Mr. W. R. Hughes, F.L.S., presiding. After tea Dr. Showell Rogers, M.A., read a characteristically interesting paper on "Michael Drayton," and exhibited Dr. Johnson's copy of Drayton's poems, now the property of Mr. Sam Timmins. The arrangements for the excursion were made by Mr. F. J. Cullis, F.G.S., the Hon. Secretary of the Section, and the enjoyable character of the excursions of the Sociological Section was well maintained through the afternoon.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D. Last month four of the members visited Stonesby and Saltby, which are situated on the strip of oolitic rock which occupies the north-eastern edge of the county. The following rare plants were collected near Saltby, of which the first two are new to the county:—*Senecio campestris*, *Hippocrepis comosa*, *Cerastium arvense*, *Astragalus hypoglottis*. On the 13th of July four members made an excursion to Glen, and thence through Wiston Park. No very rare plants were met with, but some *Conium maculatum* and good specimens of *Acorus Calamus* were found. On July 20th the ordinary monthly meeting of the section was held, when the above plants were shown, and also several others by the Rev. Mr. Preston, amongst the latter being an unusually fine example of *Carduus tuberosus*. A short discussion took place on the best methods of teaching elementary science in public schools, with special reference to natural history studies. A paper was read by the chairman (Dr. Hy. Tomkins) on "The Active Principles of some British Poisonous Plants." Various specimens of these were shown in the fresh state, and the alkaloids and other active principles from them were exhibited, with a brief account of the various parts of the plants in which these were found. Their properties and physiological action were also referred to.

ERRATUM.—No. 115 (July), page 192, line 13 from the top. *Ranunculus* "*parvus*" should be *parviflorus*, as it was described at the meeting (Dudley and Midland Geological and Scientific Society).

THE OCCURRENCE OF GOLD AT MOUNT MORGAN, QUEENSLAND.*

BY THOS. H. WALLER, B.A., B.SC.

A good deal has been heard of Mount Morgan during the last year or two, its name having been used to recommend to the attention of investors mines in the same neighbourhood which, nevertheless, may for all the English public can tell, be of a very different character, and in the course of the prospectuses some information has been given as to the mine itself. Still, I suppose the normal fate of such documents is the waste-paper basket, and the facts respecting this unique gold occurrence are so remarkable that they seemed worthy of a short note.

Those who visited the Colonial Exhibition last year will remember, possibly, the great masses of red-brown stone, piled up in the centre of the Queensland Court, looking like portions of great stalactites of hematite. The specimens I am able to show you to-night were sent to me by my brother, who obtained them when visiting Queensland on business a couple of years ago, and they show the same structure of the material.

The history of the mine is as extraordinary as its chemical and geological relations, and affords a striking instance of the value of observation when united to knowledge, and above all of the value of keeping your own counsel until you can see your way to turning knowledge to your own advantage.

About 1870 a squatter took up a couple of "selections" of land of a square mile each, about twenty-five miles (southwest) from Rockhampton, in Queensland. One of these included the south-east portion of a rough and rocky hill, which here and there showed among its stunted vegetation great boulders of a dark metallic looking-rock. Farming did not prosper with the unfortunate possessor of the land, and when copper mining seemed likely to succeed in the district, he had his selection examined by a professional geologist, who found no copper, but pronounced the rough hill a mountain of ironstone. Droughts, the frequently recurring curse of Australia, and other causes, finally ruined the squatter, and he had to take to labourer's work in a mine near by. One day, he offered to show his mountain of ironstone to the owners

* Transactions of the Birmingham Natural History and Microscopical Society. Geological Section. Read April 19th, 1887.

of the mine in which he was working, and was much surprised at receiving shortly afterwards £1 per acre for his selection, £640 in all. This took place in 1883, and in 1885 a tenth share was sold for £31,000, while the unfortunate original owner was employed as ostler at a wayside inn on the way to Rockhampton.

The hill itself is 1,225 feet above the sea, and the actual height of the summit above the level of the river bed at its foot is 521 feet. The manner of working is simply that of quarrying off the crown of the hill to a depth of about eighty feet, while a second quarry, 250 feet lower down, is cut in a different sort of deposit, which, however, is also richly auriferous. The upper part of the hill is composed of the dark rock previously mentioned, while lower down the mass is white and as porous as pumice stone; indeed, it was sold in Rockhampton for scouring doorsteps and hearths. Intermixed with this white porous stuff are masses of brilliant colours, crimson, violet, green, and in the cavities, or sometimes little caves, which are met with in the workings, stalactites and stalagmites are met with, only siliceous instead of composed of calcite, like those with which we are familiar. It is stated that some of the cavities, although quite free from stalactites, have yet the stalagmite bosses on the floor.

According to Mr. R. L. Jack, the Government Geologist, the "country rock" in the immediate vicinity of Mount Morgan consists of a quartzite full of minute crystals of iron pyrites, various ashy and siliceous rocks, shales apparently hardened by heat, and a few belts of serpentine. Cutting through these rocks are numerous dykes of rhyolite, and of a diabase in an advanced state of alteration. There are also quartz reefs which contain a fair amount of gold.

He says further:—"After a careful study of the whole formation, I have come to the conclusion that nothing but a thermal spring in the open air could have deposited the material under consideration. The frothy siliceous sinter agrees in every respect with the deposits of New Zealand and Iceland geysers, and of the still more wonderful hot springs of the Yellowstone National Park. The frothy or cavernous condition of the siliceous sinter of Mount Morgan may be accounted for by the escape of steam, while the silica was yet (after deposition on the evaporation of the water) in the gelatinous condition so frequently observed in the deposits of hot springs." Further: "The gold and, to some extent, iron may have been dissolved out of the iron pyrites of 'some of the reefs of the district,' the gold possibly by chlorine, produced by the contact of hydrochloric acid derived from the decomposition of chlorides with manganese, which occurs sparingly in the form of pyrolusite along with the ironstone of Mount Morgan."

In Mr. Jack's opinion, the great geyser which has built up Mount Morgan was of Tertiary age, and broke through the sandstone, which has been traced over a very large area in Northern Queensland, and was named by the late Mr. Daintree the Desert Sandstone, and believed to be post cretaceous. In many places the valleys eroded out of this sandstone became the seats of volcanic action, the volcanoes breaking out in the upper parts of the valleys and filling the lower reaches with floods of basaltic lavas. The geyser would thus probably be contemporaneous, or nearly so, with the basalts, which have been the causes of the wealth of Victoria, by covering and so protecting from denudation so much of the old auriferous gravels.

The main deposit of gold is in the central core and the summit cap of the hill, probably the solid filling of the pipe and basin of the geyser; the siliceous sinter being much less rich, and some aluminous deposits, apparently similar to those of some of the mud volcanoes of the Yellowstone, being quite free from the precious metal.

The solution and deposition of gold in the manner here supposed is of very great theoretical interest. Given a chlorinated water, the solution of gold from previously existing reefs is of course easy, but since these, without doubt, owed their origin to the deposition of gold from the water which also deposited the quartz, we are not shut up to the explanation, and may, if we please, take it as only a special case of deposition from deep-seated springs.

The late J. A. Phillips described some years ago the numerous metallic deposits from a modern hot spring in California, and the very wide distribution of gold, though of course in very small quantities, has long been known. It has been proved to exist in sea water. Plates of copper exposed on a ship's side through a considerable length of time had gathered quite recognisable traces, and the processes of deposition from solution have been studied by Dr. Skey, of New Zealand, and the researches published in the "Chemical News" for 1874, Vol. XXX., pp. 151, 171.

In the character and distribution of the gold Mount Morgan is again extraordinary. It is the only known gold which is free from silver, and is also the purest known, as it assays up to 99·8 per cent., the $\frac{1}{500}$ part of impurity being copper, with a trace of iron. It is a curious circumstance that in Australia, with few exceptions, the purity of the gold seems to almost universally diminish from South to North, the average fineness of Victorian gold being given as 96 per cent., New South Wales 93, and Queensland 87. The purest Australian gold hitherto known is from Maryborough, in Victoria, assaying 99·3 per cent.

Another character of the Mount Morgan gold, and one by no means so satisfactory, is the extremely fine state of division in which it occurs, making the washing after crushing a very profligate process. The "tailings" which would in ordinary cases be thrown away are here said to retain half the gold, and are therefore stored for treatment by the process of dissolving by chlorine, and subsequent precipitation of the gold by sulphate of iron. Dr. Leibius, of the Sydney mint, experimenting on about 4cwt. of the crushed stone, could extract by amalgamation less than half of the gold present, and only a very small additional quantity was obtained by again milling with mercury.

There seems a considerable probability of other geysers having been in action at the same period in the same district, and indeed all over the Tertiary volcanic districts of Queensland, and of course the discovery of the riches of Mount Morgan has given an enormous impetus to prospecting in localities where the conditions seem at all similar; but then again the possibility, indeed probability, must be recognised that the occurrence of the gold in the old thermal spring was local, and that not every old geyser hill and basin is auriferous.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 204.)

The next writer to be mentioned is Thomas Purton (1768—1833), the author of the "*Midland Flora*," or "*Botanical Description of British Plants in the Midland Counties.*" The first two volumes of this work were published at Stratford-on-Avon in 1817, the third in London in 1821. Purton was a surgeon, residing at Alcester, a Warwickshire town on the eastern side of the Ridgeway, which divides the counties of Warwick and Worcester. It does not appear that, under the term "*Midland*," Purton restricted himself to any definite geographical area, as he notices plants from Warwick, Worcester. Stafford, Hereford, Salop, Derby, Gloucester, Oxford, and even Monmouth. His most numerous references are to the neighbourhood of Alcester, and of these it is not always easy to disentangle the Worcester records from those of Warwick. About midway between Alcester and Droitwich, in the county of Worcester, is the little village of Feckenham. There was formerly in this neighbourhood a large tract of forest, known as "Feckenham Forest." The only remnant of this in Purton's time was an extensive moor, about a mile south of the village, since drained and enclosed. Some of his most interesting records are of the plants of Feckenham Moor, of which all the characteristic ones are now extinct. Another locality frequently mentioned by Purton is Astwood Common, now enclosed, on the Worcester side of the Ridgeway south of Redditch.

Among Purton's correspondents were the Rev. W. S. Rufford, of Badsey, near Evesham, who furnished records of many plants from that part of Worcestershire, and William Scott, Esq., of Stourbridge, whose work, "*Stourbridge and its vicinity*," will be subsequently noticed in these pages.

Owing to the counties not being distinguished it is impossible to treat the notices of the commoner plants as Worcester records. The following lists include all the species assigned by Purton to the county, together with a few others:—

Purton, "*Midland Flora*," Vols. I. and II., 1817.

Fumaria (*Corydalis*) **lutea**, p. 327. Found by the Rev. W. S. Rufford on Broadway Hills, Gloucestershire.

Broadway Hill is in Worcester.

* **F. claviculata**, 327. At Malvern, upon the rocks above the village.

* **Cardamine impatiens**, 301. Side of Malvern Hill. Hanley Common.

* **Sisymbrium** (*Nasturtium*) **sylvestre**, 308. Badsey. Rufford.

Cheiranthus Cheiri, 311. The ruins of the Old Church and Abbey Walls of Evesham.

* **Turritis glabra**, 313. Sides of hedges, upon hedge banks in the lanes about Kidderminster and Stourbridge.

* **Drosera rotundifolia**, 166. Bog on Bromsgrove Lickey. West side of Malvern Hill.

Sagina (*Moenchia*) **erecta**, 104. Malvern Hill.

Cerastium arvense, 220. On Broadway Hills. Rufford.

* **Stellaria uliginosa**. Cookhill, on some boggy ground.

Spergula nodosa, 223. Hanley, near Malvern. Rufford.

Arenaria (*Spergularia*) **marina**, 216. Defford Common, between Pershore and Upton. Rufford. *Almost certainly S. neglecta, Syme. Lepigonum salinum, Kindb.*

Montia fontana, 91. Malvern. In a bog on the west side of the hill.

Linum Radiola, 165. Astwood Heath. *Radiola linoides, Gmel.*

L. usitatissimum, 164. Astwood.

* **Erodium moschatum**, 316. At Cookhill on the Ridgeway.

* **E. maritimum**, 317. About Stourbridge and Bewdley.

* **Geranium phæum**, 742. Abberley. Rev. Mr. Severn. Rufford.

G. lucidum, 320. In the lanes about Wolverley, and on the rocks at Great Malvern.

G. rotundifolium, 321. On a wall at Hartlebury.

* **Rhamnus catharticus**, 130. Harvington.

* **Genista anglica**, 333. In the neighbourhood of Stourbridge, Worc., but nearly extinct since enclosures have been general. Scott.

This I believe to be a Stafford record.

* **Anthyllis Vulneraria**, 332. Cleve.

Medicago sativa, 347. Lucerne. Cleve, Worc.

Melilotus officinalis, 346. Cleve, Worc.

Trifolium filiforme, 345. Astwood Common, &c., Worc. *It is doubtful whether this is T. filiforme or T. minus.*

* **T. arvense**, 345. In the neighbourhood of Worcester. Common.

T. fragiferum, 346. Cleve, Worc.

* **Astragalus glycyphyllus**, 348. Cleve Hill.

* **Vicia sylvatica**, 742. Woods near Clifton-on-Teme. Rufford.

Lathyrus Aphaca, 339. Cleve. Littleton.

Prunus insititia, 233. Bullace Plum. Badsey.

P. domestica, 234. Common Plum. Badsey.

* **Comarum palustre**, 248. Bromsgrove Lickey. About Stourbridge.

Lythrum hyssopifolium, 227. Badsey, near Evesham. Stubble-fields, Bretforton, Worc.

Peplis Portula, 181. At Cookhill, by the side of a pool.

Epilobium palustre, 190. Feckenham Bog.

Œnothera biennis, 195. In Worcestershire. Rev. Mr. Bourne. Withering. *No locality given. This is an American plant now widely distributed in England as a garden escape.*

Sedum dasyphyllum, 218. Badsey, near Evesham. Rufford.

* **Parnassia palustris**, 163. Bromsgrove Lickey.

Hydrocotyle vulgaris, 153. Feckenham Bog. Astwood Common.

* **Apium graveolens**, 158. On the canal beyond Droitwich. In a ditch at Upton Snodsbury. Bretforton, near Badsey.

* **Sison inundatum**, 152. In some springy boggy ground on Abberley Hills, above the Hundred House.

* **S.** (*Petroselinum*) **segetum**, 151. On a ditch bank supported by the hedge, between Hanbury and Droitwich. Badsey.

* **Pimpinella magna**, 157. On the side of the road between Droitwich and Ombersley, close to Sir John Packington's Park Wall.

Bupleurum rotundifolium, 148. Badsey, Bretforton.

* **Œnanthe pimpinelloides**, 149. In a ditch with Scirpus maritimus at Badsey.

* **Phellandrium aquaticum**, 156. Near Worcester. Rufford.

Caucalis (*Torilis*) **nodosa**, 146. Spechley and Badsey.

* **Smyrnium Olusatrum**, 159. In ditches about Badsey.

Galium uliginosum, 99. Feckenham Bog.

* **Scabiosa Columbaria**, 95. Mountainous and dry hilly pastures. Common. *No locality stated.*

* **Onopordum Acanthium**, 384. At Worcester, on the Evesham Road.

Carduus Marianus, 381. Near Worcester.

* **C. pratensis**, 381. Feckenham Moors.

Carlina vulgaris, 386. Astwood Bank.

Anthemis arvensis, 398. On the Ridgeway, upon the new-made turf mounds, in great plenty.

A. nobilis, 398. Hanley Common and Malvern. Rufford.

Gnaphalium montanum, 390. (*Filago minima, Fries.*) On a common between Ombersley and Hartlebury, near the Mitre Oak. Malvern Hill.

* **G. rectum**, 391. (*G. sylvaticum, L.*) Ridgeway near Cookhill, Worc.

Senecio sylvaticus, 405. Astwood Common.

S. viscosus, 405. Badsey. Rufford.

* **Lactuca saligna**, 371. On a ditch bank by the road side at Spechley.

Jasione montana, 418. Burcot Lane, near Bromsgrove, and in other places about that neighbourhood.

* **Vaccinium Oxycoccus**, 196. Bromsgrove Lickey.

* **Erica Tetralix**, 192. Astwood.

Pyrola minor, 732. Abberley. Rev. Mr. Severn. Rufford.

* **Gentiana Amarella**, 138. Cleeve Hills, Broadway Hills.

Menyanthes trifoliata, 122. Bell's Mill, near Stourbridge. Scott.

Cuscuta europæa, 139. Badsey. S. Littleton.

* **Atropa Belladonna**, 128. Dudley Castle, 1815. Bufford. Bell's Mill, near Stourbridge. Scott.

Verbascum nigrum, 125. About Stourbridge, on the side of the Bromsgrove Road, &c.

* **V. virgatum**, 126. Discovered by the Rev. W. S. Rufford, in the neighbourhood of Worcester, where it was first found by Mr. Waldron Hill, of that place. I have since met with it on the side of the road from Worcester to Ombersley.

* **V. Blattaria**, 126. South Littleton, near Badsey. Common about Dunsley and Kinver, Staff. Scott. *I think Scott must have mistaken V. Lychnitis for V. Blattaria. It is the former species which grows about Dunsley and Kinver, as recorded by Stokes. Purton does not include V. Lychnitis in the "Midland Flora."*

* **Digitalis purpurea**, 294. Var. Flore albo. Near Bromsgrove.

Antirrhinum majus, 288. Littleton.

* **A. Linaria**, 286. (*Linaria vulgaris.*) Var. 2. **Peloria.** Badsey. Rufford.

A. Elatine, 287. *(Linaria Elatine.)* Cleve.

A. spurium, 287. *(Linaria spuria.)* Cleve and Littelton.

A. Cymbalaria, 288. *(Linaria Cymbalaria.)* Abbey walls, Great Malvern.

Limosella aquatica, 295. In ditches and roads about Badsey. Rufford.

† **Veronica triphyllos**, 53. Sandy fields. Not rare. *This must be an error. V. triphyllos is restricted to the Eastern Counties and Yorkshire.*

V. officinalis, 51. Astwood Bank.

Salvia Verbenaca, 57. By the side of the road at Harvington, leading to the mill.

Leonurus Cardiaca, 284. Near Malvern.

* **Pinguicula vulgaris**, 55. Upper side of Feckenham Bog. West side of Malvern Hill. *Extinct at Feckenham.*

Anagallis tenella, 115. Feckenham Bog. *Extinct at Feckenham.*

Plantago Coronopus, 92. On the side of the Bromsgrove Road, between Crab's Cross and Headley's Cross.

* **Rumex Hydrolapathum**, 185. In a wet ditch at Spechley.

* **Polygonum Bistorta**, 197. Near Bromsgrove, on the side of the Kidderminster Road.

Asarum europæum, 225. Very rare. *No locality given.*

Salix Lambertiana, 744. Badsey.

S. Helix, 471. Astwood.

* **Juniperus communis**, 482. Cleve Hill. Craycombe Hill.

Lemna trisulca, 436. Feckenham Moors. Cookhill.

Potamogeton lucens, 105. River Avon.

* **Zanichellia palustris**, 434. Feckenham Moors.

* **Triglochin palustre**, 188. Feckenham.

Sagittaria sagittifolia, 467. Harvington Mill.

Alisma ranunculoides, 189. In a ditch surrounding Feckenham Bog.

Orchis pyramidalis, 421. Cleve Hill.

O. *(Gymnadenia)* **conopsea**, 422. Cradley Park. Scott.

* **Ophrys apifera**, 426. Craycombe Hill, near Fladbury. Rufford.

* **Galanthus nivalis**, 170. On the side of the Ridgeway. *In which county is not stated.*

Narthecium Ossifragum, 172. Near Rubery Hill on the Lickey.

Juncus uliginosus, 177. Bromsgrove Lickey.

J. squarrosus, 176. Bromsgrove Lickey.

Cyperus *(Schœnus)* **nigricans**, 62. Feckenham Moors. *Extinct.*

Schœnus *(Cladium)* **Mariscus**, 61. Feckenham Bog. *Extinct.*

Scirpus cæspitosus, 64. Bromsgrove Lickey.

S. setaceus, 65. In a dry pool at Cookhill.

S. maritimus, 65. Marshes and ditches about Badsey. Rufford.

Carex dioica, 440. Bromsgrove Lickey. Rufford. *Extinct.*

* **C. pulicaris**, 440. Feckenham Bog. Bromsgrove Lickey.

C. stellulata, 441. Bromsgrove Lickey. Bog on the west side of Malvern Hill.

C. distans, 445. Feckenham Moors. *Extinct. It is possible that this may have been C. binervis. Sm.*

C. pillulifera, 448. Bromsgrove Lickey.

Agrostis pumila, 71. (*Var. of A. vulgaris.*) Astwood Common.

Arundo (*Calamagrostis*) **Epigejos**, 78. Not rare. *No locality stated.*

Aira (*Catabrosa*) **aquatica**, 74. About Stourbridge.

Festuca bromoides, 82. Astwood.

F. loliacea, 83. Badsey Fields. Rufford.

* **F.** (*Brachypodium*) **pinnatum**, 83. Badsey.

F. (*Brachypodium*) **sylvaticum**, 83. Cleve Hill.

Lolium arvense, 87. Fields about Badsey. Rare. *This is a variety of L. temulentum. L.*

Hordeum pratense, 88. Common. *No locality stated.*

Blechnum boreale, 517. In the lanes about Bromsgrove Lickey.

* **Asplenium Ruta-muraria**, 513. Badsey.

A. Trichomanes, 513. Badsey.

Scolopendrium Ceterach, 516. (*Ceterach officinarum.*) On walls at Badsey. Rufford.

Equisetum limosum, 501. Near Kidderminster.

* **E. palustre**, 501. Feckenham Bog.

Chara tomentosa, 435. Feckenham Bog.

C. flexilis, 435. In a stew at Cookhill.

The plants enumerated in the above list number ...		134
From which we must deduct—		
Species previously recorded ...	48	
Veronica triphyllos—an error (?) ...	1	
Asarum europæum, not specified as a Worcester plant	1—	50
Leaving for new records		84

(To be continued.)

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ON THE MEASUREMENT OF THE MAGNIFYING POWER OF MICROSCOPE OBJECTIVES,

WITH EXHIBITION OF 1-25TH INCH WATER-IMMERSION OBJECTIVE OF POWELL AND LEALAND.*

BY WILLIAM P. MARSHALL, M.I.C.E.

This objective is of exceptionally high power, having a magnifying power of from 1500 to nearly 4000 diameters, according to the eyepiece used. The aperture of the objective is very small, and the face lens is not larger than a small pin's head, this lens having to be worked to as perfect a figure as the larger lenses. This objective requires delicate and careful handling, because of the extreme thinness to which the metal mounting of the face lens is reduced in order to allow of its being brought close enough to the object for bringing it into focus; and, in consequence even a slight touch upon the metal mounting of the face lens would be liable to cause serious injury.

The objective is not, however, difficult to use, and with suitable arrangements it is practically capable of being used as easily and expeditiously as one of low power; provided that the cover-glass of the object is of suitable thinness for focussing so high a power. This cover-glass is not required to be excessively thin in the present case (·005 inch is a suitable thickness), because the objective is a water-immersion lens, and, consequently, works with much greater clearance in proportion than a dry objective; and this 1-25th inch objective allows nearly as much clearance in working as a 1-8th dry objective. The special focussing arrangement used (the plan of Dr. Anthony) is a thin loose brass plate, laid upon the microscope stage under the object to be examined; this plate has a central aperture 7-8ths inch diameter, and projects 1-8th inch beyond the stage at the right-hand end, when it is pushed home to the stop at the left-hand end. The projecting top corner of the plate is touched lightly with the finger, and slightly lifted off the stage and lowered again continuously, during the course of bringing down the objective in focussing; and this gives instant warning of the approach to the object by momentary glimpses of the object being obtained in the lifting of the plate, enabling it to be promptly brought into focus. With this arrangement, so

* Transactions of the Birmingham Natural History and Microscopical Society. Microscopical Section. Read March 1st, 1887.

high a power as the 1-25th inch is readily and safely brought down into focus by the coarse adjustment alone, leaving the fine adjustment to be used only in the further examination of the object; and definite notice is received at once if the cover-glass of the object happens to be too thick for allowing the focussing to be effected, the only care that is requisite being never to go so far in the focussing movement as to stop all freedom of motion in the loose stage plate.

In the illumination of the object, the light is concentrated as usual by an achromatic condenser, so as to get a sufficient quantity of light passed through the minute face aperture of the objective, and a reflecting prism is used instead of the ordinary mirror, because with the mirror there are two reflections of every ray—the principal reflection from the silvered back of the glass, and a secondary one from the face of the glass,—and the mixture of these two sets of rays interferes with distinctness of definition. Special care has to be taken in the adjustment of the illumination, to get the direction of the light truly in the axis of the microscope and central in position, for obtaining a sharp definition with the objective. The immersion objective has an advantage in illumination over a dry objective, because the intervening film of water that is in contact with both the cover-glass and the face lens prevents the loss of light that occurs from partial reflection of the oblique rays by the exterior surfaces of those two glasses that occurs in a dry objective, on account of those surfaces being exposed to the air.

An object now shown in the microscope, under the 1-25th inch objective, is a minute circular diatom, *Aulacodiscus formosus*, which is only 1-100th inch diameter (as small as the finest needle), and this is magnified to more than 8 feet diameter with the highest power, only 1-8th part of the diameter being then visible at once. The surface of this diatom is beautifully marked with rows of dots symmetrically arranged, at a pitch of about 80 to the diameter of the diatom (1-100th inch), and the dots are consequently about 1-8000th inch apart; these are magnified to nearly ½ inch apart, making a magnifying power of nearly 4000 diameters.

This power is measured by drawing the magnified object direct from the microscope with a camera prism, the distance of the paper upon which the image is drawn being fixed at 10 inches from the aperture of the eye-piece, which is the standard distance used for measuring the magnifying power of microscopes. A transparent micrometer scale divided into 1-100ths and 1-1000ths of an inch is then laid upon the microscope stage in the place of the object, and its image is similarly drawn upon the same paper. This scale upon the microscope drawing serves to measure the amount of magnifying, as directly and definitely as an engineer's or architect's working drawing is measured by the scale marked upon it. The accuracy of the whole is tested by checking the 10-100ths inch (or 1-10th inch) upon the micrometer scale by comparison with an ordinary 1-10th inch rule.

In the case of the 1-25th inch objective there was not the means of applying the micrometer scale direct in this manner, and the measurement of the magnifying power was effected by using the rows of dots upon the above-named diatom as a comparative scale for measurement. A drawing was first made with a 1-12th objective of a portion of the diatom, and a measuring scale drawn upon it direct from the micrometer scale, and then a drawing of the same portion of the diatom was made with the 1-25th inch objective; and by measuring the distances between the centres of the corresponding dots in the two drawings, the proportion between the magnifying power of the two objectives was obtained. The power of the 1-25th inch objective with the lowest eye-piece is found to be 1470 diameters, with the middle eye-piece 2280, and with the highest 3820 diameters. It performs well with the first and second eye-pieces, but breaks down in sharpness of definition with the highest eye-piece.*

THE SYNTHETIC PHILOSOPHY.

Students of the doctrine of Evolution, as set forth in the works of Mr. Herbert Spencer, will be interested to hear that a movement has been originated in Paris for the systematic study of the Synthetic Philosophy. The following gratifying letter, from Mons. James Grosclande, C.E., has been addressed to Mr. W. R. Hughes, F.L.S., President of the Sociological Section of the Birmingham Natural History and Microscopical Society, on the subject, to which a cordial reply has been made:—

Paris, le 15 Juillet, 1887.

Monsieur W. R. Hughes.

J'ai récemment envoyé une lettre à Mr. Herbert Spencer, l'éminent philosophe. Je lui faisais part de l'admiration que

* The objective described above is one presented to Mr. Marshall by the Exhibitors at the Bingley Hall Exhibition in connection with the visit of the British Association to Birmingham in September, 1886. Mr. Marshall was a member of the "Officers' Committee" for the Exhibition. (Eds. M. N.)

j'éprouvais pour la hauteur de ses vues philosophiques et pour l'énergie de caractère dont il a fait preuve pour mener à fin une œuvre aussi considérable que la sienne, œuvre dont un critique français, M. L. Carrau, a pu dire avec raison que c'était l'Encyclopédie de Hegel refait au point de vue de la méthode expérimentale.

