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VOL. I.

Transactions

OF THE

BURTON-ON-TRENT

Natural History

AND

Archaeological Society.

EDITED BY

G. HARRIS MORRIS, Ph. D., F.C.S., F.I.C., &c.,

Hon. Secretary.

London:

Bemrose & Sons, 23, Old Bailey; and Derby.

MDCCCLXXXIX.

TRANSACTIONS

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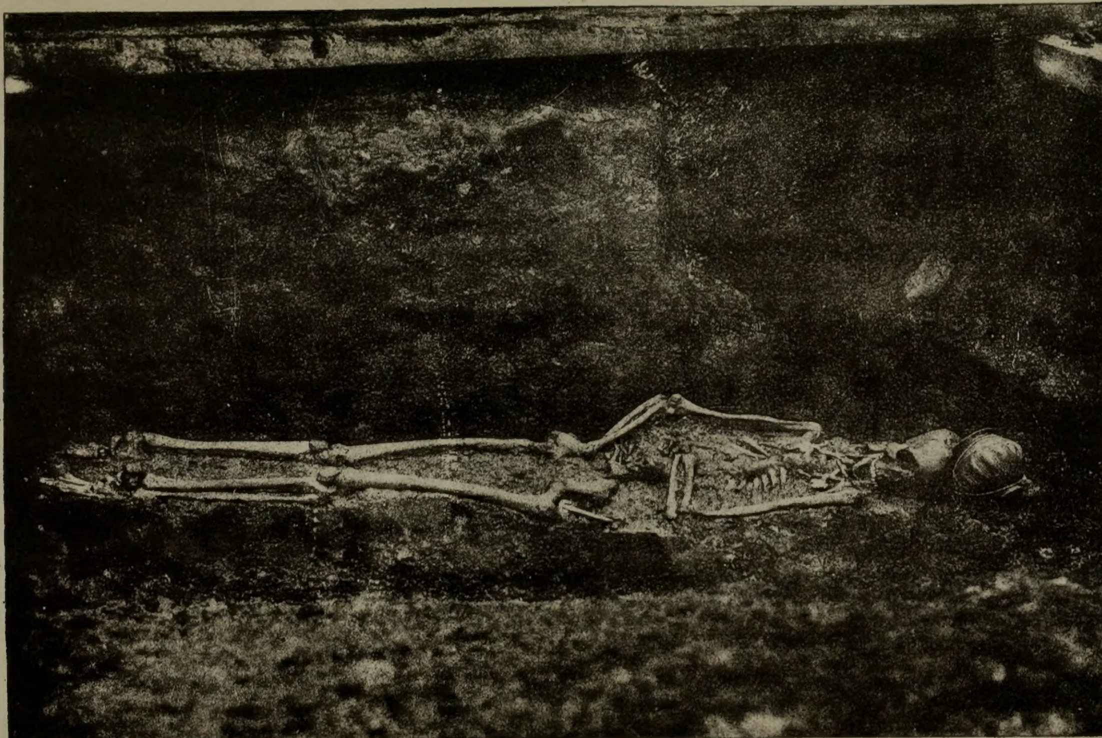
BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.



BEMROSE & SONS, PHOTO-TINT. LONDON & DERBY

FEMALE SKELETON OF PAGAN ANGLO-SAXON, WITH URN, TWO BROOCHES, NECKLACE, SPINDLE WHORL, BUCKLE FOR GIRDLE, AND CHATELAINE (?).

DISCOVERED AT STAPENHILL, FEB. 14TH, 1881, BY THE BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

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VOLUME I.

WITH TWENTY-FOUR PLATES AND SEVEN ILLUSTRATIONS IN THE TEXT.

London:
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MDCCCLXXXIX.

INTRODUCTION.

THIS volume of Transactions, the first issued by our Society, owes its existence primarily to the desire, long deferred through lack of funds, of placing upon record in a suitable manner, and with the necessary plans and illustrations, an account of the interesting Explorations carried on at Stapenhill in 1881 under the auspices of the Society.

The financial position of the Society having at length allowed this desire to be attained, the opportunity was taken of including in the volume those Papers which have been read either before the Society or one of its Sections during the past few years, and which appeared worthy, either on account of originality of matter or of treatment, of being assigned a position in our Transactions.

The Publication Committee have to express their deep debt of gratitude to Mr. J. Heron, the Hon. Secretary of the Exploration Committee, for the hearty way in which he threw himself into the preparation of the Report of the Explorations, and for the admirable way in which he has performed the task. Thanks are also due to Mr. J. Whitehead, of the Burton-on-Trent

School of Art, for preparing drawings of some of the objects found at Stapenhill, and to Mr. G. R. Strachan, of London, for his courtesy in drawing up the map and plans of the site.

It is hoped that some record of the Explorations carried on at the Burton-on-Trent Abbey will be included in some future volume of Transactions, which the Committee hope to publish from time to time.

G. HARRIS MORRIS.

March, 1889.

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BURTON-ON-TRENT

Natural History & Archæological Society.

The Rhætic Beds.

By Horace T. Brown, F.G.S., F.I.C.

(*Read before the Geological Section, October* 31*st*, 1884.)

If we look at a geological map of this country we see that the outcrop of the Triassic rocks extends in a band of varying thickness across England, from the mouth of the Exe in Devonshire to the mouth of the Tees. The direction is approximately north-east and south-west, and coincides with the general strike of the beds, the direction of the dip being to the south-east, and this applies also to the overlying formations, so that as we travel from the Midland Counties to the south-east we constantly pass over the outcrop of newer rocks.

Where the uppermost member of the Trias, the New Red Marl, dips under the Lias, there occurs a series of intermediate fossiliferous beds, of no great thickness it is true, but of very great interest, inasmuch as they link the Triassic to the overlying Jurassic rocks.

Until about twenty-five years ago, the beds of which I am speaking were classed with the Lower Lias, but about that time Dr. Wright, of Cheltenham, and Mr. Moore, called attention to their palæontological resemblance to certain beds of great thickness occurring in the Rhætian Alps of Lombardy, which had already been recognised as passage beds between the Trias and the Lias of that part of Europe. It was in the south of England that the true nature of these beds was demonstrated, and it was there that they were first differentiated from the Lower Lias, with which they had previously been confounded, but it was not long before geologists found that in all parts of England, where the junction of the two formations was exposed, they were invariably present, intercalated between the New Red Marls and the Lias. The name by which these beds are more commonly known is the *Rhætics*, from their correlation with the Alpine beds before referred to; but, deeming it expedient to adopt a name borrowed from some British locality, the Geological Survey, mainly, I learn, on the recommendation of Mr. Bristowe and Mr. Etheridge, named them the *Penarth Beds*, from the fact that they are so well developed and exposed in the cliffs of Penarth, in Glamorganshire.

The Rhætic Beds, with the overlying Lias, stretched at one time over considerable areas, from which they are now absent. This is amply proved by the existence of *outliers*, which have been separated from the main portion of the formation by long continued denuding action. These outliers indicate the previous extension of the Rhætics, just as a solitary sea-stack, composed of the same rocks as those of the neighbouring shore, is a witness to the previous existence of land which extended further seaward.

Of these Rhætic outliers we have some very interesting examples a few miles to the west of our town, capping the highest portions of Needwood Forest. Two of these patches are laid down as you see by the Geological Survey. The third occurs about a quarter of a mile beyond Henhurst Wood, and was originally discovered by my father. The boundaries of this particular outlier, which is smaller than the other two, have still to be traced. On the map before you the Rhætics are coloured as Lias, and, I believe, the credit of recognising them as Rhætics is due to the late Mr. Molyneux, who has left us some interesting particulars concerning them. The particulars and measurements are, however, necessarily imperfect, owing to the infrequency of anything like a good section, except in the lower division of the series, and to the necessity of having to rely for the most part upon a few superficial excavations in the banks of lanes, etc. Overlying the characteristic red Keuper Marls, we have first of all about 100 feet of light green calcareous marls. These are the "Tea Green Marls" of Etheridge. Above the Tea Green Marls, which here are quite unfossiliferous, come about 18 to 20 feet of strata, consisting of alternations of thin micaceous sandstones and marly limestones, containing occasional casts of a bivalve, *Pullastra arenicola*. These are succeeded upwards by the most interesting members of the whole series, consisting of black, carbonaceous, laminated shales, resembling closely in appearance coal-measure shale.

These paper-shales, as they have been well called, from the thin laminæ into which they split, are very characteristic of the Rhætics, and in some parts of England they contain abundance of fish remains. Our Needwood shales have not as yet yielded any vertebrate remains; but as they have been so little searched, this is not to be wondered at.

The black shales are the highest member of the Rhætics observed in our neighbourhood; but it is highly probable that further detailed examination may result in the discovery of some overlying rocks, probably even traces of the Lower Lias itself. The thick sheet of boulder clay which covers all the high land of the Forest renders field observations very difficult, but we must look forward to the chance excavation of marl-pits or wells to throw more light upon the subject. Anyone of our members who has friends living in the neighbourhood of Christ Church, Needwood, or Abbot's Bromley, would be doing good service by asking them to report any new wells or cuttings made in the district.

In the south of England the black shales are overlaid by the so-called White Lias, consisting of from ten to twenty feet of thinly bedded white, grey, or cream-coloured limestone. I have occasionally found in the drift deposits near here fragments of a white hard limestone exactly resembling one of the hard beds of the White Lias; but as far as I know, this sub-division has never been found *in situ* in Rhætic sections of the Midland district.

Up to a recent date the only exposures which exhibit the junction of the Rhætics, on the one hand with the New Red, and on the other with the Lias, have been coast sections, such as that at Aust, in Gloucestershire, which Mr. O'Sullivan and I had an opportunity of examining last year. It was, therefore, with considerable pleasure that I learned from the last number but one of the *Geological Magazine* that a fine and complete section had been opened up at Wigston, near Leicester. I went over recently to examine this in the expectation of finding a succession of strata strictly comparable with those of our Needwood outliers. Although I did not find the parallel quite as close as I expected, considering the comparatively short distance between the two places, yet the general resemblances are very close; and it was highly satisfactory to have an opportunity of examining a perpendicular face of Rhætics from the junction with the New Red to their junction with the Lower Lias. Unlike a coast section, a clean cut, unweathered surface, like that at Wigston, affords every opportunity for minute examination. The section itself has been carefully described by Messrs. Wilson and Quilter, but they have scarcely touched upon certain points which are of the highest possible interest to the physical geologist, viz., the changes of physical conditions during deposition, as evidenced by the altered nature of the sediment.

At the bottom of the pit, which has been opened out as a brickyard, are seen the ordinary red gypsiferous marls that we all know so well. A few feet upwards the red marls give place to thin alternating bands of grey and red marls, which merge by very slow gradations into a mass of "Tea Green Marls," about 15 feet thick. These resemble in every respect, except thickness the Tea Green Marls at the base of our Needwood Rhætics. Like the latter, they are unfossiliferous and calcareous, and, in fact, resemble them in every particular. They are succeeded upwards by 40 feet of black shales, the lower 18 feet being alone fossiliferous, and containing a few sandy partings with *Axinus cloacinus* and *Cardium Rhœticum.* The upper part of the 40 feet of shales is much more earthy and far less fissile than the paper-shales of the lower part. Throughout the shales there are a few lines of lenticular nodules of septaria, or concretionary masses of argillaceous limestone—cement stones, in fact. Organic matter is present in the shales in considerable quantities, and from the large amount of calcium phosphate and pyrites with which it is associated, and from the entire absence of vegetable remains, its animal origin cannot for a moment be doubted. Considering the immense number of fish and molluscs whose dead bodies must have contributed to the formation of this shale, the comparative paucity of recognisable organic remains is somewhat remarkable.

Wilson and Quilter found a few specimens of *Cardium Rhœticum*, *Axinus cloacinus* and *Cassianella contorta*; but during a somewhat lengthy search I was unable to find any of these. At the very base of the shales, however, I found some small phosphatic nodules containing fish remains.

The one point which interested me more than any other in this section was the line of junction between the black shales and the underlying Tea Green Marls. Instead of there being anything like a passage of one set of beds into another the line of junction is marked by *absolute abruptness*, but the two sets of beds are perfectly conformable, and there are no signs whatever of contemporaneous erosion. If I had possessed a proper cutting tool, I could have brought home a hand specimen, which would have clearly shown the line of junction.

Now let us consider for a moment what this sudden change of sedimentation implies.

The Tea Green Marls, blending as they do insensibly into the underlying Red Marls, differ from the latter only in the fact of containing a less amount of ferric oxide. Like the Red Marls, they are occasionally found containing pseudomorphs of rock salt, and this fact, coupled with the entire absence of phosphates indicates the same phase of sedimentation as that of the Red Marls. The Green Marls, in fact, represent the last phase of deposition in the land-locked and highly saline seas of the New Red period. But those waters, which had been veritable Dead Seas for ages, were once more on the point of teeming with life. In a space of time, which must have been very short compared with the rate of sedimentation, the barriers which had kept back the tidal waters of the ocean from the great salt-lakes were broken through, and the comparatively fresh water, charged with its living freight, terminated for ever the New Red epoch. We are accustomed to regard all geological changes which have not been caused by volcanic action as having taken place gradually and with extreme slowness, and doubtless this is as a rule correct. But we have here, I think, most unmistakable evidence of a very rapid and extraordinary change in physical conditions, and I am somewhat surprised that this should have hitherto escaped due attention. It is probably owing to the fact, to which I have before referred, that the Rhætics have for the most part been studied in coast sections, and not in newly-cut faces. In the former case, of course, natural weathering would preclude anything like a minute study of the line of junction.

It will be an interesting point to ascertain if the black shales differ in composition from the underlying Tea Green Marls in any other respects than in the organic matter, phosphates, and pyrites which they contain. From a rapid examination of samples of each, from just above and below the junction, I am inclined to think they show a great resemblance to each other, and if a quantitative analysis should prove this, it will go far to show, what is extremely probable, that the streams entering the open Rhætic Sea still continued to bring down the same kind of sediment as they did at the close of the Triassic period.

I have still to describe the upper part of the Wigston section, which I will do as briefly as possible. The black shales as they are followed upwards become less and less fissile, and, in the extreme upper part, insensibly graduate into the overlying Lower Lias, a thin layer of which, with its characteristic fossils, is well seen in a small claypit near the large section. Here we have the strongest indications that change in sedimentation was brought about by the physical conditions varying with extreme slowness.

Until recently it was customary to class the Tea Green Marls with the Rhætics, but I am now convinced that the view which has lately been maintained by a few geologists, that the Green Marls belong to the Trias, is the correct one, but, if this is true, the Rhætic Beds, except palæontologically, do not indicate the slow and gradual passage of the Trias to the Lias to the extent that is usually asserted.

I have confined myself in this short paper almost entirely to the physical and stratigraphical part of the subject, because, in the first place, it has been to me the most interesting, and secondly, it has been somewhat neglected by geologists, probably for reasons already given.

The palæontological part of the subject I cannot touch upon to-night, except to mention the interesting and curious fact that the Rhætic fish are closely related to those of the Trias, whilst the invertebrate fauna is of a distinct Liassic facies. You will see on the table a few of the characteristic fossils, some of them from this neighbourhood.

The section on the wall shows the relation of the Rhætics of Needwood Forest to the underlying Marls. It was constructed a good many years ago by my father, from his own levellings, and is based upon the one-inch geological maps.

Notes on Photo-Micrography.

By G. Harris Morris, Ph. D., F.C.S., F.I.C.

(*Read before the Microscopical Section, February 26th*, 1886.)

If we turn either to the standard works on the microscope or to the works dealing more particularly with the subject of these notes, we find that the practice of photo-micrography is apparently accompanied by the use of very cumbersome and very costly apparatus, the description of which is sufficient to deter the student from attempting to master this branch of microscopy. For instance, we find a very full and comprehensive chapter on Photo-micrography in Beale's " How to work with the Microscope," in which the methods of the masters of the art—Drs. Woodward, Maddox, Abercrombie, Wilson, Mercier, etc.—are described and figured. In some cases the use of a specially fitted room is necessary, in others tables or base-boards many feet in length must be used, whilst the arrangements for illumination, varying from a complex heliostat to an oil-lamp with a system of lenses, are most elaborate, and appear to exert a great influence for good or evil on the nature of the resulting picture. Even in a little book recently published on this subject by Cowley Malley,* a somewhat elaborate arrangement is recommended.