Je lui disais en outre que, grâce au principe universel qui le domine, son système de philosophie synthétique est avant tout un système de conciliation et de paix. Or nulle époque, plus que la nôtre, n'a jamais eu besoin d'être aussi guidée par l'esprit de concorde. J'ajoutais que ses principes ne devaient pas rester cantonnés dans le domaine de la spéculation pure, soumis au seul examen des professeurs, et des philosophes *de profession*, mais qu'il fallait, grâce à une propagande active et éclairée de la part de tous ses disciples, qu'ils fussent connus de la masse du grand public qui pourrait ainsi en subir l'influence bienfaisante. "Dans ce but," disais-je à Herbert Spencer, "j'ai réuni un certain nombre de mes amis, jeunes gens familiers déja avec vos théories et ayant fait une étude sérieuse et méthodique de vos principaux ouvrages et je leur ai exposé mon intention de répandre vos idées dans un cercle aussi étendu que possible, en les présentant toutefois sous une forme appropriée à tous les esprits, même à ceux les plus étrangers aux questions philosophiques. Mes amis ayant adhéré à ma proposition, nous avons convenu de recommencer en commun, sous ma direction, l'étude générale et approfondie de votre système, d'en detacher les passages les plus saillants et renfermant les idées dont l'extension doit avoir l'influence sociale la plus salutaire, puis de rechercher les moyens à employer pour réaliser cette propagande que je regarde comme si utile par l'action bienfaisante qu'elle peut exercer sur la marche de l'esprit contemporain." Dans la lettre qu'il a eu la bonté de m'adresser le 12 Juillet dernier, Herbert Spencer a accueilli ma proposition favorablement et m'a souhaité de réussir dans la tâche que je m'impose. Il m'a appris (et je vous demande pardon de l'avoir ignoré) que vous avez tenté un effort dans ce but à Birmingham et que je trouverais près de vous toutes les informations désirables à ce sujet. En conséquence je vous serais très-reconnaissant, cher Monsieur, si vous vouliez bien avoir l'obligeance de me donner quelques renseignements sur la Société philosophique que vous présidez. Dans le cas où vous pourriez mettre à ma disposition, soit des livres, soit des publications quelconques relatives à votre œuvre, je serais très-heureux de les recevoir. Je vous rembourserais immédiatement les dépenses que ces envois pourraient vous occasionner. Je regarde comme un devoir pour tous ceux qui partagent les idées de notre illustre maître, Herbert Spencer, de joindre leurs efforts pour propager ses belles doctrines qui constituent aujourd'hui l'un des plus sublimes monuments elevés à la science et à la philosophie.

Recevez, cher Monsieur, avec mes remercîments anticipés, l'assurance de ma haute considération.

JAMES GROSCLANDE,
Ingénieur Civil,
96, Boulevard Diderot, Paris.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 207.)

II.—WOULD THE WATER GO INTO THE MIDDLE LIAS BEDS?

6.—There are two or three special matters bearing upon the question of the porosity of the Middle Lias which require some consideration. It has been rather insisted upon by some of the opponents of this water scheme that the water in the Marlstone travels only by means of cracks and fissures in the Rock-bed. I am quite prepared to admit that these fissures very materially aid the circulation of water in the Marlstone, but I am also quite certain that this is not the only way by which water travels.

If water travelled only by means of these fissures, an uninterrupted series of them must extend from the well where water is obtained to the outcrop of the bed, or catchment area, and then the water supply would vary with the season, but so far as I can ascertain, this is not the case with any deep well in the Marlstone; also, the finding of water would be much less certain than it is, and its efficient filtration doubtful.

No doubt the idea that water circulates only by means of fissures arises from the fact that when a well is made such cracks are commonly met with, and water appears to issue from them only; they not only form miniature wells for the water to flow into, but may extend some distance into the rock laterally, and so act as headings in draining it.

The extreme rarity of wells in the Marlstone not yielding water has previously been pointed out; nevertheless, much has been made of the fact that no water was obtained at the Spinney Well just outside Northampton, at a point less than a mile from a well in the same formation yielding at the same time some hundreds of thousands of gallons daily. In this well, of which a description has been given, headings were driven 352 feet to the north-west, and 141 feet to the north-east, but no flow of water could be obtained. The cause of failure was, in the first instance, attributed to the existence of an anticlinal curve, and afterwards to the closeness of the rock.

I have all along believed that an anticlinal curve exists in the valley where the Spinney Well was made, and that the general lowering of the water-level in the Marlstone had thus left the Rock-bed dry. The proofs I am now able to offer are quite conclusive as to the adequacy of this cause, and I am not aware of any reason for the alternative explanation.

Speaking generally for Northamptonshire, I should say it is a mistake to sink for water in a valley, now that the general water-level is so low, because it often happens that valleys coincide with, and, indeed, had their origin in, anticlines of the strata. It is really very common to find superficial beds dipping into the hills, and consequently forming under them synclinal curves, with corresponding anticlinals in the valleys. At three points at least on the new railway line between Weedon and Daventry (about four miles) this may be seen at the present time (1887).

When a curve is produced in a set of beds by upheaval at one part, or along one line, it is clear that the beds forming the curve will occupy a larger space than the same beds did whilst forming a plane. Those forming the lower part of the convex curve may preserve their continuity by re-adjusting themselves in obedience to the pressure above them, but the upper ones will crack, and that most deeply at the highest point of the curve. The exposed edges of the strata at the cracks being much more easily denuded than the surfaces of the same strata, we have here the initiative for the formation of a valley, under which, of course, the lower beds will form an anticline.

I not only think that many of our valleys have been *started* in this manner, but that "faults" have also been produced by shearing along the line of weakness produced by these cracks.

Returning to the Spinney Well:—We find that it is situated at small, and nearly equal, distances to the south-east and north respectively of two other wells which have yielded considerable quantities of water from the Marlstone. Further relations between them are shown below:—

	Height of Surface above Sea-level.	Depth of Rock-bed from Surface.	Height of Rock-bed above Sea-level.
	FEET.	FEET.	FEET.
*Kingsthorpe Shaft	374	293	81
†Spinney Well ...	278	171	107
Billing Road Well	235	160	75

It will be seen from these measurements that the water-bearing bed at the Spinney Well is at least 32 feet above the same bed at the Billing Road Well; therefore, at a time when the water at the latter place would scarcely rise above the bed from which it came, it could not be expected that this higher portion of the same bed would yield water. If water had been obtained at the Spinney Well, then it would have been necessary to account for it either by a "fault," by a want of general porosity in the bed, or by a very high gradient in the saturation level arising from resistance; as it is, however, it became a proof of the absence of all these obstacles to the success of the water scheme under discussion.

I may say, incidentally, that a piece of the hard green rock containing *Terebratula punctata*, from this well, was thrown into some water, and on breaking it up in about fifteen minutes, it was found to be saturated with water throughout.

I was told that after salt water had been tapped, at a depth of about 800 feet, it rose to within about 145 feet of the top, but fluctuated about that level, probably running away into the Marlstone until properly stopped out. I do not attach much importance to the *depth* of the salt water, because, although it was given to me by one who might have known, he had not actually measured it. Considering that salt water at this time filled the old Kingsthorpe shaft to within 270 feet of the surface, that is, 104 feet above sea-level, it is scarcely possible that the same water at the Spinney

* I have taken the responsibility of altering the depth of the Rock-bed from 210 feet to 293 feet, believing that the evidence to follow amply justifies it.

† The section of the Spinney Well given in a previous page shows the Rock-bed to be at a depth of 164 feet, whereas Mr. Eunson ("Range of the Palæozoic Rocks beneath Northampton," Q.J.G.S., 1884) gives to it a depth of 171 feet. I have assumed that the latter is a correction of the former.

Well could rise 133 feet above sea-level; indeed, bearing in mind the general dip and strike of the Mesozoic beds, and the situation of these two wells respectively, one would expect a slightly lower level for the water at the Spinney Well. At any rate it is evident that the water must have risen quite or nearly up to the Middle Lias Rock-bed, for if we add to the depth of the Rock-bed at the Spinney Well its thickness of 7 feet 6 inches, making altogether 178½ feet from the surface, it will be evident that its base is 99½ feet above sea-level, and so, if the water rose as high as at Kingsthorpe shaft (104 feet above sea-level), the Rock-bed would be covered to the extent of 4½ feet, and the salt water would run away into it.

Kingsthorpe Shaft is situated a little over a mile from the Spinney Well, but is within sight of it; it was made 50 years ago with the idea of finding coal. According to the account left of the work, it has a depth of 967 feet, the Marlstone was reached at 210 feet, and yielded a supply of water equal to 36,000 gallons per hour. The shaft is now filled with salt water to within 270 feet of the top—that is, 60 feet below the recorded position of the Marlstone Rock-bed. No water now flows into it from any point above the salt-water level.

I should not think of calling in question the accuracy of any of the figures given above but for the fact, well known, that no detailed section of the shaft was taken at the time it was being made, hence errors of depth might easily be made.

Shortly after the Spinney Well was abandoned, the Kingsthorpe shaft was opened to see if the Marlstone there continued to yield water. A small quantity of water was found to be making its way into the pit near the surface of the ground, but when that was stopped there was no flow anywhere. The lining of the shaft was broken through and the rock tapped, at short intervals, from the surface of the water to a considerable distance above it, but no water obtained. In April, 1881, I made a slight investigation of the pit, at the request of Lady Robinson, on whose land it is situated. A workman broke the lining of the shaft, or utilised the openings already made, and brought up small specimens of the rock from numerous depths between 150 feet and the surface of the water. The rock in every case was clay, and although, in the absence of fossils, one might be easily misled, my impression was that it was all Upper Lias, and that the Middle Lias Rock-bed was below the water level, and so at least 60 feet lower than its supposed position.

We will assume for a moment that the depth of 210 feet for the Marlstone is correct, then the section would be about as below:—

	FEET.	
Great Oolite, Inferior Oolite, Upper Lias	... 210	
Middle Lias ...	... 21	(Spinney Well Estimate.*)
Lower Lias ...	... 629	
Sandstones ...	... 80	
Red Marl... ...	... 12	
Conglomerate ...	... 15	
	967	

The notes respecting the last three beds are said to have been made by Dr. William Smith, F.R.S., F.G.S., and Mr. Sharp, in whose possession they were, appears to have quoted the thicknesses of the upper one and the sum of the beds above it differently in two separate papers.† In the earlier one, he says, the Lower Lias was pierced at a depth of 860 feet, and 80 feet of Sandstones met with; in the later one 880 feet and 60 feet are the thicknesses quoted for the same things. It may be that the second figures are a correction of the earlier ones, and certainly the thickness of the Sandstones agrees better with the Spinney Well record; nevertheless, I have preferred to retain the earlier ones, although less favourable to the particular contention founded upon them.

Now the total depth of the Kingsthorpe shaft is no doubt correct, the thicknesses of the lowest three beds are probably so; but if we accept the other figures given, then, (1) The Lower Lias must have a thickness of 629 feet, that is, 88 feet more than at the Spinney Well, about a mile away; (2) The Marlstone Rock-bed is 164 feet above sea-level, that is, 89 feet higher than at Northampton, and 51 feet higher than at the Spinney Well; (3) The thickness of 210 feet for the Great Oolite, Inferior Oolite, and Upper Lias is less than might be expected.

Considering that after the termination of the Carboniferous land period the inequalities of surface then produced were largely obliterated by deposition of the Permian or Trias, or both, and that the highest parts of the Carboniferous limestone in this very district were covered by the latter, it is

* "The Range of the Palæozoic Rocks beneath Northampton," by Henry J. Eunson, Esq., F.G.S. Q.J.G.S., August, 1884.

† "The Oolites of Northamptonshire," Part I. Q.J.G.S., August, 1870. "Note on a Futile Search for Coal near Northampton," Geol. Mag., Vol. VIII., p. 505, 1871.

quite incredible that the Lower Lias would vary in thickness by more than 80 feet at two places only about a mile apart. An anticline could not account for the increased thickness of any bed of the section at Kingsthorpe, and if it could the suggestion would be entirely opposed to the evidence which can now be obtained with regard to the superficial beds, for the Upper Estuarine Clay just at the edge of the hill, where the Kingsthorpe shaft is situated, is at the same level as the Great Oolite limestone a little further on the hill, and must, therefore, dip below it. By giving the Lower Lias a thickness of 546 feet, the same as at the Spinney Well, the Marlstone would be at a depth of 298 feet from the surface.

To get a correct idea of the thicknesses of the beds above the Middle Lias it is necessary that measurements should be made where undenuded Upper Lias and Inferior Oolite at least are met with, and preferably where the Great Oolite forms the Upper bed. The nearest place I can appeal to as supplying the information is Duston, situate a little less than three miles from Kingsthorpe shaft. In a well made at Berry Wood Asylum the following beds were passed through :—

SECTION OF WELL AT BERRY WOOD ASYLUM.

		FEET	
Upper Estuarine	... Clay	about 20	*Sunk.*
Inferior Oolite	Sand	,, 50	
	Sandstone (like that in the quarries at New Duston)	30 to 36	
	Blue greasy stone ...	3	*Bored.*
Upper Lias	... Clay	190	
Marlstone	... Hard bluish stone...	3	

The spring at the base of the Inferior Oolite was used for some time before the boring to the Marlstone was made.

It is known that the Upper Estuarine beds of the Great Oolite at Kingsthorpe are about 20 feet thick, the same as at Duston, because they were once worked for brickmaking, and if we add to these 83 feet of Inferior Oolite (Northampton Sand) and 190 feet of Upper Lias (the minimum of each at Duston) we get 293 feet as the depth of the Marlstone, the exact depth arrived at from a different set of data, a result certainly remarkable, and therefore strongly confirmatory of the contention that the Marlstone at the Kingsthorpe Well is below the present water-level there.

Altogether, then, it appears that the wells at Kingsthorpe and Northampton which yielded water tapped the Marlstone at a lower level than that formation had at the Spinney Well.

It is scarcely necessary for me to point out that so long as the bed is continuous, the presence of an anticline in the

Marlstone, at any point, would not in the least degree be a drawback to the success of a dumb-well constructed there.

Other evidence with regard to the continuity and general porosity of the Marlstone will better appear in the next Section.

(To be continued.)

Review.

The British Moss Flora. By R. Braithwaite, M.D., F.L.S. Part X. L. Reeve and Co. 10s.

This part, which will be welcomed by moss students, concludes the first volume of this valuable work, and is about one-third of the whole work. It is illustrated by nine plates, on which are given delineations of forty-five species, and of these plates no word of praise can be said too much. The letterpress, of which there are seventy-eight pages, contains descriptions of the remaining species and varieties of Tortulaceæ, including the conclusion of the genus Mollia and the genera Leptodontium, Barbula, Leersia (the Eucalypta of British authors), and the one British species of Weberaceæ of Ehrhart, *Webera sessilis (Diphyscium foliosum*, Mohr), illustrated by a full-page plate, which is a most beautifully finished one.

Since the monograph of the genus Fissidens (Part IV. of this work) was published, Mr. Mitten has published in the Journal of the Linnean Society an important paper on this genus, which adds considerably to our list of species, and alters many of the older views. To bring the present work level with the times Dr. Braithwaite gives in this part eight pages containing descriptions of the new species, and also all alterations in nomenclature deemed needful. These are illustrated by one plate, and the extra pages are so paged that they may be added to Part IV. without any alteration of the general paging. In addition to this is a Supplement giving descriptions of the various species that have been added to our flora whilst the work has been in progress and since the issue of the various monographs to which they belong, and this is so well up to date that the newest addition to our flora is fully and well described. There are also addenda giving new localities for some of the rarer species, and a classified list of all the species described in Vol. I., and it is to be hoped that this latter may be completed and issued separately, as it would be a valuable aid for indexing herbaria, &c. The part concludes with a full index, title-page, &c., so that the volume forms a complete series of monographs of the various genera at present treated.

The volume is also published in a complete form, containing forty-five plates, and giving details of 225 species, with 3,000 figures. Of these species about eighty are additions to the British Flora since the publication of Wilson's "Bryologia Britannica," descriptions being also given of an equal number of varieties not recorded by Wilson.

It is much to be desired that the two concluding volumes may be passed through the press at a quicker rate than the one just now completed, and that the talented author may be spared not only to complete his great and valuable undertaking, but also to reap the honour he so richly deserves. J. E. Bagnall.

Wayside Notes.

"THE NATURALISTS' MONTHLY" is a new journal devoted to the interests of Nature-lovers and Nature-thinkers, the first number of which will appear synchronously with the present issue of the "Midland Naturalist." If we may judge by the prospectus, it is intended to enter into competition with our well-known contemporary "Science Gossip," but of this the first number will give a clearer conception. It is to be edited by Dr. J. W. Williams, and published by Walter Scott, Warwick Lane, Paternoster Row.

PROBABLY THE MOST MARKED FEATURE of the Meeting of the British Association at Manchester, commencing on August 31st, will be the number of foreign visitors who are expected to take part in the proceedings. Somewhere about 120 of these are expected. Perhaps the most remarkable assemblage will be on the botanical side of Section D. To mention the name of Professor Sachs, of Würzburg, is to bring to mind one who stands head and shoulders above all his contemporaries as a physiologist; though scarcely less renowned is Professor Anton de Bary, of Strassburg, distinguished alike as anatomist, morphologist, and fungologist. Cohn, of Breslau; Count von Solms Laubach, of Göttingen; Pringsheim, of Berlin; Da Saporta, of Aix; Dr. Treub, Director of the Botanical Gardens at Buitenzorg, Java; and Professor Asa Gray, of Harvard, complete a gathering of foreign botanists such as this generation will scarcely have seen before.

HAYES WATER.—Walking in May last from Mardale to Patterdale, in Westmoreland, by way of Kidsty Pike and High Street Mountains, I diverged down to this lonely mountain tarn (which should not be confused with the much larger lake of Hawes Water), being attracted by its clean seclusion and pastoral enclosure of long, grassy hillsides; but was most struck by the great number and uniformity of shape of moraine masses grouped about the south-east and north-west ends of the little lake (which is 1,383 feet above sea level), looking almost artificial, and arresting the attention by their totally different aspect from ordinary weathered *detritus* at the base of cliffs or below long slopes of rock, and having something of the regular shape and rounded contours of broad, colossal beehives; several are like these, with one side slightly flattened against the mountain. So uniformly and beautifully rounded are they, and so numerous, you see at once some special agency has been at work in the far past to produce them, although quite recently in a geological sense. The entire long, narrow valley has every appearance of being in a perfectly natural condition, and this agency, *there so very decided*, I can imagine to have been none but that of glaciers once present in the valley, and probably very slowly retreating upwards as the climate ameliorated, until at length the present conditions prevailed. I can strongly recommend the study of this particular valley of Hayes Water to geologists, it being comparatively little known; and it is easily reached by diverging to the right, on descending from Kirkstone Pass towards Patterdale, directly after passing the interesting lake of Brothers Water.—HORACE PEARCE, F.G.S.

TOLYPELLA INTRICATA IN BEDS.—This was first observed in this county on March 3rd, 1883. It was growing in a small pool about three yards long, by two yards wide, and about two feet deep. In the course of the succeeding month it had attained its full development, when it filled two-thirds of the pool. During the succeeding year (1884) there was not the least trace of it, but in the following three successive seasons, viz., 1885-6-7, it has appeared in the same station in limited quantities. This is so unusual an occurrence in the history of this plant, as known in Britain, that it will probably interest the readers of the "Midland Naturalist" (*vide* Messrs. Groves' "Review of the British Characeæ," "Journal of Botany," 1880, p. 163, pl. 209; in reprint, p. 16). The uncertain appearance of these plants and their apparent independence of roots is worthy of note. The writer has at the present moment living *Nitella mucronata* in an aquarium, gathered more than a year ago, and in obtaining them they were broken off about the roots, so that they have existed without them, never having developed any during that period.—J. SAUNDERS, Luton.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL MEETING, August 2nd, 1887. Mr. Thomas Clarke exhibited piece of fossil wood and three siliceous pebbles brought from the Soudan by Gunner W. Allen, E Battery, Royal Horse Artillery. Mr. Edmonds exhibited a specimen of rose with the sepals of calyx converted into leaves. Mr. Bolton exhibited specimens of male and female *Asplachna intermedia*, a rare rotifer found at Hartshill.—BIOLOGICAL SECTION, August 9. Mr. R. W. Chase in the chair. Mr. J. E. Bagnall exhibited and described for Mr. W. R. Hughes a fine series of plants representing the rarer flora of the Medbourne district of Leicestershire, and containing *Vicia sylvatica* and *Euonymus Europæus*; these were all collected by the Rev. T. Norris, Rector of Alexton, and one of the authorities referred to in the "Flora of Leicestershire." Mr. W. P. Marshall exhibited a collection of plants from Hartlebury Common and the neighbourhood, including *Sagittaria sagittifolia*, *Carex ampullacea*, *Jasione montana*, and *Comarum palustre*.—GEOLOGICAL SECTION, August 16. Mr. Thomas Clarke in the chair. Mr. Horace Pearce, F.G.S., exhibited specimens of silver-bearing rocks from the Rocky Mountains near Pueblo, in Colorado, United States. Mr. Bolton exhibited specimens from the Severn at Hampton Loade of the rotifer *Lacinularia socialis*, and of a curious Caddis larva in a transparent case, having vibrating gill appendages. Mr. Reading exhibited a specimen of *Daphnella Wingii*, an entomostracan from Sutton Park. Mr. Rabone exhibited a photograph from Dunedin, in New Zealand, showing very luxuriant vegetation; also a specimen of a double kidney bean. Mr. Wilkinson exhibited for Mr. Pumphrey a specimen from Switzerland of the lichen *Usnea barbata*, variety *florida*, that was beautifully in fruit. Mr. Marshall exhibited a number of plants collected in the Dingle, near Hampton Loade, and the neighbourhood, including the following rare specimens:—*Hypericum androsæmum*, *Dipsacus pilosus*, *Vicia sylvatica*, *Viburnum opulus*, *Eupatoria cannabinum*, and *Cynoglossum officinale*.—SOCIOLOGICAL SECTION, August 23rd.—Mr. Bolton exhibited the freshwater alga, *Hydrodictyon utriculatum*, from Sutton Park. Mr. Reading exhibited the very rare and most remarkable rotifer, *Pedalion mira*, which so much resembles the nauplius larva of an Entomostracan in its jumping movements, from a new locality, King's Norton.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 27. Mr. Deakin exhibited specimens of *Pupa umbilicata*, var. *edentula*, and *Helix pulchella*, from Brecknockshire, also a curiously distorted specimen of *Anodonta anatina*; Mr. J. Madison, specimens of *Patella longicosta* and other shells, from Australia, also a small collection of insects from the same place. Mr. H. Insley then gave an address on "*Ranunculus repens*: A Study." This plant was chosen because it was very common and belonged to the first natural order. It was described from the root to the flower, the minute structure of each part being enlarged upon. The concluding part dealt with its development, and recommended the structure and physiology of plants as a subject of greater interest than their mere classification. A large number of slides and diagrams illustrated the subject.—July 4. Mr. J. W. Neville exhibited a leaf of cabbage showing an abnormal growth; the midrib had divided, one portion springing from the centre of the leaf formed a stem, on the summit of which a pitcher-shaped leaf was borne. There were many instances of this growth in the same garden. Mr. J. Madison exhibited specimens of *Limnæa glabra* and *Paludina contecta*, from Yorkshire—the latter shell is said to be extinct in that county; Mr. Mulliss, ruby-tail fly, *Chrysis ignita*. Under the microscope Mr. H. Insley showed coniferous glandular structure.—July 11. Mr. F. Holden read a paper on "A Day's Ramble over the Marlstone of East Leicestershire." The writer described the journey to Burrow Hill, where the marlstone was first worked on its bluff escarpment. Pickwell was next reached, and yielded some very perfect specimens of Cerithium and the largest Belemnites he had met with. At Illstone were found five species of Ammonites. The journey was then continued to the railway cutting at Tilton, where a fine exposure of the formation was seen; these rocks yielded many fossils, including a vertebral column of Ichthyosaurus. These beds also contain iron, the lower ones in the form of a carbonate, the upper ones as a peroxide. The top bed was surmised to be the top bed also of the formation. The writer concluded an interesting paper by describing the percentage of iron found in the marlstone, which, though small in quantity, was so readily extracted that it opened up a wide field for commercial enterprise. The fossils collected were exhibited.

CARADOC FIELD CLUB.—The third meeting of the Club was held on August 10th at the Breidden Hills. The interest of the meeting was mainly geological; the chief features of the Hills in this respect being pointed out by Mr. W. W. Watts, M.A., F.G.S., who has devoted special attention to the district, and whose paper on the subject appeared in the Quarterly Journal of the Geological Society for November, 1885. An address was also given by the Rev. D. P. Lewis, President of the Oswestry and Welshpool Field Club, on the claims of the Breidden to be the site of the last stand of Caractacus (or Carádoc), against the Romans under Ostorius Scapula, as related by Tacitus.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—The fourth field meeting of this society for this season was held on August 8th at Minsterley and the Stiperstones. On arriving at Minsterley station carriages conveyed the party to the Snailbeach lead mines, where, by the kindness of the proprietors and H. Dennis, Esq., the manager, they inspected the several processes of raising, sorting, crushing, and sifting the ores, and also the mode of smelting and casting the pig lead. The ore is raised from a depth of 500yds. in the Llandeilo rocks, and no doubt the veins of lead ore were worked at the surface by the Romans both here and at other places in this neighbourhood. A Roman pig of lead was found here by some workmen in 1851 while sinking through a heap of slag, which bore the following inscription in raised letters:—IMP. HADRIANI. AUG. A number of interesting specimens of the various minerals raised here were placed at the disposal of the party, consisting of galena, zinc blende, quartz, amethyst quartz, carbonate and sulphate of baryta, calcspar, &c. The drive was then resumed to the Stiperstones, several exposures of Llandeilo rock being noticed on the way. On reaching the summit and after having climbed to the Devil's Chair, the members opened their stores of refreshment and enjoyed a well-earned repast. Then the president, Mr. Horace Pearce, F.G.S., gave the following short address:—This ridge of the Stiperstones, described by Sir R. Murchison as Lingula Flags, Dr. Callaway has shown to be the equivalent of the Shineton Shales and Tremadoc Series (as referred to in Mr. D. La Touche's recent admirable work on the "Geology of Shropshire.") In this district occur rocks, some of which are among the most ancient in these islands. as at the Ercall, Wrekin, and Primrose Hills. the Caer Caradoc, Hope Bowdler, and other portions of the Stretton Hills; notably at Pontesbury Hill, or Pontsford, only a short distance from the Stiperstones, where not long ago I was interested to find specimens of remarkable intrusive and changed rocks, such as Diorite, Felsite, varieties of Basalt, and forms of what are now generally reckoned as Archæan, singularly varied and intermixed in a small area about this hill, changing often in a few yards in a striking degree. These have been described by Dr. Callaway, and are most interesting to study on the spot. Then, again, we find these primeval rocks, if I may so term them, occurring further north; largely seen in some of the Hebrides, those wild islands off the West Coast of Scotland; and probably more instances of their being found on the surface will yet result, for I cannot but think they are not yet fully investigated, the intrusions and faultings being so frequent and so complex, while the present openings in the hills are, comparatively speaking, so few, and at intervals so great. These Archæan rocks are closely allied to the Laurentian of Canada, which are also still under discussion, and, as probably forming the original backbone of our islands, have an interest of great extent, especially when we remember the enormous range of their development in the remote past, followed by denudation of proportionate magnitude. For I would remind you, in relation to this subject, that Professor Hull considers that in a far-gone geological age there existed a vast tract of this most ancient land, where part of the North Atlantic Ocean now is, what one may call an old Continental Area of land, the ruin of which went largely to build up subsequent formations, themselves to suffer degradation, in the sense of being worn down, to form rocks of enormous thickness in ages still geologically nearer our own brief period. Of this *old land* there are here and there the fragments, such as those worn Hebrides, still suffering the wasting of the ocean storms. And upon this subject of denudation or disintegration of rocks we should remember that this bold, castle-like crest of the Stiperstones is but a trifling portion, a mere *relic* of once great and lofty masses; just as Snowdon is but an inner relic of its once gigantic substance—frost, lightning, air, and water having worn down that great mass into the picturesque mountain we now admire.—Mr. Pearce then read to members present some extracts from La Touche's "Geology of Shropshire" upon this district. Mr. W. Madeley also mentioned the interesting fact that Dr. Callaway had discovered that the strike of these Archæan hills was not originally in accord with their present trend, showing that they were parts of chains of hills which have been subjected to an enormous amount and length of erosion, and represent but the ruins of former mountain chains. The botanists were not at all fortunate in finding the rare plants which are noticed as occurring on these hills, owing, no doubt, to the long dry season; the only plants which were reported were *Empetrum nigrum* and *Vaccinium Oxycoccus* and *Vitis-Idæa*.

ON THE RECENT RIVIERA EARTHQUAKE.*

BY W. P. MARSHALL, M.I.C.E.