In by far the largest majority of these arrangements we also

* "Photo-Micrography," A. Cowley Malley, 2nd edition, 1885.

find that a special camera, or a special microscope, or sometimes both combined, is needed, and, furthermore, we are repeatedly warned that it is almost useless to expect to obtain good results with anything less elaborate than the apparatus described. The exposure required is also usually very long.

There is figured, however, in the work of Beale, to which I have already alluded, a mode of adapting the camera to the microscrope, which is adopted by Gerlach and which the author dismisses in a couple of lines. It consists in connecting the camera to the tube of the microscope placed upright. My friend, Dr. George Harrow, has lately adopted the same method, as being the only arrangement which allows a temporary microscopic preparation, such as yeast, to be photographed. The same arrangement is employed in the apparatus which I have the pleasure of bringing before you this evening. This apparatus possesses the advantages of being comparatively inexpensive, easily portable, occupying only a small space, adapted for use with any kind of microscopical preparation, and, as I hope to show you, capable of turning out very good results; it moreover requires only an ordinary camera and microscope.

It consists of a small quarter-plate camera—Lancaster's "Le Mèritoire"—with the lens and front removed, and the body made rigid by means of small wooden supports and a brass plate securely fastened to the top of an oblong wooden case, with one side removed and with a circular hole cut in the top immediately under the camera. The microscope is placed in the case either standing on the bottom or raised by means of blocks. The case itself stands on a three-legged support.

Plate I., Figs. 1, 2, and 3, shows the apparatus in three different positions, front, back, and side, and renders the construction easily intelligible. *A* is the camera, maintained in a rigid state by means of the four wooden pillars *a a*, which are kept in position by means of pins and hooks, and by the brass plate *b*, which is fastened to the camera by means of the screws provided for the brass-strip of the camera, as ordinarily used. The camera is secured to the wooden case *B*, by being accurately fitted between the strips of wood *cc*, and maintained in position by small buttons. There is a hole cut in the top of *B*, corresponding to the opening of the camera; this hole, on the under side, is surrounded by a circular flange of wood, to which is attached a tube of black velvet about six inches in length. On the bottom of *B* there is a series of wooden blocks, which serve as a support for the microscope. The front of the apparatus, shown in Fig. 1, has an oblong slit cut in it; this is bordered on either side by a grooved flange, in which a slide works. The slide, *e*, has a circular orifice cut in it, and it can be moved up or down, being maintained at any required height by a slight spring; at the lower end it carries a little shelf, on which rests a shallow glass cell full of ammoniacal solution of copper sulphate, for the purpose of giving a mono-chromatic light. *C* is the support on which the whole rests. It is, of course, necessary that the whole should be accurately levelled, and that the base on which the microscope stands be parallel with the focussing glass of the camera.

The apparatus described stands 3 ft. 6 in. in height from the floor to the focussing glass of the camera; the wooden body is 1 ft. 9 in. long by 10½ in. wide, inside measure, and 5 in. deep.

As a source of light, I usually employ an oxy-hydrogen lantern, but sunlight or any artificial light may also be employed. With the first mentioned illuminating agent the exposure is very short.

The method of using the apparatus is as follows: * The preparation is placed on the stage of the microscope, the draw tube drawn out, the object roughly focussed, and the instrument placed in a vertical position in the centre of the bottom of the body of the apparatus, the tube of the microscope, *with the eyepiece still in*, being inserted in the tube of black velvet and the joint made light-tight with an elastic band (Fig. 2 shows the microscope in place). The orifice in the slide *e* is now brought exactly opposite to the mirror of the microscope, and the source of light

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* It is unnecessary to refer here to the photographic manipulation of the plates; the introduction of dry plates and the consequent extension of amateur photography has resulted in the publication of a number of books on photographic manipulation, from which all information can be obtained.

so arranged that the illuminating beam falls exactly on the mirror. The illumination of the object can now be adjusted and the image accurately focussed on the glass of the camera, by means of the ordinary focussing screws of the microscope. An ordinary dark slide is then substituted for the focussing glass and the plate exposed, the exposure being regulated by means of a card interposed between the source of light and the orifice of the slide.

I am well aware that the use of the eyepiece is contrary to the usually accepted opinions on the question, but I have found it to be more advantageous for several reasons, for instance, it allows of only a short distance between the object and the focussing glass, thus enabling the focussing screws to be easily under the direct control of the operator; it also allows of a considerable magnification being obtained without increasing the distance between the object and the plate, and when a strong light, like the oxy-hydrogen lime-light, is used it does not make the exposure a very lengthy affair; it also does not appear to disadvantageously affect the definition.

The microscope which I usually employ with the above arrangement is one of Seibert's, fitted with an Abbé condensor; the powers used are either Nos. O, IV., or VIb objective and Nos. 1 or 3 eyepiece, varying of course with the nature of the object. The most usual combination is No. IV. objective and No. 3 eyepiece, which gives, with the draw-tube out, a magnification of about 450 diameters. With the lime-light and an Ilford ordinary plate this combination requires an exposure of 20 to 30 seconds. When an oil-lamp with reflector is used, the exposure must, of course, be longer, thus the above-mentioned combination requires an exposure of two minutes to give a good negative. Without an eyepiece a much shorter exposure is naturally required, thus Seibert's No. VIb objective, corresponding to an English one-eighth, required 60 seconds exposure with an oil-lamp, and Seibert's No. IV., corresponding to an English one-fourth, required 15 seconds only with the same source of illumination.

Plates II. and III. show some examples of photo-micrographs obtained with the above described arrangement. They are from untouched negatives.

Plate II., Fig., 1, is a longitudinal section of barley, showing the embryo. The combination used was Ross' 2 in. objective and B eyepiece. Exposure, 20 seconds, lime-light. Magnification 30.

Plate II., Fig. 2, is also a longitudinal section of barley, showing the endosperm, aleurone cells, testa, pericarp, and palea. Ross' $\frac{1}{4}$ in. objective and B eyepiece. Exposure, 30 seconds, lime-light. Magnification 350.

Plate III., Fig. 1. Scales of *Epinephele Fanira*. Seibert's No. IV. objective, No. III. eyepiece. Exposure, 15 seconds, lime-light. Magnification 450.

Plate III., Fig. 2. Portion of scale of *Epinephele Fanira*. Seibert's No. VIb objective, No. III. eyepiece. Exposure, 60 seconds, lime-light. Magnification 1,700.

Plate III., Fig. 3. Pure cultivation of *Saccharomyces arevisiæ*. Seibert's No. IV. objective, No. III. eyepiece. Exposure, 20 seconds, lime-light. Magnification 450 diameters.

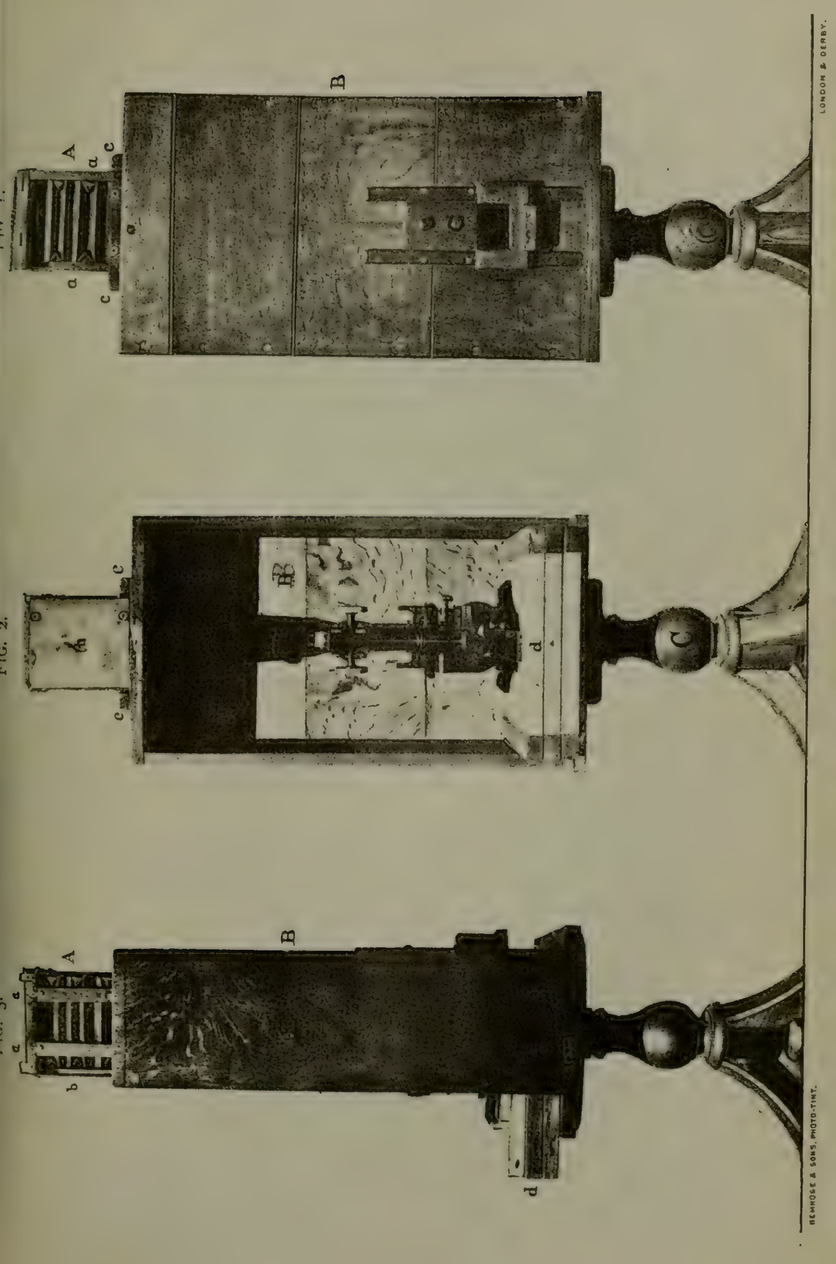

FIG. 1.

FIG. 2.

FIG. 3.

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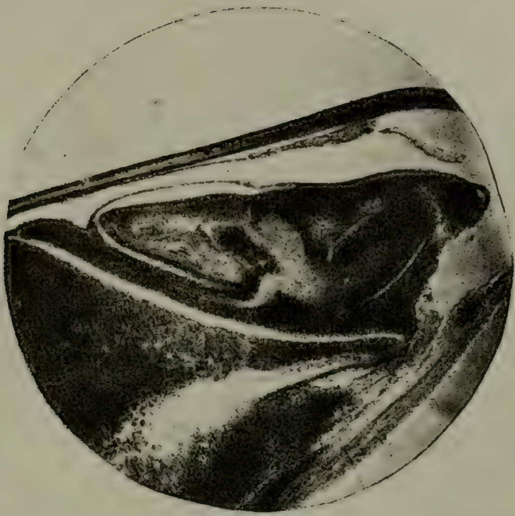
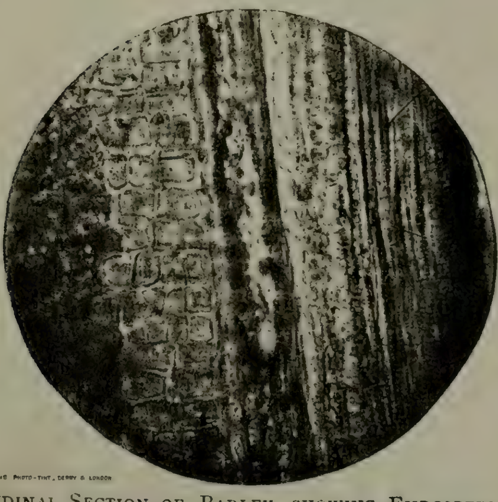
FIG. 1.



LONGITUDINAL SECTION OF BARLEY, SHOWING EMBRYO.
X 45.

FIG. 2.

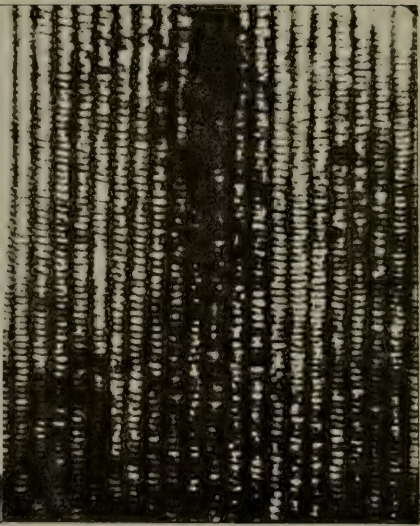


LONGITUDINAL SECTION OF BARLEY, SHOWING ENDOSPERM, ALEURONE CELLS, TESTA, PERICARP, AND PALEA.
X 350.

FIG. 1.

X 450.

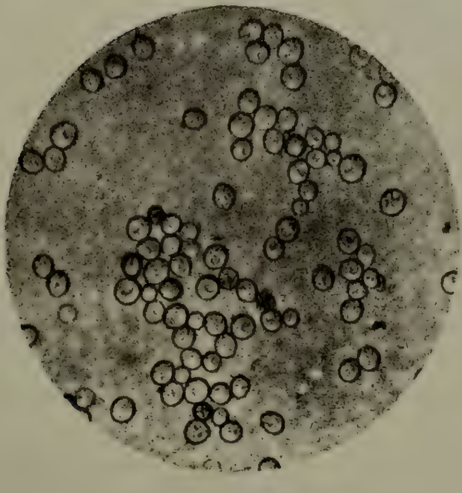
FIG. 2.



X 1,700.

SCALES OF EPINEPHELE IANIRA.

FIG. 3.



SACCHAROMYCES CEREVISIÆ. X 450.

BEMROSE & SONS PHOTO-TINT, DERBY & LONDON.

Notes on Micro-Organisms.

(With Four Plates).

By Chas. Geo. Matthews, F.C.S., F.I.C.

(*Read before the Microscopical Section, March 30th*, 1886).

I WAS requested some four or five weeks ago to read a paper before our Section on some subject that I might choose. I felt at the time that I was not likely to be in a position to furnish any particularly new or original matter, but wishing to do something in the way of promoting the consideration and discussion of an interesting topic—than which there is none more interesting for scientific investigators at the present time—I ventured to put together extracts from the works of some of the recognised authorities on Micro-organisms, and lay before you a general sketch of the Identification, Classification Life-history, and Culture of these organisms; entering into detail with some that are well-known, and incorporating a few notes of my own collected at different times. Before proceeding further I should like to say that I hope the reiteration of facts that several here are quite conversant with will meet with their indulgence, for in all probability others of your members present this evening have not made Bacteriology a special study, and may not be unwilling to further an acquaintance with some of the leading features of the science. I purpose confining myself more especially to what are generally known as the Schizomycetes or fission-fungi, but a digression here and there into other groups of organisms will perhaps be allowed me.

It is hardly necessary to say that the microscope is the indispensable adjunct to this kind of work, and the lenses of the instrument cannot be too good. Expense in these last does not necessarily mean excellence, and it is astonishing what remarkably good definition may be obtained with low-priced eye-pieces and objectives of certain makers, chiefly German. Amongst English makers, I should like to mention Messrs. Swift and Son, several of whose microscopes I have seen with higher combinations ranging from 300–450 diameters of magnification, and their performance leaves little to be desired. (I have one on the table before me, which perhaps some would like to examine later.)

Where expense is not a matter for consideration, the indulgence in objectives such as those of Messrs. Powell and Lealand is no doubt productive of a commensurate amount of satisfaction. For all ordinary purposes a magnification of 3–400 diameters is adequate, but since Bacteria require very good definition, the glasses should be carefully selected. There is nothing more irritating than to see objects looming through the tube of the microscope with blurred outline and uncertain structure, causing the observer to first doubt his own powers of perception, next to clean every glass in the instrument, and finally to arrive at the conclusion that the defect is practically irremediable, and the only cure is to obtain other powers. As regards manipulation and cultivation of the commoner organisms, comparatively simple appliances will in most cases enable the experimenter to secure fair results. It is somewhat different with the organisms connected with disease or certain pathological conditions. To study these efficiently a more considerable array of apparatus is essential, and conveniences and opportunities requisite that are only enjoyed by the medical faculty and a few others. Time, patience, and reasonably good eyesight are other indispensables for work on micro-organisms, and a capacity for sketching is decidedly useful, unless one is in a position to apply micro-photography; and I might just allude in passing to the results in this art that have lately been obtained, in Burton especially, by one gentleman who was good enough, at a previous meeting of our Section, to put us in the way of similar achievements.

In looking over some very old volumes of the history of the Royal Society, published in 1756, I found some interesting references to letters received by the Society about the year 1680 from the Dutch scientist, Leuwenhoek, in which he describes his discovery of minute organisms obtained from the lees of wine and beer, and from other sources, such as putrid water, saliva, &c. Two or three years previously I find that Dr. Hooke had brought under the notice of the Society certain observations of his on small moving organisms in infusions of pepper and some other vegetable products. He had also seen organisms in the contents of the stomach under certain conditions. From the very brief and inadequate description, I conclude that Hooke's microscope and apparatus were not sufficiently good to enable him to see the organisms with any degree of clearness; and before he could forward his investigations Leuwenhoek, with his greatly improved objectives, had made independent and much more rapid progress. A certain Dr. King, working contemporaneously with Hooke, had also described organisms before the Society, "thousands of which," to use his own words, were less "than a blood globule," by which last he presumably means a blood corpuscle. There is a suspicion of exaggeration in this statement. Seeing that 200 years have elapsed since Leuwenhoek and these other investigators, Drs. Hooke and King, recognized and described what were undoubtedly Bacteria, it seems rather strange that not till the last 15 or 20 years should any very rapid advance have been made in this branch of scientific investigation, though during the period last mentioned, progress has indeed been rapid, assisted undoubtedly by the greater state of perfection to which the microscope has been brought, but more especially owing to the great talent and patient skill brought to bear by men whose names are familar to the Bacteriologist; for instance, Cohn, Koch, De Bary, Zopf, and Pasteur, whose name is associated with a series of splendid researches, ending in victories over the influence of minute, and in many cases deadly organisms, such as human beings and animals are at most times exposed to—invisible enemies that may be present in every breath of air taken under the ordinary conditions of our daily life in towns and villages. Amongst investigators, the name of Cohn should not be passed by here without something more than casual mention, for he helped largely in laying the foundations of a scientific study of Bacteria by very careful researches, leading to an improved classification, which even at the present time has its adherents amongst investigators. Later, we may contrast Cohn's classification with the more recent and elaborate one of Zopf.

It is painfully obvious to Englishmen that the large majority of the names connected with the more important Bacterial investigations are foreign ones. It is hardly necessary to say that England *has* produced workers of note, but they have until lately been few. The main cause is probably to be found—not in the lack of interest in the subject—but in the restrictions to which medical men and others have been, and are, exposed in this country by the laws relating to vivisection. Whilst wishing to avoid argumentative matter on this point, one can hardly help saying that our position in this respect, in comparison with other countries, is to a certain extent humiliating. No one would desire a sacrifice of animal life to useless or inconclusive experiment at the hands of any chance worker; but surely we possess men to whom liberty (as regards vivisection) could safely be conceded. The marvellous and benefactory results obtained by Pasteur seem to prove in themselves that the sacrifice of a few lives may mean the saving of many, for let us consider the outcome of one of his researches, viz., on anthrax fever. His experiments necessitated the loss of a few score of sheep, but since the conclusion of his work many hundreds of thousands of animals have, there is good reason to believe, been secured by inoculation against the disease.

Before going into detail in connection with some of the members of this kingdom of the "infinitely little," as it has been aptly termed, let us quote some every-day instances of effects produced by the development of Bacteria. We have the souring of milk, beer, and other liquids; the ripening of cheese, especially in the case of such powerfully flavoured varieties as Limburg, Roquefort, Camembert, etc.; the putrefactive decomposition of meat and fish, besides many other decompositions where a bad smell is a noticeable feature. Additional examples are furnished by ensilage and the German Sauer Kraut, which, by the way, show some sort of relationship to each other in their method of preparation. In all or any of the above-mentioned cases, Bacteria may be detected easily by the microscope.

We will now endeavour to arrive at a general conception of the appearance and attributes of some commonly occurring Bacteria.

In Plate I. we have the following varieties:—

1.	Spherical Bacterium	Micrococcus aurantiacus.
2.	Acetic Ferment	Bacterium aceti.
3.	Putrefactive Ferment	,, termo.
4.	Lactic Ferment	,, lactis.
5.	Hay Bacterium	Bacillus subtilis.
6.	Spiral ,, ...	Spirillum volutans.

We will briefly describe the properties of these organisms.

I. Produces orange-coloured spots on white of egg, pieces of cooked vegetable, etc. The pigment produced is outside the organism. There are many other organisms of the same class, producing different colours. Having seen this one myself, I select it as an example of spherical Bacteria.

II. The acetic acid or vinegar plant, used industrially for the production of vinegar. Much light has been thrown on the workings of this organism by Adrian Brown, in a very interesting paper to the Chemical Society.

III. In the common accompaniment of putrefactive changes of all kinds, especially with decomposing animal matter. It is more often seen in an actively moving state than any other Bacterium.

IV. Is found associated, as its name implies, with milk that is turning sour. It is frequently seen in other liquids undergoing a similar change.

V. Can be obtained easily from an infusion of chopped hay in warm water. It is obtained with more certainty and free from other forms if the liquid be boiled and put aside covered up in a warm place.

VI. Present not unfrequently during decompositions of very moist animal matter. In meat infusions, also during decomposition of brewers' grains.

We have here a considerable variety of shapes, ranging from spheres to spirals, and possessing essentially different properties. We will now enter into consideration of the structure of these organisms. The outer enveloping membrane is a fairly resisting and elastic substance of the nature of cellulose. In the case of Bact. aceti and an organism called Leuconostoc, it is pretty certain that it is cellulose. The inner portion of the Bacterium cells is a pasty mass, rich in nitrogen, conveniently called Protoplasm or Mycoprotein, varying in density, transparency, and refractive power. Many Bacteria enter into a motile or actively moving state at some period of their development, and the organs by which this movement is effected are hair-like protusions from the organisms known by the names of Cilia or Flagella. Having probably about the same refractive power as water, it is very difficult to view them unless their movement be stopped, and the membrane of which they consist be condensed by treatment with iodine solution or osmic acid. It is affirmed that some organisms have the power of retracting the cilium into the cell. A curious fact is mentioned in Zopf's work, viz., that micro-photography will sometimes render visible the cilia that cannot be seen by the eye, the sensitized plate being more susceptible than the retina.

We may now deal with the plan of reproduction or multiplication of some typical Bacteria, and for convenience in grouping take Cohn's classification of 1872 :—

Class I.—Sphœro-bacteria ... ... Dot or Sphere.
,, II.—Micro-bacteria ... ... Short Rods.

Class III.—Desmo-bacteria ... ... Threads.
„ IV.—Spiro-bacteria ... ... Spirals.

Class I., generally known as the coccus or micrococcus form, propagates usually by simple division in two or more directions.

This is very well shown by an organism—Sarcina litoralis—(Plate II., Fig. 1) found in putrefying sea water. Another coccus form, but not a true micrococcus, is brought about by the breaking up of longer or shorter rod lengths into ovals and spheres, by constriction of the outer envelope at given points. Several of the micrococci connected with interesting though painful complaints that men and animals are liable to, are probably reproduced in this way.

Separated pairs, as in the case of Bact. aceti (Plate I., Fig 2), are called Diplococci.

Budding of one spherical cell out of another has not, so far as I know, been observed in connection with Bacteria.

The normal methods of reproduction of Classes II. and III. are—(*a*) by the continuous development of rod lengths, (*b*) by the formation of spores capable of germination and reproduction of the Bacterium form. I have selected Cladothrix dichotoma as an illustration of rod lengths, showing at the same time what is called false-branching (Plate III., Fig. 1), and as examples of spore formation :—Bacterium amylobacter (Plate II., Fig. 2) and Bacillus subtilis (Plate I., Fig. 5).

The spirillum forms of Class IV. are, with exception of sporulation, produced in a very similar way, sometimes in short lengths, sometimes in very long pieces, which afterwards break up into separate individuals.

According to Cohn, all Bacteria tend to reproduce a constant and uniform type, Micrococcus yielding Micrococcus, and Spirillum, Spirillum ; but if Zopf's more recent researches be accepted, this position is no longer tenable, for Zopf shows clearly that with many Bacteria long rod lengths may produce short ones, and even coccus forms, in fact, almost every form assumed by these organisms at all. Plate II., Fig. 5.—Bacterium merismopedioides — shows all forms but the spiral, whilst Cladothrix dichotoma shows coccus, rod and spiral forms (Plate IV., Fig. 1).

It could only be expected that Zopf, after satisfying himself that distinct species of organisms could go through a cycle of changes at some period in which they might have departed from the typical form and were not to be identified, should have devised a classification to cover the morphological differences he had encountered. The following is his highly elaborate system :—

Class I.—Coccaceœ—Micrococcus forms and threads of Cocci.
,, II.—Bacteriaceæ, includes Cocci, short rods (Bacteria), long rods (Bacilli), long threads (Leptothrix), no spirals.
,, III.—Leptotricheæ, includes Cocci, Bacteria, Bacilli, Leptothrix, spirals.
,, IV.—Cladotricheæ, includes Cocci, Bacteria, Leptothrix, spirals, and false-branching.

The first three classes include the forms mentioned by Cohn, Class I. being the same as Cohn's. If I may venture to criticise the arrangement, I should say that it was hardly worth while establishing a new class (viz., No. IV.) for the false branching, which constitutes the only difference between Classes III. and IV.

A very elaborate classification of the Schizcmycetes has been arranged by Flügge, but time and space will not allow me to introduce it in detail. It contains two general groupings into round or ovoid cells, and cylindrical cells, and about twelve different special groups. Very slight morphological differences are made a good deal of, and, generally speaking, the classification seems rather a cumbrous one.

Nägeli includes the whole of the classes in the one term, Schizomycetes, and maintains that Bacteria are allied to yeast, classing all the microscopic fungi producing decomposition as under:—

Mucorini, or Moulds.
Saccharomycetes, or Alcoholic ferments.
Schizomycetes, or Bacteria.

It then appears that in the majority of cases it is almost impossible to identify a Bacterium from its mere appearance at any one time. Zopf's statements are not unsupported, for Klebs and other workers have seen rod and spirillum forms in the same organism. There seems to be a very general tendency for Bacteria in the form of rods and threads to become curved or crooked, especially with alterations of nourishment. Besides the normal forms exhibited by Bacteria, very curious deformities are occasionally met with, showing dark-coloured protoplasm and peculiarity of form, that were the portions viewed by themselves one would not associate them with the original form. Such deformities are called retrograde or involution forms, and are probably called into existence by deficient nourishment (Plate I., Fig. 2, *aa*).

Let us return to a closer consideration of the reproduction by fission of rod lengths. Zopf says that the membrane by which the Bacteria are enveloped is capable of thickening and then dividing into layers, one of which (the inner) is capable of rearranging itself, whilst the other (the outer layer) grows for a longer or shorter time till finally it may yield to the pressure of enclosed cells and some of these last be pushed out. This may be seen in Plate III., Fig. 2, Crenothrix Kühniana, Plate IV., Fig. 2, with an enlargement to show the process just described more plainly. This organism is somewhat closely allied to the moulds in its characteristics, but is classed by most authorities amongst Bacteria. It affords a striking example of cell formation by internal differentiation of the protoplasm in the threads. We can now proceed to consider in greater detail the reproduction of Bacteria by spore formation, a process first observed by Cohn in Hay bacillus. Spores are formed by a contraction of the contents of the cell and condensation into small spherical masses with a new and independent membrane. A disintegration of the old cell envelope often takes place about the same time, thus freeing the spores. The process of sporulation is clearly seen in two kinds of Bacteria, the Bacillus subtilis and the Butyric ferment, or Clostridium butyricum; also called Bacillus butyricus and Bacterium amylobacter (Plate I., Fig. 5, and Plate II., Fig. 2).

I find in my sketch book two very good instances of sporulating Bacteria, one (*a*) growing in brewers' grains after a cultivation of mould, the other (*b*) in a mass of ground rice used for the same purpose (Plate II., Fig. 3). In both cases the Bacteria were found underlying the mould growths, where they must have been formed out of free contact with air. One was most probably Bacterium lactis, and the other Bacillus subtilis. It is very easy to obtain the latter in a spore-bearing state from hay infusions, as before pointed out. After an active growth of the Bacillus, sporulation generally takes place. I should like to remark here that, although the conditions in beers are rather favourable than otherwise to spore formation, I do not recollect having seen in them any of the rod or thread Bacteria in a sporulating state.

Bacteria under certain circumstances develope a very curious condition known as the Zooglœa, or resting state, caused by the reproduction in close proximity of swarms of Bacteria (Plate II., Fig. 4) with a gradual withdrawal of nourishment. Owing also to a tendency that the organisms have to increase the enveloping membrane, which at the same time becomes gelatinous; and this may proceed till the contour of the separate cells is almost lost, and sometimes an almost indistinguishable mass remains where formerly well defined Bacteria were seen.

To proceed to some of the more general phenomena associated with the growth of micro-organisms. The production of a definite pigment (as in the case of Micrococcus aurantiacus) is a property belonging to a fairly large class called Colour Bacteria, producing a considerable variety of pigments, amongst which crimson, scarlet, violet, and yellow are included. The Bacterium form is in most cases a small sphere, varying somewhat in size and appearance, though in some cases the colour produced is the only means of identification. Some of the colours are so vivid that the question arises in one's mind as to whether some commercial application of the property of these organisms could not be devised. Colour Bacteria can easily be obtained from slices of boiled vegetables, and of some fruits such as melon, when left under bell-jars, standing in a plate of water. In this way I have obtained micrococcus forms giving red, yellow, and blue pigments. The best nourishing material is undoubtedly boiled white of egg, and this will yield them almost to a certainty. The spots of colour Bacteria can be picked off and resown. Lately I obtained a beautiful growth of Micrococcus violaceus in this way, covering quite half a square inch of surface. The colouring matter is external to the organism.

Production of colouring matter is not confined to Bacteria, but is not unfrequently exhibited in mould growths, as, for example, in Penicillium, Aspergillus glaucus and niger, and some moulds that develop spindle-shaped compound spores. Neither in the case of colour Bacteria, nor with the colour-producing moulds, have the colouring matters been satisfactorily identified. They are said to show some relation to the Aniline dyes. At present they only help to identify a particular mould or Bacterium.

Another interesting phenomenon, associated with the growth of some putrefactive organisms, is a phosphorescent or luminous appearance exhibited in the dark by meat and fish in a state of decomposition. Shell-fish show it very frequently. The organisms causing the appearance can be resown on animal substances, and again give rise to the characteristic appearance. It will be remembered that some of the microscopic fungi have the same property, rotten wood occasionally showing it. Phosphorescence, whether in the animal or vegetable kingdom, is a very remarkable occurrence, and would afford an interesting field for study, for as yet very little light has been thrown on the matter.

A great variety of products are obtained from Bacterial decomposition. Amongst the commonest are free acids, such as lactic, acetic, and butyric, formed from such substances as glycerine vegetable gums, starchy bodies, and the carbohydrates generally; or we have a production of ammonia from certain nitrogenous bodies, or an oxydation of these last to nitric acid and nitrates, a highly important action that is always going on in porous soils charged with sewage and decomposing animal and vegetable matters, thus bringing them into a form in which they can be assimilated by plants, and so enter again into the round of life. Hydrogen, nitrogen, sulphuretted hydrogen, and carbonic acid gas are also products of decomposition by the intervention of organisms, and some other bodies not very easily identified are those of the phenol class. Nägeli has advanced a theory that the decompositions are set up by molecular vibrations within a certain radius of the organism, and proceed partly internally, partly externally. In the case of all these decompositions, a point is reached when the action of the organisms is arrested or checked by the nature of their products, which act towards them as poisons, whether they be acids, alcohols, or other of the substances mentioned. It is the same with the Saccharomycetes or alcoholic ferments, and is a very important fact, as will be more apparent in its relation to the pathogenic or disease organisms.