This terribly sudden catastrophe, on 23rd February last, by which more than 1000 lives were lost, and a great number of buildings destroyed, was of special interest because the locality where it occurred is a favourite resort for visitors from this country, and many here had personal friends who experienced some of the effects of the earthquake. I happen to have had some friends there at the time, two parties in different places, from whom interesting particulars have been received of their personal experiences of this earthquake, which so rudely disturbed the charming calm retreat of the Riviera. That favourite place being the resort of invalids for winter quarters on the mild shores of the Mediterranean made the occurrence specially distressing, and terrible sufferings were caused to many invalids by their being suddenly turned out of doors by the destruction of the buildings in which they were staying. Although earthquakes have been experienced there before, three others having occurred in the district within the present century, in 1818, 1831, and 1854, these were only comparatively slight in amount, and no apprehension of such a calamity as the recent earthquake was entertained.

The Riviera (the name signifying "shore" in Italian) is a long narrow strip of shore, at the foot of a mountainous district that extends down so close to the sea as to leave only a narrow strip with precipitous cliffs and deep ravines, which is occupied by a succession of towns and villages, extending for about seventy miles distance from Cannes to Alassio, and in the more closely populated portion lying at only three or four miles distance from one another. In the fifty miles further distance on to Genoa is the celebrated "Cornice Road" with its lovely views of sea and mountain, and about ninety miles in the other direction we reach Marseilles. The line of railway runs close along the shore most of the way from Marseilles to Genoa and on to Leghorn, that being the only passage available at the foot of the mountainous district.

* Transactions of the Birmingham Natural History and Microscopical Society, Geological Section, read May 17th, 1887.

The railway was obstructed by rocks that were thrown down by the earthquake, and by damage to the tunnels; and the traffic between Mentone and Cannes was stopped for a day by a landslip. The earthquake was also felt slightly at Turin, Parma, Leghorn, and Marseilles; there was also some indication of it in Austria and in France, and as far north as Cologne. In Mentone, which was in the district that suffered most, a large number of houses were so much shaken as to become dangerous, and required partly pulling down. The smaller town of Diano Marina was nearly destroyed, many of the inhabitants killed, and a large number injured; the great amount of personal injury in this case was attributed to the circumstance of the houses being mostly built over large vaults, in which casks of olive oil were stored, and in the earthquake the people were precipitated into these vaults with the ruins of the houses. The towns of the Riviera generally are marked by being built with a special provision against the effects of earthquakes, in arched buttresses extending across the narrow streets at various levels, to support the walls of their somewhat high-built stone houses. Taggia was another place that was nearly destroyed by the earthquake, and at Oneglia the houses generally were so much shaken as to be in danger of falling. In many towns the people had been caught in the act of escaping from their houses, and became buried in the ruins; and the danger of the remaining walls falling was so great as to make the rescue of those buried a very difficult work. This difficulty was terribly aggravated by a recurrence of the earthquake shocks several times, which, though weaker in intensity, were sufficient to bring down more of the already damaged walls.

The occupants of the damaged hotels rushed out of doors on the first shock, and mostly remained camped out in the open air during the next night, some in arm-chairs, some on benches, some in tents, some on tables, and some in waggons, carriages and hotel omnibuses, and in bathing machines. The first shock occurred early in the morning, a little before six o'clock, when all were in bed, and the visitors rushed down instantly and out of doors, with very little clothing in many cases, and only able to obtain a further supply afterwards by getting clothes thrown out to them from the windows of their hotels.

The following graphic account has been received from one of my friends, whose party was at Mentone, sleeping at the top of one of the large hotels. They were awaked by a horrible crash, and walls and roof seemed cracking in with a terrific sound; in one bed-room the window was smashed, and light was seen through a gaping crack in the outside wall. They snatched up such things as they could lay hands on, and rushed down the lofty marble stairs, which seemed to sway as they passed, and afterwards partly gave way under the subsequent shocks. It was then scarcely daylight (being in February), and all the company assembled in the hall and seemed to pause a little; but another alarming shock quickly came, and they flew down the flight of steps out into the garden of the hotel. It is remarked that never will they forget, as they shivered out there in the cold early morning, the sight of the horrid vivid red glow on the jagged mountains above (though so beautiful a scene at other times), as the sun rose on all this horror and destruction, and it seemed as if the end of the world was upon them.

The scenes around were sad enough. In the hotel a dying gentleman with nurse was left inside, and a lady dying was left in the next large boarding-house; both were at last carried out and laid in the garden, where also was a poor lady lying motionless on blankets in an attack brought on by fright. About two hours after the first two shocks, when it was supposed the shocks were over, another third one occurred, and after that they were unable to go into their hotel again, and some of the clothes left in their rooms were lowered to them in a sheet out of a window. They went on afterwards towards the railway station to endeavour to get away from the place, and were pulled up on the way by a sensation "resembling a horrible immense hot snake wriggling under their feet." At the railway station they found the roof and walls so cracked that they feared to go in, and having learned that the railway bridge beyond the station was cracked, and that the succeeding towns to Mentone were also in a bad state, they stopped the night at Mentone, and managed to hire for 100 francs a small carriage to sleep in. Another slight shock occurred in the afternoon, and though no more shocks occurred that day beyond slight tremours, no one who has not gone through it can possibly understand how the recurrence of tremours, though slight, keeps the mind in a sense of suspense and expectation that makes it impossible to rest. It was reckoned that there were altogether from thirty to forty shocks of different degrees.

The other party of friends referred to were also staying at Mentone, but at a distant part, which was much less affected by the earthquake, and the hotel where they were sleeping was higher up on the rock, and was not damaged. They were sleeping on the first floor above the ground, and were roused by an extraordinary sound, and at once thought of an earthquake, and just managed to get dressed somehow, when the disturbance came again, and they instantly rushed down stairs, and after looking out to see that no stones were failing, ran down the steps into the garden. The sea was visible from the end of the garden, and they went out to see if there was any tidal wave to be seen, but the whole surface of the water was quite calm, and no signs of any wave. A solitary fishing boat was lying off at some distance from the shore, and the men in it were stated to have said afterwards that they did perceive a considerable rise and fall of the sea at the time of the shocks.

The luggage was all packed up at once ready for a removal, and during this occupation the third shock came (the one about a couple of hours after the first ones), when there was another stampede of the occupants of the hotel, and the party went off to the railway station, which was situated higher up the mountain slope, and found the trains continued running. The lower portions of the town were seen to be greatly damaged, and it was expected the other coast towns of the Riviera would be similarly effected, so the party decided to escape at once into France by Marseilles to Lyons, and thus round into Switzerland, as the best chance of being able to sleep in peace. In this they were successful, but they found at Lausanne that the shocks had been felt there and at Geneva, although only slightly, and noticed only as matters of curiosity and of no importance. Their fellow-travellers from Mentone were a French family with children and servant, who had been staying in another hotel that was much damaged by the earthquake. At the first shock the ceiling of the room fell upon them and upon their clothes, and they could not find more than a few wraps, and fled down the stairs with their children and servant, who had only a few things tied up in her apron. They managed to get down between the first and second shocks, and the second one brought down the marble staircase bodily, and little dressed as they were, they went off in that way by the train through to Paris. Fortunately it was a lovely day for the travelling, but the apron full of things was all they had been able to bring away out of the 200 kilos of luggage they had taken out with them for their excursion.

In Mentone, a large portion of the town was seen to be greatly injured, and some lofty newly-built hotels and some new villas had suffered severely; there were even two houses with the ends out, and the beds and furniture in the rooms were visible outside. Several invalids lay upon beds on the pavement, with débris of all kinds from the fallen buildings lying about. At San Remo, however, about fifteen miles distant, it was learnt from an eye-witness that the buildings had suffered very little. San Remo is one of the largest and most typical of the Riviera hill-towns, and the houses are all clustered round the lump of rock on which it is built, and the winding streets are in many places completely arched over, with houses built over the arches; and in others they are very narrow, with lofty houses on each side, and the houses are tied together with arches after the manner of flying buttresses, high in the air. These arches are said to have been intended to protect the houses in the case of earthquakes, and now it seems they have done good service in this way. It would be interesting to know how far the old interlaced system of building has stood firm in other towns of the Riviera, when so many of the detached modern structures have been shaken to pieces.

Earthquakes and volcanic eruptions are not to be looked upon as exceptional phenomena, but as portions of the regular chain of events in the progress of the earth, and as necessary occurrences from time to time; not only necessary results from the causes that are in constant operation, but also necessary changes in elevation of the earth's surface to counteract the constant levelling action of atmospheric and water denudation. These last forces are continually wearing down the mountains and hills, and depositing the débris to fill up the ocean; and if there were no counteracting forces, it would only be a question of time for the inevitable result to be brought about, of the land being all levelled down to the sea and the water spread over the whole surface of the earth, making it uninhabitable except for aquatic life.

The constant gradual cooling that is taking place in the whole earth, in consequence of the annual loss of heat by radiation into space being greater than the annual supply of heat received from the sun, causes a continuous (though very slow) and gradual reduction in size of the whole earth, and a corresponding reduction in its circumference. As the surface is rigid and not elastic, this contraction of circumference can only take place by the compression and crumpling up of the surface, and as the surface is not homogeneous, but on the contrary, varies greatly at different parts in its hardness and soundness, this compressing and crumpling up action has more effect in some localities that are weaker and more yielding, than in others where the surface is more solid. The weak places in the earth's crust are thus found out, and although the acting cause is continuous and uniform, the resulting disturbances consist of an irregular series of interrupted starts and jumps, as the successive weak points give way under the severe lateral pressure, causing the disturbances of the earth's surface that are felt as earthquakes. These vary greatly in intensity from the slight tremours that have been felt occasionally in this country, seldom sufficient to do serious damage, to the fearfully destructive earthquakes of other places in which whole towns have been suddenly destroyed; there appear to be certain permanent lines of weakness in the earth's crust, such as the west coast of South America, where these occurrences are much more frequent and more severe than elsewhere.

It has been inferred from careful examinations of the various directions of the forces exhibited in earthquakes, that these forces radiate from centres of action at moderate depths below the surface, extending probably to not more than thirty miles depth at the greatest, and often but little exceeding the actual inequalities upon the earth's surface, namely, five miles the height of the highest mountains, and five miles the depth of the deepest seas, making ten miles total variation in level of the surface of the earth. The earthquake phenomena may consequently be looked upon as really occurring in the superficial portion of the crust of the earth, to a depth probably only two or three times greater than the present inequalities upon the surface; and although the damage caused by them to life and property is occasionally very severe in amount, it may be questioned whether the annual loss from this cause is really any greater on the average than that arising from storms and floods, the other destructive causes that are in continued action on the earth's surface.

It may be added as an experience of actual beneficial effects from an earthquake that has recently occurred in North America, where a series of violent earthquake shocks have just taken place in Arizona and Mexico, and at twenty miles distance from Tucson, in Arizona, that a crater has been formed on a mountain, from which streams of water have burst forth, redeeming a vast area of country that was previously unwatered and sterile; also in the same vicinity large tracts of the Santa Catalina mountains were torn asunder, revealing rich veins of gold, that were previously unknown. The same earthquake was also felt at Guaymas, on the coast of Mexico, but there, unfortunately, great damage was done to the buildings and many lives were lost.

INDIVIDUALISM IN ART.*

W. KINETON PARKES.

The 19th Century is remarkable by reason of the four great movements in Thought which have characterised it. The first was that originated at Oxford by the publication of the "Tracts for the Times." This, with Cardinal Newman at its head, has had a most potent influence upon national life, and was the stirring in Religion which corresponded to the next of these great movements, the Renaissance of Art in England, which had been commenced years before by Blake. The Pre-Raphaelite Brotherhood, with Dante Gabriel Rossetti as their leader, made an effort for English Art which it sorely needed. In the whole of the history of Art in this country, no such movement had before taken place, and most happily it came at the right moment. English Art was falling into evil repute, for its chief characteristics were inanity and childishness, and an utter want of poetry and feeling. The Pre-Raphaelites made a step in the right direction. They went direct to Nature for their inspiration, in the true spirit of the dwellers in the 19th Century. The next movement was the revolution in Philosophy. The philosophers, as well as the artists, went to Nature, and the result was *Evolution*. Darwin and Mr. Herbert Spencer were the prophets. The last movement of the century is, it seems to me, the application of the scientific method to Literature. In this we still await the prophet; that he is born and among us, although at present we hardly know where to find him, is certain. Soon we shall make the discovery, and the devotees of the new Literature will gather round his standard, as the devotees of the new Philosophy gather in the library formed by the volumes which compose the "System of Synthetic Philosophy"; as the devotees of the new English Art gather in the galleries where Rossetti, Holman Hunt, Burne Jones, and Watts are represented. It is the scientific method to which the adherents of the synthetic philosophy must give their aid and their abilities, the scientific method devoted to all branches of thought and knowledge. It is the method of the times, and the one which alone will serve. It must be applied to religion, to philosophy, to literature—to poetry as

* Transactions of the Birmingham Natural History and Microscopical Society, Sociological Section, June 16th, 1887.

well as to prose—and to the fine arts. Above all must it be applied to social problems, to the exclusion of party politics, with their baneful and pernicious influences.

That this influence is being felt in all directions is plainly evident. We see it in the utterances of a bishop of the Church of England; we see it in the references of purely literary men to the writings of Mr. Spencer, Prof. Huxley, and Darwin; we see it in a small degree in some of the novels of the day; we see it in the articles we find month by month in the magazines and reviews; we see it in modern poetry; and we see it in the exactitude with which our great living artists paint natural phenomena. That this movement is one of the greatest importance, and of the utmost value, goes without saying, for while there is nothing lost, many things are gained. Often a seemingly beautiful work of art has been spoilt by an imperfect training in anatomy or optics. In many instances, what would otherwise have proved a noble poem has, from lack of scientific knowledge, been ridiculed and forgotten; and frequently we find in religion a very beautiful idea when first looked at, which, when examined by the light of truth, becomes absurd or worse.

The leaven of Science has been introduced into Literature and Art, and the whole will in time be leavened. Vibrations emanate from Science and are communicated to the affairs of our life. Motion has been imparted to the mass, the equilibrium has been disturbed, and has become a "moving equilibrium." "Every active force produces more than one change—every cause produces more than one effect."* The scientific method is the "active force;" the changes it has produced and will continue to produce are obvious. The increased knowledge afforded by the researches of Science are the "cause"; the effects are the fuller knowledge of truth, the higher view of life, the nobler aspect of Nature, and the more reasonable, though not less reverent, attitude towards religion.

To show how intimately related to Science all Art is, it is only necessary to remember that for our knowledge of the earliest Art we are directly indebted to Geology and Archæology. The very earliest forms of Art we know are the drawings made by primitive man. In the cave deposits we find bones and antlers with rough, but in most cases, very correct drawings (which cannot be said for a good many of the drawings turned out by our most highly-trained School of Art three-days-a-week students) of the animals who lived

* Herbert Spencer. Essay on "Progress."

around him; these drawings are fairly numerous, and represent the most elementary stage of the plastic arts. These cave men were excellent artists in their way; their names have not come down to us, so we cannot speak familiarly of them, but, nevertheless, we feel our indebtedness and give them our thanks accordingly. Next, speaking roughly, after the drawings on the bones found in the cave deposits, come the remains of early pottery, rough masses of clay moulded by the hands and sun-dried. Then we get pottery made on the primitive potter's wheel, and dried by fire. Then come rude attempts at ornament, drawings on the outer surfaces of the domestic utensils made of clay, or carvings on the exteriors of gourds. The development of pottery through the varied forms of domestic utensils, urns for the ashes of the dead, and other things ornamental and useful, at length resulted in Sculpture.

Where Painting commenced it is difficult to say. It is certain, however, that it is a development from the drawings of the cave men, and probably progressed along with pottery, but from its nature all remains of its earliest forms have perished. The various forms of fresco, oil, and water-colour painting with which we are familiar are naturally a high development. We know that the Greeks were acquainted with the art of painting, but from the evidences which have survived it seems certain that this Art had not reached to anything like the perfection to which its sister art, sculpture, had attained.

Music has had a most remarkable development, consisting first in the beating of drums and other rude instruments, which formed an accompaniment to the savage yells and cries, and still more savage and hideous dances and contortions of the body, of an early uncivilised people.

Poetry, too, had the same origin, for the wild, almost incoherent, songs of these uncultivated people were the first attempts of human beings to give utterance to their feelings in language possessing a rudimentary kind of rhythm. Just as the rude outline drawings on bones and antlers preceded sculpture and painting, so the wild choruses of savage or semi-savage races preceded music and poetry.

In these low forms of Art we cannot trace any distinct individuality. They were collective, being of a uniform character, varying but slightly, and having no distinguishing mark. It is not till the highest forms of Art are reached that originality and individuality begin to manifest themselves. The early or collective forms of Art were used solely for the purposes of decoration and ornament. As ornament applied to persons, we find them in the tattooing of the body, in the wearing of nose and ear-rings; and in dress, from an idyllic arrangement of leaves to the highly complicated dress of some mighty official, extending to ten or a dozen different garments, serving to keep up the empty grandeur of some obsolete custom or ceremony. As decoration, we find it applied to inanimate objects, as pottery and other household utensils; to weapons of warfare; to the tombs in which the dead are buried; to the temples in which the living worship. Art has existed through many centuries, but it does not always display individuality. The houses of the poor, almost devoid of Art, display, perhaps, as much originality as the palaces of the rich; the hermit's cell as much as the great temples of religion; the Bible of the early persecuted Christians, hidden away in a rude box beneath the floor, as much as the elaborately printed volume, with its illuminated text, chained to its delicately wrought and polished eagle lectern.

It is not in elaborate display that individuality is to be found. It is in the quiet study, not in the noise of the fashionable world; in the poorly furnished studio, not in the princely mansion of the favourite of Society; in the orchard beneath the apple tree, or in the kitchen beside the boiling kettle, the genius produces for the world his great and individual work. It is not true progress of Art when its object has been to increase the splendour of some barbaric court, to add to the pomp of some powerful monarch. The highest Art does not serve for ornament alone, neither does it become subservient to the useful. It is for a far higher purpose than this, far higher even than to give delight merely. It is to raise the souls of all men of all time higher than the highest pinnacle they may have previously reached. It is to lift the thoughts from the contemplation of the mundane to the contemplation of the highest good, the great Ideal! This is the object of true Art: all other objects that it may have are necessarily insignificant when compared with it.

(*To be continued.*)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(*Continued from page 236.*)

III.—Would the Water which goes in be Available for our Use?

I have had to refer, repeatedly, to objections urged against this water scheme; these, in many cases, I am pleased to say, had the sole object of eliciting explanations; but whether they had or not, the objections have been valuable to me in indicating the nature of the evidence desirable to offer in its favour.

In reference to the matter indicated by the above heading, it has been suggested by some that the area to be filled is so vast that the water would be almost as completely lost as if poured into the sea; by others that the water would flow entirely away from the district, owing to the dip of the beds, forgetting that if it could, it would have done so years ago, and so left us without water.

It has been stated previously that the height to which water will rise in a well, its *artesian rest-level*, as it is called, is directly proportional to the height of intake, and inversely proportional to the resistance of the bed, where there is no intermediate relief of pressure. A local depression is always caused by local pumping, the extent of which varies with the porosity of the bed, and the pumping power. The difference in height of the artesian rest-level at different pumping stations gives the *artesian gradient*, and affords a measure of the resistance of the bed. Such being the case then, an equality of depression over a large area is a sign of extreme porosity.

There is scarcely a doubt that the continuous pumping of large quantities of water from the Marlstone, for the supply of Northampton, has been the main cause in reducing the water-level of the bed over a considerable area, say a sector of a circle having a radius of fifteen miles or more, because the amount extracted has been in excess of the natural intake in an equal time.

The importance of this consideration is, that it gives a good idea of the distance at which *feeding wells* may be constructed, for it is perfectly certain that if the pumping at Northampton has reduced the artesian rest-level over a certain area, that same area can again contribute any water which gets into it, whether naturally or artificially.

In 1881, the late Mr. Samuel Sharp contributed a paper to the "Journal of the Northamptonshire Natural History Society," entitled, "Some Remarks upon Local Wells and Borings, and upon the Consequences of Excessive and Indiscriminate Agricultural Drainage," in which he showed how the water-level of the county had fallen considerably. I cannot agree with his contention that it was due to excessive agricultural drainage; indeed the remarks to follow will show conclusively that that is not the cause, but the facts he cites are quite relevant to the subject under discussion, hence I have incorporated them in the descriptions of wells below. The "now" refers to 1881, the date of Mr. Sharp's paper.

KINGSTHORPE SHAFT. When first made the water from the Marlstone rose to within 60ft. of the surface, *i.e.*, there was a head of 150ft at least.* No water now flows.

MR. BRETTEL'S FOUNDRY WELL, in Cow Lane, Northampton, was made about the same time as Kingsthorpe Shaft, and had a depth of 178ft. It was sunk 104ft., and bored 74ft., and the water rose to within 30ft. of the surface, thus giving a head-level of 140ft. Now dry. (No doubt this "head" would have been greater but that the water ran away into the Inferior Oolite, a kind of ragstone, as it is called in a report I have since seen.)

BARRACKS WELLS. Two wells were sunk in the Barracks yard many years ago, at least previous to 1847; the first had a total depth of 174ft.; the second was sunk to a depth of 140ft., and bored to a further depth of 106ft., thus making a total depth of 246ft.

COUNTY JAIL WELL. This was sunk 102ft., and bored 72ft., making a total depth of 174ft.

The last three exhibited the same decline as Mr. Brettel's well, have been disused many years, and I believe filled up.

THE WATERWORKS WELLS. Three wells altogether have been made in close proximity to each other, near the Billing Road, in Northampton. The water rose at first from a depth of 168ft. to within about 70ft. of the surface, thus giving a "head" of over 90ft., but during the time pumping was continued, *i.e.*, from 1846 to 1885, this diminished till the water had to be extracted directly from the rock itself. After a period of rest of less than two years (1885—7) the water has again risen between 40ft. and 50ft., and probably would have risen higher but that it has been again used, as a supplementary town supply.

THE RESERVOIR WELL, on the Kettering Road, made only a few years ago, never yielded much water. I am not in possession of any particulars with respect to it.

KETTERING FURNACES WELL. This well was finished in 1878; it had a diameter of 6ft., and passed through 13ft. of Inferior Oolite, 157ft. of Upper Lias clay, and 14in. of Marlstone, a 5in. bore hole being carried a few feet lower. The water rose very little above the Rock-bed. Through the kindness of Mr. H. Sartoris, I am able to add that the water

* If my estimate of the depth of the Marlstone be accepted, this should be 213ft.

supply being unsatisfactory, the bore hole was plugged and an adit was made to the adjacent brook, perhaps some 50ft. lower than the surface of the well, the old well being used as a reservoir. The water-bearing rock is 119ft. above sea level, that is, 44ft. higher than at Northampton, but only 12ft. higher than at the Spinney Well. The well is now silted up to within 70ft. or 80ft. of the surface, hence I could obtain no information as to whether the Marlstone water had increased during the last two years.

THE WELL AT BERRY WOOD ASYLUM. A description of this well was given on page 235, so it will suffice here to record some recent observations. In 1885 there was a small supply of water, and special precautions were taken to prevent waste; nevertheless, the water sank till there was only 3ft. in the well. This year (1887) more water has been used necessarily than in 1885, no particular care has been exercised to prevent waste, and yet the lowest ascertained depth of water was 6ft. 3in. We should be well within the mark, I think, if we assumed that the water supply here had been doubled within the last two years. Berry Wood Asylum is about 3¼ miles W.N.W. of the Northampton well.

The particulars concerning these wells show—

1. *That the old wells yielded abundance of water when first made, but the amount continuously declined till* 1885, *the time of greatest depression at Northampton.*

2. *The newer wells, even when first made, never yielded much water, and one—the Spinney Well—none at all.*

3. *Coincidently with a rise of the water-level at Northampton, a rise has taken place some miles away.*

There is only one way of accounting for the increase of water at Berry Wood, and *it is not agricultural drainage that we have to look to;* in fact, this latter, as a cause affecting water supply, must take quite a secondary place.

Altogether it appears that the head-level of the Marlstone water within the Northampton district has sunk 150ft. to 200ft. within the last fifty years.

Some wells south of the Nen Valley have also been referred to, for instance, Brackley and Milton. These have a similar tale to tell—the water level has been gradually declining, though, as Mr. Sharpe points out with regard to Brackley, the decline is not so great. Mr. Sharp does not appear to have considered the great Nen "fault," or he would have probably seen that the results observed are consistent with, and only to be explained by, the draining of the northern Marlstone area by Northampton. The lowering of the water-level in the southern area is only due to extraction of water from a large number of smaller wells, many of which are situated on or near to the catchment area.

If, therefore, Northampton has exercised its power to obtain water from the Marlstone to such an extent that all other near sources, in certain directions, have been drained, by the continuous exercise of this power, and by keeping the water-level low, it would get the larger share of any water artificially put into it. I never could understand the mean and shortsighted opposition of some people to the filling up of the Marlstone, because other people would be benefited. Neglecting altogether any consideration for those who may, so far, have been debarred from getting water from the Marlstone, owing to our own monoply of it, surely if we, at Northampton, could get all we want by this method, at less expense than by any other, we ought to be satisfied.

What I have been saying with regard to the draining of the Marlstone, of course, can only apply to the area westward of a line drawn through Northampton in the direction of strike of that formation, that is in a direction almost N.E. by S.W. It so happens that Kettering, Gayton, and Brackley, are situated almost exactly on this line, the first being 13 miles and the last 18 miles away. Making some allowance for curves in the strata, and resistance in the bed, one would expect to find the water-level at Kettering very low, as indeed it was. Eastward, however, of this line one would expect to find the Marlstone full, and the head-level of the water to increase most in a south-easterly direction. Fortunately I have been able to verify this, by finding a Marlstone spring at Raunds, nine miles S.E. of Kettering. This well, at a time when there was scarcely enough pressure at Northampton for the water to rise above the Rock-bed, and when there was very little water at Kettering in the same bed, had a "head" of nearly 60ft. of water. Considerable quantities of water were pumped from this well in 1884, for the supply of the village, but they could never reduce it more than two or three feet, and it rapidly regained its former level.

There are certain peculiarities with regard to this well which it would be of interest to investigate; but since it is situated some seventeen miles from Northampton, it could not have much influence on the Northampton area, and so I am content to simply give it as an illustration in support of the theory that in a certain direction the Marlstone has remained full, when in other directions it has been drained.

One great advantage that the scheme of water supply here discussed offers, is, that the artificial swallow holes will take in the drainage of districts where no conservation of water now takes place, owing to impervious beds occupying the surface, so it will practically enlarge the catchment area to a great extent. It does not matter where the water is put in, whether where the bed is now empty or where it is full, providing that in the latter case the water already present does not rise to the surface and the situation is not too far away from the pumping station to be supplied, because the water will tend to find its own level. I have placed a restriction as to distance, in the direction in which the bed is full, because the further away the opening the higher the natural "head" of water would be, and when only a few feet remained to be filled up the increased head obtained by filling up would have an insignificant result owing to resistance. On the whole it is fortunate that it should be so, for this same resistance, by producing an artesian gradient in the water-bearing bed, prevents the contingency of a well being opened sufficiently far to the south-east for the water to freely overflow, and so reduce the water-level in the whole bed to its own surface level. There is another good reason why this is not likely to occur, but as it depends upon data still to be considered, I have deferred giving it. It remains now for us to consider the storage capacity of the material of the bed, and the area to be filled, before we can arrive at any approximate idea of the time within which a satisfactory result might be anticipated.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 225.)

The Appendix to the "Midland Flora," forming Vol. III. of the work, was published in London in 1821. It introduces us to some new correspondents, and contains the following Worcester records :—

Fumaria (*Corydalis*) **solida**, 58. Abberley Woods. Mr. Hickman, surgeon, Ludlow.

Silene anglica, 37. Areley, near Stourport. Mrs. Gardner, late of Stourport.

Stellaria glauca, 36. Lickhill Lane, Worcestershire. Mr. Hickman.

* **Hypericum montanum**, 62. Blackstone Rock, near Bewdley. Perry.

Ulex nanus, 59. Astley Common. *This was doubtless U. Gallii Planch.*

* **Pyrus domestica**, 38. *Purton quotes the old authorities and some new ones for the occurrence of this tree in "Wire" Forest.*

Sium repens, 25. Bogs on the side of Abberley Hill; Cookhill, near Alcester. T. P. (*Thomas Purton*). *This is a variety of Sium* (Apium) *nodiflorum.*

* **Sium latifolium**, 26. Blakedown Pool, near Stourbridge. T. P.

* **Asperula cynanchica**, 14. Broadway Hills. Rufford.