Bacteria thrive best in weakly alkaline solutions, containing carbon and nitrogen in the form of carbohydrates and albuminoids. After the Bacteria have ceased growing, Saccharomycetes forms and moulds may appear. In an acid solution, such as grape juice, the sequence is different, the Saccharomycetes developing first, followed by Bacteria, aerobic ferments, and lastly moulds.

Bacteria in the motile state have an extraordinary affinity for oxygen gas. This is shown in an interesting way when a cover-glass is placed over a drop of liquid, containing them on a microscopic slide, especially if air bubbles be enclosed. The moving Bacteria flock to the edges of the bubbles, and also to the edge of the cover-glass If Algæ giving off oxygen are introduced into the same drop the Bacteria will collect about them ; so that these motile forms constitute rather a delicate test for oxygen. One authority, Engelmann, says that the motile condition ceases in darkness. It also appears to do so in a very strong light, for if flashes be sent through a solution containing the motile forms they are seen to start as if they had received a sudden shock, the movement ceasing for a few seconds and then recommencing. This is certainly extraordinary, and tends to raise the Bacteria in one's estimation to a higher position amongst low organisms. With the exception of the influence just stated, light does not seem to affect the growth and development of Bacteria.

A weak current of electricity affects Bacteria but little, but a stronger one can sterilise a solution in a time proportionate to strength of the current. For instance, the current from two ordinary battery cells are said to sterilise a solution in something over twelve hours, but if the current be stopped, freshly added Bacteria will grow in the same solution. The sterilisation is more complete at the + pole of the battery than the −. A fluid completely sterilised, as far as Bacteria are concerned, will allow moulds to develope subsequently. It is a question whether electricity could not be economically applied for the sterilisation of certain liquids—wines, fruit, syrups, &c.; though in all probability spores would not succumb to even a powerful current of electricity.

Very little has been done, speaking comparatively, in connection with the effect of chemical substances on Bacteria. It appears that mineral and fruit acids have a marked deterrent action, and this is notably the case with Bacillus subtilis, which cannot grow in even a weakly acid solution. Many substances, having a markedly destructive action on developed Bacteria, affect the spores of the same but little, for these bodies have been dipped in concentrated solutions of sulphate of copper and mercuric chloride without losing their capacity for germination.

Bacteria are much influenced by the degree of moisture obtaining with them. Gradual and nearly complete loss of water may be sustained without loss of vitality, and desiccated spores of some Bacteria may retain their power of germination for several years. Forms other than Micrococci or spores do not, however, live long in a dry state.

Temperatures below 60 degrees Fahrenheit are not favourable to the development of Bacteria, but between this temperature and 100 degrees Fahrenheit each form of Bacterium finds some favourable range.

Before proceeding to consider in brief the chief methods of research adopted for micro-organisms, I might make mention of some other sources of such organisms, a matter which we have as yet treated very generally. Many kinds of Bacteria in various stages of development are to be found in the slime that generally collects on a dripping water-tap, as also in pipes used for the intermittent conveyance of water and other liquids. In such slime the following organisms may be seen:—

Bact. termo.	Leptothrix.
Bact. lactis.	Pasteur's Lactic Ferment.
Bacc. subtilis.	Bact. aceti.
Spirillum undula.	

And also mould growths.

Another very fruitful source of organisms is the steep water from maltings, which, after a few hours, may swarm with them. Such a large quantity of organisms are present on barley itself, and so rich is the steep water in phosphoric acid, nitrogen bodies, and other matters suitable to the nourishment of Bacteria, that the growth of these last is extraordinarily rapid—temperature being favourable. I should like to revive the recollection, which most here will have, of the unpleasant-looking growth that was in former years seen in the river below the sewage outfall at Newton Solney during the summer.. I collected some of this in March, 1883, and thought I might produce a sketch of it for this evening. It consists of a submerged fungus growth, reproducing by simple division in one direction; and amongst its interlaced threads many kinds of Bacteria and some Infusoria were lodged, which had probably developed in the mould growth as it died off. (Plate III., Fig. 3.)

Just at present, the air seems to be teeming with organisms, and quite lately I have encountered the following, many of which may be met with at all times of the year:—

Nearly all the commoner forms of Bacteria.
Bacteria producing red, yellow, and blue pigments.
Clostridium butyricum, Spiromonas volubilis, Bacillus ulna.

Two aerobian Saccharomyces forms.

Various common moulds, including Dematium pullulans.

Altogether a very fair array.

Some interesting figures relative to organisms in the air are given by Miquel from observations made at Montsouris. In a cubic metre of air he found—

In the autumn	142	organisms.
,, winter	49	,,
,, spring	85	,,
,, summer	105	,,

No Bacteria were found at from 2,000 to 4,000 feet above sea level.

In a cubic metre of air in the Rue de Rivoli, Paris, he found 5,500 organisms.

A good deal of matter has of late appeared in print in connection with the organisms present in potable waters, and methods have been described based on Dr. Koch's gelatine process for their estimation and identification. Dr. Percy Frankland, in a paper read before the Society of Chemical Industry, described such a process in detail, and also appended some interesting experiments on filtration through different substances, such as sand, animal and wood charcoal, spongy iron, brickdust, coke, etc., from which it appears that after some weeks' use animal charcoal proved the least effective, the number of organisms after filtration being much greater than before, whilst spongy iron and coke gave a reduction of 99·8 per cent. and 98·5 per cent. respectively. Powdered coke is very easily obtained and adapted for use by washing well in boiling water till soluble matters are removed. With a large and a small glazed flower-pot, a cork, and a piece of glass tube an efficient filter can be fitted up at a nominal cost. Such an instrument would be economical for a working man, and possesses one or two distinct advantages, viz., one can see to a certain extent what is going on and keep a watch on the cleanliness of the upper layer of coke, and, again, fresh filtering material can be put in at any time (see Fig. 1). Several modifications of this arrangement might be devised. Boiling is,

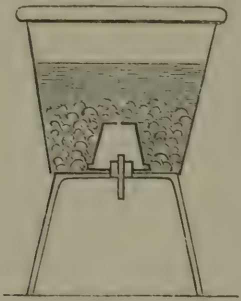


FIG. 1.

of course, the most effectual way of rendering a water innocuous, but the time consumed in the operation and subsequently cooling are drawbacks, not to mention the vapid taste of the liquid so treated.

Water treated by Heisch's method with sugar and kept in a warm place developes Bacteria in proportion to the combined phosphorus in solution. With a trace of phosphoric acid a free growth of Bacteria will at first take place, but they pass quickly into the Zooglœa state. Very good examples of Zooglœa can be obtained in this way. It may be mentioned here that phosphorus in some form is just as necessary to the Bacterial life as to other living creatures and organisms.

In connection with the growth and culture of organisms some important questions present themselves, viz.: —

1. In what plasma or food stuff does the Bacterium thrive best?
2. Through what stages of development does it go?
3. As to the products of decomposition by specific Bacteria?
4. How does the ferment behave in relation to oxygen?
5. How is it affected by temperature?
6. As to the action of antiseptics?

Having obtained the specific Bacterium one is desirous of cultivating, the next thing is to provide a suitable food and keep out air-borne germs. Amongst the various cultivating media there is nothing much better for Bacteria than plain gelatine, which can be adapted for use in a variety of ways; the addition of peptone or meat extracts such as Liebig's and Brandt's undoubtedly increases the nutrient power. I have found the much vaunted Agar-Agar very difficult to deal with; it is more especially suited for disease organisms, but requires the greatest care to obtain clear, and with anything like prolonged heating loses its power of congealing.

Time will not permit me to enter into the minutiæ of sterilising vessels, infusions, apparatus, etc. In all cases it is a matter of employing heat in such a way as to kill germs that are not wanted. Where something short of absolute sterilisation will do, I have found glycerine very useful for smearing over the inside of bell-jars, the edges of plates, etc., for it holds any dust falling on it, and can easily be washed off when desired. In designing a room for Bacterial investigation, it appears to me that much might be done with tile walls kept moist with glycerine, floors that would not make or store up dust, etc.; in fact, as far as possible, a dust free room, for it would save a large amount of trouble from accidental inoculation. Every time a room is swept the conditions are rendered about as unfavourable for pure cultures as they well can be.

A supply of wide-mouthed bottles, test tubes, and flasks for stock gelatine, with a few small pieces of apparatus, will enable one to grow ordinary micro-organisms. Such things as water baths, drying ovens, etc., can be easily contrived out of every-day appliances.

I have found petroleum to be a very effectual seal against air germs in cultivations in gelatine carried out in bottles. The petroleum is run on when the gelatine is cold and set.

There are several methods of obtaining a pure cultivation of one particular organism, and, speaking generally, they depend on the excessive dilution of a liquid containing a preponderating quantity of the organism sought. Such dilution may be carried out till it is calculated that a single drop contains a few organisms only. This drop is then sown with necessary precautions, and may give rise to a pure culture straight away. If not, the process is repeated with the new culture.

Continuous observation may be made by inoculating, with a needle or platinum wire, thin films of gelatine on glass slips, or in specially contrived glass chambers made of pieces cemented together with Canada Balsam or Coaguline.

Marked peculiarities are met with at times in gelatine cultivations; for instance, the formation of gas bubbles, usually of lenticular shape, but varying according to the density of the gelatine. In these cases a large volume of gas is occasionally developed by quite a slight growth of the organism, which is generally a very minute one. Spherical or pear-shaped liquid cavities are also formed, whose contents are usually acid. Some time ago I obtained a very nice growth of Bacillus ulna from such a cavity, the largest Bacterium I have yet seen. It was at least three times the diameter of Bacillus subtilis, and showed an active movement.

A greatly improved definition under the microscope, of the membranes and cell divisions of micro-organisms, is obtained by staining with certain dyes; a process very elaborately described in Crookshank's recent work on Bacteriology. I have tried staining with some of the aniline dyes in the following ways, which yield results quite good enough for ordinary examinations: Two or three drops of the liquid are placed on a glass slip, with sufficient space between them. They are then dried off gradually on a copper plate at a temperature of about 100 degrees Fahrenheit; a drop of very dilute Rosaniline or Methyl violet is put on to each of the dried spots, and evaporated to dryness as before. The surplus dye can be removed with very weak alcohol or very dilute nitric acid. These last are washed away with a little water, the slides dried off, and a little clove oil can be put on the spots, followed by Canada balsam. If the slide is wanted for immediate examination, it is unnecessary to remove the surplus dye; a little turpentine, followed by clove oil, will give very good specimens, and the slides can easily be cleaned afterwards if desired. During the last few days I have tried staining with Eosine, used according to the methods for other dyes. It seems to give excellent results; in fact, I should say better than magenta or methyl violet, the defining densities of the protoplasm being shown very clearly.

Some very artistic effects have been produced by double staining, where organisms are present with tissues of other substances. The first colour used is removed from the tissues, but not from the organisms, by nitric acid or alcohol, and after removal of these last a contrast colour is run on. I have noticed that Bacteria will often show active movements even when they have been dried off at 100 degrees Fahrenheit, and stained quite deeply.

An extract of logwood is said to be useful for staining cell envelopes and the Flagella. It is sometimes convenient to treat drops of liquid or tissues containing Bacteria on a thin cover-glass, instead of on a glass slip.

Hitherto we have almost exclusively dealt with Micro-organisms that, with the exception of a septic effect on wounds, do not appear to have any poisonous action in the human body, for every day we take in myriads of them with air, food, etc., and in the main do not seem any the worse for it; and, indeed, it is a question whether some of the changes that food undergoes in the system, necessary to its conversion into easily assimilable matter, are not facilitated by the presence of organisms. On the other hand, there can be no reasonable doubt that certain maladies and diseases have their origin in so-called Pathogenic Bacteria. This is certainly the case in erysipelas, anthrax fever, glanders, and tuberculosis; whilst in the case of blood-poisoning, diphtheria, relapsing fever, small-pox, typhoid, and a considerable number of other diseases, including cholera, there is good reason to believe that the micro-organism associated is the causal agent, always presuming that the human body has by some means become predisposed to the growth of the organism involved (Plate III, Fig. 4, and Plate IV., Figs. 3, 4, 5, 6). The spherical bodies in Figs. 4 and 6 are blood corpuscles.

Klein mentions four facts as essential to establishing the certainty of an organism being associated with disease :—

1. Presence of the organism in the blood or tissues.
2. Obtaining pure cultivations of this organism.
3. The retention of virulent properties, that is, being able to originate the same complaint.
4. The same organism must be found in the dead body.

There has been much debate about the relations of pathogenic to ordinary septic organisms, and it remains an open question whether these last can under any conditions promote a state of the body of animals inducing an infectious disease. Dr. Hans Büchner some years ago positively asserted that he had transformed the hay bacillus into the anthrax bacillus, but there is every reason to doubt the fact, especially as Büchner was experimenting on anthrax at the time, and so probably obtained impure cultures. Klein points out besides, that there are very considerable morphological differences in the two organisms, Bacillus anthracis, for instance, has never been seen in a motile form.

The only established case of a common septic organism being transformed into a pathogenic one is in the case of a mould called Aspergillus. Spores of this mould were introduced into the jugular vein of a rabbit, which died 36 hours after, and a free growth of the mould was found in various parts, especially the kidneys. Any organism that has an effect in the system probably possesses it *ab initio*, and does not acquire it.

Generally speaking, the temperature of the human body is a very favourable one for the development of micro-organisms. Where fevers are accompanied by an organism, it may be presumed that the rise of temperature first favours the growth, and that later a temperature is reached that has an adverse effect ; and that every Bacterium has its most favourable point in such a range of temperature. It is evident that were the favourable and unfavourable degrees of temperature known for each pathogenic organism, that additional light would be thrown upon the treatment of certain fevers.

One of Pasteur's most interesting experiments has a distinct relation to the foregoing matter. He found that birds were not susceptible to Anthrax virus, and, presuming that it was from the high blood temperature, 105 degrees Fahrenheit, he tried the experiment of reducing the temperature of a fowl to 98 degrees Fahrenheit, by placing the feet in cold water. Under these conditions it was inoculated with Anthrax virus, and died in twenty-four hours. Another fowl, so inoculated and assisted back to its normal blood-heat by exposure to a temperature of over 100 degrees Fahrenheit, recovered completely.

One of the most important points connected with researches on pathogenic organisms, is to discover methods for weakening or attenuating the virus. Pasteur has, we know, been exceptionally successful in this line. In the case of splenic or anthrax fever guinea pigs were employed. and it appeared that when these were young the virus had not so much effect as on old ones, and in the former case had lost power. The full strength of attenuated virus would be restored by cultivation in guinea pigs of successive ages. starting with young ones and ending with old. Many micro-organisms have their virulent properties reduced by exposure to air or oxygen gas.

Public interest has been gradually, but is now fully, awakened by Pasteur's splendid research in connection with hydrophobia, commenced in 1880 and now apparently brought to a successful issue. So much notice of this work has been taken by the daily press that the main facts are fresh in our recollection. Some of the most important departures in the earlier days of this research were:—inoculating with brain substance from animals that had died of rabies, by introduction into the brain of living animals, and the attenuation of the virus by cultivation in rabbits.

There is little doubt that the spores of some of the pathogenic Bacteria have nearly the same resisting powers as those of commoner organisms. The spores of Bacillus anthracis, for instance, can stand a boiling heat without destruction.

Whilst the tissues are in a thoroughly healthy condition they are probably well able to resist the influence of organisms, otherwise existence would be well nigh impossible. Pathogenic organisms have not necessarily the same action in men and animals, in fact, their action varies much in different individuals; for instance, Anthrax bacilli will produce the disease in human beings or herbivorous animals, but not in carnivorous animals or the omnivorous pig, but infusions from the blood or tissues of the last-named animals will nourish the organism. Death from the development of a specific Bacterium, such as in the case of Tubercle Bacillus inoculated into guinea pigs, is not always attended by the production of large numbers of the organisms, that is to say that their number is hardly commensurate with the effect. It has been argued from this that Bacteria may give rise to specific poisons in the blood, and that these are mainly accountable for the symptoms.

There are two theories connected with non-recurrence of some diseases and immunity by inoculation.

1. That the organism uses up substances favourable to its growth, and that a further supply of these matters is not directly forthcoming. This is called the Exhaustion Theory.

2. That the organisms give rise to substances that act as poisons to Bacterial life, these substances remaining in the system for a greater or less time. This is known as the Antidote Theory, and covers the facts of the case much better than any other.

Amongst antiseptics generally, Sulphurous Acid and Mercuric Chloride seem to be the most effectual, but they have very little effect on Bacteria in the state of spores.

It will be fairly evident from what has been said of nourishment for Bacteria, that a particular food may suit one organism much better than another, and that it would be possible in a certain plasma to supplant an organism growing indifferently by one that could thrive in the same medium. An application of this view has recently been made by an Italian doctor, Cantani, in the case of consumption, or tubercular disease, by what is called Bacterium termo treatment, which consists in supplanting the tubercle Bacillus by inoculation of the lung substance with

Bacterium termo by means of spray containing the latter organism. It is affirmed that Bacterium termo will so thrive as to kill out the former occupant, and that the septic condition so induced can be cured by ordinary antiseptic treatment. As yet this highly interesting process lacks substantiation. One objection appears to me against the whole affair, namely, that inherent defects of the system, or other predisposing causes, probably allow the tubercle Bacillus to commence its growth, and one can hardly believe that Bacterium termo, or any other organism, could remove these radical tendencies.

We will conclude with some considerations relative to the age of Bacteria, and the position they occupy amongst other organisms.

It is a matter of certainty that some forms of Bacteria have existed on this earth from some very distant period of its history, for well-defined Bacteria have been discovered by Van Tieghem in thin sections of fossil roots of coniferæ and other fossilised vegetable remains from the coal measures. The organism is almost identical with an existing species known as Clostridium butyricum (Plate II., Fig. 4), and shows various characteristic stages of development; whilst the fossil membrane in which they are embedded gives such indications of destruction as are associated with a Bacterial growth.

It is an interesting fact that the tartar removed from teeth of an Egyptian mummy exhibits a micro-organism identical with what is known at the present time as Leptothrix buccalis, which is associated with caries of the teeth. So, perhaps the ancient Egyptians, possibly even the Pharoahs themselves, did not enjoy immunity from the distracting cares of an aching tooth.

An interesting field for speculation is afforded by considerations as to what course of evolution, or perhaps involution, gave rise to Bacteria. It seems probable that they were originally retrograde forms from some higher organism, and having acquired, like the moulds, a parasitic habit in respect to vegetable life, they adapted themselves gradually to the richer food afforded by animal substances. A well-defined fossil mould has also been found in the coal measures, so that the two classes of Saprophytes were co-existent so far as this epoch is concerned.

Now, taking into consideration the three classes of Bacteria, moulds, and alcoholic ferments, the relation between the last two is so strong that I think one is quite justified in considering the alcoholic ferments as derivatives of the moulds, for the following reason:—Two or three well-known moulds can be converted into alcoholic ferments. This is notably the case with Mucor racemosus, and in the last few years Brefeld has published the information that he has converted a great many moulds into simple cells, having the ferment form

Secondly, it appears to me that the relationship of Bacteria to moulds is much stronger than to alcoholic ferments, more especially turning on this point that the Saccharomycetes never show a motile state caused by Cilia. Whilst many moulds produce actively moving bodies or Zoospores, with Bacteria the motile stage is an ordinary feature. All three classes of organisms may form spores, but the Saccharomycetes only do so under very exceptional conditions, probably never as a normal method of reproduction.

Bacteria in a moving state seem to display something akin to intelligence. The susceptibility to light has been already noted, and it may be mentioned besides that some organisms display a certain ability for avoiding collisions with moving or stationary matters that they may encounter in their wanderings through a liquid.

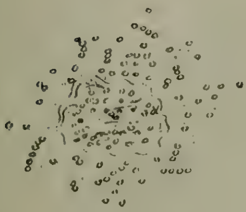
Bacteria require, as a rule, more complex forms of nourishment than moulds or Saccharomycetes. These last will thrive fairly well in a mineral solution, in which the carbon and nitrogen are represented by ammonium tartrate, whilst Bacteria grow but very feebly in the same.

Bacteria, then, may be ranked higher than moulds or alcoholic ferments, for although they show characteristics which, at each end of the scale, join them to separate kingdoms, making it a question between animal and vegetable life, the weight of evidence goes, I should say, to point out a much nearer alliance to the former than to the latter condition of existence.

Plate I

Micro-organisms

Fig. 1

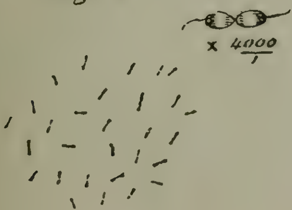


Micrococcus Aurantiacus $\times \frac{300}{1}$

Fig. 2

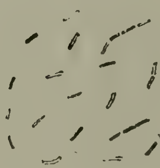
Bacterium Aceti $\times \frac{600}{1}$

Fig. 3



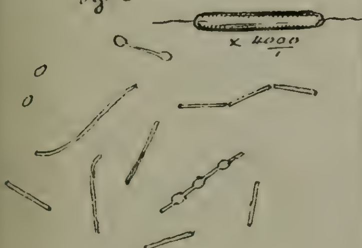
Bacterium Termo $\times \frac{700}{1}$

Fig. 4



Bacterium Lactis $\times \frac{450}{1}$

Fig. 5



Bacillus Subtilis $\times \frac{700}{1}$

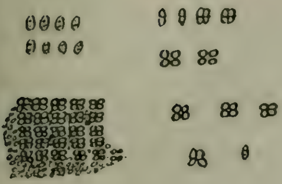
Fig. 6

Spirillum Volutans $\times \frac{700}{1}$

Plate II

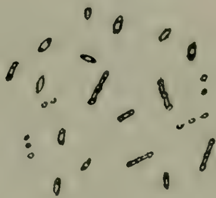
Micro-organisms

Fig. 1



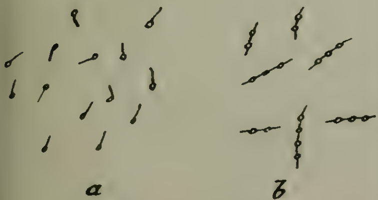
Sarcina Litoralis × 650/1

Fig. 2



Bacterium Amylobacter × 350/1

Fig. 3

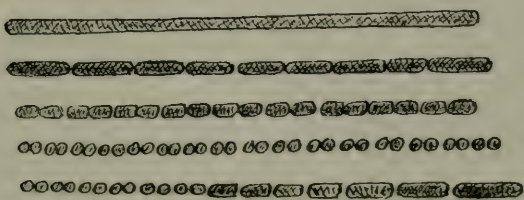


Sporulating Bacteria × 300/1

Fig. 4

Zooglœa of Bact. Lactis × 300/1

Fig. 5



Bacterium Merismopedioides × 700/1

Plate III

Micro-organisms

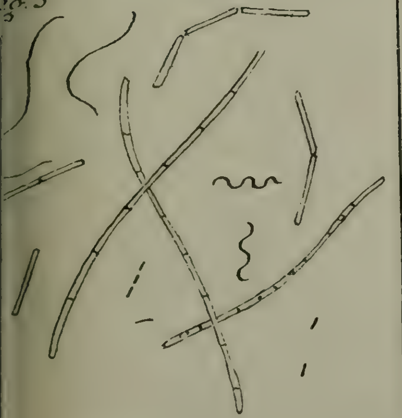
Fig. 1

Cladothrix Dichotoma × $\frac{500}{1}$

Fig. 2

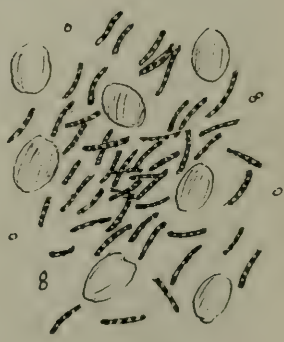
Crenothrix Kühniana × $\frac{600}{1}$

Fig. 3



Sewage Fungus × $\frac{300}{1}$

Fig. 4

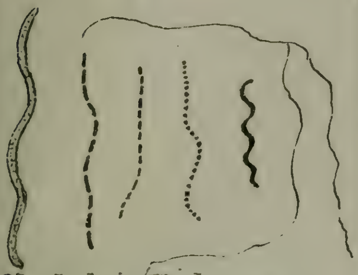


Bacillus Tuberculosis × $\frac{700}{1}$

Plate IV

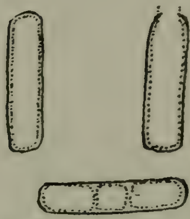
Micro-organisms

Fig. 1



Cladothrix Dichotoma

Fig. 2



Differentiation of Cell-Wall

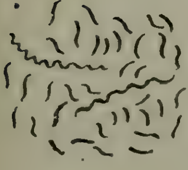
Fig. 3

Diphtheritic Membrane

Fig. 4

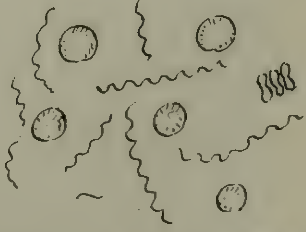
Bacillus Anthracis × 700/1

Fig. 5



Spirillum Choleræ Asiaticæ

Fig. 6



Spirillum of Relapsing Fever

A Chapter in the Physical Geography of the Past.

By Horace T. Brown, F.G.S., F.C.S., F.I.C.

PRESIDENTIAL ADDRESS

DELIVERED

November 4th, 1887.

THE first aim of a local Society like ours should be to make a careful and accurate record of all the natural phenomena of our neighbourhood; but were we content with this alone, we should scarcely be entitled to consider ourselves a *scientific* body; science does not consist in the mere accumulation of facts, for no matter how interesting these may be in themselves, we must remember that after all they are only a means to an end. Facts *belong* to science it is true, but we must look upon them merely as the raw material out of which we elaborate, by processes of scientific reasoning, great principles of universal application.

I sometimes hear it asked whether the lists of the district fauna and flora, which are so carefully compiled by many hard working members of our local societies, have any value apart from that of an index to the student of the exact locality where he may expect to find any particular plant or insect which he may be studying. Now, undoubtedly, the immediate value of such lists is the one I have indicated, but they have a far greater importance than this, in affording material to the philosophical naturalist for studying geographical distribution, and for working out all those great influences of climate, soil, and general external conditions, upon the varietal changes which occasionally become stereotyped as new species. In order to facilitate this highest aim of the naturalist, our local societies ought, I think, to make their lists more *quantitative* in character, if that is possible, and to note more than they do at present the interdependence of animal and vegetable life, and the relations of the plants to the geological nature of the soil upon which they are found. The field geologist often gets valuable hints as to the character of the rocks hidden under a thick mantle of vegetation, by observing the nature of the plants growing upon them. Plenty of instances of this kind must occur to any geologist who has occupied himself with the minute survey of a district. As a good example, I may mention that Professor A. H. Green, during his survey of the Carboniferous Rocks of North Derbyshire, found that he was often able to define the boundary of the Carboniferous Shales and Sandstones by the fact that rushes are found on the shales, and that heath and furze grow more plentifully on the sandstones; and he also notes that a crowded belt of the little *Viola lutea* is often seen along the outcrop of a sandstone bed, whilst not a single plant will be found on the shales that come out on either side.

The aid which botany is able to afford to geology is manifestly reciprocal, and if botanists would only take care to note, amongst other things, the kind of sub-soil upon which any particular plant grows, they would, I think, render their lists more valuable, and attach to them a far wider interest than they commonly possess.

These are mere suggestions which I venture to make for your consideration, but I will not enlarge upon them this evening, as I wish to occupy your time in trying to deduce from a mass of geological facts, which to many of you must seem dry and uninteresting, certain generalizations which I trust will prove of interest even to those who have no special knowledge of geology.

The student of geology, whilst occupied in observing the thickness of the strata, their physical nature, order of superposition, angles of dip, and fossil contents, finds, it is true, a keen and vivid enjoyment in such work, but if he is of a philosophical turn of mind, he will place but little scientific value upon such observations, when they are regarded as mere isolated phenomena; but when a large mass of facts has been accumulated and systematized, it becomes possible by a comparison and correlation of results, and by the application of strict methods of reasoning, to make out the order of past events, and to read by the light of the present the physical changes which this world of ours has undergone in ages long past. This is, indeed, the highest aim of geology, which has been well defined as the "physical geography of the past," and I think I shall do well by attempting to show you something of the methods by which this re-construction of old world features is accomplished, and by applying them to the elucidation of some of the past conditions of the portion of Central England in which we live. The period which I have selected for this purpose is that in which were laid down the great mass of the Carboniferous Rocks, rocks including the Mountain Limestone and the Coal Measures. Owing to their vast superficial exposure in Great Britain and Ireland, and to the manner in which they have been explored for their mineral wealth, we have, perhaps, in the Carboniferous Rocks a greater accumulation of important facts to work upon than we have in any other system.

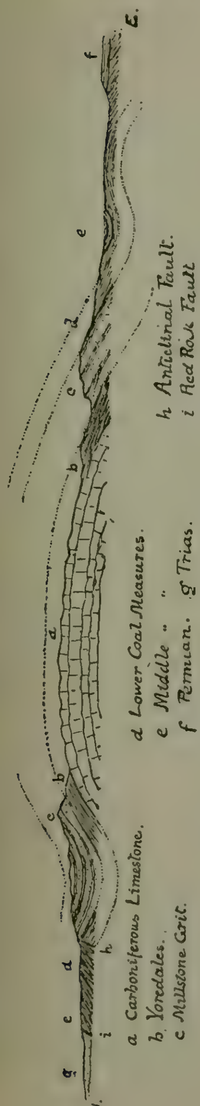
Before attempting to throw any light upon this chapter in the ancient physiography of our Midland District, I must, in the first place, call your attention to the existing conformation of the surface, and to the close connection there is between the nature of the underground rocks and the features of the country as now presented to us.

If we look at any good physical map of England, we notice, running almost down the centre of the Northern part of the country, a broad range of hills which forms a great water-parting, from the western side of which the streams run into the Irish Sea, and from the eastern into the North Sea. This broad ridge of high ground—one of the most striking natural features of our country—is known as the Pennine Range, and has been aptly described as the *back-bone* of England. It attains its highest elevation of about 2,600 feet in the North Riding of Yorkshire; and in the Peak, the highest part of North Derbyshire, it reaches about 2,000 feet above the sea-level. When followed from the northern counties southward this ridge of high land is found to terminate abruptly, a few miles to the west of Ashbourne, in the Weaver Hills; and it is this southern portion of the range which serves to illustrate, in the best possible way, the geological structure of the Pennine Chain.

The rocks, constituting the Chain, belong exclusively to the Carboniferous System—that great division of the older rocks which, in its upper part, contains all the principal coal seams of this country. This division, or *system* as geologists call it, can be broadly divided into four series of strata which are invariably found in the same vertical order or succession. The lowest series is that of the *Mountain Limestone*, a mass of hard, and, in some cases, almost crystalline Limestone rock. Above the Mountain Limestone we have a series of black shales and sandstones, with thin beds of impure limestone, known as the *Yoredale Shales;* and above the Yoredale Shales we have the *Millstone Grit*, a mass of coarse sandstones with thick shale partings, and an occasional thin seam of impure coal. The Millstone Grit is, in turn, overlaid by the Upper, Middle, and Lower Coal Measures, which are made up of an assemblage of sandstones and shales, with many important and excellent beds of workable coal in their middle division.

UPPER CARBONIFEROUS	COAL MEASURES	Upper
		Middle
		Lower
	MILLSTONE GRIT	
LOWER CARBONIFEROUS	YOREDALE SHALES	
	MOUNTAIN LIMESTONE.	

The exact line drawn between these various members of the Carboniferous System is, for the most part, an arbitrary one; for, although when looked at as a whole, each division has very different characters from the one below and above it, yet they often pass into each other vertically by insensible gradations.



DIAGRAMMATIC SECTION ACROSS PENNINE ANTICLINAL. DISTANCE ABOUT 35 MILES.

The total thickness of this great pile of strata is probably over 12,000 feet in Derbyshire, and this does not represent the whole of the original thickness of the beds. From the evidently *sedimentary* character of all these rocks, we are quite sure that the materials were laid down under water, in a horizontal or almost horizontal position; but we now find them elevated considerably above the level of the sea, and with their original bedding lines inclined to the horizon at all sorts of angles. The true relation of such beds to each other, and to the present conformation of the surface can only be ascertained when a large district has been surveyed, and all the outcrops of the strata laid down on a map with the observed inclinations, or *dip* of the strata, as it is called. From such maps it is possible to construct imaginary sections across a country, showing at a glance the present position of strata, which once forming horizontal and continuous sheets, may now have become folded, faulted, and disconnected, in all sorts of complicated ways.