Campanula rapunculoides, 18. Discovered by the Rev. G. H. Piercey, of Chaddesley, near Kidderminster, in a lane on a dry bank near to Shrawley Wood, September 30th, 1820.

Monotropa Hypopitys, 36. Shrawley Wood. Mrs. Gardner.

† **Melampyrum cristatum**, 54. Near Ombersley, Worcestershire. Mrs. Gardner. *Surely this must be an error.*

Myosotis versicolor, 16. On the top of Malvern Hill, nearly opposite the village. Rev. W. S. Rufford.

* **Cynoglossum sylvaticum**, 17. Near to Evesham on the Fladbury Road. Communicated by Edward Rudge, Esq., F.L.S., to Rev. W. S. Rufford.

Daphne Mezereum, 33. Eastham and Stanford, Worcestershire. Rev. Edward Whitehead, of Corpus College, Oxon.

Euphorbia platyphylla, 38. South Littleton.

Ceratophyllum demersum, 70. In fish ponds at W. Rawlins's, Esq., Brockencot, Worcestershire, filling nearly the whole of one pool.

Salix aurita, 76. On the Ridgeway. Common.

* **Acorus Calamus**, 31. On the banks of the Avon near Pershore, and at Hanley, Worcestershire. Rufford.

Potamogeton compressum, 16. In the ditches near Abbots Moreton.

P. compressum of Linnæus is represented by the four modern species—P. zosterifolius, P. acutifolius, P. obtusifolius, and P. mucronatus. P. zosterifolius and P. obtusifolius both occur in the county. Purton's plant was probably one of these.

Ophrys muscifera, 67. Eastham. Rev. Ed. Whitehead.

† **Scirpus carinatus**, 6. Chickhill Pool near Enville, and at Himley, Staffordshire; Scott, Stourbridge.

I assume the meaning of these records to be that the two Staffordshire localities were vouched by Mr. Scott, of Stourbridge. In "Stourbridge and its Vicinity" Scott refers the plants from these localities to S. lacustris.

Carex Œderi, 69. On the highest ground of Bromsgrove Lickey. *This must be the plant now known as Carex flava, var. minor.*

Avena pratensis, 13. Broadway Hills. Rufford.

* **Aira** (*Kœleria*) **cristata**, 8. Broadway Hills. Rufford.

* **Festuca Calamaria** (*F. sylvatica, Vill.*), 12. Communicated by Thomas Shrawley Vernon, Esq., who showed me a plant growing in his shrubbery, at Astley, near Stourport, Worcestershire, which he had removed the year before from the wood pointed out by the original discoverer, W. M. Moseley, Esq., of Winterdyne. Mr. Moseley informs me that he discovered Festuca Calamaria in Shrawley Wood in the year 1801, and sent a specimen to Dr. Smith for his inspection. He found it, not rare, in a particular part of the wood, though never producing a flowering stem, except where the coppice wood was recently cut and the plant exposed to the sun.

Aspidium Filix-fœmina, 79. Burcot, and the wet lanes near Bromsgrove Lickey. Very common. T. P.

27 plants are enumerated in the above list, of which 8 are previous records. From the residue of 19 we must further deduct Melampyrum cristatum as a probable error, Scirpus carinatus as a probable error and a Stafford record, and Potamogeton compressus as insufficiently identified. There remain 16 new County records to be credited to Purton's Appendix, 1821. Some of Purton's names of places require correction in spelling. "Spechley" is now usually spelt Spetchley, and "Headley's Cross" should be Headless Cross.

"A Description of Malvern," by Mary Southall, contains a list of "Plants growing at Malvern and in the neighbourhood." I have only seen the second edition, in which the list is printed at p. 215. The preface is dated August, 1825. The first edition was probably published a year or two earlier. The list contains 25 flowering plants. The majority of these are old records. The following are worth notice:—

Potentilla verna. Limestone rocks upon the western side of the hill.

Whether in Worcester or Hereford is not stated. This species is known as a Worcester plant at Wynd's Point on the eastern side, and as a Herefordshire plant on the western side of the hills. I fear the record belongs to Hereford.

* **Orchis** (*Gymnadenia*) **conopsea.** Upon the western side of the hills.

* **Orchis ustulata.** In meadows about the foot of the hills.

If we do not admit Potentilla verna, the list yields only Orchis ustulata as a new record. It still grows at West Malvern.

Mr. W. G. Perry, of Warwick, bookseller, the author of "*Plantæ Varvicenses Selectæ,*" 1820, communicated to Loudon's Magazine of Natural History, Vol. IV., 1831, p. 450, a list of the rarer plants of Worcester. The list is dated Warwick, March 12, 1830, and is stated to contain only plants which were observed and gathered by himself in 1812, 1813, 1816, 1827, and 1829. The list is rich in records from the neighbourhoods of Kidderminster and Bewdley, and is worth printing entire, although it contains a large number of repetitions.

W. G. Perry, Mag. Nat. Hist., Vol. IV., 1831, p. 450—452.

Ranunculus hederaceus. In a swampy place on Abberley Hill, above the Hundred House.

* **Aquilegia vulgaris.** On the banks of Dowlass (*Dowles*) Brook, in Wire Forest.

Still one of the characteristic plants of the Forest.

* **Fumaria** (*Corydalis*) **lutea.** On a limestone wall near the church at Abberley.

* **F.** (*Corydalis*) **claviculata.** At Picket Rock near Kidderminster.

Picket or Pecket Rock is in Habberley Valley.

* **Turritis glabra.** (*Arabis perfoliata, Lam.*) Chester Lane, and in a lane near Crane's, of Habberley, Kidderminster; and on the road side between Kidderminster and Chaddesley Corbet.

Nasturtium terrestre. (*N. palustre, D.C.*) On the banks of the Lodge Pools, Kidderminster.

Thlaspi arvense. In gardens near Broad Street, Kidderminster; and in fields near Hartlebury.

* **Teesdalia nudicaulis.** On Falling Sands Common.

* **Drosera rotundifolia.** In a swamp on the north side of Falling Sands Common, and at Devil's Spital-fields (*Spittleful*) near Kidderminster.

Polygala vulgaris, with white flowers, at Picket Rock near Kidderminster. *Probably P. depressa, Wend.*

* **Dianthus deltoides.** Blackstone Rock, near Bewdley.

* **Montia fontana.** In a swampy place on Abberley Hill, above the Hundred House.

* **Hypericum Androsæmum.** In a wood by Picket Rock near Kidderminster.

* **H. montanum.** Blackstone Rock, near Bewdley; near a wood on Abberley Hill, west of Abberley Church; and at Picket Rock near Kidderminster.

* **Malva moschata.** In a wood on the summit of Abberley Hill, west of Abberley Church; and in hedges about Bewdley.

* **Linum usitatissimum.** In fields near Hartlebury.

* **Erodium maritimum.** On the heath at Picket Rock near Kidderminster.

* **Geranium lucidum.** Blackstone Rock near Bewdley.

G. columbinum. Road side toward Broadwaters, Kidderminster.

Trifolium striatum. At Picket Rock near Kidderminster, and on the side of the Kidderminster Road near Bewdley.

* **Ornithopus perpusillus.** Blackstone Rock near Bewdley, on Sutton Common near Kidderminster, and in fields between Kidderminster and Picket Rock.

Hedysarum Onobrychis. (*Onobrychis sativa.*) Near a wood on Abberley Hill, west of Abberley Church.

Vicia angustifolia. In a swamp on the north side of Falling Sands Common, Kidderminster; and in a field between Kidderminster and Picket Rock.

* **V. sylvatica.** In Wassal Wood, near Bewdley.

* **Potentilla argentea.** On the top of the rock at Foxholes, and on a rock by the road side at Wolverley near Kidderminster, and on rocks by the road side between Kidderminster and Bewdley.

* **Comarum palustre.** Oldfield near Ombersley.

* **Pyrus domestica.** In Wire Forest, June 25th, 1827. This solitary tree was observed by Mr. Pitts, in the time of Ray, and is supposed to be more than 250 years old. In the neighbourhood of the Forest it is well known by the name of the Witty pear. It appears to be rapidly decaying, as it bears leaves on the upper branches only, and shows no signs of fruit.

Rosa gracilis? In Wire Forest, near Pyrus domestica.

It is doubtful to what species this name is intended to refer.

* **Epilobium palustre.** On Falling Sands Common, Kidderminster.

E. roseum. In a garden before a house in Church Street, Kidderminster, 1816; and in Mr. John Lea's drying ground, Mill Street, Kidderminster, 1829.

* **Sedum dasyphyllum.** On a wall by the side of the Kidderminster Road, Bewdley.

* **Cotyledon Umbilicus.** On Picket Rock, and about Foxholes, near Kidderminster. Plentifully.

* **Sium repens.** In a swampy place on Abberley Hill, above the Hundred House.

Sambucus nigra, with laciniated leaves. Chester Lane, near Land Oak Turnpike, Kidderminster.

Galium saxatile. On all the heaths in the vicinity of Kidderminster.

* **Dipsacus pilosus.** Blackstone Rock near Bewdley.

Carduus acanthoides. In fields between Kidderminster and Picket Rock.

Cnicus (*Carduus*) **palustris,** with white flowers. At Picket Rock near Kidderminster.

* **Onopordum acanthoides.** At Summer Hill near Kidderminster.

Conyza squarrosa. (*Inula Conyza, D.C.*) In a lane near Hartlebury, and about Chaddesley Corbet.

Solidago virg-aurea. In Burnt Wood near Bewdley.

Prenanthes (*Lactuca*) **muralis.** Blackstone Rock and Rock Wood, near Bewdley; in a wood by Picket Rock, and Summer Hill, near Kidderminster; and Rock Hill, one mile and a-half from Bromsgrove, on the road to Alcester.

Hieracium murorum. In a wood by Picket Rock near Kidderminster, and in the Rocky Wood, Finny Rough, near Stone.

* **H. sylvaticum.** (H. vulgatum, *Fries.*) Summer Hill, near Kidderminster; in a lane leading from Foxholes towards Kidderminster; and in Rock Wood, Burnt Wood, and Wassal Wood, near Bewdley.

* **Campanula patula.** In Dolphin Lane and in hedges, Chaddesley Corbet.

C. Trachelium. Blackstone Rock, near Bewdley; banks of the Severn near Stourport, and on a steep bank about four miles on the Hereford Road from Stourport.

* **Menyanthes trifoliata.** In a boggy field by Finny Rough near Stone.

* **Verbascum virgatum.** Near Worcester, on the road to Ombersley, 1813.

* **V. Blattaria.** Lanes about Foxholes near Kidderminster.

* **Antirrhinum majus.** Walls near the Cathedral, Worcester.

* **Linaria spuria.** In a hilly field at Hampton Magna, near Evesham.

* **Melampyrum pratense,** with orange flowers. In Wire Forest; in Rock Wood, and Burnt Wood, near Bewdley; and at Blackstone, near Bewdley.

Pedicularis palustris. Oldfield, near Ombersley; in Wire Forest; and in Burnt Wood, near Bewdley.

P. sylvatica. In a swamp on the north side of Falling Sands Common, Kidderminster; Oldfield, near Ombersley; and in high pastures at Trimpley Green, near Kidderminster.

* **Verbena officinalis.** In a lane near Hartlebury, on the Stone Cross at Stone; and between Dunley Hall and Abberley.

* **Thymus Calamintha** (*C. menthæfolia*). Hampton Magna, near Evesham.

* **Scutellaria minor.** In Rock Wood, near Bewdley.

* **Marrubium vulgare.** Opposite to Crane's, of Habberley, on the side of the road leading to Picket Rock from Kidderminster.

Myosotis cæspitosa, with white flowers. In Burnt Wood, near Bewdley.

* **Symphytum officinale,** with purple flowers. On the banks of the canal, &c., Kidderminster.

Lysimachia nemorum. In a wood by Picket Rock, near Kidderminster.

* **Anagallis tenella.** In a boggy field by Finny Rough, near Stone. *Extinct in this locality.*

* **Rumex maritimus.** On the banks of the Lodge Pools, Kidderminster. 1816.

* **Juniperus communis.** In Wire Forest.

* **Triglochin palustre.** Finny Rough, near Stone.

* **Alisma ranunculoides.** Oldfield, near Ombersley.

* **Orchis** (*Gymnadenia*) **conopsea.** In a bog in Wire Forest.

* **Juncus squarrosus.** Devil's Spitalfields (*Spittleful*), near Kidderminster.

Scirpus sylvaticus. Near the Lodge Pool, Kidderminster, and in Wire Forest.

Eriophorum polystachion. In a bog in Wire Forest, and in a boggy field by Finny Rough, near Stone.

E. angustifolium. In a swamp on the north side of Falling Sands Common, Kidderminster; and in Burnt Wood, near Bewdley.

The two last are varieties of the same species. The Wire Forest Cotton Grass is E. latifolium. Hoppe.

Carex remota. In the Rocky Wood, Finny Rough, near Stone.

C. Pseudo-Cyperus. In the Lodge Pools, Kidderminster.

Melica uniflora. Blackstone Rock, near Bewdley.

* **Nardus stricta.** On Sutton Common, near Kidderminster.

* **Blechnum boreale.** At Foxholes, and on the Stourport Road, near the Larches, Kidderminster; Rock Wood, Burnt Wood, and Blackstone Rock, near Bewdley; in the Rocky Wood, Finny Rough, near Stone; and in a dingle between Dunley Hall and Abberley.

* **Asplenium Ruta-muraria.** On the church at Stone.

* **A. Trichomanes.** At Blackstone Rock, near Bewdley.

Aspidium spinulosum. In a cave on the right-hand side of the road from Kidderminster to Bewdley.

A. dilatatum. Blackstone Rock, near Bewdley.

* **A.** (*Athyrium*) **Filix fœmina**, with a scaly stalk. In the Rocky Wood, Finny Rough, near Stone.

Of the 80 plants enumerated in Perry's List, 82 only can be claimed as new to the county. There is a good deal of confusion in the nomenclature of places. Finney, otherwise Finny Rough, near Stone, so called by Perry, and still known to the country people as the Finney, is noted on the Ordnance map as "*Fenny Rough.*" The Parish of Abberley, near the Hundred House, is confused with Habberley, near Kidderminster, from which the H is omitted. It is in the middle of Habberley Valley that Pecket Rock is situated, miscalled by Perry *Picket* Rock. I have been unable to identify "Foxholes," a locality named very frequently by Perry.

(*To be continued.*) p 2..

Review.

Palæolithic Man in N.W. Middlesex. By Jno. Allen Brown, F.G.S., F.R.G.S., &c. Macmillan and Co., 1887.

This book of 200 pages, with plates in addition, consists mainly of a compilation from the author's reading; but contains also an account of some original investigations which, a year or two ago, excited some interest when presented in the form of papers to the Geologists' Association and Geological Society of London. It is almost needless to say that it is well got up by the publishers. The plates are good, many of them being from blocks lent by well-known authors of other works on the subject, and they give a very clear idea of the implements used by the palæolithic hunters and warriors.

The introduction gives a very fair, though not by any means full or lengthy, account of the archæological and geological remains of ancient man from various localities in Europe. Then we have a full account of "The Earliest Men of Ealing and its Neighbourhood; and the Physical Conditions indicated by the Drift Deposits in N.W. Middlesex." This part of the book, containing the original investigations of the author, appears to form the *raison d'être* of the whole; the introduction naturally leading up to it, and the sequel tending to explain and illustrate the facts here given. To many readers this sequel may prove highly interesting. It is entitled "A Consideration of the Conditions of Life presented by certain Savages apparently analogous to Palæolithic Men;" and contains a *résumé* of what is known of the manners and customs of many existing savage tribes and nations. Nor does the writer confine himself merely to facts, for in the body of the work (p. 60), he starts a curious speculation as to the existence of an island in the ancient Thames, which was the abode and secure retreat of some palæolithic men; and, in the conclusion, he gives a highly imaginative sketch of a palæolithic winter and spring.

Readers who wish a clear and concise narrative of the salient points in the evidence for human antiquity will find here what they require; for although the book cannot pretend to the completeness of larger works, it presents fairly the main conclusions which have been reached. We think the author is a little too much inclined to accept extreme conclusions on little or no evidence; as, for example, with respect to the human (?) fibula of the Victoria cave at Settle. This small fragment of bone, though at first considered to be human, after passing through a stage in which it was assigned to an elephant, is now almost universally admitted to have belonged to a bear. With this slight caution we can heartily commend the volume to those who desire to make themselves acquainted with the questions relating to the antiquity of man in Britain.

A word or two must be added concerning the original researches in the Ealing district. These bring out two points of importance. One is the extension of the valley gravels to a greater altitude than had previously been known, accompanied by the occurrence of rock fragments from the west and north of England, due presumably to ice transport. Indeed, the author goes so far as to attribute certain superficial furrows which he found to the grinding of icebergs; but in the discussion at the Geological Society, the glacial experts refused to admit the cogency of his reasoning as to the ice-origin of these furrows. The other point of importance is the discovery of a floor which had been a manufactory of palæolithic implements, for about 400 flakes and fragments, sharp and unabraded, were here found. Such floors have been discovered in other localities of the Thames valley by Messrs. Spurrell and Worthington Smith; but the point of interest in this floor is that the deposits are associated with foreign blocks traceable to the boulder drift. Thus Mr. Brown's discovery has an important bearing on the question whether, in the Thames valley, man was post-glacial or pre-glacial; a difference, however, which many will consider to be like the difference between "tweedle-dum and tweedle-dee."

G. D.

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS FOR 1887.

Earliest observed Dates of Flowering.

Name.	Dates. 1885.*	Dates. 1886.*	Dates 1887.	Aspect, 1887.	Situation, &c.
Tussilago farfara......	Feb. 8	Mar. 3	Feb. 5	S.W.	Railway bank.
Corylus avellana	,, 1	Feb. 14	,, 6	N.E.	Hedge bank.
Poten. fragariastrum ..	Mar. 15	Apr. 4	,, 13	S.W.	Hedge bank, one blossom.
Mercurialis perennis ..	Jan. 4	Feb. 14	Mar. 13	N.E.	In 1887, inflorescences and foliage were noted Feb. 6, but no blossoms in the same station till March 13.
Petasites vulgaris	April 3	Apr. 7	Mar. 20	Open	Boggy meadow, several plants well open.
Ranunculus Ficaria ..	Mar. 8	Apr. 4	Mar. 20	Open	With the preceding
Salix caprea	,, 8	,, 4	,, 27	,,	Hill top.
Caltha palustris	,, 27	,, 4	Apr. 3	,,	Boggy meadow.
Cardamine hirsuta	,, 27	—	,, 3	S.W.	River bank.
Viola odorata	—	Apr. 4	,, 3	,,	Hedge bank.
Anemone nemorosa ..	Mar. 15	,, 4	,, 3	Open	Coppice.
Nepeta glechoma......	April 3	,, 23	,, 8	S.W.	Hedge bank.
Viola Riviniana	Mar. 29	—	,, 24	S.E.	Ditto.
Prunus spinosa........	Apr. 12	Apr. 23	,, 24	S.W.	Hedge.
Orchis mascula	May 5	May 16	May 7	Open	Coppice in Herts.
Scilla nutans	Apr. 25	—	,, 7	S.	Hedge bank.
Cardamine pratensis ..	,, 21	—	,, 7	Open	Meadow.
Stellaria holostea	,, 26	—	,, 7	S.W.	Hedge bank.
Ranunculus auricomus	,, 28	Apr. 23	,, 7	,,	Ditto.
Adoxa Moschatellina ..	Mar. 22	—	,, 7	,,	Ditto.
Geranium Robertianum	May 28	May 23	,, 29	S.	Ditto.
Cratægus monogyna ..	,, 17	,, 23	June 4	S.W.	Ditto.

* See "Midland Naturalist" for 1885 and 1886.

Leafing of Oak and Ash.

Oak trees were not in leaf till the last week in May, and ash trees till the first week in June. This is now the eighth season in which these two kinds of trees have maintained the same sequence in foliation, that is, in the districts of S. Beds. and N. Herts., where the observations have been made. There have been occasional exceptions owing to constitutional variations; sometimes a very vigorous ash tree may be as forward as a weakly oak; but it is no exaggeration to say that ninety-five per cent. of oak trees are in leaf earlier than the ash trees in the same situations. This statement does not take long to write, but the observations on which it is based are to be numbered by thousands, extending over the last eight seasons, and have been made in varied situations, and on different subsoils, as sand, clay, and chalk. The conviction has gradually been forced on one that the old adage was formed from insufficient data, and without allowing for constitutional differences, and dissimilarity of localities.

Pinguicula Vulgaris in South Beds.

The last edition of Watson's "Topographical Botany" makes no mention of this plant as occurring in Bedfordshire. It may, therefore, be worth recording that it has recently been found in two localities, one at Totternhoe, in a boggy meadow not far from the base of Totternhoe Knoll, where it is associated with *Parnassia palustris, Orchis latifolia, Carex binervis*, and the locally rare moss *Hypnum Sendtneri*. The other station is on the lower chalk escarpment, on the open hill side, but with a northerly aspect, and with a fringe of trees crowning the top of the hill above them, so that they are never exposed to the full heat of the sun. Pinguicula was first detected in this place by Mr. C. Crouch, whose eye was arrested by its blossoms as he was walking up the hill side, but with no thought of finding this plant in such a locality. The station is on one side of a large coombe, which has apparently been hollowed out by the action of springs, one of which still exists. The Pinguicula is here also associated with *Parnassia palustris*, and not far from it is *Carex binervis* by the side of the spring, and these plants are possibly the last lingering relics of a rich paludal flora that once occupied the base of the coombe when the springs were much higher than they are now. Both Pinguicula and Parnassia are abundant, but the former is limited to a narrow strip of the hill side, while the latter is distributed over a considerable area. It would seem that the Butterworts are dependent entirely upon the soil for their nitrogenous food, as one could detect no insects on the leaves, and the station is not favourable to the development of insect life, as it is decidedly cool. Have any other readers of the "Midland Naturalist" found these plants in similar localities?

James Saunders, Luton.

Wayside Notes.

We referred last month to the "Naturalists' Monthly," the first number of which was then about to be issued. The number contains an article on the "Pathology of the Celandine"—why the word "Pathology" is used, Mr. Friend, the writer, can probably tell us; a rather imaginative, but still thoughtful sketch describing the descent of the present-time salmon hook from the flint hook of prehistoric man; the first portion of each of "A Study in my Garden" (on Aphides), "Binary Suns," a "Biography of Charles Darwin" (with an engraved portrait, of which the moustache bears alone a close resemblance to reality), "Shell Collecting in Guernsey and Hern," "A Chapter on the Centipedes and Millipedes," and "The Origin and History of Fresh Water Faunas." Add to these numerous brief notes, reports of various societies, both metropolitan and provincial, and reviews, the whole occupying twenty pages of the size of the present "Gardeners' Chronicle," and our readers will see that a very copious bill of fare is offered. We heartily wish Dr. Williams success with his venture, but our faith is not strong. Happily for it, the Editor of the new "monthly" thinks differently, and already talks of an

"Editor's Easy Chair" when the periodical is enlarged. *We* can't afford an "Easy Chair;" to keep good, honest, but homely "Windsors" in sound repair is as much as we can hope for.

IN THE LIST OF DISTINGUISHED FOREIGN BOTANISTS intending to be present at the British Association Meeting at Manchester, the name of Count von Solms Laubach was misprinted in our last month's "Notes."

"SOME PERSONS PRESERVE ROSES during the whole of the year in the following manner: they take a number of rosebuds and fill with them a new earthen jar, and, after closing its mouth with mud so as to render it impervious to the air, bury it in the earth. Whenever they want a few roses they take out some of these buds, which they find unaltered, sprinkle a little water upon them, and leave them for a short time in the air, when they will open as if just gathered." This extract is from Lane's "Arabian Society in the Middle Ages," p. 163, and is given apparently on the authority of "Halbet-el-Kumeyt," a M.S. Arabian work of the fifteenth century. Can any reader of the "Midland Naturalist" furnish a commentary upon it?

ANOTHER POINT IN THE SAME WORK (p. 166), and given upon the same authority, is as follows:—"Another flower much admired and celebrated in the East is the gilliflower (menthoor or kheeree). There are three principal kinds; the most esteemed is the yellow, or gold-coloured, which has a delicious scent both by night and day; the next, the purple, and other dark kinds, which have a scent only in the night; the least esteemed, the white, which has no scent. The yellow gilliflower is an emblem of a neglected lover." Now the gilliflower, or gillyflower, of most people of the present day is the wallflower (*Cheiranthus Cheiri*), a flower which for many reasons is improbable. The stock (*Matthiola*) is likewise known by the same name to some folk, and would be a more likely plant. *M. odoratissima*, for example, is a Persian plant, with a flower becoming purplish brown when old, and which is very sweet scented in the evening. But the gillyflower of older English writers, down to Shakespeare's time, and that of South Europe as well, is the wild original of the carnation (*Dianthus Caryophyllus*). If any faith is to be placed in the fixity of the meanings of flowers, themselves probably of Persian or Arabian origin, there can be little doubt that this latter is the plant intended, for the deep red carnation has attached to it the meaning of "Alas! for my poor heart," the striped carnation, "Refusal," and the yellow carnation, "Disdain," all terms very closely allied to that attributed above to the "yellow gilliflower." By the way, according to the same dictionary of flower language, the gilliflower (undefined) implies "Bonds of affection," the stock "Lasting beauty," and the wallflower, "Fidelity in adversity."

THIS SAME ARABIAN AUTHORITY gives highly respectable antiquity to the now-revived Narcissus cult. "The Narcissus," it says, "is very highly esteemed. Galen says, 'He who has two cakes of bread, let him dispose of one of them for some flowers of the Narcissus; for bread is the food of the body, and the Narcissus is the food of the soul.' Hippocrates gave a similar opinion." *Lilium viruptuum* is but a sample of *Galen redivivus*.

IN THE BRITISH MUSEUM OF NATURAL HISTORY, at South Kensington, a new geological gallery has just been opened to the public, which is specially devoted to collections illustrating geological types and the history of the science. Of these, four are of peculiar interest, the collections of Sloane, Brander, Smith, and the Sowerbys. The Sloane collection was purchased of Sir Hans Sloane so long ago as 1753, and is the most ancient of all the geological collections. The collection formed by Gustavus Brander, F.R.S., is of special value in that it is the earliest in which types of named and described species of fossils have been preserved, the descriptive account of them having been published in 1766. Dr. William Smith's collection, commenced about 1787, purchased in 1816, and subsequently extended, is remarkable as being the first collection in which a connection was shown between fossils and strata, *i.e.*, in which fossils were used in determining strata. Lastly, there is the collection made by the Sowerbys, father and son, and used in the preparation of their great work on the Mineral Conchology of Great Britain, published in parts between the years 1812 and 1845.

A SPECIMEN OF THE GIANT PUFFBALL (*Lycoperdon giganteum*), more than deserving of its name, has been produced (mid-September) in a garden in Edgbaston. The monster was as nearly as possible globular, 37in. in circumference, and weighed, when at length gathered, 7lbs. 15oz. It grew in the midst of a clump of Michaelmas daisies, and when first discovered had attained 26in. circumference, and was taken by the gardener to be a stray fox terrier dog curled up in a comfortable berth. This puffball when young is edible, is indeed a great delicacy to mycophagists; its skin is of a delicate white kid-glove texture, and the interior likewise white; when old the interior becomes yellow, and the skin rougher and brownish.—W. H.

EXAMINATION ANSWERS.—Below we give a specimen answer extracted from a paper, worked by one of the candidates in Geology, at this year's examinations of the Science and Art Department. As an example of "how not to do it," this attempt would not be easy to surpass. It is only fair, however, to say that such answers are the exception, and not the rule:—"The age of sedimentary rocks are known by their fossils. If you know the age of one rock you can easily tell the age of other rocks. You find fossils in the rock you don't know the age of. You then compare them with the fossils of the rock you know. If there are more fossils in the rock you don't know, of the same species of the rocks you do know, it must be newer. For there are more species of the same kind. If there are not so many species of the rocks you do know, the rocks must be older."

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION, September 13. Mr. W. B. Grove in the chair. A number of specimens were exhibited by Mrs. Kent of unusually luxuriant galls on oak leaves, three species being represented in some cases on one leaf. Mr. Walliker exhibited a collection of mosses, lichens, and hepaticæ that he had found in Norway, including *Racomitrium lanuginosum*, *Tortula tortuosa*, *Ulota Bruchii*, and *Parmelia perlata*; Mr. Wilkinson exhibited *Medicago sativa* from Stratford-on-Avon. *Atropa Belladonna* (Deadly Nightshade) with its seeds under the microscope, and some grasses from Dudley Castle; Mr. Grove exhibited the following fungi from the Rhine:—*Phyllosticta cruenta*, *P. scrophulariæ*, *Septoria saponariæ*, *S. rubi*, *Ramularia arvensis*, *Camarosporium robiniæ*, *Asteroma reticulatum*, and *Xylaria polymorpha*; Mr. Marshall exhibited some microscope objects from the Puffin Island dredging expedition of the British Association. Professor Harrison, of Barbadoes, presented to the Society, through Mr. Alleyn, of Bristol, a box of microscope slides of Polycystina and Diatomaceæ collected in Barbadoes.