You have before you such a horizontal section taken along an east and west line across the Pennine Range, from about eight miles north-east of Chesterfield, through Buxton to Macclesfield, a total distance of about 35 miles. This section must be considered as diagrammatic, for besides having its vertical scale much exaggerated it has been somewhat generalised so as to bring into prominence the salient points bearing upon the structure of the Range.

You will observe that the rocks, which, as I have said before, were originally laid down in a horizontal position, are now thrown into a huge *fold* or *arch*, with one or two minor folds or corrugations flanking it.

The direction of the folding is approximately north and south, and, looked at in a general way, the strata incline from the centre of the arch, both to the east and to the west, just as the slanting sides of a roof do from the ridge tile. As we travel from the central mass of limestone of North Derbyshire in either of these directions, we pass successively, and in ascending order, over the edges of all the divisions of the Carboniferous System right up to the Coal Measures. A study of the map and section would strongly suggest to us that the strata which are now thus severed were once continuous right across the arch, and this is put beyond doubt, not only by the similarity of the sedimentary strata on either side, but also by the proved identity, a little further north, of several of the Coal Seams in the Lancashire and South Yorkshire Coalfields, which lie on opposite sides of the great fold. The crown of the arch or *anticlinal* has, in the district we are considering, been so far destroyed since its elevation, by the ceaseless action of rain and river, frost and snow, aided to some extent by the sea, that the great mass of Coal Measures, Millstone Grit, and Yoredales, which once stretched right across from side to side, has been completely swept away, exposing to the light of day the Mountain Limestone; so that this, the lowest member of the Carboniferous Series, now occupies the most elevated part of the ridge.

The same graving tools of nature which removed the upper measures have also cut deeply into the limestone itself, producing those lovely and picturesque dales which render our Derbyshire districts so beautiful.

We are thus enabled to form some idea of the immense amount of material which has been denuded from the central portion of the Pennine Area. We have had swept away the whole of the Coal Measures, the Millstone Grit, Yoredale Shales, and a variable thickness of the Mountain Limestone itself, which must represent in the aggregate at the very lowest estimate 10,000 to 12,000 feet of rock. If the elevatory forces had not been compensated by the subærial waste, we should have had not *hills* in Derbyshire but *mountains*, raising their heads far above the snow line of this latitude.

Although it is pretty certain that our range of hills at one time reached a higher elevation than at present, it is unlikely that this ever equalled the total thickness of strata which have been removed from its central portions; for we have reason to believe that the great upheaval was not the result of one sudden earth movement, but was brought about by a slow, gradual, and intermittent process, extending over a vast period of time. Under these circumstances those never-ceasing atmospheric influences, which are constantly at work through the agency of rain and river, must have commenced their wasting action as soon as the bottom of the Carboniferous Sea was brought above the level of the water, and the erosion of wave and current would begin even before this. In this way the planing and sculpturing forces of nature almost kept pace with the upheaval, and the great anticlinal ridge was scarred, furrowed, and truncated from its earliest childhood.

We can trace the great north and south Pennine Axis right through North Derbyshire into the West Riding of Yorkshire, a total distance of about 60 miles, but in the extreme north of the first mentioned county, the beds, of which the hills are composed, begin to bend over a little to the north, and this tendency increases rapidly as we travel further in the same direction. At the southern extremity, in the Weaver Hills, the limestone is also seen to bend over gently, but in this case it is towards the south. It is evident, therefore, that we must to some extent correct our notion of this great anticlinal, which is not a mere arch of indefinite length, but a very long, low, elliptical dome of rock.

To return once more to the Yorkshire end of this dome, or *periclinal* as it is called, we notice that the north and south folding of the rocks gives place to great corrugations in a direction at right angles to this, that is east and west.

The result of this has been to bring up lower beds from beneath the Coal Measures, these latter having been entirely swept off north of a line drawn due east and west a few miles to the north of Leeds, as far as the Tees. These east and west folds have impressed themselves on the physical conformation of the North of England, just as the great Pennine anticlinal has done further south ; for to them is due that system of east and west valleys, with high separating ridges, which run across the moorlands of Yorkshire. Here also, just as further south, the upper parts of the folds have been denuded right down to the Mountain Limestone.

Having now briefly considered the structure of the Pennine Hills we must turn our attention for a short time to the Central Midland District immediately south of the termination of the range, and I must ask you to accompany me in imagination to the summit of the Weaver Hills near Ashbourne. Here, at a height of 1,200 feet above sea level, we find ourselves on the southern extremity of the Pennine Range. If we look upon the range as the "backbone" of England, we are now standing upon what an anatomist would call its *terminal caudal vertebra.* To the north is all the rugged hill country of Derbyshire, but to the south, the country over which we look, stretched out like a map at our feet, is of an entirely different character, and consists of a gently undulating plain, which, elevated only 300 to 400 feet above the sea, is in fact the western extension of the largest plain in the world. When standing on Weaver we look towards the rising sun, if it were possible to extend our powers of vision to an indefinite extent, and allow for the curvature of the earth, we should find no mountain or hill to obstruct our line of sight until our eyes rested upon the Ural Mountains, which divide Europe from Asia. Broken only by the inconsiderable ripple of these mountains, this mighty plain extends across the whole of Northern Asia.

In Europe the strata underlying the plain are of much more recent date than those constituting the Pennine Chain. At the base of the Derbyshire Hills they consist of sandstones and marls belonging to the New Red Sandstone Series, which, sweeping round the base of the hills, follow every curve and inlet, so as to suggest, what is actually the case, that they were deposited round the flanks of the older rocks at a time when the high land of Derbyshire had its southern coast line in the Weaver Hills.

Far away to the south and south-east we can discern, rising out of the sea-like plain, three tracts of elevated ground, which mark the position of the Coal Fields of South Staffordshire, Warwickshire, and Leicestershire, respectively. In all three of these tracts Carboniferous Rocks are again brought to the surface in dome-like masses, from which the overlying New Red Rocks have been stripped by the waste of ages. These Carboniferous Rocks doubtless owe their present position to the action of the same forces which elevated the Pennine Range. In the case of the Leicestershire Coalfield, upon the western edge of which our town of Burton is situated, I shall be able to give you some proof of the correctness of this statement, but I shall have little time to refer to the South Staffordshire and Warwickshire areas. I may state, however, that, unlike the Derbyshire district, in all three of these coalfields we have occasional glimpses of the old sea floor upon which the Carboniferous rocks were deposited; thus affording us valuable information in our attempt to reconstruct the physical features of the country at that very remote period.

On the Eastern side of what we may term our home district of the Leicestershire or Ashby coalfield, this old floor upon which the Carboniferous sediments were thrown down has been bared to the light of day, exposing in Charnwood Forest a large tract of some of the oldest rocks in the British Isles, consisting mainly of slates, grits, volcanic agglomerates, and syenite, and occupying a ridge of ground about eight miles long and five miles broad.

Although the elevation of the Charnwood Ridge does not, in its highest point, reach more than 900 feet above sea level, it presents, especially when viewed from its eastern side, a bold, serrated edge, in strange contrast to the gently flowing outline of most of the other hills of the Midlands. Its jagged and craggy summit, under certain atmospheric conditions, has a strangely mountainous aspect, and has often been justly compared with a miniature Alpine range. This resemblance, after all, is not a fancied one, for the Charnwood hills have all the characteristics of a true mountain range. It was pointed out, many years ago, by the late Professor Jukes that here, within a very small area, and without any laborious climbing, we can study at our leisure nearly all the geological phenomena afforded by mountainous districts. Although of very diminutive proportions as compared with the mountain chains of Europe, we must bear in mind that denudation has played its part here also, and that it is only a ruin of its former self. Its elevation, doubtless coeval with that of the Pennine Range, took place at a very remote period of the world's history. The now lofty chains of the Alps, the Pyrenees, the Andes, and, in fact, nearly all the important mountain ranges of the world, are but mere children in point of age when compared with the venerable antiquity of our Leicestershire hill country. In fact, the Charnwood area had an elevation far in excess of its present height, and had been subjected to denuding forces ages before the sedimentary rocks, which form the greater part of those mountain chains, had even been laid down in their ocean beds.

The Charnwood ridge has been produced by an anticlinal fold with its axis running N.W. and S.E. This fold has been ruptured at the crown of the arch by the great forces which brought about its elevation, and the western ridge has in consequence been forced some 500 feet higher than the eastern. Such a rupture, attended with the vertical uplift of the rock on one side of the great earth crack, is called a *fault*, and if it had not been for the constant planing action of sub-äerial forces keeping pace with the slow uplift, we should have had one side of the range elevated as a lofty wall of rock above the other side. As it is, however, nature has so planed the surface that the old scar is not visible, and can only be inferred from the want of correspondence in the beds on either side of the anticlinal.

On the West of the Charnwood area the actual super-position of the Carboniferous strata upon their old sea bottom, consisting of Charnwood rocks, is not visible, owing to the existence of another large fault running parallel with the anticlinal fault, letting down the Coal Measures against the former. It is only on the North and North-West that the Mountain Limestone, the lowest member of the Carboniferous system, is found resting upon the Forest rocks ; and here we find unmistakable evidence that the latter must have been immensely disturbed and denuded before the limestone was laid down upon them. Such a super-position is known as an *unconformity*, in contradistinction to the term *conformity*, which is used to express an unbroken sequence of sedimentation, like, for instance, that of the various members of the Carboniferous System from the Mountain Limestone right up to the Coal Measures.

From the fault last referred to the Coal Measures occur at the surface to a little east of Burton, where they are lost sight of under the mantle of New Red Rocks which surround the Leicestershire Coalfield. These Coal Measures, as far west as we can trace them, have also been affected by the great earth movements which brought about the Charnwood axis of elevation, and show a system of faults and folds approximately parallel with this. They have also been subjected to plications and faulting at right angles to this axis, with the result that the strata of the western or more productive parts of the Coalfield have been thrown into a basin-like form, which has much conduced to their preservation. And here, perhaps, in dwelling upon this, it will be well to correct a misapprehension which has probably arisen in the minds of some of you, that elevated tracts of land are generally coincident with upward folds or ridges in the underlying rocks, whilst the valleys run in the troughs. This is undoubtedly sometimes the case, and we have seen two good instances of it in the structure of the Pennine and the Charnwood Ranges ; but more frequently the very reverse holds good. When a mass of strata which has been thrown into a series of folds is planed down on its upper surface by the action of the sea, forming what is called a plain of marine denudation, it is evident that the folds which are convex upwards must be planed off before the concave portions or the troughs can be reached. Moreover, when such a plain of marine denudation becomes again dry land, and subjected to atmospheric influences, the trough and saucer-like portions of the folds, owing to the inclination of the strata towards each other, will be more stable than the convex portions in which the strata incline outwards. In one case the force of gravity will *retard* denudation, in the other it will *facilitate* it. And thus it may, and often does come to pass that the summit of a hill is coincident with the trough of one of the folds, or the synclinal as it is called, whilst the valley runs along the anticlinal. Another reason for the difference is to be found in the frequent fracture of the tops of anticlinals allowing the freer access of water, and thus hastening the destruction of the arch.

It now becomes easier to understand what I have said about the saucer-like shape of the western portion of our coalfield conducing to its preservation. This is a structure common to nearly all our coalfields, and is merely a geological instance as applied to strata of the "survival of the fittest" to withstand denudation.*

Having now briefly glanced at the physical features and geological structure of the Pennine Range and of its southern extension under the newer rocks of the Central Midlands, we must try to ascertain something about the conditions under which

* I do not know any better instance of the comparative stability of synclinally curved strata over strata curved in the opposite direction than is shown in a portion of our coast which most of you know well. The great Orme's Head at Llandudno is a bold hill of massive Mountain Limestone connected with a smaller hill of the same rock, the Little Orme, by a very narrow neck of low lying ground. When the two hills are seen from Llanfairfechan on the west, it can be clearly seen that the strata of the Great Orme are bent upwards in a synclinal or saucer-like form, and it is perfectly evident from the lines of the curved strata that they once bent over again in the form of an arch to the mainland, and joined those of the Little Orme. The result of denuding forces acting equally upon this once continuous mass, has been entirely to remove the comparatively weak arch or anticlinal portion, and to leave the saucer-like synclinal untouched.

the sediments forming the various portions of this huge pile of Carboniferous rocks were originally deposited. But before we attempt to do this let us turn for a moment to what is going on at the present day around our coasts, and see if we cannot deduce from our observations some guiding principles with regard to the phenomena of sedimentation, which may help us in our enquiry.

We find that the material which is constantly being brought down by streams and rivers, and which has of course been derived from the degradation and waste of the land, is deposited on the bottom of the sea when the velocity of the currents bringing it down has been sufficiently checked. The particles thus carried down to the ocean vary in size from large rounded pebbles to the finest possible mud; and, since the carrying power of water is dependent upon its velocity, it is not surprising that we find a sorting action going on; that whilst the coarser sediment is deposited near the coast the finer material, under the combined influence of the outflow of rivers, and wave and tidal action of the sea, is carried out to a far greater distance from land before it is deposited on the more or less shelving bottom.

If we could make a horizontal section at right angles to the shore line of any large body of water, fed by running streams, we should find, as a general rule, a belt of coarse, roughly stratified shingle, giving place gradually to a less coarse and more sandy sediment, and this again graduating further from shore into beds of fine mud, which may extend for a very considerable distance. From the somewhat intermittent character of the streams and currents we should not expect anything like a sharp or invariable line dividing off these various sediments horizontally, but we should observe them dove-tailing, as it were, into each other laterally.

It is evident that the beds of fine mud forming the very outermost fringe of the land must come to an end somewhere, for, given a sufficient time, the very finest sediment will fall to the bottom.

As a rule, except in shallow seas and opposite the mouths of great rivers, the very finest mud deposits do not extend more than

100 miles from land. Farther out than this, in deep water soundings have shown the bottom to consist of a widely spread deposit of a white, sticky *ooze*, which when dried resembles chalk in appearance and also in composition.* This is a veritable *limestone* now in course of deposition, and is the product of minute specks of living jelly, which abstract the carbonate of lime from sea water wherewith to form their shells, which, after the organisms are dead, are showered down upon the sea bottom. These microscopically minute animals are known as Foraminifera, and many of the limestones known to geologists have been built up almost entirely by their agency. They are, however, by no means the only limestone builders. Coral Polyps play a most important part in the production of modern limestones, and that they have played as important a part as far back as Devonian and Carboniferous times is equally certain. Then again we find some limestones made up almost entirely of the remains of Encrinites or sea-lilies, and of the shells of molluscs. Muddy water is absolutely inimical to the life and growth of these limestone builders, and we may be quite sure when we find a mass of pure or almost pure limestone of organic origin that the deposit was formed far away from land, or at any rate in water absolutely free from the influence of streams bearing their freight of mud seawards.

Such a mass of limestone is that of Central and North Derbyshire, and we are justified consequently in taking the first step in our reconstruction of the physical features of the Lower Carboniferous Period, by assuming that this immensely thick mass of almost pure limestone marks the position of an area of deep and perfectly clear water.