Mr. Grove presented a monograph on the Gold Wasps of Germany. Mr. W. J. Morley presented a large microscopic slide cabinet as a memorial of his late brother, Mr. John Morley, so many years the Honorary Secretary of the Society.—GEOLOGICAL SECTION, September 20. Mr. T. H. Waller, B.A. B.Sc., in the chair. Exhibits:—Mr. W. B. Grove, B.A., magnificent specimens of *Agaricus muscarius*, also *Phallus impudicus* in fulness of growth and smell, from Hopwas Wood, Tamworth (for Mr. Clarson); also *Agaricus fusipes*, and *Mucor fusiger* parasitic thereon, from Bedford (for Mr. Hamson); also a specimen of pumice from the Eifel. Mr. C. R. Robinson, *Coprinus comatus*, grown in Elvetham Road; appears regularly in same place each year. Mr. Waller, a curious fasciated lily. Mr. J. E. Bagnall (for Miss Taunton), an interesting series of plants collected during a recent visit to Sicily, including Eucalyptus, Asphodelus, and *Olea europæa*. Mr. Bolton, *Ceratophyllum demersum* in fruit. Mr. Walliker, *Cetraria Islandica*, and flexible limestone from Marsden quarries.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 18th, Mr. Barradale exhibited specimens of dragon flies from North China; Mr. J. Madison, specimens of *Helix thyroides*, *H. solitaria*, *H. profunda*, *H. palliata*, *Planorbis campanulatus*, and other land and freshwater shells from Ohio. Mr. Rodgers, *Volvox globator*. Mr. J. W. Neville then read a paper on "The Honey Bee," a practical study. The subject was treated under three heads: first, the honey bee and its work; secondly, its structure; and thirdly, its special modifications. The writer said this insect had received so large a share of attention that little new matter remained to be said under the first head; still, many questions suggested themselves that were difficult to answer. Why should honey bees have so far outstripped other insects in the race of life? What advantages do they gain from a social life? What first induced such a change, most probably from a solitary habit? How did bees first lose their sexuality, and what caused it to be transferred to a queen or mother bee? The structure of bees was next dealt with at some length. Under the third head the writer described some of the singular modifications of the large family of bees, and traced them back to a probable normal form not widely different from the present wasp, and showed how, by a series of gradations, the high development of the hive bee was reached. The paper was illustrated by a series of microscopical preparations.—July 25th, Mr. H. Hawkes exhibited a male specimen of *Dicranura vinula*; Mr. J. Madison, specimens of *Valvata tricarinata*, *Ancylus tardus*, *Planorbis deflectus*, *Vertigo ovata*, *Pupa contracta*, and *Helix pulchella*, all from the United States. Under the microscopes Mr. Moore exhibited gizzard of cockroach; Mr. Hawkes, pollen of *Œnothera biennis*; Mr. Rodgers, caddis worms just hatched.—August 8th, Mr. J. Madison showed specimens of *Planorbis parvus* from Packington Park, and *P. nautileus* from Scarborough; Mr. Corbet, leaf and polished specimen of wood of tulip tree.—August 15th, Mr. Moore exhibited under the microscope the gizzard of *Dytiscus marginalis*; Mr. J. W. Neville, water net, *Hydrodictyon utriculatum*; Mr. J. A. Grew, Protococcus in its resting stage.—August 22nd. Mr. J. Madison exhibited specimens of *Alcyonella fungosa*; Mr. Wagstaff, a rare caddis worm, *Oxythira costalis*. Mr. Corbet then read a paper "On and Around Snowdon." The ramble was made early in the year, when the range was about half covered with snow. The writer described the ascent from Capel Curig by the Copper Mine to the summit; the difficulties, even through the snow, being more imaginary than real. The view from the cairn was very fine, though far more limited than the view of the guide-books. The descent was made by Llanberis, where the glacier-scooped valleys, striations, moraines, and erratic blocks were described as furnishing a five-mile walk of surpassing interest to the geologist. The paper was illustrated by photographs and collections of rocks, shells, &c., gathered by the way.—August 29th. A general exhibition, friends being invited. The specimens comprised collections of British birds, birds' eggs and nests, British and foreign insects, fossils of the Carboniferous period, caddis cases, land shells, dried plants, microscopic fungi, and a series of objects under the microscopes. The meeting was well attended, and the interest shown by the visitors in the different objects made it an instructive and enjoyable evening.—September 5th. Mr. J. Madison exhibited specimens of *Helix rufescens*, var. *rubescens*, from Edge Hill; Mr. Deakin, eggs of quail, *Coturnix vulgaris*. Under the microscope, Mr. H. Hawkes showed a slide of five pollens; Mr. J. W. Neville, auditory organs of grasshopper. Mr. H. Insley then read a paper contributed by Mr. C. F. Beale, on "A Visit to the Ordovician Rocks of the Corndon District." The paper described a ramble from Montgomery to Warrington Dingle, through Chirbury. An exposure of the Whiltery ash was first met with, where a few graptolites were found. The Aldress shales yielded a few fossils; by following the Spybrook for some distance the Spyburn grit was reached, which yielded some splendid fossils, notably some very large specimens of *Berychia complicata*. The Middleton beds, Corndon beds, and Weston grits were explored, and a good number of specimens secured.—September 12th. A paper was read by Mr. Armstrong on "Volcanoes." The writer said the subject of the paper had been enveloped in mystery and superstition from the earliest ages, but the advances of science had stripped it of its supernatural elements. The paper dealt with the different kinds of volcanoes, their number and uses, and described the more important products ejected from them, concluding by pointing out to how great an extent the beauty of English scenery was owing to volcanic agency. The paper was largely illustrated by diagrams.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Evening Meeting, September 21st. Attendance twelve (three ladies). Mr. F. T. Mott in the chair, in the absence of Dr. Tomkins, chairman. Exhibits:—By Rev. T. A. Preston, white variety of *Viola Riviniana* in flower, and growing plants of *Astrantia major* for distribution. By Mr. T. Palmer, fronds of *Nephrodium Thelypteris* from Norfolk. By Mr. F. T. Mott, dried specimens of *Asplenium viride* from the Craven Hills, Yorks., for distribution. Mr. Mott presented reports upon the publication of the "Flora of Leicestershire," showing the cost of publication and advertising, and the number of copies sold; also on Mr. Bates's collection of 1,700 microscopic slides of the Freshwater Algæ of the county, purchased by the Society; also copies of the report of the Corresponding Societies' Committee to the British Association, giving a Catalogue of Papers published in the Transactions of the various Local Societies for the past twelve months, thirteen papers read in the Sections of the Leicester Literary and Philosophical Society being mentioned; and of the report of the Provincial Museums' Committee of the Association, giving particulars of 211 museums in the British Islands, exclusive of those in London. The chairman then read a short paper on "The Songs of some Leicestershire Birds," showing that there were about thirty species of singing birds known in the county, and giving particulars of the songs of twenty with which he was most familiar.

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S. (PRESIDENT).*

In working, during the winter of 1882-3, upon the question of the movements of food-substances in the plant during the period when the chlorophyll-function is not being carried on, I was much impressed by the wide distribution and often abundant presence of that variable body known generically as tannin. It seemed to me to be hardly credible that a body so prevalent in vegetable growth should have no direct relations of utility to the plant. My attention being thus directed to the matter, I endeavoured during the ensuing summer to carry on, in the intervals of other work, a few investigations into the relations of tannin with plant life, which are here recorded, the temporary loss of the manuscript through a domestic removal being almost wholly responsible for the delay in publication.

In the large series of bodies, which, from their capability of resolution by boiling with dilute acids or alkalies, or by the action upon them of ferments, into a glucose and one or more other compounds, are grouped together under the generic name of *Glucosides*, there is none which approaches, whether in economic importance, universality of distribution, or physiological interest, to the group of the tannins, or, as I shall hereafter as a rule speak of them, to tannin.

General Chemistry.—In all its forms tannin is characterised by a weak acid reaction, and an easily recognisable astringent taste. As obtained, it forms a shining amorphous powdery mass, freely soluble in water and alcohol, producing characteristic reactions with ferric salts, precipitating a solution of gelatine or albumin, and uniting with animal membrane so as to produce a substance (leather) which is capable of resisting decomposition. This latter property is the scientific basis of the process of tanning.

Although we shall find it convenient hereafter to speak of the group under a single name, it must be borne in mind that the name includes a considerable series of bodies, of slightly varying character, and our knowledge of which is still extremely limited. Most of them appear to be glucosides of gallic acid, and capable of resolution into gallic acid

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and glucose; those which give the blue-black reaction with ferric salts as a rule yield pyrogallol ($C_6 H_3 (OH) 3$), which gives with ferrous salts a blue-black, with ferric salts a red colour; while those which give the iron-green reaction commonly yield pyrocatechin ($C_6 H_4 (OH) 2$), which gives with ferric chloride a dark green colour. The blue reaction with iron salts, a reaction which lies at the basis of the manufacture of ink, is by far the more prevalent amongst tannins. In the tannins known as Kino and Catechu, and in the tannins obtained from the leaves of the tea-plant and the twigs, &c. of the Sumach, are examples which produce the green reaction with the same salts.

The most important form of tannin, gallotannic acid, is especially abundant in the gall-nuts of *Quercus infectoria*, and other species, in the common oak apple, and many other parts, and gives a typical example of the power of resolution into glucose and gallic acid, being, however, most probably first resolved into glucose and tannic acid, and this latter then converted into gallic acid. It is, however, probable that gallotannic acid, when quite pure, is not a glucoside, but directly consists of digallic acid.* As gallotannic acid is the only form in which tannin has been at all carefully investigated, and even this with the difficulties indicated in the foot-note, it is clear that nothing of importance can be said of the various other forms of tannin recognised, on more or less valid grounds, by the chemist. Two conclusions we are however justified in drawing. These are (1) that tannin is richer in carbon and oxygen than are carbohydrates, and (2)

* There is marked confusion in the chemical mind as to the exact nature of the body in question, and the cause is not difficult to recognise. All the solvents used for the extraction of tannin are likewise solvents, amongst other things, of glucose, which probably in all cases is present in the tissue. Hence, the tannin extracted contains free glucose which cannot be separated from the tannin itself. It will be seen that this fact likewise affects all experimental investigations into the growth of fungi, &c., in solutions of tannin. When the chemist has found some way of separating glucose from tannin, a more perfect appreciation of the constitution of tannin will exist. The ordinarily accepted formula is

$$C_{14} H_{10} O_9 = C_6 H_2 (OH)_3 \cdot CO \cdot O \cdot C_6 H_2 (OH)_2 \cdot CO_2 H.$$

Another formula illustrates the relations between tannin and gallic acid thus:—

$$C_{14} H_{10} O_9 \text{ (tannin)} + H_2 O = 2\ C_7 H_6 O_5 \text{ (gallic acid)}.$$

Strecker, who worked very largely at tannin, gave as his earlier formula $C_{27} H_{22} O_{17}$. He now accepts the formula $C_{14} H_{10} O_9$ for tannic acid or tannin, and considers it as probably the first etherial anhydride of gallic acid, using the lengthy composition formula given above.

that either free, or in comparatively loose combination with it in the vegetable tissues, is an uncertain percentage of glucose. This latter may, in part at least, account on the one hand for the possibility of growing to some small extent moulds in solution of tannin, and, on the other hand, for the fact that solutions of tannin can be readily decomposed by means of moulds or bacteria into sugar (glucose) and gallic acid, and, it is said, under certain circumstances even further. Schiff's formula for this decomposition by a ferment is

$$(a)\ C_{34}H_{28}O_{22} + 2\,H_2O = C_6H_{12}O_6 \text{ (glucose)} + 2\,C_{14}H_{10}O_9 \text{ (tannic acid).}$$

$$(b)\ C_{14}H_{10}O_9 + H_2O = 2\,C_7H_6O_5 \text{ (gallic acid).}$$

Schiff is stated to have obtained tannic acid free from the glucose above referred to by a process consisting essentially in acting upon tannin, as extracted, by means of oxychloride of phosphorus, but this I take the liberty of very strongly doubting.

MICRO - CHEMISTRY. — The botanist who works out the chemistry of the cell-contents under the microscope is far more restricted in his power of producing chemical reactions than is the ordinary laboratory chemist. Any changes produced by his reagents must be clearly optically recognisable, and hence, as a rule, he is confined to reagents which produce colour reactions, or changes of form (*e.g.*, by swelling), or which act as solvents. Thus, many of the metals, such as antimony, lead, barium, strontium, &c., produce tannin reactions which the macro-chemist can work upon, but a white precipitate is for micro-purposes useless, owing to the difficulty of recognising it. The most time-honoured reagent for tannin is a salt of iron, a reaction known even to Pliny.* The salts most commonly in use are chloride, acetate, and sulphate, but others have been recommended from time to time. With any of these tannin takes either a green or blue colour, giving rise to the customary classification of the tannins into iron-blue or iron-green. The main micro-chemical utility of iron-salts as reagents for tannin lies however in their indicating which of these two groups is present; otherwise they have several distinct disadvantages. The most important of these is that they indicate presence but not position. The solution of tannin diffuses so readily and rapidly that the

* "Die sehr characteristische Reaktion eines Galläpfeldekokts mit Eisen war schon Plinius bekannt, und wurde in Alterthum verwendet um Verfalschungen des Grünspans mit Eisenvitriol zu entdecken. Es ist dies überhaupt die allererste chemische Reaktion." Müller's Poulsen's "Botanische Mikrochemie," 1881, p. 69.—Adulteration is no modern device of those who make haste to grow rich. It is probably as old as trade itself.

coloration of the contents of a cell is no proof that those cells in their uninjured state contained tannin. Further, all these salts, and especially the chloride, are uncertain. I used German preparations of "Eisenchlorid," or of "Schwefelsaures Eisenoxydul,"* in all of the observations hereafter detailed, as a preliminary, in order to test the nature of the tannin present. I took all the customary precautions, but sometimes my notes were "no tannin," when the subsequent use of another salt, or of potassium bichromate showed it distributed widely, if not plentifully. I cannot, therefore, agree entirely with Nägeli,† when, speaking of the reactions of the iron oxide salts, he says "Diese Farben treten . . . in so intensiven Tönen hervor, dass sie der Jodreaction auf Stärke an Sicherheit und Zulässigkeit kaum nachstehen." Perhaps in another sense of the comparison I can however coincide, since I have already shown ‡ that very frequently the iodine reaction for starch is unreliable, unless the reagent be decidedly aqueous.

Sanio has recorded still another general objection. "Gerbsaures Eisenoxyd ist in überschussigen Eisenchlorid löslich." § Take a section of gall apple in water; add one drop of iron chloride and you have a dark-blue precipitate; add iron chloride to excess, the precipitate dissolves to a greenish yellow, or, if much precipitate be present, to an olive-green clear fluid.

The same author had previously ‖ recommended the use of dilute iodized chloride of zinc (Chlorzinc iodine, Schultz's solution), by which tannin is coloured rose-red to violet. The same general objection of easy diffusibility applies equally to this reaction, with the additional one that the cell walls and any starch contents of the cells are alike coloured from red to violet, thus adding an element of confusion, especially in the case of researches like the present, where the presence of starch in the same cells with the tannin is an important feature.

* This latter I have found by far the more certain.

† *Nägeli und Schwendener*, "Das Mikroskop," 2te Auflage, 1887, p. 490. Further on (p. 491), speaking of Sanio's Potassium bichromate reaction, he says, "Wir haben dieses Verfahren selbst nicht geprüft (!), doch scheint uns die Behandlung frischer Schnitte mit Eisenchlorid wenigstens für saftige Gewebe den Vorzug zu verdienen." This, after Sanio's reaction had been in use for 14 years; and the preference, too, is given to the salt of iron which, of all those in general use, is the most uncertain.

‡ "Proceedings of the Camb. Phil. Soc.," 1883, p. 400, 402.

§ *Sanio*, "Einige Bemerkungen ü. den Gerbstoff ü. seine Verbreitung bei den Holzpflanzen." Bot. Zeit., 1863.

‖ *Sanio*, Bot. Zeitung, 1860, p. 213.

By Hanstein* aniline violet has been used, colouring tannin fox-red. I have similarly used fuchsine, by which (after passing the sections through dilute sulphuric acid) tannin contents of the cells are coloured purplish red, the colour being retained for some months.

Kraus † has suggested that tannin may be recognised by means of its relations with glycerine, under the influence of which it forms drops which later disappear. In this, however, it is not recognisable from glucose, which reacts in the same way.

The reagent which is used in the bulk of the following experiments, and in all those which I considered crucial or upon which I have founded any conclusions, is a watery solution of potassium bichromate, first recommended by Sanio.‡ When portions of the tissue to be examined are laid for from two to seven days in this fluid, the tannin contents of the cells form with the reagent a compact moderately dark-brown gelatinous mass, either in one lump filling the cell, or in several lumps or balls of various sizes; or, if only a trace of tannin be present, a few reddish small granules. This compound is insoluble, and sections of the tissue (rejecting the external ones) can be cut and preserved as preparations for at least two years or so, showing definitely both the position and the quantity of the tannin, though not showing to which of the tannin groups the particular one belongs. It is quite true that certain other cell contents are liable to reduce bichromate of potash, and produce a colour reaction; the tannin reaction is, however, distinguished more even by form and appearance than by colour, and no one with experience is likely to go astray.

I have found that osmic acid also is (in one per cent. solution) a reagent for tannin. The solution turns black by reduction. Provided the cells are unbroken, this colour reaction can also be preserved, but unfortunately certain other cell contents reduce osmic acid, and discrimination is not always easy.

Distribution.—This will be specially considered hereafter.

Function.—As to the part which tannin plays in the metabolism of the plant, the opinions of observers have widely differed.

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* *Hanstein*, Bot. Zeitung, 1868.

† *Kraus*, "Ueber das Verhalten des Zuckersaftes der Zellen gegen Alcohol und Glycerin, u. s. w." Stzb. d. Naturforsch. Ges. zu Halle, 1876 (Bot. Zeit., 1876, p. 644).

‡ *Sanio*, l. c. Bot. Zeit., 1863.

Sachs,* in his researches into the germination of *Phaseolus multiflorus* (the scarlet-runner kidney bean) says, "Den leicht beweglichen Kohlenhydraten und Eiweissstoffen gegenüber bilden der Gerbstoff und die Farbstoffe eine Gruppe träger Elemente, da sie, wo sie einmal entstanden sind, liegen bleiben. Diese beiden Gruppen sind in der That physiologisch in jeder Hinsicht verschieden; Kohlenhydrate und Eiweissstoffe sind in ruhenden Keim vorhanden, sie sind nicht das erste, sondern das letzte Assimilationsprodukt der Mutterpflanze, ein fur Nachkommen aufgespartes Capital; Gerbstoffe und Farbstoffe dagegen treten auf an den Stellen wo die Vegetation beginnt, wo jene Assimilationsprodukte der Mutterpflanze nur in neue Form übergehen. Der Gerbstoff, und der mit ihm in denselben Zellen enthaltene Farbstoff scheinen Nebenprodukte des Chemismus in producirenden Gewebe."† This sentence is the foundation of the views of one body of vegetable physiologists, that tannin is a bye-product of assimilation. In this connection it ought, however, to be pointed out that the tannin of *Phaseolus* is, in many respects, quite unlike the tannins so commonly met with in the cortex, &c. of woody plants.

Wigand‡ believed that tannin forms an essential factor in the chemical processes of plant life, and always physiologically as a member of the series of carbohydrates. Always appearing in opposition to starch, it in general seems to play a part in the series of materials possessing formative energy, though in some cases it also acts as a reserve material. Nothing could be more diametrically opposed to the view of Sachs than this.

Wagner§ endeavoured to distinguish a pathological from a physiological tannin, based on their varying relations to ferments and dilute acids; but it is not apparent that he intended by his choice of classificatory terms to convey any idea of the physiological significance of tannin to the plant.

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* *Sachs*, "Ueber die Keimung von Phaseolus multiflorus;" Sitz. der Wien. Akad., 1859, pp. 57, et seq.

† The gist of this sentence is that the carbohydrates and albumins on the one hand, and the tannins and colour bodies on the other, are physiologically opposites. The former are products of the mother plant stored within the seed; the latter appear with renewed growth, simultaneously with the chemical changes in the stored food materials, and are probably, therefore, bye-products of these changes.

‡ *Wigand*, "Einige Sätze ü. d. physiologische Bedeutung des Gerbstoffes und der Pflanzenfarben"; Bot. Zeit., 1862, pp. 121-5.

§ *Wagner*, "Beiträge zur Kenntniss u. s. w. der Gerbsäuren," Journ. f. Prakt. Chemie., Bd. 99, 1866, pp. 294-305.

Wiesner* believed that tannin is an intermediate member between the carbohydrates, starch cellulose, &c., and resin.

Sachsse "ist sogar geneigt, die Gerbsäure als eine Uebergangsbildung der Stärke in Cellulose, anzunehmen, da diesen Uebergang immer unter Entwickelung von Kohlensäure stattfindet, und von den Auftreten an Gerbstoffen begleitet ist."†

Hartig‡ believed that tannin remained in the oak through the winter in the form of grains, very similar to starch grains. He called this "Gerbmehl," distinguished from starch by its solubility in cold water, and its reactions with iron.

Schell,§ in the most extended researches into the distribution and function of tannin which have been published, arrives at the conclusion that in some cases tannin is a bye-product of metabolism, in others an actual constructive material. He comes to this latter conclusion from its disappearance and subsequent reappearance during growth. In the germination of some oily seeds, *e.g.*, *Cynoglossum vulgare*, *Anchusa officinalis*, *Asperugo procumbens*, *Symphytum echinatum*, *Echium vulgare*, the tannin begins to serve as a constructive material with the disappearance of the oil, and then diminishes in quantity; in all other cases, when the plant presents much oil or starch, and these do not disappear, the tannin is laid by as a bye-product. In the stem, amongst others, where it is present in some quantity during winter, it mainly disappears in spring. Schell believes in general that tannin acts as a constructive material only when the carbohydrates, oil and starch (? and sugar), are present in small quantities or are wanting; the same occurring when plants (*e.g.*, *Faba vulgaris*) are germinated in unfavourable circumstances, as in pure sand.

Th. Hartig in his more recent publications || adheres to his old opinion on the nature and function of "Gerbmehl,"

* See *Wiesner*, Bot. Zeit., 1862, pp. 389-394, for further views on the relations between tannin and colours.

† *Sachsse*, in "Ebermayer's Physiologische Chemie der Pflanzen" p. 412, is disposed to consider tannin to be a transition product from starch into cellulose, as this change always takes place with evolution of carbonic acid gas, and is accompanied by the appearance of tannin.

‡ *Hartig*, "Ueber den Gerbstoff der Eiche," Stuttgart, 1869; see also Bot. Zeitung, 1865, pp. 53 and 237.

§ *Schell*. I am acquainted with this paper only in the form of an abstract, "Physiologische Rolle der Gerbsäure," in Bot. Jahresbericht, 1875, pp. 872–8. The original is in Russian, 136 pp. quarto, with two plates, 1874.

|| *Hartig*, Anatomie und Physiologie der Holzpflanzen, 1878, pp. 119-123; "Das Gerbmehl."

resubstantiates his earlier statements on the storage of tannin in the form of grains in the winter food reservoirs of plants (*e.g.*, the oak), and its solution in the spring sap. He sums up his opinions thus:—"Die physiologische Bedeutung des Gerbmehls ist dieselbe wie die aller übrigen Reservestoffe. Es wird in Frühjahrsafte der Bäume aufgelöst, ohne seine Reaktion auf Eisensalzlösungen dadurch einzubüssen, im Sommer und Herbste jeden Falles in den zugewachsenen Baumtheilen neugebildet. Was und wie viel vom Gerbmehlgehalt der Bäume im Winter, auf Neubildung von Zellen im darauf folgenden Jahre verwendet wird, welche veränderungen die Gerbmehllösungen hierbei erleidet, ob der Gerbsäuregehalt des Gerbmehles hierbei betheiligt ist, dafür fehlt mir zur Zeit noch eine lange Reihe nothwendiger Ermittelungen." (l.c. p. 123).

So far for experimental evidence, and now for two opinions expressed upon the evidence afforded by others.

De Bary* thus expresses himself on the subject:—"It is true that the abundant presence of this body, tannin, in secretory sacs is not decisive, since it exists also elsewhere, in the epidermal cells, and in many, especially ligneous, plants, and particularly in the assimilating starch-forming parenchyma, and, as far as we know at present, it is at least undecided whether it exists here as a bye-product in constructive metabolism, as is the case with calcium oxalate, or is a definite transition phase therein."

Sachs† says:—"Very widely distributed further are certain tannins, often mixed with a red colouring matter, and which are either present in special isolated cells, or in rows of cells, without being again used in metabolism, which therefore are to be considered as excreta. In other cases, on the other hand (*e.g.*, the germ shoot of the oak), there are tannins of another kind which, by their origin and disappearance and by their behaviour in growth, are to be recognised as special forms of reserve food-material, which find further use in metabolism . . . ."

* *De Bary*, Vergleichenden Anatomie, p. 160. Some further references to literature will be found here, and also in *Nägeli u. Schwendener*, l.c., and *Pfeffer*, Pflanzen-Physiologie, i., 305-6.

† *Sachs*, Vorlesungen über Pflanzenphysiologie, 1882, p. 209.

(*To be continued.*)

INDIVIDUALISM IN ART.

W. KINETON PARKES.

(Continued from page 250.)

If we trace the history of the opera, we shall see how individualism gradually asserted itself.

Opera is the blending of three arts, the art of acting, of music, and of poetry. It originated in the application of recitative to recitation. Recitative was in the beginning all the music that was used in opera, if it can be called opera at that stage. This in time gave place to concerted music: choruses, part-songs, and solos alternated with the recitatives, and dialogue became entirely eliminated. From being a play in its function it became one of the best forms of musical expression, and it is now, with oratorio, the highest form of musical art in which poetry is employed. The history of opera is one of the most striking examples of the development and progress of an art. "Transformation of the homogeneous into the heterogeneous," we know, "is that in which progress essentially consists," * and this is exemplified in the evolution of the opera as it is in all the products of human thought and action. From the simple homogeneous productions of unknown men, we see opera in our time evolved into the complex, heterogeneous production of several great men. For the successful performance of primitive opera little was required, but see the numberless things that have to be combined for the performance of a great modern opera in which the individuality of those whose genius has produced it must be displayed. The instrumental music is composed by a great musician in such a way that it entails a large and varied orchestra; the vocal parts are written so that none but the most highly trained singers can sing them. The music is ingeniously wrought into harmony with the words of the poet, and the whole must be interpreted by the genius of the actor-singer. Take Gounod's "Faust:" there is the wonderful individuality of the composer; there is the glorious individuality of Goethe; and to interpret these great masters we must have such men as Signor Foli and Maas; such women as Mdme. Patti and Mdme. Nilsson.

In the realm of pure sensuous music we may instance the great and vivid individuality of Wagner. With him, everything is in harmony with the music; the acting is that

* Herbert Spencer. Essay on "Progress."

which is suggested by the fervour, fire, and fascination of it. But sound is the really important factor, to the exclusion of every other motion or emotion, to be taken into account in a consideration of this composer's work. He, more than any previous master, insists that the surroundings shall be in accordance with the music; insists that the scenic effects shall be good, the poetry good, and the acting and singing good. He, more than anyone, so wrote his operas that the music should wholly accord with the demands of the situation, the poetry, and the action. It is in this that his individuality consists; it is this that will cause him to be remembered for all times as the originator of a school of music which satisfies this analytic age.

As is the case with music, so has the progress of all the arts been. A change from the homogeneous to the heterogeneous, from the tom-toms of the savage to the glorious compositions of Wagner, Gounod, Sullivan. From the drawings of the cave men to the Elgin marbles; to the work of Michael Angelo, Raphael, Titian, or Dante Gabriel Rossetti, Holman Hunt, and Burne Jones. From the old, old unwritten ballads to the epics of Homer and Dante, from the ancient bards to Shakspere and Shelley. From the early chroniclers to Goethe and Carlyle. From the alchemists and their elixir of life to Galileo, Newton, and Darwin. And this progress of Art has taken place contemporaneously with the development of individuality; and the greater the rate of the progress the more pronounced has been the individuality of those who participated in the process.

True progress of Art is always co-existent with the prevalence of individualism. The efforts of the Pre-Raphaelite Brotherhood, which was a distinctly individualistic movement, resulted in an impetus to Art which cannot be sufficiently estimated. We in our time see much of the fruit of these efforts, but their full significance is hardly yet apparent. The fruits of it are yet to ripen in the years to come. All great reformations are brought about by the spontaneous action of originality and individuality, which will assert itself in spite of the greatest difficulties which may assail it.

The evolution of Art offers an analogy to the nebular hypothesis. We have the great nebulous mass, homogeneous throughout: by its movements a ring is thrown off which condenses into a planet, an individual, with a separate existence of its own. This is the production of the individual from the mass. The process is continued until the nebula has produced many such planets, each of them having a distinct individuality. The homogeneous has split up into the heterogeneous: for the planets to resolve themselves again and become part of the original mass would be a backward step. For individuals to become Socialists is reversing progress. It is a change from the heterogeneous to the homogeneous, which cannot but be followed by disaster. In Social Science this is true; in Art it is true also. Institutions of all kinds should be watched with the utmost care, for their inevitable tendency is to crush individualism. This has become painfully apparent in the Royal Academy. Many of our greatest modern painters have held entirely aloof from it, and those other great men who are now R.A.'s or A.R.A.'s are only so because the outcry against the institution has become so menacing. The Royal Academy most foolishly, though as is generally the case unconsciously, instituted a standard of merit to which all artists must attain before they could be admitted into its body. This standard has varied according to the ideas of the men forming the Academy. That such a system was pernicious goes without saying, for artists who were struggling for a livelihood would necessarily endeavour to attain to this Academy excellence, for it meant money. It is only in a few rare but glorious cases that the individuality has been so pronounced that it has enabled its possessor to struggle on through despair, neglect, and poverty, and make for himself that position in the world which it is beyond the power of all Academies to give—the position of one of the world's heroes.

Art schools and the progress of universal Art training, too, should be watched very narrowly. That these influences will result in the production of mediocrity and uniformity in Art work is certain. That their system will nourish and develop genius is not so certain. Individuality will assert itself, and if it gets into the curriculum of a provincial Art school and finds that it is not sufficient, then individuality will have its way, either in the alteration of the system pursued at the school, or by leaving it. Therefore, where extraordinary talent manifests itself, it should be the first duty of the officers of the institution to foster it in its own peculiar way; not to adhere strictly and uniformly to the rules and regulations of the school. In many instances it is absolutely impossible for a man with genius to go through all the petty annoyances, tests, and examinations that are so very necessary to the ordinary student.

It is curious to note that although religious institutions have in many cases had so pernicious an influence on progress, yet in the cases of painting, architecture, and sculpture, and in music too, their influence has been good and useful.

Some of the world's greatest paintings have been done expressly for the purposes of religion; some of the noblest specimens of architecture are found in temples, cathedrals, and churches. Some of our most beautiful music is that composed expressly for church services, as the Masses of Mozart, Schubert, Gounod, and others. I do not say that the religious influence has been entirely good, because, as I have already pointed out, ornament and decoration are not the highest forms of Art, and work done for the great religious establishments was almost wholly decorative or ornamental. There is a seeming paradox in this consideration, for while religion has called forth some of the sublimest efforts of the greatest geniuses, religious bigotry and oppression has, sadly enough, destroyed many noble and glorious works in Art, Literature, and Science. That Art has in some cases been degraded by its contact with doctrinal religion is also a fact which needs no proof. That such a mind as that of Shelley, so wholly attuned as it was to the delicate influences of Art, should be disgusted by some of Michael Angelo's work, is not surprising when we consider what that work was. Some of his most celebrated pictures are representations of a repulsive, savage, awful being, which is meant to represent God. Men with the same ideas concerning the unknowable as those of Shelley cannot help being affected in the same way by these fearful productions. They are repulsive alike to the eye and to the mind. Architecture owes a vast deal to religious institutions; so much so, that we cannot sufficiently estimate it—all the splendid cathedrals and churches which adorn our own land, and those which are among the great glories of the Continent; all the magnificent temples of India and China, and all those of ancient Greece and Rome, the ruins of which still are marvellously beautiful, delighting the eye of him who can see beauty, and forming the inspiration for many a noble poem. But sadly enough, as in painting, so in architecture, we are troubled by the edifices erected by the Primitive Methodist, which he calls the "Temple of God," and with which he disfigures an otherwise picturesque little village in a way most distressing. Although the Masses composed for church services are of extreme beauty, we still have to contend with the comic music set to the still more comic words of the Salvation Army man. We see from this that religion, as applied to the Arts, has not been altogether beneficial. It is, in some of its forms, answerable for much that is derogatory and debasing in Art, while, on the other hand, it has been in many directions the friend and nourisher of the artist and of his work.

In reference to Criticism, which I regard as one of the Arts, it is individualism which plays the most glorious part—the man of originality who can break away from the established canons of bygone times, and assert himself by the views he holds. It was Emerson—a great prophet of individualism—who, when all other critics went astray, saw the grandeur of "Sartor Resartus," the great prose poem of the mighty individualist Carlyle. The man who is affected most by Nature is he who is most affected by Art, and as Emerson expresses it:—"The individual in whom simple tastes and susceptibility to all the great human influences overpower the accidents of a local and special culture, is the best critic of Art." * There are critics who scarcely answer to this description, but then, they are neither "susceptible to the great human influences" or to any influences whatsoever.

It would be pleasant to linger over some of the great names which have been such prominent examples of individualism in the present century—a century which is remarkable for the progress of individualism among a certain class of the community, and which has seen the rise of those ideas which in England are termed Democratic. (Of the Socialist movement, about which we hear so much just at present, it is hardly necessary to speak, for it is but a passing phase of the discontented, who, like the poor, are ever with us. That Socialism will not cure their maladies it requires but a year or two to prove.) The poet-painters alone furnish us with splendid examples of individualism. The wonderful genius of Blake, with his strange visions, his lurid paintings and weird poems, made an assertion for individuality which could not be withstood. Those by whom he was surrounded did their best to mould him into the orthodox shape, but they were peculiarly unsuccessful. He continued in his own way, inventing his own methods, producing his compound works of Art in painting and poetry. Dante Gabriel Rossetti, another great individualist who worked in the same arts as did Blake, if not so strange in his methods and life, was as great a genius. Some of his works in poetry, while they do not display the strangeness of some of Blake's, have qualities which Blake's poetical work does not possess. Their grace, their beautiful examples of alliteration, their perfect form, their effect upon the senses, are allurements which cannot be withstood when once the spirit of their author is thoroughly assimilated. In painting, his work is the greatest ever done by an Englishman. As a colourist he is the rival of the greatest

* Emerson. Essay on "Art."

names of Continental artists. His pictures have the same psychological effect as his poems, producing a species of subdued delight which is only effected in this high degree by his works, but which is occasionally approached when some of the pictures of Mr. Holman Hunt, Mr. Burne Jones, or Mr. Watts, or some of the poems of Shelley, Keats, or Coleridge, are the subjects of contemplation. There are other great poet-painters, too, who have influenced the thought of the century very strongly—Sir Noel Paton, Mr. W. Bell Scott, and others. In the region of prose literature many great names immediately suggest themselves—Goethe, Carlyle, George Eliot, and Mr. Ruskin; in science—Dr. Huxley, Prof. Tyndall, and Sir Richard Owen; in philosophy—John Stuart Mill, Darwin, and Mr. Spencer; in music—Wagner and Gounod: all these have impressed their individuality upon their time with a stamp that can never be obliterated. These are the great individualists who have made their respective arts so glorious and so famous. What has been done in the past for Art by individualism will, as civilization and its accompanying culture progresses, develop into something even greater and grander. It is only to individualism that we can look with certainty for progress and development: if collectivism steps in and usurps its place, then the progress of Art, as well as everything else, must necessarily end.

We have, then, briefly traced the origin and development of the Arts. We have found that progression consists in the development of the homogeneous into the heterogeneous alike in Art and in life. We have seen that the highest Art is co-existent with the greatest display of individualism, and that all great efforts exerted in order to alter some current mode of thought and opinion were the efforts of the individualism which displays itself wherever genius is present. We have also seen that where collectivism is the prevailing feeling true high Art cannot exist, be produced, or be enjoyed. As Art-work is *produced* by the individual, so does it *administer* to the individual. It affords him scope for thought and feeling, it affords him delight and pleasure.

In this our day, when to be great all Art must possess the scientific spirit, we must look to it that Science shall possess the *artistic* spirit too; that it shall not run into materialism or any other of the thousand pitfalls which beset its path of progress. There must be a glorious union of Science and Art. "When Science is learned in love, and its powers are wielded by love," and the whole of Science is artistic, and the whole of Art scientific, then the prophet of the movement will arise, and lead his army of workers, and the triumph of the teachings of the Synthetic Philosophy will be complete.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 261.)

A List of Malvern Plants, appended to a paper by Mr. Wm. Ainsworth, M.R.C.S., entitled "A Sketch of the Physical Geography of the Malvern Hills," in Jameson's "Edinburgh Philosophical Journal" for 1828, pp. 99—100, has been kindly extracted for me by Mr. Druce, of Oxford. It should, as well as the List next in order, have preceded that of Perry.

It contains, among others, the following records :—

Cistus Helianthemum. (*H. vulgare.*)

† **C. polifolius.** (*H. polifolium.*) *Must be an error.*

Ulex europæus.

* **U. nanus.** *This is U. Gallii. Planch.*

* **Genista anglica.** Scattered about the Hills.

Spartium scoparium. Little Malvern.

Ononis arvensis.

Campanula rotundifolia.

† **Polygonum viviparum.** *An error.*

* **Orchis ustulata.**

O. (*Habenaria*) **bifolia.** *Almost certainly H. chlorantha. Bab.*

The List, from which the above is an extract, contains 36 plants, of which 6 are new records.

The name of my friend, Mr. Edwin Lees, of Worcester, a name more intimately connected with the botany of his county than that of any other writer, must now be introduced into this history. His first botanical work was a catalogue of the "Plants on the Malvern Hills," made in the year 1829, and published in Loudon's "Magazine of Natural History," Vol. III., 1830, p. 160.* This record should have taken precedence of that of Perry, which was published in Vol. IV., 1831, of the same work, although Perry's observations were for the most part made earlier than those of Mr. Lees. Unfortunately I did not find Mr. Lees's article until Perry's List had gone to press. There is another paper by Mr. Lees in Vol. IV. of the same periodical, p. 437, in which a few Worcester plants are mentioned, but it will be unnecessary to refer to them in this place. Mr. Lees has

* Mr. Lees published a previous List in 1828, which will be referred to hereafter.

passed away from us since this paragraph was first in type, his botanical work having extended over a period of nearly sixty years.*

The Malvern List contains a few records from the County of Hereford which is entangled with that of Worcester in the vicinity of the Malvern Hills. These I have marked with the letter H. There are also a few cases in which I think the author has fallen into error in the identification of his plants.

Edwin Lees: in Loudon's "Magazine of Natural History," Vol. III., 1830, p. 160. "Plants on the Malvern Hills." The List is dated September 18th, 1829.

* **Ranunculus parviflorus.**

* **Aquilegia vulgaris.**

* **Fumaria** *(Corydalis)* **claviculata.**

* **Cistus Helianthemum.** *(H. vulgare.)*

* **Drosera rotundifolia.** Bog on western side of the Beacon.

* **Dianthus Armeria.**

* **Stellaria uliginosa.**

* **Spergula saginoides.** *(S. nodosa, L., must be the plant intended.)* In a marshy spot on the western side of the Worcestershire Beacon. Also in another springy spot near the Wych.

Arenaria rubra. Abundant on the rocks. Also near the Wych.

* **Montia fontana.** In plashy rills on the Hill.

* **Hypericum Androsæmum.** In a wood near Little Malvern Priory.

H. pulchrum. Abundant on the heathy ground at the north base of the End Hill.

Tilia parvifolia. Woods at the north end of the Range.

* **Linum usitatissimum.** Near Little Malvern.

* **Geranium lucidum.**

Ilex Aquifolium. Almost covering the hills in the southern part of the chain.

* **Anthyllis Vulneraria.**

† **Trifolium ochroleucum.** On the Link Common. *Must, I think, be an error.*

* **Ornithopus perpusillus.**

Hedysarum Onobrychis *(O. sativa)*. On the limestone rocks.

* **Vicia sylvatica.** In the wood below the Worcestershire Beacon.

Spiræa salicifolia. Near Welland Common, perhaps naturalised there, as a garden was not far from the spot.

* **Alchemilla vulgaris.**

* **Potentilla argentea.** Plentiful on the rocks.

H **P. verna.** On the rock above the cave on the Herefordshire Beacon.

Rosa villosa. *(R. mollissima.)*

* Mr. Lees died on the 21st October, 1887, at the advanced age of 87.

R. tomentosa.

* **R. rubiginosa.**

R. micrantha. On the thickety side of the Warren Hill.

R. Borreri. In the woods.

R. Forsteri. In the woods. *Var. of R. canina, now known as R. urbica, Leman.*

Pyrus torminalis. In the woods.

*P. **Aucuparia.** Numerous at the base of the North Hill.

Circæa lutetiana.

* **Sedum Telephium.** Abundant on the rocks of the North Hill.

* **S. acre.** Abundant on the rocks of the North Hill.

* **S. album.** Abundant on the rocks of the North Hill.

* **Cotyledon Umbilicus.** Numerous in the fissures of the rocks.

* **Chrysosplenium oppositifolium.** Abundant in shallow plashy rills.

* **Sium repens.** In marshy ground on the west side of the Worcestershire Beacon.

H * **Viburnum Lantana.** In the woods on limestone near Ledbury.

* **Asperula odorata.**

* **Dipsacus pilosus.**

* **Carlina vulgaris.**

* **Anthemis nobilis.** Abundant on the wet commons near the Hills.

* **Solidago Virgaurea.** On the rocks.

† **Hieracium murorum.** On the rocks.

I suspect H. vulgatum, Fries, abundant on the rocks at Malvern, is the plant intended here.

* **Vaccinium Myrtillus.** On the rocks of the Worcestershire Beacon.

Calluna vulgaris. No other kind of heath grows throughout the range.

H * **Vinca minor.** In a wood on the summit of a limestone hill near Cradley.

* **Chlora perfoliata.** Near the limestone quarries.

* **Gentiana Amarella.** On limestone in a rocky wood near the Wych. Plentifully.

Cuscuta Epithymum. On the North Hill.

Datura Stramonium. On waste ground near the Church.

* **Hyoscyamus niger.** In abundance at the base of the Hills near the Wells.

* **Verbascum Thapsus.** In abundance.

* **V. Blattaria.** Side of the road to Worcester.

* **Digitalis purpurea.** In all parts of the range. Profusely.

*† **Veronica triphyllos.** At the northern extremity of the Link Common. *An error. See "New Botanists' Guide," p. 622.*

* **Lathræa squamaria.** At the base of the North Hill on the roots of holly, and in a thick wood on a conglomerate near the Teme on the roots of maple.

Lycopus europæus.

Mentha piperita. Plentiful by the rills on the Chase.

M. viridis. By the side of a stream near Newland.

* **Thymus Calamintha.** *(C. menthifolia.)* Abundant.

* **Nepeta Cataria.**

Lithospermum officinale.

Myosotis cæspitosa.

* **Cynoglossum sylvaticum.** In the woody glen at the foot of the Warren Hill, Little Malvern.

* **Pinguicula vulgaris.** In a bog on the west side of the Worcestershire Beacon, but in no other part of the Hills.

* **Anagallis tenella.** Mossy bog at the foot of the Worcestershire Beacon.

Rumex palustris. Marsh by the Chalybeate Spring.

* **Polygonum Bistorta.** In moist copsy meadows to the north of the Hills.

† **P. viviparum.** *No locality stated. An error. See "New Botanists' Guide," p. 203.*

* **Juniperus communis.** On the limestone rocks.

* **Taxus baccata.** Abundant in the woods on limestone.

* **Triglochin palustre.** In boggy places.

* **Orchis pyramidalis.** On the limestone banks.

* **O.** *(Gymnadenia)* **conopsea.** Covering whole meadows at the foot of the northern limestone eminences.

* **O.** *(Habenaria)* **viridis.** In pastures at the base of the North Hill.

* **O.** *(Habenaria)* **bifolia.** In the woods.

Almost certainly H. chlorantha. Bab.

* **O.** *(ophrys)* **apifera.** On the limestone rocks at Leigh Sinton.

* **Neottia spiralis** *(Spiranthes autumnalis).* On the wet commons.

* **Narcissus Pseudo-narcissus.** In profusion in a wood near Little Malvern Church.

H * **Galanthus nivalis.** In great abundance in a mossy glen at the north-western base of the Herefordshire Beacon, and in the adjoining wood.

* **Paris quadrifolia.** In the thick woods at the western bases of the two beacons.

Tulipa sylvestris. This was found among the limestone quarries by Jas. T. Goodman.

* **Colchicum autumnale.** Abundant in the moist meadows on the western side of the Hills.

Eriophorum polystachion. In a bog on the western side of the Hills.

Aira caryophyllea.

Festuca gigantea *(Bromus giganteus).* On the limestone hills north of Malvern.

† * **F. Calamaria.** On the limestone hills north of Malvern. *I suspect an error in this locality.*

* **Nardus stricta.** On the commons.

A further list of "plants varying in the colour of their flowers" follows the list of "plants on the Malvern Hills." The following Worcester records are extracted from it:—

* **Polygala vulgaris.** White flowers. (*Possibly the typical form.*) On limestone to the north of Malvern.

Geranium pusillum. White flowers. Henwick Hill, on sandy ground.

* **Saponaria officinalis.** With double flowers. In a hedge on the road to Cothridge.

Spiræa Ulmaria. With full flowers. In a marshy place at Battenhall on the road to Cruckbarrow Hill.

Rubus leucostachys. In a hedge on the north side of Worcester.

R. glandulosus. Bromsgrove Lickey.

Carduus nutans.

* **Antirrhinum majus.** Cream coloured flowers. On an old wall near the Commandery, Worcester.

Betonica officinalis. White flowers. Helbury Hill, west of Worcester.

Prunella vulgaris. White flowers. West side of Worcester.

Crocus vernus. With white flowers. In a low field south side of Worcester.

There are so many old records in these lists that it will be convenient to recapitulate the new ones.

Arenaria rubra.
Hypericum pulchrum.
Tilia parvifolia.
Geranium pusillum.
Ilex aquifolium.
Hedysarum Onobrychis.
(*Onobrychissativa.*) (*Perry.*)
Spiræa salicifolia.
S. Ulmaria.
Alchemilla vulgaris.
Rubus leucostachys.
R. glandulosus.
Rosa villosa.
R. tomentosa.
R. micrantha.
R. Borreri.
R. Forsteri. *Var. of canina.*
Pyrus torminalis.
P. Aucuparia.
Circæa lutetiana.
Sedum acre.
Solidago Virg-aurea. (*Perry.*)
Calluna vulgaris.
Cuscuta Epithymum.
Datura Stramonium.
Lathræa squamaria.
Lycopus europæus.
Mentha piperita.
M. viridis.
Betonica officinalis.
Prunella vulgaris.
Lithospermum officinale.
Myosotis cæspitosa. (*Perry.*)
Rumex palustris.
Crocus vernus.
Tulipa sylvestris.
Eriophorum polystachion.
(*Perry.*)
Aira caryophyllea.
Festuca gigantea.
(*Bromus giganteus.*)

It thus appears that Mr. Lees contributes in his first list of Worcester plants 38 new records, 4 of which must be taken away from Perry, thus reducing his number from 32 to 28.

(To be continued.) XI, 15

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 255.)

WHAT IS THE STORAGE CAPACITY OF THE MATERIAL OF THE BED?—I am not aware of any experiments bearing upon the question of the actual capacity of the Marlstone for water. According to Professor Ansted* many building stones will absorb about a gallon and a half of water per cubic foot, ordinary Sandstones about one gallon, best building stones of the Sandstone group four to five pints, and Limestones generally more than a gallon. Considering that the Marlstone Rock-bed is a calcareous Sandstone, I thought that an average capacity of one gallon per cubic foot would be a fair estimate. To test this, four specimens of the rock were selected; they were dried first in a water-bath, and afterwards on a sand-bath at a temperature of about 200° C., and immersed in water for several hours before taking the specific gravity, then left suspended in a loop of platinum wire to drain before the final weighing. The additional loss by drying at the higher temperature varied from ·23 to ·6 per cent. of the total weight of the specimen. The stone distinctly lost weight from evaporation of water whilst the weighing was being conducted, and therefore, of course, during the time it was draining.

No. 1. Was a hard Oolitic stone of a greenish colour, containing fossils.

No. 2. A ferruginous stone of a ruddy colour, with fossils, and some crystallised carbonate of lime.

No. 3. A hard green stone closely resembling No. 1.

No. 4. A hard grey stone, one surface of which had become oxidised.

* "Applications of Geology to the Arts and Manufactures," by Prof. D. T. Ansted, M.A., F.R.S.

The results obtained are tabulated below:—

TABLE SHOWING DATA FROM WHICH THE CAPACITY OF MARLSTONE ROCK FOR WATER WAS DEDUCED.

No.	Specific gravity.	Weight of Dry Stone in grammes.	Weight of Stone saturated with water in grammes.	Weight of Water in grammes.	Bulk of Water compared to bulk of Stone.	Gallons of Water per cubic foot of Stone.
1	2·945	7·870	8·290	·420	·157	·98
2	2·7	15·16	16·34	1·18	·21	1·3
3	3·0	46·467	48·910	2·443	·16	1·0
4	2·78	56·285	59·236	2·951	·146	·91

It will appear from this table that the average capacity of these particular specimens of rock for water is a little over one gallon per cubic foot, and the balance of possible errors was certainly in a direction tending to reduce the calculated capacity. Making an allowance of one-third of a gallon for water which would always be retained by the rock under the particular conditions in which it is met with in the ground, there would still be room for two-thirds of a gallon per cubic foot, of what we might call replaceable water.

One cubic foot = 6·25 gallons, therefore, if one cubic foot of rock in its normal condition is capable of receiving two-thirds or ·6 gallons of water, it is equal to ·6 ÷ 6·25 = ·107 gallons, or a little over one-tenth of its bulk. Thus, neglecting the capacity of the fissures, one square mile of rock, 6ft. in thickness, could receive or yield over 111,000,000 gallons of water.

WHAT IS THE AREA TO BE FILLED?—In considering the storage capacity of the bed itself, naturally, a volume of water equal to nine-tenths of the volume of the fissures ought to be added to the estimate given above, for in these fissures there is, or might be, a full cubic foot of water where only one-tenth has been allowed for. I cannot give the least idea what that volume should be, but I may say, without any hesitation, that the storage power of the bed as a whole is considerably greater than that given for the material of the bed.

On the other hand, six feet, about the average thickness of the Rock-bed for the county, is not the average for the particular district which alone can assist Northampton, indeed so much is the Rock-bed reduced in the northern parts of the county that I should think an average of three feet would be sufficient. It is, perhaps, important to mention that the area that would first be affected by filling up the Marlstone would be that nearest Northampton, where the average thickness may be more than six feet.

As one of the boundaries of the area to be filled is the Nen "fault," it would be better here perhaps to say what is known of this "fault."

THE NEN "FAULT" is first mentioned in the "Memoirs of the Geological Survey,"* and is marked on the map by a white line. According to the Memoir and map the "fault" extends from Newnham to Kislingbury, *i.e.* about eight miles, and is greatest at Weedon, where on the south side of the valley the Upper Lias is brought into contact with the Lower Lias, entirely cutting out the Middle Lias. I cannot add much to the information given above with respect to this neighbourhood, but during the recent works in connection with the new railway line from Weedon to Daventry, the Middle Lias was well exposed near to the station and barracks, and from the thickness of it there we can estimate the minimum displacement necessary to bring the Upper Lias into contact with the Lower Lias; this would be about 30ft. It is, of course, very probable that the actual displacement, particularly where increased by the subsidiary N.W. and S.E. "fault," is much more, for the actual zone of the Lower Lias against which the Upper Lias abuts is not known, and the lowest beds of the Upper Lias are not shown, although they are presumably present, as they are well developed on the northern side of the same valley.

At Kislingbury the displacement seems to be much less than at Weedon, for a little east of Kislingbury a connecting link of Middle Lias is shown across the valley, though the Rock-bed is absent.

At Northampton we have evidence of a "fault" in which the displacement is greater even than that at Weedon, for on the northern side of the Nen valley the Middle Lias Rock-bed is only 75ft. above sea-level, whereas on the southern side the lower water-bearing bed is about 130ft. above sea-level. Allowing 20ft. (the recorded thickness at the Spinney

* Description of Quarter Sheet No. 53, S.E., by William Talbot Aveling, F.G.S., and Richard Trench, B.A., F.G.S. Published in 1860.

Well was 21ft.) for the thickness of the Middle Lias in this neighbourhood, it will be evident that the total displacement is about 75ft.

Two wells have been made on the south side of this "fault," and it is these that have supplied the necessary evidence with regard to it. One at Messrs. P. Phipps and Co's. Brewery passed through 27ft. of alluvium and gravel, and about 30ft. of alternating beds of clay and rock before reaching the water-bearing bed. Another, at the London and North Western Railway Station in Bridge Street, seems, according to the account left of a boring made there, to have passed through the Middle Lias at 46ft. The description runs as follows:—

Superficial accumulation, consisting of detrital gravels, dark tenaceous clays, with erratic boulders	46ft.
Lias blue clay, with bands of stone	550ft.

A well at Delapre Abbey, 40ft. deep, is also supposed to reach the Marlstone, but whether the upper or lower spring is tapped is uncertain. The Abbey is only a little over a third of a mile S.E. of the railway station.

It will be seen on reference to a map, that the three places particularly mentioned, viz., Weedon, Kislingbury, and Northampton are situated almost in a straight line running east and west, and that this coincides almost exactly with the direction and position of the Nen as far as Northampton.

The "fault" is only marked on the Geological maps as extending from Newnham to a little east of Kislingbury, but it appears quite evident (*a*) that the fault at Northampton is a continuation of the other, and, if so, (*b*) that in this part of the Nen valley the "fault" and the river stand related to each in the manner of cause and effect.

With respect to the first contention (*a*), it is probably unnecessary to say much, because a displacement of 75ft. must have had an effect much beyond the immediate neighbourhood where it has been detected, and being, so far as can be ascertained, in almost an exact line with the older known "fault," and within three miles of it as marked on the Geological maps, it is extremely unlikely that it should be a separate one. The evidence to be obtained from wells, too, shows that the northern and southern Marlstone areas are quite disconnected. It may be that the neighbourhood of Kislingbury formed, as it were, the fulcrum about which the movement took place that resulted in the southern area becoming highest at Northampton and lowest at Weedon.

With regard to the second statement (*b*), I would say that the presence of a "fault" coincident for nearly 11 miles with the Nen valley cannot be regarded as the result of chance, Moreover, the arrangement is quite in accordance with statements previously made with respect to the origin of "faults" and valleys (see page 231, Vol. X.).

We are now in a position to define, with a considerable degree of probability, two of the boundaries of the area that might be filled with water, for two lines may be drawn on a map from the position of Northampton, one running westward along the Nen valley, representing the boundary of the southern area, which can neither give water to nor take water from the northern area; and the other at an angle of 125° with this, *i.e.*, in the direction of strike of the bed, on one side of which the Marlstone is full and the other requires filling. I candidly admit my inability, at present, to even approximately define the other boundary, as it depends upon the inclination of the bed, and the artesian gradient, neither of which are known with a sufficient degree of certainty. Of course, dumb wells constructed anywhere between the lines just referred to, and within the outer boundary of the Marlstone outcrop, could help to fill up the bed. Hence a previous suggestion of a radius of 15 miles for such wells, but it does not follow that the bed could ever be filled up to their position.

What is known about the inclination of the Marlstone I will now give, more for future reference than present use.

The Marlstone at Northampton is 75ft. above sea-level, at Daventry 490ft., a fall of 415ft. in $11\frac{3}{4}$ miles = $35\frac{1}{3}$ft. per mile, nearly.

At Naseby, about 11 miles from Daventry on the line of strike, the Marlstone is said to be 500ft. above sea-level, a fall of 425ft, in 12 miles = $35\frac{1}{2}$ft. per mile, nearly.

The true dip deduced by taking a line at right angles to that joining Daventry and Naseby and passing through Northampton, gives 40ft. per mile.

These are satisfactory and consistent enough if taken by themselves, but do not agree with the inclination deduced in another direction in another way. It has been remarked and explained in Part I. that where streams run over clay beds, the beds have the same dip or inclination as the valleys in which they are exposed, it thus seemed probable that we might ascertain the dip of the Middle Lias by the fall of the river.