When this mass of limestone of the Pennine Range is traced along the country to the north, we lose sight of it in the neighbourhood of Castleton, owing to its disappearance below the Yoredale Shales and Millstone Grit. When it is once more brought to the surface in the neighbourhood of Skipton, in

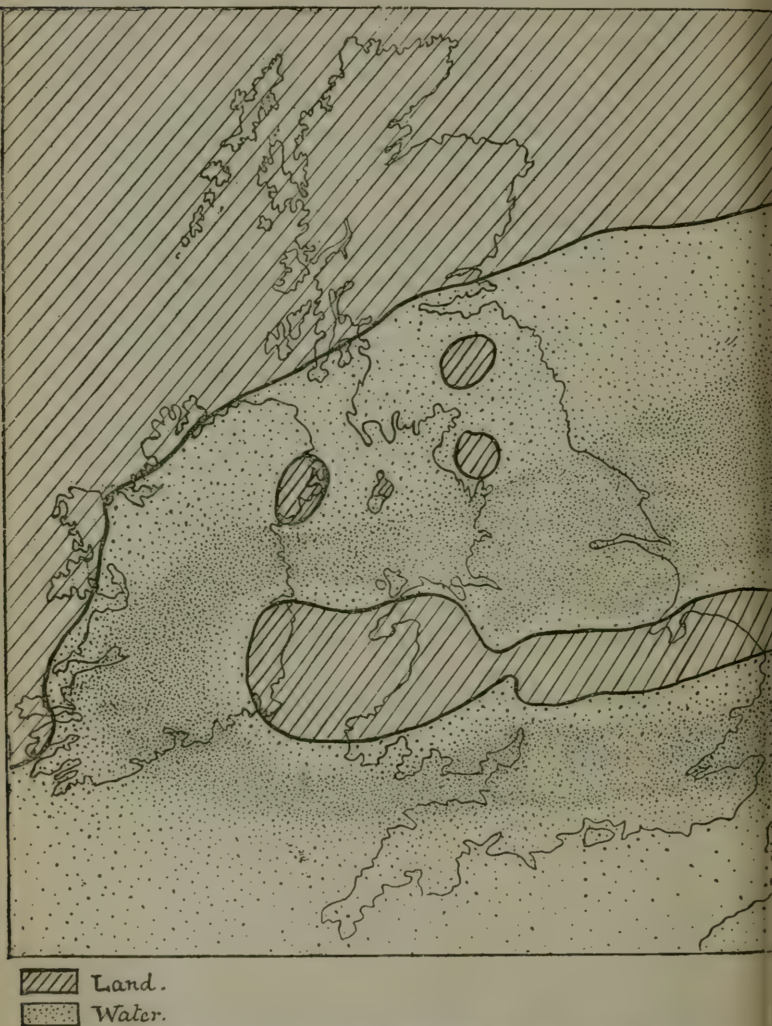
* In the abyssal depths of the ocean this calcareous ooze is replaced by a red clay, the origin of which is at present unknown.

Yorkshire, by the east and west plications already referred to, it shows some decided indications of altering its character, for we now find it containing several beds of shale, or hardened clay. Still, however, the limestone predominates, but the deposit has not quite the pure character of the limestone further south. A little further north still the shales or clays become thicker, and the limestones thinner, and, at the same time, the beds of limestone become divided by beds of *sandstone.* This progressive change continues right into Northumberland, where the massive Mountain Limestone and Yoredale Series of Derbyshire are found to be replaced by a mass of sandstones, shales, and thin limestones, containing in the upper part as many as seventeen seams of thin, but workable coal, all deposits of shallow water origin.

Now this extraordinary but gradually progressive change in the character of the beds when traced laterally, can only be satisfactorily explained in one way, when we bear in mind what we may call the physics of sedimentation. As we proceed northwards, we are leaving behind us the deep sea of Lower Carboniferous times, with its clear water and limestone-building creatures, and are approaching, through gradually shoaling water, *the old coast line, and the mouths of the rivers which brought down from the old Carboniferous land the sand and mud which now form the sedimentary deposits.*

The exact position of this old coast line is indicated by a bed which lies at the very base of the Carboniferous rocks of the North of England, but which is, of course, not met with in the Midlands. It is what is known as a Conglomerate, a rock-like mixture of sand and rounded pebbles. It is, in fact, a consolidated and fossilized sea-beach, and we find it abutting against the old shore formed by the Cheviot Hills, from which most of its rolled fragments have been derived.

Although the Cheviots formed land during early Carboniferous times, we have sufficient evidence to indicate that the area was an *island*, and that we have to look still a little further North for the coast of that great continent which was drained by the rivers of the Carboniferous period. In Lanarkshire



MAP OF THE AREA, NOW OCCUPIED BY BRITISH ISLES, DURING THE LOWER CARBONIFEROUS PERIOD.

N.B.—The relative depth of the water is indicated by the dotted shading.

we find the old Carboniferous beach resting upon the old Red Sandstone, and, to a great extent, derived from its waste. From the thinning out of all the beds above this, there is the strongest possible evidence that, across a line drawn from the Firth of Tay to the extreme North of the Island of Arran, the shore conditions continued for a very long period in Lower Carboniferous times, and that the land rose rapidly North of this line, in the region of the Scotch Highlands, to a much greater height than it does at the present time.

In Ireland the Carboniferous Limestone is strongly represented in Clare, Tipperary, and Queen's County, its greatest development being only about half a degree of latitude further south than its greatest development in our own Northern Midlands. Here, just as with us, the limestone shows the same tendency to give place to mechanically formed deposits, *i.e.*, sandstones and shales, further towards the north and north-west, indicating, as with us, the direction in which the old land lay. That the western portions of Donegal, and of Connaught, formed part of this coast there is a great deal of evidence to show, and it is probable that the western portion of County Kerry was also above water.

Around the old Silurian Rocks of our Lake District there are found thick uneven deposits of Conglomerate and Sandstone, belonging to the base of the Carboniferous, and, from their irregularity and the rapid way they thin out, it is evident that they were beach deposits banked around an island in the Carboniferous Sea. There are also similar deposits in the southern part of the Isle of Man.

Having traced the Mountain Limestone of the deep water of Central Derbyshire to the north and north-west shore of the sea in which it was deposited, we will retrace our steps once more to the Derbyshire district, and ascertain what becomes of this massive limestone when followed southwards.

The southern prolongation of the limestone of the Weaver Hills plunges, as we have seen, beneath the more recent New Red Measures near Ashbourne, and we see nothing more of it until, owing to a series of small folds, it is brought to the surface again some 20 miles to the south-east on the northern margin of Charnwood Forest. We there find it in eight small patches, of which that of Ticknall is the most northerly, and that of Grace Dieu the most southerly.

But the rock has undergone a great change between Derbyshire and Charnwood. Instead of the thick, massive beds of limestone, of which we have never seen the base, and which must be at least from 4,000 to 5,000 feet thick in North Derbyshire, we find a rapid tailing off in thickness as Charnwood is reached; a tailing off which at Grace Dieu, only 20 miles south of the Derbyshire hills, *has reduced the thickness to about* 40 *feet*. At the same time the rock loses somewhat its purity, and becomes rather more earthy in character, but there is no intercaldation of sandy beds. At Ticknall, as some of you will remember, we have unmistakable evidence of the shelving nature of the bottom upon which the limestone was deposited.

Taking all the evidence together, there can be no doubt that we are approaching once more a *coast line*, for the attenuation of the Mountain Limestone cannot be due to denudation, since we find it overlaid by the Limestone Shales and Millstone Grit.

This new southern land must have been of an entirely different character from the continent bounding the sea to the north. That there must have been clear water nearly close up to the shore is proved by the existence of an organically formed limestone very near the old coast line. That the land must have been of too small an extent to give rise to any great streams, is shown by the absence of any material incoming of sedimentary strata as the southern shore is approached. This southern land was in fact an *island* bounded by a rocky coast. Of this island the northern portion of the Charnwood area was part, and there is not much difficulty by the aid of natural exposures, and by the results of borings, in determining approximately its extent and shape. It must have been long, narrow, and rocky, and extended from what is now the east coast of Ireland, through the Central Midlands, to an indeterminate point eastward.

The proof of this is afforded by the following facts:—At Coalbrook Dale, in Shropshire, we find an attenuated representative of the Mountain Limestone, very similar to that of Grace Dieu, of the same earthy character, and having about the same thickness. This must also have been a shore deposit, and a line drawn through these two places, which are 50 miles apart, cannot deviate far on either side from the old coast line, which must have had a general trend a little south of west. South of this line lies the Coalfield of South Staffordshire, in which the Coal Measures rest directly upon the older Paloeozoic rocks, without the intervention of the Mountain Limestone, so that we are quite sure that the sea in which this latter was deposited did not extend so far south.

From the neighbourhood of Coalbrook Dale the old coast bent round somewhat to the north, for it must have run to the east of the tract occupied by the Shrewsbury Coalfield, where, just as in South Staffordshire, the Mountain Limestone is absent under the Coal Measures. Mantling round the hilly district of North Wales are undoubted beach deposits of Lower Carboniferous age, and by means of these we can trace, with close approximation to accuracy, the old shore line in its course northward and westward between Anglesea and the mountains of Snowdonia to the margin of the Irish Sea.

The western limit of the old island was doubtless where are now the mountains of Wicklow in Ireland, and its southern coast is clearly marked for some distance across South Wales.

On its southern side, in what is now South Shropshire, was a deeply cut little inlet or bay, the existence of which is indicated by the small outlying representatives of the Carboniferous Limestone in the Clee Hills. That there was land on the eastern side of these hills is shown by the Coal Measures of the Forest of Wyre resting on the older rocks, without the intervention of any members of the *Lower Carboniferous*. From this point to Northampton, almost due east, we have no direct evidence to guide us, but at or near the latter place a series of borings through a great thickness of the overlying Secondary Rocks has proved the existence of a sandy and degenerate representative of the Mountain Limestone, thinning out northwards against land rising rapidly in that direction.*

It can be shown by a similar line of reasoning that these old Carboniferous seas, which spread over the greater part of the southern and northern portions of our country, were really arms or inlets of a far larger sea which extended throughout the greater part of Northern Europe, far into Russia. Scandinavia formed part of the great northern continent, and from this, as well as from the south, the rivers were constantly bringing down into this island-studded inland sea their freight of sand and mud, whilst in the deeper and clearer portions limestone was being formed.

As the limestone thickened, filling the hollows in the sea bottom, the water necessarily shallowed, and the deposits of sand and mud, which were originally confined to near shore, invaded the now shallowed areas, and gradually, though at first intermittently, rendered the water unfit to support the life of limestone-building organisms.

We can readily understand how, by slowly alternating conditions, sometimes impure limestone, and sometimes mud and sand were deposited over the same areas. These are the conditions under which the *Yoredale Rocks*, the next in upward succession to the Mountain Limestone, were formed. But it is certain that these muds and sands, and the still coarser sediments of the Millstone Grit which followed them, were deposited in a slowly subsiding area. We have seen how the sandy deposits around our present coasts are laid down in comparatively shallow water, and it is manifestly impossible to explain the existence in the Carboniferous rocks of thousands of feet of shallow water deposits, deposits which could scarcely have been made in water deeper than 100 to 200 feet, without supposing subsidence of the bottom to have taken place concurrently with the throwing down of the coarse sediment.

* Some of the rocks forming this old land have been shown by Professor Bonney to be identical with certain Charnwood Rocks. J.G.S., 1885. Proceedings, p. 48.

That a subsidence of this kind actually did take place is shown by the fact that each member of the Carboniferous Series creeps over the edge of the deposit below it. The Millstone Grit, for instance, extends beyond the original boundaries of the Mountain Limestone, and the Coal Measures again beyond those of the Millstone Grit. This is the phenomenon of *overlap*, which has been so largely made use of in determining the original boundaries, or in other words the *coast-line* of any particular member of the Series.

Up to the present time we have been dealing with sedimentation which took place in salt or brackish water; but, after the deposition of the masses of sandstones and shales of the Millstone Grit, the great Inland Sea, now so shallowed by coarse sandy shoals and mudbanks, became wholly or partially cut off from the ocean, and the water threw down finer sand and clay. We now begin to find traces of old land surfaces, which ever become more and more frequent. Subsidence was still going on, but slowly and intermittently, and the fine clay deposits of the alluvial flats were often for long periods together so near the surface of the water as to support a thick mass of vegetation, the remains of which we now have in our Coal Seams.*

In order to find anything at all approaching the morasses which covered a great part of the surface of the British Isles, and of Northern Europe, in the Coal Period, we must look to the gloomy cypress swamps of the Mississippi. In the Great Dismal Swamp accumulate immense thicknesses of vegetable matter, the product of generation after generation of growing trees and semi-aquatic plants. These masses of peaty matter owe their wonderful freedom from any admixture of sand or silt, to the filtering agency of the marginal belt of reeds and brushwood, which effectually prevents any sediment from mixing with the

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* These land deposits seem to have taken place in the deltas of large rivers, even at a very early period in Carboniferous times, for thin beds of coal are found in Northumberland in sandy and detrital deposits, which are actually contemporaneous with the Mountain Limestone of the Midlands; it is manifest, however, that these could have had but a local extension, and that the conditions favourable for the growth of vegetation over extensive areas were long subsequent.

vegetable mass. Doubtless some such cause as this produced the extraordinary purity of some of our coal seams.

In picturing to ourselves the appearance of those huge, swampy flats of the Coal Period, which covered hundreds of thousands of square miles, we must not imagine a forest growth like that of the present day. The predominating forms, and those whose remains had most to do with coal-forming were *Cryptogams*, and consisted of trees related to our Lycopods or Club Mosses, and to our Equiseta or Horse Tails. These acquired proportions which were truly gigantic as compared with their lowly and degenerated modern representatives. The ferns were mostly of the herbaceous kinds, but some large Tree Ferns also existed, far outstripping in height the noble Tree Ferns of our tropical islands. We look in vain for the higher orders of the flowering plants, for the Phanerogams were only represented by their lowest order the Gymnosperms, which included some Conifers, and a few Cycads. These dense and tangled brakes were not without animal life, for we have found in the Coal Measures remains of scorpions, spiders, cockroaches and crickets. The Coleoptera were also represented, but, as far as we know at present, the Lepidoptera did not yet exist; nor is this to be wondered at when we consider the entire absence of the higher flowering plants. In the waters were numerous fish, but the only known air-breathing Vertebrates were Amphibia, of which the Labyrinthodonts, huge frog-like animals, were the chief. These are known to us principally by the curious hand-like footmarks which they left upon the mud.

The remains of these great sub-tropical forests must have formed originally very thick masses of peat, probably ten or twenty times thicker than the coal seams they were destined to become. This peat consisted, for the most part, of the decomposed cellular tissue of plants which grew upon the spot; and, within the last few years, we have had a curious piece of evidence to show that the initial decomposition of the tissue was effected, not by the mere chemical action of air and moisture, but by the agency of those minute living organisms which we now recognise as playing such an important part in all putrefactive and fermentative change.

That there are some of you here, to-night, who are specially interested in bacteriology, must be my excuse for referring somewhat at length to this interesting fact which, as far as I know, has not yet found its way into text-books.

In the year 1879 Van Tieghem announced to the French Academy of Sciences that he had discovered in certain microscopic sections of plants from the Coal Measures of Saint Etienne, undoubted traces of a minute organism well-known to bacteriologists as *Bacillus Amylobacter*. This Bacillus is very active in the destruction of the cellulose of vegetable tissue, and is identical with Pasteur's butyric acid ferment. So we see that in the marshes of the Coal Period plants underwent decomposition by identically the same agent as they do at the present day, and that even at this very remote time, probably separated from our day by millions of years, this *bacillus* was at work partially destroying the dead tissues of the higher plants, and facilitating their conversion into coal for our use. This is the only well authenticated case, as far as I know, of the discovery of a fossil bacterium,* and it is a suggestive fact that, whilst in course of untold ages its contemporaries high up in the scale of existence have undergone enormous change, this lowly organism is to-day both morphologically and functionally what it was in the Coal Period

In order that you may picture to yourselves the relation of land and water in the British Islands during the Coal Period, I must refer you once more to the map of Lower Carboniferous times. You must imagine that all the area marked as sea has been converted into very shallow water or swampy ground, and that these lagoons have somewhat encroached upon the old shore lines, thus reducing the area delineated as land on the map. The great Central Island still existed, but it was narrowed somewhat, and perhaps also split up into a chain of two or three islands. The Southern Uplands of Scotland, which stood above the water in Lower Carboniferous times, were now submerged, and the island of the Lake District became much smaller. Still on the whole the

* Béchamp's observations on his supposed fossil microzyme of the chalk —Microzyma cretœ—have been found to be erroneous.

general distribution of the land was pretty much as it was when the Carboniferous Limestone was deposited, and this must have been occasioned by the land areas not participating to the same extent as the sea bottom in the slow downward movement which admitted of the accumulation of so many thousand feet of strata.

This is sufficiently indicated in the case of the Central Island, by the great thinning out of all the strata as we approach its northern shore. The Coal Measures, for instance, in our Ashby Coalfield are about 2,500 feet thick, and probably were originally 3,000 feet; these as they approached the barrier ridge southward have thinned out in North Warwickshire within a distance of only 12 or 14 miles to 600 feet.