The average fall of the Nen between Northampton and Wansford is 38·7 inches per mile. The actual fall of the Nen from Northampton to Wellingborough is about 45ft., and the straight distance almost exactly 10 miles, so that probably the river in winding about increases the distance by 4 miles ($14 \times 38{\cdot}7$in. $= 541{\cdot}2$in. $= 45{\cdot}1$ft.). Now I happen to know that the same zone of the Upper Lias is met with nearly on a level with the river at Northampton, Wellingborough, and Higham Ferrers, and, therefore, we should expect to find the Middle Lias at somewhat the same depth from the surface at these places. After making due allowance for these places being a less distance from the line of strike than they are actually from Northampton, that is making them 6 miles and 8 miles respectively from that line, we only get 7½ft. dip per mile, as compared with 40ft. arrived at in another way.

(To be continued.)

Review.

Report of the Rugby School Natural History Society for 1886. 8vo., 69pp., illustrated. A. J. Lawrence, Market Place, Rugby.

This twentieth annual report of the excellent Natural History Society established in connection with the famous school at Rugby certainly does not yield in interest to any of its predecessors.

The report of the work done during the year includes a description of the development of a vivarium, in which quite a large collection of birds and small animals are maintained. The Archæological Section has been revived, and the museum has been enriched by the geological collection and library of the late J. K. Worthington.

The "local lists" have frequently been a valuable feature in the report, and we find here a list of birds noticed near Rugby, by J. E. Kelsall; while Mr. Wait gives a list of many plants which have been found in the neighbourhood since the publication of the local flora in the report for 1875.

Among the papers printed we note a very interesting and well-illustrated account of the "Dispersion of Seeds and Spores," by the Rev. H. Friend, F.L.S.; Mr. Seabroke (who still continues to work in the admirable "Temple" Observatory attached to the school) shows how the "Motion of Stars in the Line of Sight" is measured with the spectroscope; and there are also descriptions of a "Visit to Wicken Fen," the "Natural History of Northumberland," &c. The reports of the sections show that good work has been done in Archæology, Meteorology, Botany, Zoology, and Entomology.—W. J. H.

Check List of British Mosses, from Dr. Braithwaite's "British Moss Flora," Vol. I., price 3d., postage extra. This is a list of all the species and varieties enumerated and described in Vol. I. of the "British Moss Flora," and being printed on one side of the paper only will serve either as a check list, a note book, or as labels for the herbarium. It may be had, with or without paper covers, of the author, 303, Clapham Road, S.W.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—The Session of this Society was inaugurated on Tuesday, October 4th, by a most successful Conversazione, held in the Examination Hall of the Mason College. The attendance numbered nearly 200, including no less than eight past-presidents of the Society, viz., Messrs. W. R. Hughes, F.L.S. (1864-6 and 1873), W. P. Marshall, M.I.C.E. (1869), G. Deane, D.Sc., F.G.S. (1874), Lawson Tait, F.R.C.S. (1876), Edmund Tonks, B.C.L. (1877-8), J. Levick, F.R.M.S. (1882), T. H. Waller, B.A., B.Sc. (1883-4), and R. W. Chase (1885-6). Amongst those present were Professors Tilden, F.R.S. (President of the Birmingham Philosophical Society), Allen, Lapworth, and Hillhouse; Dr. Anthony, Mr. Horace Pearce, F.G.S. (President of the Dudley Geological Society), Mr. J. B. Stone (Mayor of Sutton Coldfield), Mr. E. de Hamel (Tamworth), Mr. Councillor Barclay, and many others. There was a very fine collection of exhibits:—A large number of zoological specimens, from the Museum of the Mason College, shown by Professor Bridge; a very beautiful exhibit of British Birds, mainly albinos and downy birds, from the private collection of Mr. R. W. Chase; an extensive series of negatives of photographs of Alpine scenery, by Mr. C. Pumphrey, and of flowers, &c., by Mr. C. J. Watson, who also exhibited a number of "nature-printed" British ferns; a collection of minerals and fossils from the College Museum, by Professor Lapworth, including rare and valuable specimens; a complete collection of the sedges of Warwickshire, by Mr. J. E. Bagnall, A.L.S.; a gigantic puff-ball (*Lycoperdon giganteum*), and a considerable number of vegetable monstrosities, by Professor Hillhouse; many fungi, including numerous edible species, by Mr. W. B. Grove, B.A.; the spectrum of chlorophyll and blood, by Mr. E. F. J. Love, M.A.; living mosses, &c., by Mr. S. Walliker; Miss Taunton, photographs and specimens, mainly from Sicily; and a long list of microscopic specimens, by various exhibitors, including specimens illustrating the Hessian fly, by Mr. W. P. Marshall. The rooms were tastefully decorated with plants, lent by Mr. W. Spinks (of Messrs. Hans Niemand and Co.). In the course of the evening, the President (Professor Hillhouse, M.A., F.L.S.), gave a brief address, congratulating the members and associates on such an auspicious commencement of what he hoped would be a most successful Session, and commenting on the presence of so many former presidents of the Society. He had hoped that an address on the relations between Natural History Societies and the scientific work of Colleges and Universities (in that building so appropriate a subject) would have been delivered by Professor Bayley-Balfour, F.R.S., of Oxford, but, unhappily, pressure of work had caused an illness, which rendered it impossible for him to undertake the task at present. From a letter which Professor Balfour had sent him, Professor Hillhouse read a long extract, drawing attention to the strong necessity which exists in the present stage of biological teaching in England for systematic attempts to cultivate a love of nature in the earlier portion of the student's life, so as "to make that blend between field naturalists and laboratory workers which is so important at the present critical juncture." BIOLOGICAL SECTION.—October 11th, Mr. R. W. Chase in the chair. A paper was read by Mr. W. P. Marshall, on "The Dredging

Excursion to Puffin Island at the recent Manchester Meeting of the British Association." This excursion was taken by a party of about fifty members, on the 3rd of September, by a special steamer from Liverpool to Puffin Island, at the entrance of the Menai Straits, forty-five miles distance. The party was under the leadership of Professor Herdman, of Liverpool University College, and was well supplied with several dredges and tow-nets, and a trawl-net. Numerous interesting specimens were taken, including some rare in the district. The new station was visited that has been established this year on Puffin Island by the Liverpool Marine Biological Committee, containing a zoological laboratory, at which naturalists are afforded facilities for carrying out original research and investigations into the life history of marine animals, with the advantage of the continued supply of fresh specimens from a surrounding region containing a rich and varied marine fauna. An improved tow-net was described in the paper, that had been tried in the previous year's dredging excursion at Tenby, by the Birmingham Society, and some modifications were suggested from the further experience of its use.—GEOLOGICAL SECTION.—October 18th, 1887, Mr. Thos. H. Waller, B.A., B.Sc., in the chair, twenty-one members present. On the proposition of Professor Hillhouse, seconded by Mr. Clarke, and carried by acclamation, the warmest congratulations of the Section were presented to Mr. W. P. Marshall upon his election to the office of President of the Birmingham Philosophical Society. The following gentlemen were unanimously elected members:—Mr. Alfred Hughes, Paradise Street. Re-elected:—John Anthony, M.D., F.R.C.P., F.R.M.S., 6, Greenfield Crescent, Edgbaston; Mr. H. J. Sayer, Cambridge Street; Mr. Edmund Tonks, B.C.L. (ex-president Birmingham Natural History and Microscopical Society), Packwood, Knowle. Exhibits:—Mr. R. W. Chase, Richards' Pipit, *Anthus Richardi*, near Brighton; Mr. Charles Mantell, Jun., several photographs—"Ledbury Station Yard," showing passage beds, &c. Mr. T. H. Waller read a paper on "The Micro-Chemical Methods for the Examination of Minerals." The paper was illustrated by experiments in flame coloration, and solutions of minerals placed under the microscope.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 19th, Mr. Beale exhibited specimens of Roe stone and Pisolitic limestone from the Oolite, and a similar limestone, containing fossils of Saccamminia Carteri (a foraminifer), from the Bunter drift; also a specimen of the same rock from the Elf Hills, Northumberland; Mr. J. W. Neville, large variety of mussel from the Pacific; Mr. W. H. Bath, specimens of *Dorites apollo* and *D. delius* from Switzerland; Mr. Hawkes, a collection of fungi, including specimens of *Polyporus rufescens*, *P. betulinus*, *Coprinus comatus*, &c. Under the microscope, Mr. Hawkes showed a slide of five species of Mildew; Mr. J. W. Neville, section of *Favosites Forbesii*, a fossil coral. —September 26th, Mr. H. Hawkes showed a collection of fungi, including specimens of *Agaricus phalloides*, *A. butyraceus*, *Boletus badius*, *Paxillus involutus*, *Lactarius quietus*, and *Dædalea quercina*; Mr. P. T. Deakin, specimens of *Sphærium ovale*. Mr. C. Beale then read a paper on "Anecdotes of Animals from Personal Observations." The writer observed that few pleasures were so great as those of noting the winning ways of our non-human friends. The anecdotes were numerous, and bore upon the sagacity of the horse, the intelligence and loving nature of the dog, the affection and love of home of the cat, and the many good qualities of other beasts and birds educated by, or brought into contact with, man. The paper concluded by recommending kindness to all dumb creatures, as they were a sacred trust, and should be cared for as such.—October 3rd, Mr. Corbet exhibited a collection of fossil coal plants in shale from Darlaston; Mr. J. W. Neville, chirping file and drum of cricket.—October 10th, Mr. H. Hawkes showed specimens of the following fungi:—*Agaricus elatus*, *Panus conchatus*, *Nectria cinnabarina*, and *Tubercularia vulgaris*, the two last being a common instance of dimorphism; Mr. J. Madison, a curious shell of *Limnæa stagnalis*, which had two distinct lips. Under the microscope, Mr. Collins showed *Vaucheria hamata;* Mr. Mulliss, moss fruits; Mr. Hawkes, a large series of slides of microscopic fungi.

CARADOC FIELD CLUB.—The concluding meeting of the season—specially devoted to the study of Cryptogamic botany—was held at Pulverbatch on Friday, September 23rd. The party drove first to Pontesbury, and then proceeded on foot through the woods to Westcott, and thence over Cothercot Hill to Castle Pulverbatch. Here a halt was made at the Mound, where stood the fortress which was probably founded by Roger Venator, one of the followers of the Conqueror. On the drive homewards, the party paid a visit to Lower Moat Farm, which still contains some ancient portions, and stands on the site of a manor house of the Stapletons, who claimed descent from Roger Venator, lord of Pulverbatch. They also stayed for awhile at Stapleton Village to examine its very interesting church, the peculiarity of which is that it is really made up of two churches, the one built over the other, and originally forming a second storey. In the evening the Annual Dinner of the Club was held at the "George" Hotel, Shrewsbury, the President, Rev. J. D. La Touche, occupying the chair. After dinner, the President delivered his Annual Address on the work of the Club, and the following papers were also read:—"The Hessian Fly," by Rev. W. Houghton, M.A., F.L.S.; "Chlorophyll," by Mr. T. P. Blunt, M.A.; and "Methods of reproduction in Fungi," by Mr. W. Phillips, F.L.S.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—This Society held their last Field Meeting for this season on Saturday afternoon, October 8th, at Moseley, for the purpose of examining the fine exposure of glacial gravel and sand in the cutting of the Midland Railway. Mr. A. J. Evans, who has devoted a vast amount of labour to breaking up these pebbles in search of the fossils they contain, and whose fine collection formed so interesting a feature in the Geological Department of the Birmingham Exhibition last year, kindly undertook the guidance of the party, and exhibited a number of specimens of *Orthis Budleighensis*, worm-burrows, &c. from the quartzite pebbles, *Pentamerus*, &c. from the Caradoc sandstone, and crinoid stems, &c. from the mountain limestone, and explained the character of the pebbles most likely to contain fossils. A few fossils were found, and the party were much interested in examining the lithological character of the stones, which is so varied, and unfamiliar to this district, *in situ*. Mr. Horace Pearce, F.G.S. (the President of the Society), expressed the thanks of the members to Mr. Evans for his kind assistance and valuable information.

THOMAS BOLTON, F.R.M.S.

It is with deep and unfeigned regret that we record the death of probably by far the most widely known of all our local naturalists, Thomas Bolton, who, after a short and, to most people, unknown illness, passed quietly away to his rest on Monday, November 7th, at the comparatively early age of fifty-seven. About a couple of months before, he had, for the good of his health which was suffering somewhat from an inactive liver, gone for a holiday to Bournemouth, from which place he returned with, however, but little relief. Shortly after his return, complications, arising probably in the main from a weakened heart, set in, and with comparative rapidity brought about the end.

Thomas Bolton had seen more troubles than most men. Born to good estate, he saw himself reduced to accepting, with thankfulness, the meagre pittance that the Birmingham Natural History and Microscopical Society could spare to him as its curator. And yet nothing appeared to disturb the natural happiness of his disposition, and probably few in the many hundreds or thousands of those who encountered him in the course of recent years dreamt that in him they saw a ruined ironmaster.*

Yet so it was. His father, likewise named Thomas, was partner in the firm of Messrs. Lee and Bolton, of Kinver, Staffordshire, at whose works at the Hyde were employed upwards of three hundred men. The chimney stacks of the works can still be seen down in the valley just beyond the point on the road from Stourbridge to Kinver where you pass Stourton Castle, the birthplace of Cardinal Pole; but, like many another former hive of industry, they lie idle and silent, and the busy hands who worked there have nearly all gone, God alone knows where. At Kinver, Thomas was born, the eldest son of his father and inheritor of his name, in the year 1831. He was educated in the first instance at Kinver Grammar School, and subsequently at King's College, London, then, more than now, a famous place for educating the children of the Staffordshire coal and iron masters, especially such as, like Bolton, were destined to become engineers.

* We are asked to mention, in the interest of the late Mr. Bolton's family, that he has by his will given all his scientific instruments, books, and apparatus to his son, Mr. Thomas Bolton, Junr., who was carefully trained as a microscopist by his father, and who will continue to carry on in Birmingham the business carried on for many years by his late father of supplying living objects for the microscope.—Eds. "M. N."

At King's College Bolton studied with marked success, especially in mathematics and natural philosophy. In 1848, he obtained a Junior Scholarship, and in 1849 was awarded an Associateship in Natural Philosophy. In 1851 he passed the Matriculation Examination of the University of London, being placed fifth in honours in mathematics and natural philosophy. But from this training ground he was suddenly withdrawn by the death of his father, in October, 1851 (likewise at the early age of fifty-five), compelling him to undertake the management of the works, and at about the same time another member of the Lee family, distantly related to Mr. Bolton, likewise entered the firm, namely, Mr. Yate Lee. From this time Mr. Bolton took a most active part in the whole educational and public life of Kinver, then a flourishing little town of some 4,000 inhabitants, and his efforts to promote the moral and intellectual well-being of the people were most untiring and unselfish. He was governor of the local grammar school, an honour which indeed he enjoyed up to the time of his death. He devoted weekly many hours of his evenings, which most other men would have spent in relaxation, to, on the one hand, prosecuting his own studies into microscopic life, and, on the other, to the endeavour to spread amongst the inhabitants of his own neighbourhood a desire for scientific knowledge, long before the value of such knowledge was so generally recognised by the public as it now is. It may be specially mentioned that he organised the first science classes ever held in his own district in connection with the Science and Art Department. When the Education Act first brought School Boards into existence, he shared in the labours of the first Board in putting the Act into operation at Kinver. He took an active part in the institution and management of evening classes, and in the work of the Young Men's Mutual Improvement Society. His devotion to the study of science brought him early in its formation into the ranks of the Birmingham Natural History and Microscopical Society, of which he became a member nearly five-and-twenty years ago, and likewise brought him into connection with the Dudley and Midland Geological Society, of which he was for several years one of the secretaries; and his scientific pursuits, thus cultivated, soon widely extended his acquaintance with men of similar tastes. Nor was it in these directions only that his interest in the popular good manifested itself. During his whole residence in Kinver, Mr. Bolton was an active man in church and parish matters generally, and filled the position of churchwarden for many years. While he held this office he devoted a good deal of time and attention to putting the charities of the neighbourhood upon a better footing, and was instrumental, with others, in securing the restoration of some of the bequests.

Side by side with all this outlying work, however, the state of their own business was a source of much anxiety. The formation of railways, so advantageous to the Midlands generally, was fatal to the trade of Kinver. Lying as they do right off the route of the iron roads, the Hyde ironworks were dependent upon water carriage alike for the coal and iron needed for their trade purposes, and also for the removal of the manufactured produce—bars, wire-rods, and the like. It can hardly be doubted, too, that Mr. Bolton had not a commercial soul, and it is not at all probable that his partner, with the training and instincts of a lawyer, was more fitted than he for the successful pilotage of a great commercial concern through the anxious years of the later sixties. In 1868 the crash came. For some years, it is true, Mr. Bolton continued at the works as manager for one of the chief creditors, who had purchased them, but at length even that despairing effort ceased, and the works were entirely closed. The whole of his private property gone, Bolton had to begin the world afresh at an age when many men are thinking of retiring, and with a young family dependant upon his exertions. He then removed to Birmingham.

It is from this event, however, that the widespread knowledge of Mr. Bolton's name and abilities is dated, for he spent his time and earned his living by searching out and providing materials for the investigations of other naturalists, turning to good account the experience gained during his quarter of a century of study at Kinver, sending living materials to all parts of the three kingdoms, while at the same time continuing his own investigations into the microscopic fauna of the Midlands. Thus, many of the specimens described in Saville Kent's "Manual of the Infusoria" were supplied by Mr. Bolton; and the same may be said of the rotifers in the classic work of Messrs. Hudson and Gosse; and several of these minute organisms have been named in honour of him. In our own columns this year (p. 124) are described four new species found by him and supplied to Mr. Gosse. In 1884 the Council of the Royal Society placed £50 at the disposal of Professor Ray Lankester for the purpose of employing Mr. Bolton to collect material for an investigation of the freshwater fauna of the Midland Counties; and at the Fisheries Exhibition a gold medal was awarded to him for an exhibit illustrating minute life relating to the food of fishes. In the same year (1884), on the death of Mr. W. H. Cox, assistant curator to the Birmingham Natural History and Microscopical Society, Mr. Bolton was appointed his successor, a step from which it cannot be doubted that the Society richly profited, as, in his daily attendance at the Society's rooms in the Mason College, he ever placed his knowledge freely at the disposal of all enquirers, and by which, therefore, his loss will be all the more keenly felt.

In bringing together the collection of exhibits in various departments of local natural history which formed such a remarkable feature of the Bingley Hall Exhibition, initiated for the purposes of the visit of the British Association to Birmingham in 1886, a permanent skilled superintendent was found to be necessary, and, without hesitation, the post was offered to Mr. Bolton, the Natural History and Microscopical Society gladly relinquishing its claims upon his time during the ten weeks that the exhibition was open. In this way Mr. Bolton's person became familiar to tens of thousands of visitors, while his own persistent attempts to interest the people in minute life by means of living microscopic exhibits added in no small degree to the interest and success of that unique exhibition. Advantage was taken, too, of the visit of the Association to bring to a successful issue an attempt, initiated by Mr. W. R. Hughes, F.L.S., the first president of the Birmingham Natural History Society, and Mr. T. Grosvenor Lee (son of Mr. Bolton's former partner, Mr. Yate Lee) to obtain from Government some recognition of Mr. Bolton's labours in the cause of science, and a memorial, signed by Sir W. J. Dawson, President of the Association, and by every biologist of repute who attended the meeting, secured from Lord Salisbury a pension of £50 a year upon the Civil List, dating as from June 30th of that year.* This

* It may be of interest to give a list of the signatures to this memorial, as a permanent record of the widespread estimation in which Mr. Bolton's labours were held:—

Sir J. W. Dawson, President British Association.
Thomas Martineau, Mayor of Birmingham.
Professor Michael Foster, Cambridge, Secretary Royal Society.
Professor H. N. Moseley, F.R.S., Oxford.
W. Carruthers, F.R.S., P.L.S., President Section D (Biology).
P. L. Sclater, F.R.S., Vice-President Section D.
Professor Milnes Marshall, F.R.S., Owens College, Manchester.
Professor G. B. Howes, Royal School of Mines.
Professor D'Arcy W. Thompson, University College, Dundee.
Professor W. Stirling, F.R.S., Owens College, Manchester.
Professor Marcus Hartog, D.Sc., Queen's College, Cork.
Professor Alfred H. Young, F.R.S., Owens College, Manchester.
Dr. Patrick Geddes, Lecturer on Zoology, Edinburgh.
W. Percy Sladen, Zoological Secretary, Linnean Society.

pension Mr. Bolton has unhappily not lived long to enjoy, but none the less is it a source of gratification to his innumerable personal and scientific friends that this highest honour that the English Government can pay to deserving merit was paid to him.

The funeral at Kinver, on November 11th, was the nearest approach to private that the circumstances of the case would admit, being attended, besides the immediate family and relations of the deceased, only by Mr. T. Grosvenor Lee, whose close historical relations with the family is sufficiently indicated above, and by the writer of this sketch, as representing Mr. Bolton's scientific friends, and especially the Society whose curator at the time of his death he was. Although the relics of the old works still living at Kinver are few, a small number of them, grey or white with years, spontaneously gathered together and acted as pall bearers to the remains of their former master and master's son. The day was emblematic of the fallen fortunes of Kinver; but the cold grey clinging mist, while it shut out the beauties of the scene as viewed from the grandly-placed churchyard, served but to concentrate thought and attention upon the hero of science, whose last years, spent amidst the gloom of financial difficulty, were yet brightened by a courage which naught could damp, and a Nature love which keepeth all things young.

W. Hillhouse.

Dr. J. R. Macfarlane, Lecturer on Botany, Edinburgh.
Henry B. Brady, F.R.S.
Professor F. O. Bower, M.A., Glasgow.
Professor Alfred C. Haddon, M.A., Royal College of Science, Dublin.
Professor W. Hillhouse, M.A., Mason College, Birmingham.
Professor T. W. Bridge, M.A., Mason College, Birmingham.
Henry Trimen, M.B., Peredenya, Ceylon.
Professor Alfred Newton, F.R.S., Cambridge.
Professor Alex. Macalister, F.R.S., Cambridge.
Professor Isaac Bayley Balfour, F.R.S., Oxford.
Professor E. Ray Lankester, F.R.S., University College, London.
Professor Sir James Sawyer, M.D., Queen's College, Birmingham.
J. B. Stone, J.P., F.G.S., F.R.G.S., Mayor of Sutton Coldfield.
Sir John Lubbock, M.P., F.R.S.
Professor G. J. Allman, F.R.S., Edinburgh.
Dr. W. H. Dallinger, F.R.S., Pres. R.M.S.
Professor B. C. A. Windle, M.D., Queen's College, Birmingham.
Professor J. B. Haycraft, M.B., Mason College, Birmingham.
Professor W. A. Tilden, F.R.S., Mason College, Birmingham.
R. W. Chase, President Birmingham Natural History and Microscopical Society.
Thomas Grosvenor Lee, B.A., Birmingham.
W. R. Hughes, F.L.S., Borough Treasurer, Birmingham.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 293.)

I might give numerous instances to show that the inclination of valleys, or the streams running through them, is not greatly different from the dip of the beds in the same direction, where the streams run over clay, though in some cases the dip of the beds may be a little the greater and in others the less. The stream rising near to West Haddon runs over the "unfossiliferous" beds of the Upper Lias near to Ravensthorpe and Holdenby respectively, but over the lower portion of the "Leda ovum" beds at Northampton, the distance being about seven miles. Again, one of the streams running by Kettering, and afterwards joining the Ise, runs over the "Leda ovum" beds at both Kettering and Wellingborough, although they are of a little lower zone at Wellingborough than at Kettering, distance about seven miles.

The fall of the Nen, from its source near Staverton to Northampton, would give an average incline differing only a little from that previously deduced for the Marlstone by taking the height of it at Daventry and Northampton respectively, for the river flows from the Marlstone, and rapidly cuts down to the Lower Lias clay,* and runs over that to within about three miles of Northampton, and then over its own alluvium, though originally it ran over Middle Lias again; that is, it formerly flowed over nearly the same beds at two places over thirteen miles apart.

Putting together the facts just enumerated, viz.:—(1) That streams running over clay beds, in Northamptonshire, do not materially cut into them, but run over their dip plains; (2) that the two branches of the Nen meeting at Northampton, actually run over higher beds there than they do over most of their course, and (3) that the dip of the beds, deduced from such information as is available, westward of Northampton differs considerably from that deduced from equally reliable data eastward of the town, it appears evident that the dip of the beds is considerably reduced as we approach Northampton from the west, on both sides of the Nen "fault," though more on the south side than the north. I would suggest that the position where this change begins is approximately indicated by the commencement of the river alluvium, that is

* This may at first be bed "M" of Middle Lias. (See Typical Section.)

to say, near Kingsthorpe on the north and Kislingbury on the west. By joining these two places where the alluvium is marked as commencing, we get a line deviating not very much from the strike of the beds, such deviation as there is being well explained by the preceding remarks. This theory is rendered the more probable by the fact that in one of the directions the alluvium commences only a trifling distance eastward of the point where Middle Lias reappears, as shown on the geological maps. This is also the position previously pointed out for the change in character of the Nen "fault," hence it affords additional evidence of the continuity of the older-known "fault" with the one more recently discovered. I may say here that no evidence of this "fault" has been discovered eastward of Northampton, and as the Nen makes a decided curve to the north-east soon after passing the town, it is unlikely that the two coincide further.

My readers will now naturally expect that I shall claim a less average dip for the Marlstone near Northampton than 40ft. per mile; this I propose to do, as it is in accordance with the evidence so far obtainable, though I am quite indifferent to the result, so far as the water scheme is concerned, because whatever increases the area to be filled increases the time within which satisfactory results might be anticipated, and *vice versa*.

The Artesian gradient of the Marlstone is not at present known, but considering that in the highly porous New Red Sandstone it amounts to 5ft. per mile, I think it cannot be less than 7½ft. per mile* (the dip of the beds eastward of Northampton), and therefore, so far as the dumb wells are concerned, there could be a head of water of 110ft. at Northampton before they would cease to act, or occasion loss.† The head of water at the Billing Road well when first made was 90ft., or 20ft. less than this. An addition might reasonably be made to the gradient for those dumb wells situated along the Nen Valley eastward of Northampton, because they would be actually more than a mile away from the town when only a mile from the line of strike.

It has been previously stated that coincidently with a rise in the water at the Northampton well of between 40ft. and

* Probably more than this if the material of the bed only were considered, but the prevalence of fissures may make it less in some directions.

† Height of Nen and river alluvium south of Billing Road pumping station, about 185ft. above sea-level. Height of Marlstone at Billing Road well, 75ft. Difference = 110ft. Artesian gradient counteracts dip of valley.

50ft., there was a small rise at the Berry Wood Asylum well, at Duston, three and a quarter miles away (see page 253). Both wells were being used at the time my information was obtained; the exact height of the former is indefinite, and the minimum height of the latter only known to me, hence I do not wish to attach too much importance to any calculations founded on them.* Take the rest-level of the water at the Billing Road well as being 40ft. above the Marlstone, and the rest-level at Duston as 9ft. above the same bed, and the Artesian gradient as $7\frac{1}{2}$ft. per mile, then the 40ft. of water at Northampton would sustain 40ft.$+3\frac{1}{4}\times7\frac{1}{2}$ft.$=64\frac{3}{8}$ft. at Duston, subtract the 9ft. of water there and we get about 55ft. as the increased height of the Rock-bed, and the dip would amount to a trifle over 17ft. per mile.

If this dip were maintained, and all other conditions remained the same as supposed, then a sector of a circle having a radius of twelve miles could be filled before the water would stand at the height of 110ft. at Northampton, as may be ascertained by a simple calculation. It is quite certain, however, that the dip increases as we get further away to the west or north-west, and equally certain that it is less than this northwards, so that I have based the following calculation on an area bounded by two radii at an angle of 125° with each other and an arc eight miles distant, in order to be well within the region of probability.

Area capable of being filled $=\pi r^2\times\frac{125}{360}=70$ square miles nearly.

One square mile of rock, 4ft. thick, would contain, at $\frac{2}{3}$ gallon per cubic foot, 74,342,400 gallons, and therefore the whole 70 square miles nearly 5,204 millions of gallons.

I do not say this is correct, but to show that it is reasonable, I would point out that for about forty years an average of something like 500,000 gallons per day has been pumped from the Marlstone, besides that lost by springs; this would amount to 7,300 millions of gallons, and reasoning on the assumed capacity of the Marlstone as given above, we will suppose that to get a "head" of 90ft., such as was obtained at first, 4,300 millions of gallons were already stored in the Marlstone, then 3,000 millions of gallons would have to be supplied by percolation during the period of forty years, this would amount to 75 millions of gallons per year, or 200,000 gallons per day. This the Marlstone seemed capable of yielding, but not much more, for when the Billing Road well

* Pumping was continued at Northampton for some time, after the rough estimate of 40 or 50 feet was given me, before I obtained the information about Duston well.

was supplying only about 315,000 gallons per day the amount was still declining, showing that the drain was then greater than the supply.

(To be continued.)

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S.

(Continued from page 276.)

In the following investigations I have in the main confined myself to a consideration of the "food-material" hypothesis of tannin. I have no evidence to offer as to the connection by Wigand* and Wiesner† of tannin with the colours of plants, and certain other points, too, which naturally suggest themselves, such as the relations of tannin with the vegetable acids. and the possibility that its ready oxidisability is of value to the plant, I have in no way investigated.

The question has been to me solely whether or not tannin must be looked upon as a member of the series of constructive materials, analogous to oil, sugar, and starch, a question which experimental evidence alone can answer. Deductive chemical biology can give no real assistance. The test by which it is determined that oil (in some forms), starch, and glucose, are materials out of which cellulose, &c., are formed must be here applied. If tannin be a constructive material, then, like starch and glucose, it will disappear through consumption; if it be not, it will be left behind. True, starch is in some cases not used up. I have found it in the old duramen of many trees (*e.g.*, *Cytisus Laburnum*), but here it remains, not because it is in itself useless, but because the plant forms more of it during the formative season than it has need of in the following spring.‡

* *Wigand*, l. c., Bot. Zeit., 1862.

† *Wiesner*, l. c., Bot. Zeit., 1862. Compare also Pfeffer, Pflanzenphysiologie, I., p 306; and Nägeli and Schwendener, Das Mikroskop, p. 492.

‡ When leafing takes place normally in the spring, the new leaves begin to assimilate long before the limits of the reserve materials from the previous summer are reached; there is, therefore, a progressive accumulation of starch in the stem, especially in the wood parenchyma. If, on the other hand, from any cause the leaves first unfolded are killed or injured, the unused residue of the food-material is used to enable the axis to extend, and the plant to put out new leaves. This is the probable explanation of the difficulty I have experienced in exhausting branches of trees. When local supplies are exhausted they can still draw from unused stores below.

It will be seen from the foregoing abstracts that there is a radical divergence of opinion upon this point. Sachs, and with him Schröder,* have observed no consumption of tannin in the plants investigated by them; Dulk† found by quantitative analysis an increase of tannin in the autumn emptying of the leaves of the beech. On the other hand Wigand, Schell, and Th. Hartig state explicitly that they have in many cases seen a decrease or consumption of tannin in the processes of growth. The point is one, therefore, of conflicting evidence on a matter of considerable physiological importance.

My investigations have been conducted upon the following lines:—

1. To determine whether, as Wigand says, as the period of winter rest approaches, the quantity of tannin in stems diminishes *pari-passu* with the increase in the quantity of starch, so that the quantity of tannin is in winter at its minimum.

2. Whether, as Wigand further declares, in spring the quantity of tannin increases as that of starch decreases; or, as Hartig asserts, in the oak there exists a "Gerbmehl" which is dissolved and used up in spring.

3. Whether, as Schell believes, in germination and in stems in spring tannin is used up when the quantity of starch or other carbohydrate has reached a low point.

Firstly, to take the contention of Hartig.

In *Quercus pedunculata*, according to Hartig,‡ the stems contain "Gerbmehl." Nägeli§ had investigated this point, and found that Hartig's Gerbmehl is starch saturated with tannin, and, hence, taking the iron reactions. He tested it by saturating potato-starch with dilute solution of tannin, and found that the grains then gave the tannin reaction. Hartig, however, does not accept this explanation, for, as already noted, in 1878 he says that his opinion "ist von Seite anderer Physiologen einer Prüfung bis jetzt nicht unterzogen worden, und die von einer Seite erhobene Einwendung, dass das Gerbmehlkorn von flüssigen Gerbstoff durchdrungenes Stärkemehl 'sein könne,' eine durchaus willkührliche, gegenüber dem von mir geführten Nachweise, dass in den Gerbmehl

* *Schröder*, Versuchsstat., 1871, Bd. 14, p. 118.

† *Dulk*, ibid., 1875, Bd. 17, p. 192; see Pfeffer, Pflanzenphys., I., p. 305.

‡ *Hartig*. See also Anat. u. Phys. der Holzpflanzen, Taf. I.

§ *Nägeli*. See Nägeli u. Schwendener, Das Mikroskop, 2te Auflage, p. 492.

bildenden Zellen bis zum frühesten Zustande derselben aufwärts, die Körner in kaltem Wasser ohne Quellungserscheinungen leicht löslich sind, und von Eisensalzlosüngen schwarz, zugleich aber auch durch Jodlösung wie Stärke blau gefärbt werden." (l. c., p. 119).

Quercus pedunculata I have carefully examined at different periods through the late autumn, winter, and succeeding spring and summer. Throughout the winter the distribution of the tannin is as follows (*e.g.*, in a three year old stem):—In cortex, in large numbers of cells, each with a large mass of tannin (*i.e.*, diffused); bast, with small amount; bast rays, every cell filled with a granular, turbid-looking mass; wood ray cells, with abundant tannin, as have also many of the cells of the pith-crown, and fewer of the inner pith-cells.

Investigation at the same time of the contents of the stem by means of iodine reagents, and particularly by chlorzinc iodine, shows the following distribution of starch:—Cortical tissue and bast very little; bast rays none, or only a trace; wood rays quite full, commencing abruptly at the cambium layer (the starch in these cells stains at first very light reddish violet alike with iodine and with chlorzinc iodine). Wood fibres of all years in parts densely crowded, not only in the elongated wood-cells, with straight or oblique partitions, but also in many of the true libriform fibres with fusiform overlapping ends, and this especially the case in the innermost ring of wood; pith-crown cells full, as also many cells of the inner pith.

The use of chlorzinc iodine shows that in the coloration of the starch of the wood there is a large amount of red, overcoming in parts the blue; the whole contents of the soft bast show also a reddish tinge. The medullary rays I have already referred to; the starch in many of the pith-crown cells stains at first reddish with a voilet tinge, and where a grain from these is accidentally isolated it can be seen to be often of a pure magenta-red, or with a brownish tinge. In some cells often are grains which are red and others blue. In some cells all grains have a blood-red colour, in other cells all are more or less violet.

Iron salts showed in many isolated pith-crown cells, and in most of the wood-ray cells, grains, like in size and form to starch grains, but coloured of a cloudy blue tint. Sections placed in oil, after the fashion of Hartig, showed the same granules, no more and no less, and with the same reactions.

Repeated and careful examination showed that in no case did this so-called Gerbmehl of Hartig occur, except where the same cells and the same granules also responded, by a reddish coloration, to the action of iodine reagents.

The use of these and other reagents showed, therefore, that we had here granules which—

(*a*) Stain reddish, and subsequently bluish, with iodine reagents, and are therefore starch;

(*b*) Stain bluish with iron salts, black with osmic acid, form brown balls with potassium bichromate, and are therefore tannin.

In other words they show that these grains are at the same time starch and tannin.

Through preparations which were treated with an iron-salt I passed for an hour or more, under the microscope, a current of water. This removed from cut cells the light iron tannin precipitate, but left the grains still coloured, but more lightly so, with the reagent. Each grain was distinctly bluish, but in no case did any grain which was so coloured dissolve.

Next I treated sections, with which I had not used any reagents, with a stream of water. No solution of grains was observable. The use of iron salts showed that from the cut cells a considerable quantity of tannin had been removed, readily identifiable in the water, but that in no case, so far as I could tell, had any granules been dissolved, and many of the grains in the cut cells showed as before a blue coloration with ferric salts.

In order to try whether by their differing solubility it is possible to separate tannin from glucose, I had had sections of this same plant in absolute alcohol for about three weeks. The tannin I had found to be not yet nearly dissolved out. Some of these sections, and others which had lain for a few hours in water, I tested with reagents. I found in no case a diminution in the number of the granule-containing cells, but I found that in the sections from water the granules no longer showed the tannin reaction, or only very feebly, while in the alcohol preparations some showed it slightly. These latter granules were in the same preparations treated with iodine, and showed themselves to be starch.

These experiments I controlled by others when *Q. pedunculata* was coming into leaf in late spring, and by yet others in summer. The granules (starch) had disappeared, but the tannin contents of the cells were still there, but in a fluid and not in a granular state.

With arrowroot starch soaked in a solution of tannin, I have followed out all the reactions. The results practically are the same. Starch grains saturated with tannin take the tannin reaction, the strength of the reaction depending on the strength of the tannin solution in which they had lain. That this was not due to a film of tannin in the grain I showed by rapidly washing grains in alcohol, when the grain still gave the tannin reaction; and the use of iodine on similar grains showed the tendency to the same red coloration, which I have noted in starch-containing cells of *Quercus*.

Hartig's "Gerbmehl" is, therefore, starch, into the intermolecular reticulum of which the solution of tannin in which they were lying had penetrated.

Some further light may be thrown on this by the case of *Acer Pseudoplatanus*. In the cells of the pith-crown I observed (October 22nd), in several specimens, the starch grains, after the action of iron chloride, surrounded by a cloudy blue coating. In the same species, on December 20th, the phenomena presented by *Quercus pedunculata* were substantially repeated in a large number of cells in the median portion of the pith-crown, where fluid tannin was earlier, and was then, most abundant. The same phenomenon was observed, though not followed out, in *Populus angulata*. Its distinctness in *Quercus* is probably due to the large quantity of tannin present.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Chapters IX., X., and XI.

Coincidence between High Nutrition and Genesis.

Specialities of these Relations.

Interpretation and Qualification.

(Abstract.)

BY W. R. HUGHES, F.L.S.

Mr. Herbert Spencer reminds us in the opening chapter (IX.) that we have seen "that after individual growth, development, and daily consumption have been provided for, the surplus nutriment measures the rate of multiplication. This surplus may be raised in amount by such changes in the

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environment as bring a larger supply of the materials or forces on which both parental life and the lives of offspring depend. Be there, or be there not, any expenditure, a higher nutrition will make possible a greater propagation. We may expect this to hold both of agamogenesis and of gamogenesis; and we shall find that it does so."

The following illustrations, which are given mostly in Mr. Spencer's own words, will be appreciated by every naturalist.

"On multi-axial plants, the primary effect of surplus nutriment is a production of large and numerous leaf-shoots. How this asexual multiplication results from excessive nutrition is well shown when the leading axis, or a chief branch, is broken off towards its extremity. The axillary buds below the breakage quickly swell and burst into lateral shoots, which often put forth secondary shoots: two generations of organic individuals arise where there probably would have been none but for the local abundance of sap, no longer drawn off."

"No less conclusive is the evidence furnished by agamogenesis in animals." Sir John Dalyell, speaking of *Hydra tuba*, on which he had made some original observations, remarked: — "It is singular how much propagation is promoted by abundant sustenance. This polype goes on budding-out young polypes from its sides with a rapidity proportionate to the supply of materials." * * *

It is further shown that "the sexual multiplication of organisms under changed conditions, undergoes variations conforming to a parallel law. Cultivated plants and domesticated animals yield us proof of this."

Omitting for the sake of brevity the illustrations as to plants, those of animals are given, more particularly as to Birds and Mammals. In birds, "let us first contrast the farm-yard *Gallinaceæ* with their kindred of the fields and woods. Notwithstanding their greater size, which, other things equal, should be accompanied by smaller fertility, the domesticated kinds have more numerous offspring than the wild kinds. A turkey has twelve in a brood, while a pheasant has from six to ten. Twice or thrice in a season a hen rears as many chickens as a partridge rears once in a season." "Anserine birds show us parallel differences." Tame geese and ducks not only lay a larger number of eggs, and rear more young than wild ones, but the eggs are of larger size. So with pigeons. Every experienced poultry-keeper knows that to secure a good supply of eggs his fowls must be kept well fed and well housed. The same holds good as to rearing

chickens. "Equally clear proof that abundant nutriment raises the rate of multiplication, occurs among Mammals." Comparisons of the litters of the dog with those of the wolf and fox are shown to be considerably in favour of the dog. So with the wild and tame cats. So with the stoat and ferret. "Perhaps the most striking contrast is between the wild and tame varieties of the pig." While the one produces according to its age from four to ten young ones once a year, the other produces sometimes seventeen in a litter, or will bring up five litters of ten each in two years—"a rate of reproduction that is unparalelled in animals of as large a size, and it is specially noted "that this excessive fertility occurs where there is the greatest inactivity—where there is plenty to eat and nothing to do." * * *
The remainder of the chapter is devoted to meeting an objection:—"Many facts may be brought to prove that fatness is not accompanied by fertility, but by barrenness; and the inference drawn is that high feeding is unfavourable to genesis. The premiss may be admitted, while the conclusion is denied." * * *

The following chapter (X.) shows (1) that "if certain organisms are so circumstanced that highly nutritive matter is supplied to them without stint, and they have nothing to do but absorb it, we may infer that their powers of propagation will be enormous. If there are classes of creatures that expend very little for self-support in comparison with allied creatures, a relatively extreme prolificness may be expected of them. (2) Or if, again, we find species presenting the peculiarity that, while some of their individuals have much to do and little to eat, others of their individuals have much to eat and little to do, we may look for great fertility in these last, and comparative infertility, or barrenness, in the first." The numerous illustrations which follow amply verify these anticipations. A few only are selected:—(1) Parasitic plants like the *Rafflesiaceæ*, which live on the juices they absorb from other plants, have their organs for self-support only rudimentary because needless, but the organs devoted to reproduction, and distribution of germs, constitute the mass. *Fungi*, which grow on living plants, have the spore-producing parts relatively enormous. Parasitic animals, both in the *Epizoa* and *Entozoa*, afford similar illustrations, especially so in the nematoid *Entozoa*, where the mature female of *Ascaris lumbricoides*, living in the body of its host, and surrounded by nutriment, contains, according to Eschricht, as many as 64,000,000 ova, and even this remarkable number is exceeded among the cestoid *Entozoa*. The phenomena of pseudoparthenogenesis and metagenesis in insects, as occurring in the *Aphides*, are similarly accounted for by the fact "that they get plenty of easily assimilated food without exertion." (2) The remaining portion of the chapter answers the anticipation set forth at the beginning, and *inter alia* points out that "the physiological lesson taught us by bees and ants, not quite harmonising with the moral lesson they are supposed to teach, is that highly-fed idleness is favourable to fertility, and that excessive industry has barrenness for its concomitant." Illustrations will be familiar to most of us. * * *

The last chapter of this series (XI.) commences with the inference that, "considering the difficulties of inductive verification, we have (thinks Mr. Spencer) as clear a correspondence between the *à priori* and *à posteriori* conclusions as can be expected." It is pointed out that "the many factors co-operating to the result in every case, are so variable in their absolute and relative amounts, that we can rarely disentangle the effect of each one; and have usually to be content with qualified inferences." Though in the mass, organisms show a relation between great size and small fertility, yet special comparisons among them are to an extent vitiated by differences of structure, nutrition, and expenditure. But, says Mr. Spencer, "the broad fact is that organisms in which the integration and differentiation of matter and motion have been carried furthest are those in which the rate of multiplication has fallen lowest." * * * "How is the ratio between Individuation and Genesis established in each case?" Many detailed illustrations follow, showing that "all specialities of the reproductive process are due to the natural selection of favourable variations, and obviously, too, that a survival of the fittest has a share in determining the proportion between the amount of matter that goes to Individuation and the amount that goes to Genesis." * * * A qualification has to be made. It is pointed out that "each increment of evolution entails a decrement of reproduction that is not accurately proportionate, but somewhat less than proportionate." It must always be borne in mind that "each advance in evolution implies an economy." * * * Most interesting illustrations are traced as giving a solution of various minor anomalies "by which the inverse variation of Individuation and Genesis is obscured." A comparison between the blackbird and linnet, both of which usually lay five eggs and have two broods in a year. Yet the blackbird is far the larger of the two, and ought, according to the general law, to be much less prolific. Why is it not? The blackbird is omnivorous—the linnet graminivorous.

The feeble linnet is continually flying about to pick up his spare vegetal diet, thus involving much expenditure. The superior strength and intelligence of the blackbird enables it to procure a better and more varied diet—grain, fruit, worms, snails, beetles, larvæ. "The result is that the blackbird is ready to breed very early in spring, and is able during the summer to rear a second, and sometimes even a third brood." A comparison illustrating the same principle is instituted between the rat and the mouse. Both are equally prolific. although they differ greatly in size. But the rat, by its greater power, intelligence and cunning, is enabled to get a far larger and varied supply of nourishment than the mouse, which is mainly a vegetal feeder, without involving extra expenditure; "and this relative excess of nourishment makes possible a large size without a smaller rate of multiplication." The same principle is further evidenced by the contrast between the common rat and the water-rat. The common rat has several broods of as many as twelve each in a year, while the water-rat, a vegetal feeder, though somewhat smaller, has no more than six in a brood, and only one or two broods in a year. The difference between them, as in previous cases, is therefore mainly owing to the character of their food.

It is thus demonstrated that the inverse "variation of Individuation and Genesis is, therefore, but approximate," and the general law is seen that "Genesis decreases not quite so fast as Individuation increases."

Before approaching the final chapters in this grand work, on the "Multiplication of the human race," and on "Human population in the future," which are of the most vital importance and interest, Mr. Spencer sums up the preceding evidence in these words:—"Hence every type that is best adapted to its conditions, which on the average means every higher type, has a rate of multiplication that insures a tendency to predominate. Survival of the fittest, acting alone, is ever replacing inferior species by superior species. But beyond the longer survival, and therefore greater chance of leaving offspring, which superiority gives, we see here another way in which the spread of the superior is insured. Though the more-evolved organism is the less fertile absolutely, it is the more fertile relatively."

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—SOCIOLOGICAL SECTION. Tuesday, October 25th. At this the first meeting of the section for the session, the President, Mr. W. R. Hughes, F.L.S., delivered a brief address on "The Progress of the

Doctrine of Evolution," as evidenced by the literature that had appeared on the subject since the corresponding meeting last year. He said it was most gratifying to report that the name and influence of Mr. Herbert Spencer had penetrated into popular channels (some of them) the least anticipated. For instance, sketches of his system of philosophy (with portraits) had recently appeared in "Great Thoughts," and in the "Illustrated London News." There was also a reference to him in the Christmas Number of "Truth" for 1886, and a most appreciatory notice in the article, "Our Noble Selves," in the "Fortnightly Review" of February last. In the "Record of Ellen Watson" (3rd Ed., Macmillan and Co., 1886), that accomplished lady who died prematurely at the Cape, an extract of a letter to a friend (speaking of Mr. Spencer's "Education") states: "The great pleasure one has in reading anything of Spencer's springs from the breadth of the view he opens out before you. He lays the universe under continual contribution, and in discussing the least significant point keeps you awake to its connection with the whole of life." In "A Look Round Literature," by Robert Buchanan (Ward and Downey, 1887), this distinguished poet, novelist, and dramatist, says: "His (Mr. Spencer's) width of view, his catholicity of sympathy, his fearlessness in investigation, his faculty of crystalline exposition, seem to me almost superhuman." And again: "He closes no one gate of the universe, but leaves all wide open while we stand awe-stricken at the dazzling vistas which open out beyond them all." A most valuable and sympathetic exposition of Mr. Spencer's "Theory of Religion and Morality" had been written by Mr. Sylvan Drey, of Baltimore, and published by Messrs. Williams and Norgate (1887), as an essay, which should be in the hands of all Spencerians. In the magnificent work published by Messrs. Smith, Elder, and Co. (1887), in two volumes, entitled "The Reign of Queen Victoria: a Record of Fifty Years of Progress," and which contained contributions by some of the most eminent men of the day in literature, science, and art, the article on "Science" being by Professor Huxley, and "Literature" by Dr. Richard Garnett, of the British Museum, the latter states that "His (Mr. Spencer's) 'First Principles' (1862), the first number of a philosophical series, designed to be all-embracing, is the most characteristic bequest of the Victorian age to posterity;" and again: "In ethics, as in psychology and sociology, Mr. Spencer is our only great systematic writer." Finally, Mr. Hughes alluded to the remarkable sermon preached at St. Margaret's Church, Westminster, by the Bishop of Ripon, in May last, before the House of Commons, on the occasion of Her Majesty's Jubilee, in which he ranked "The Doctrine of Evolution," as formulated by Mr. Spencer, equal in point of importance to Newton's Law of Motion. Mr. Hughes said there were two local subjects that called for special notice--the departure of Miss Naden from Birmingham, and the publication of a most meritorious poem by the first Honorary Secretary of the Section, Mr. Alfred Hayes, B.A. With regard to the former, the loss which the Section and the Society had sustained was irreparable. Miss Naden's admirable scientific training added to her rare gifts as a poetess had enabled her to thoroughly grasp and appreciate the Synthetic Philosophy. The two addresses delivered by that lady before the Section, dealing with very intricate questions arising out of the Doctrine of Evolution, were monuments of her genius. Her recent beautiful volume of poems, "A Modern Apostle, &c." (Kegan, Paul, and Co., 1887), was thoroughly in harmony with that great doctrine. Birmingham had sustained a severe loss by her removal, and we could only wish her success and happiness in her future career. It was most satisfactory to note in connection with the publication of Mr. Hayes' beautiful volume, "The Last Crusade"

(Cornish Bros., 1887), that he had caught the spirit of the master. The following powerful lines from the poem indicated a thorough sympathy with the Doctrine of Evolution:

"Yet take heart;
"For the eternal power who sowed the seed
"Of all things, hath ordained that hate shall tire,
"And love grow ever stronger."

It was gratifying to record that efforts were being made, as had been previously announced to the Section, to establish societies for the study of Mr. Spencer's system of philosophy, both in Derby and Paris. We wished Mr. L. Archbutt, in the former, and Mons. James Grosclande, C.E., in the latter city, every success. The only cloud that at present hung over his admirers was the sad state of Mr. Spencer's health, which prevented him from pursuing the object of his life —the completion of the synthetic philosophy. All his friends would cordially concur with the members of the section in sincerely wishing him improved health and strength. His was a most precious life, and one that we all earnestly hoped might be prolonged.— Thursday, November 3rd. Tea was served in the Society's room at 5 30, and at the meeting afterwards, the chair being taken by the President, Mr. W. R. Hughes, F.L.S., the first part of a paper on Mr. Herbert Spencer's essay on the Classification of the Sciences, was read by Mr. F. J. Cullis. After showing the impossibility of arranging the sciences in one lineal series, an explanation was given of Mr. Spencer's primary grouping of the sciences under the three denominations of "Abstract Sciences," "Abstract Concrete Sciences." and "Concrete Sciences." The "Abstract Sciences," Mathematics and Logic, were seen to deal with relations; the "Abstract Concrete Sciences," Mechanics, Physics, and Chemistry, with properties, and the "Concrete Sciences," Astronomy, Geology, Biology, Psychology and Sociology, with aggregates. Leaving the "Abstract Sciences" as farthest removed from the special work of the Section, it was seen that a fundamental difference again appears in the fact that the "Abstract Concrete Sciences" are essentially analytical; while the "Concrete Sciences" are mainly synthetical. It was further argued that this great group of sciences thus distinctly differentiated—both by their object, the study of phenomena in their totalities, and also by their method of comparison, classification, and synthesis—is most fitly denominated Natural History; and thus these "Concrete Sciences" both constitute and limit the special sphere for the work of a Natural History Society.—BIOLOGICAL SECTION. Meeting, November 8.—Mr. R. W. Chase in the chair. On the motion of Prof. Hillhouse, President of the Society, seconded by Mr. R. W. Chase, President of the Section, the meeting of the Section was adjourned, with a resolution expressive of the great loss the Society, the Biological Section in particular, had sustained in the death, on the previous day, of Mr. Thomas Bolton, F.R.M.S., curator of the Society, and conveying the earnest sympathy of the meeting to his widow and family.—GEOLOGICAL SECTION. Meeting, November 15.—Mr. W. P. Marshall, M.I.C.E., took the chair in the unavoidable absence of Mr. Waller. A paper by Mr. William Pumphrey on "The recent Disaster at Lake Zug," was read by his brother, Mr. Chas. Pumphrey. The paper was illustrated by a photograph and ground plan. Exhibits:—Mr. W. H. Wilkinson, (1) Dried flowers showing the colours (eight or nine colours, including blue) successfully preserved; (2) Double autumn crocus, *Colchicum autumnale*. Mr. W. B. Grove, (1) *Agaricus phalloides* from Coleshill Pool; (2) *Polyporus radiatus* on alder from Sutton.—SOCIOLOGICAL SECTION. Thursday, November 17th.—Mr. W. R. Hughes, F.L.S., in the chair. After tea, which was served at 5 30, the concluding portion of the paper on Mr. Spencer's essay on the Classification of the Sciences, was read by Mr. F. J. Cullis. It having been shown at the preceding meeting that Natural History includes and is constituted by the "Concrete Sciences,"—Astronomy, Geology, Biology, Psychology and Sociology; it was taken as a matter for congratulation that this Society has recognized and provided for a completely comprehensive scheme of Natural History. While probably the first Natural History Society to include Sociology within its sphere, it was certain that *of* this it will one day be proud; and *in* this it must necessarily be followed by Natural History Societies generally.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 17th. Mr. C. F. Beale exhibited a stone celt from New South Wales; Mr. J. Madison, specimens of *Planorbis complanatus* var. *rhombea*, from Coleshill; Mr. W. H. Bath, a dragon fly, *Libellula quadrimaculata*, from Waterford; Mr. A. T. Evans, peaty matter from an old bed thirteen feet from the surface, exposed in trial holes at Small Heath; Mr. H. Hawkes, under the microscope, *Peziza coronata*, and a series of slides of the same genus. Mr. J. Betteridge presented to the Society a collection of twenty birds of the district prepared for the cabinet, including specimens of the night jar, hawfinch, curlew sandpiper, dunlin, little grebe, and black tern.—October 24th. Mr. H. Hawkes exhibited a collection of fungi, including specimens of *Agaricus procerus* and *Boletus badius*; Mr. Deakin, part of skeletons of birds showing modifications of the sternum, clavicle and scapula; Mr. W. H. Bath, stag beetles, *Lucanus cervus*; Mr. Corbet, a cluster of amethysts, from Rowley Regis. Under the microscope, Mr. J. W. Neville showed palate of *Fusus islandicus*; Mr. Hawkes, *Phacidium ilicis*, and the secondary stage of the same fungus; Mr. J. Collins, flower of *Trifolium arvense*; Mr. Hutchinson, *Protococcus pluvialis*.—October 31st. Mr. H. Hawkes showed specimens of *Peziza aurantia* and *Puccinia graminis*; Mr. J. Madison, unusually large specimens of *Helix rupestris*, from Edge Hill; Mr. A. Bennett, jaws of young shark, and saw of sawfish. Under the microscope, Mr. Hawkes showed a fungus, *Botryosporium pulchrum*.—ANNUAL MEETING. The annual meeting of the Society was held on November 7th. The Treasurer's, Secretary's, and Curator's Reports were passed unanimously, the financial statement showing a balance in favour of the Society. The retiring President, Mr. J. Edmonds, delivered an address, in which he commended those careful and patient workers who loved Nature for her own sake, and who would leave a legacy of observation to future times. Such a Society should be a brotherhood in aim, without ostentation pursuing a useful course. The taste for natural science had been so great and pleasurable that he (the speaker) had tried to foster it in others. We must, however, remember that the pursuit of knowledge was not as simple and smooth as gliding down a glassy plane aided by grease and gravitation, but that Nature yielded up her treasures to the painstaking and importunate. The speaker urged the importance of making careful notes of all observations, and when practicable faithful drawings for future reference. The usefulness of photo-micrography, as an adjunct to science, was spoken of at some length, and recommended for the accuracy of its delineation and the simplicity with which a knowledge of the manipulation could be acquired. Mr. J. Edmonds proposed Mr. T. H. Waller, B.A., B.Sc., as president for the ensuing year; Mr. Dunn seconded the resolution, which was carried unanimously. After the usual votes of thanks were passed to the retiring President and other Officers of the Society, Mr. Oliver Hutchinson and Mr. John Collins were elected Vice-Presidents; Messrs. H. Insley and P. T. Deakin, Honorary Secretaries; Mr. W. Dunn, Treasurer; Mr. J. W. Neville, Sub-Editor; and Mr. J. A. Grew, Curator. Mr. John Betteridge was elected a life member in recognition of his kindness in presenting to the Society a collection of the birds of the district.