But we have independent testimony to the fact that the land of our Central Island was comparatively stationary whilst the sea bottom was subsiding, and that the amount of subsidence increased from the Island towards North Derbyshire. This evidence, to which but little or no attention has hitherto been paid, is as follows:—

In our Ashby Coalfield the largest and most valuable seam is that known as the *Main Coal*, which consists of two beds, the Over and the Nether Coal, with a thickness of 5 and 7 feet respectively. In the northern part of the Coalfield these coals are separated by as much as 60 feet of sedimentary strata, but when traced southwards they are found to come rapidly together, and, at the Moira Colliery, form a single undivided bed of about 14 feet thick. Now we know from the conditions under which coal has been formed that the beds must have been laid down on a perfectly horizontal surface. After a sufficient thickness of peat to form the Nether Coal had accumulated, subsidence must have been commenced, which gradually increased in amount towards the north, and thus effectually prevented the continued growth of the peat bed in that direction, whilst in the south the growth was uninterrupted. By and by subsidence ceased, and allowed the forest growth which was to produce the Over Coal to spread once more over the whole area. In this way only can we account for the splitting up of a coal bed.

Both in the Warwickshire and in the South Staffordshire Coalfields we find this splitting up of the Coal Seams even more marked than it is in our district, and the splitting up in both cases takes place, as in our Ashby Coalfield, *towards the north*. In the South Staffordshire district, in the neighbourhood of Dudley, the 10 yard Coal, as it is called, is an undivided seam 30 feet thick; but when traced northwards within a distance of a few miles it divides into *nine* distinct seams, separated by an aggregate thickness of 420 feet of sandstone. The combined thickness of these nine seams of coal is only a little short of the original thickness of the undivided seam, so that besides having here a good example of horizontally progressive and intermittent subsidence, we have an indication of the extreme slowness with which the peat beds must have increased in thickness. The time taken to accumulate 420 feet of sedimentary strata was only sufficient to add at the outside a foot or two to the thickness of the coal seam.

Thus we see all the evidence is in favour of the comparative stability of the land areas in Carboniferous times, and the gradual bending down of the floor upon which the sediment was deposited.

I have now given you a condensed account of the leading facts connected with the laying down of the materials forming the Carboniferous Rocks of this part of Europe, and have shown you how the record of the conditions prevailing during their deposition is written in indelible characters in the rocks themselves.

My sketch would, however, be incomplete if it did not include some reference to the agencies which have upheaved these once horizontal strata, and have brought them into the elevated position which they now occupy in the hill country of Northern England.

We have already seen how, in the Pennine Range of hills, the rocks composing them are now arranged in a series of folds or corrugations. With a difference in degree only we always find this tendency to ridge and furrow arrangement in all strata which have been in any way disturbed, but it attains a maximum of development in mountainous districts, where the disturbing forces have been great; the folds, in such cases, assuming great height, and bending on themselves in a very abrupt and remarkable manner.

The more this folded structure of the earth's crust is studied the more evident it becomes that it has not been brought about by any subterranean forces acting vertically upwards. We can only find a reasonable explanation of the complicated, and often inverted foldings of mountainous districts, by assuming that the force was a *lateral* one, and that it has ridged up the rocks, just as a piece of paper or a cloth is puckered when it is laid flat upon the table and the fingers pressed upon it with a slight sliding movement.

That nearly all the elevations of old sea bottoms into hills and mountains have been produced by lateral thrust all geologists are agreed, but on the question as to how that lateral thrust has been brought about there are at least two distinct opinions.

The hypothesis, which has up to recently found most favour with geologists, and which taken by itself perhaps explains the greatest number of observed facts, is the so-called hypothesis of *Secular Contraction.*

That the earth was originally a molten mass, which has gradually cooled from within outwards, is rendered highly probable from certain astronomical considerations; and that its interior has still a very high temperature is indicated both by volcanic phenomena, and by the fact that the deeper we go down the hotter it becomes; the increment of temperature being about 1° Faht. for every 50 feet of depth. The hot interior or nucleus must still be cooling down by conduction of its heat through the solidified crust and its dissipation into space, and this cooling must also mean *contraction.* There is, consequently, a constant tendency for the interior nucleus to separate itself from the outer and cooler shell, and since it is manifest that the shell cannot stand alone, it must tend by the power of gravitation to adapt itself to the "diminishing circumference of the contracting interior," and in its efforts to do so, great lateral pressure is evoked, which bends, breaks, and ridges the crust along certain lines. Thus, on this hypothesis, have been produced the great lines of elevation of most of our mountain ranges. They may not inaptly be compared with the wrinkles on the skin of a drying apple, for the skin of the apple becomes wrinkled in its efforts to adapt itself to the shrinking interior of the fruit.

We should certainly expect that the elevation of ridges on the earth's surface, if these are to be looked upon as the expression of secular contraction, would take place along the lines of least resistance, where, in fact, the earth's crust is the thinnest; it is, consequently, a little startling at first to find that the great elevations have nearly all taken place where sedimentation has been the *thickest*, and where we might expect the crust of the earth to be the strongest. The difficulty, however, disappears on examination, and for the explanation we will return once more to the Carboniferous strata of the Pennine area. These, as we have seen, were laid down in a great trough which gradually bent more and more downwards as more sediment accumulated in it. Such a great and constantly deepening depression in the earth's surface is called a *geosynclinal*, and in such troughs have been deposited, sometimes to a thickness of miles, the strata which are now elevated in our mountain chains.

As the great geosynclinal bends more and more downwards, the first formed and lowest strata are carried through zone after zone of constantly increasing temperature, which at last is sufficient to melt, or at any rate to soften, the deepest part of the inverted arch. The very keystone of the arch is then gone, and it is unable to withstand the great lateral strains due to the secular contraction of the earth, and forthwith the elevation of the mass begins.

On the second hypothesis, the lateral pressure which has brought about the folds and wrinkles in the earth's crust is attributed to the expansion of the mass of sediment when it is carried into the zones of higher temperature, as the geosynclinal, or great earth trough, bends more and more downwards under the weight of the superincumbent strata. This hypothesis has, within the last year or so, come into more prominence, owing to the appearance of a most suggestive work, by Mr. Mellard

Reade, "On the Origin of Mountain Ranges," to which I must refer any of you who may wish to gain further information on the subject.

These two theories, framed to account for the upheaval of vast thicknesses of strata deposited on old sea bottoms, are, in my opinion, not so antagonistic as they appear at first sight. I believe that further research will show that *both* agencies, *i.e.*, secular contraction, and expansion of the sediments by heat, have had a hand in the work.

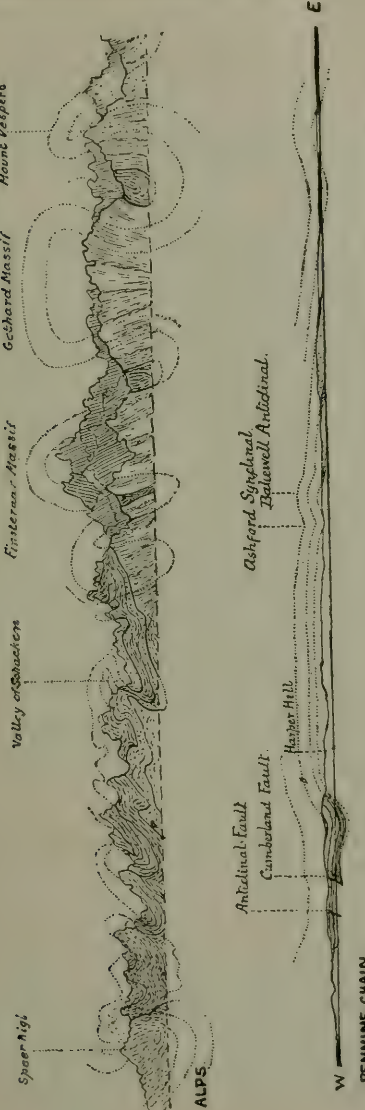
In all highly folded mountainous districts we find that the rocks are bent in such a way as to indicate that the lateral force was exerted more on one side of the elevated region than on the other; that the range in fact exhibits a "shoving" side and a resisting side. Our Pennine Range is no exception to this rule. On its western side, as indicated in our diagram, the corrugations and faulting are much more pronounced than on the eastern side in the colliery districts of North Derbyshire and South Yorkshire, where the inclination of the strata from the centre of the great anticlinal arch is much more even and regular.

In order that you may have a due idea of the proportion of the Pennine folding to that of a lofty range like the Alps, I must refer you to the sections in the adjoining plate, drawn to a true scale of $\frac{1}{430,000}$, both vertically and horizontally.

You may now ask, at what period of the world's history did all this folding of our English Carboniferous Rocks take place?

I need scarcely tell you that geologists cannot reckon by the ordinary standard of years and centuries. They can only refer geological occurrences to certain great periods coincident with the laying down of masses of strata, which for various reasons they are agreed to consider as belonging to one geological age.

The strata which are found succeeding the Carboniferous Rocks in upward succession are known as the *Permian*, and it is manifestly possible, by observing the position of these latter rocks relatively to the underlying Carboniferous, to ascertain if the great earth movements which produced the Pennine Anticlinal were *anterior* to the deposition of the Permian or *subsequent.* If, for



Horizontal Sections across the Alps and the Pennine Chain, to a true Vertical and Horizontal Scale of $\frac{1}{130000}$

instance, we find that the overlying Permian does not participate in the great folds of the underlying rock, or if we find great faults, which it can be shown have resulted from the Pennine upheaval, affecting the Carboniferous Rocks and not the overlying Permian, it is evident enough that the Pennine uplift must have taken place *prior* to the Permian epoch.

Nearly twenty years ago Professor Hull came to the conclusion that the folding of the rocks in the Pennine Chain was of two distinct ages; whilst admitting that the east and west foldings were of pre-Permian age, he contended that the north and south folds must have been produced after the deposition of the Permian. The unsoundness of the latter opinion was shown not very long ago by Mr. E. Wilson and Mr. J. J. H. Teall, who instanced proof, that the north and south flexures must also be considered as pre-Permian. I am inclined to dwell upon this point for a moment, since I think our own neighbourhood affords an opportunity of testing the question, even better perhaps than some of the districts selected by the geologists I have named.

I have stated that the North and South corrugations of the Pennine area may be traced southward into the region of our Ashby Coalfield. Here we have also certain beds which I have recently proved to be of Permian age, and which were evidently not laid down until all the great* North and South earth movements of the Carboniferous Period had attained a maximum, thus leading irresistibly to the conclusion that the Pennine upheaval was entirely pre-Permian. On this subject I may possibly have more to say to you later on in the Session

You may now feel inclined to ask, What is the use of all this? How can a knowledge of the distribution of land and water in a period removed from our day by perhaps millions

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* It is too often assumed by geologists that the common arrangement in a disturbed district of folds and faults running at right angles to each other, forming what are known as a *conjugate* series, must have been produced by two distinct acts of lateral compression. It seems to me that the key to these phenomena is to be found in the beautiful experiments of Daubrée on the influence of torsion and pressure upon the fracture of solid bodies, and that conjugate series both of faults and folds are best explained on the supposition of their contemporaneous origin.

of years, be of more material service to the human race than, say, a knowledge of the conformation of the continents of Jupiter and Saturn? I would answer that these are all subjects well within the legitimate aim of science, and that her votaries need seldom trouble themselves about the ultimate utility of their discoveries. Let but the work be good, thorough, and honest, no matter whether it be on the structure of the mountains of the Moon, the internal economy of a cockroach, or the optical effects of a crystal, the worker may be well assured that his hardly-earned knowledge will some day be put to good account; and in pursuing knowledge for its own sake he has his immediate reward in the ever-enlarging views of the Universe and of its great Designer, which are engendered by constant and loving communion with Nature.

It would not, however, be difficult to shew a great and immediate advantage to be derived from such enquiries as we have been making to-night, an advantage which I think would satisfy even the most persistent of Utilitarians; for it is evident that upon an accurate knowledge of the original extent and present limits of the various members of the great Carboniferous series of rocks must depend the proper direction of capital in the exploration of the vast mineral wealth they contain, and upon which the material prosperity of our country so largely depends.

The Source of the Modern English (Roman) Alphabet.

By T. Knowles, M.A.,

Of St. John's College, Cambridge.

(Read before the Society, December 2nd, 1887.)

THE modern English Alphabet is practically the same as that used by the Romans; that is to say, the order of the letters is practically the same, and the powers of the consonants are, with few exceptions, the same. The difference between the two lies chiefly in the pronunciation of the vowels, the symbols of which sounds are, however, only five or six in number, whilst the whole alphabet consists of twenty-six letters. Anyhow, it is a fact beyond any dispute that our modern English alphabet was forced upon, or adopted by us, consequent on the Noiman invasion of this country. Now, the Roman alphabet is derived from the Greek alphabet, which it follows pretty closely. Therefore, my inquiry resolves itself into this, namely, What is the source of the Greek alphabet?

The answer to this question, as I shall endeavour to show, is, From the east, whence so much of European learning and science was originally derived. The truth is, we have borrowed or adopted our alphabet from a family of languages altogether alien to our own. This alphabet is the one thing which Aryan languages seem to have taken from Semitic languages. So dissimilar and repugnant are the several characteristics of these two families of languages from one another that this adoption by the Aryans of one of the Semitic characteristics is most remarkable. Whatever we may think of the nomenclature, Aryan and Semitic, there cannot be a doubt but that each of these families forms a true class. Some of the chief peculiarities of Semitic languages are as follows:

(1) They are written from right to left.

(2) They have no letters to express vowels.

(3) They have four or five consonants not found in any Aryan language.

(4) They arrange their characters in that peculiar string of letters called the "Alphabet."

Comparatively little is known of the genealogy of Semitic languages. The principal languages of the family are: Phœnician, Chaldee, Aramaic, Hebrew, and Arabic. Of these, Hebrew possesses the alphabet that has undergone the least alteration since the 10th century before Christ. It is for that reason the best adapted for showing the connection between Semitic alphabets and the Greek alphabet.

Before, however, coming to that it will be interesting to see the system of letters that was in use in Aryan languages. Aryans did not string their letters one after the other in the manner of (for want of a better word) the Shemites, but they arranged them according to their pronunciation by the different organs of speech, in a very scientific classification. The following is the system of letters used in the Sanskrit language, which is the parent of all Aryan languages.

Vowels:

a, á; i, í; u, ú; ri, rí; lri, lrí; e, ai; o, au.

*Consonants:**

	Surd.	Sonant.	Nasal.	
Guttural	k ...	g ...	ng.	
Palatal	c ...	ch ...	n.	
Dental	t ...	d ...	ṇ.	
Labial	p ...	b ...	m.	
Semivowel ...	y	r l		v.
Sibilant	sh	s.		
Aspirate	h.			

* The aspirated surd and sonant consonants, and the Cerebral letters have been omitted for the sake of simplicity.

It is clear from an examination of the above that the alphabet used by almost all European languages is not derived from the Sanskrit system of letters.

It is interesting to note in passing what a strong resemblance there is between the Sanskrit vowels and the Anglo-Saxon, or old English vowels. The vowels, ri, rí, lri, lrí, have dropped out of the old English alphabet; but the Sanskrit vowels are arranged in pairs, a long and a short vowel forming a pair, just as in old English.

Now the above system of letters is in use in the Aryan languages of India, so that the descendant Aryan languages of India have adopted the old Aryan system. How comes it that the European Aryan languages have rejected, or lost it. and have adopted in its stead a system taken from Semitic languages? The following seems to be a probable account of the matter.

Previously to the ninth century before Christ the art of writing was either unknown among the Greeks, or was practised to a very limited extent. For some centuries, both prior to the ninth century, and subsequent to it, the Phœnicians were the principal commercial people of the world bordering on the Mediterranean sea. There is a well-authenticated legend of a man named Cadmus, a son of Agenor, king of Phœnicia, founding a colony in Attica, and teaching the Greeks the art of writing. This would be prior to the 10th century before Christ. Whether this person, Cadmus, actually existed or not, it is a fact that the three radical consonants of the word Cadmus form a root, signifying, throughout Semitic languages, "the East" And it is well-known that the Phœnicians worked mines in Thrace and Attica. In fact, the legend points, undoubtedly, to a Phœnician settlement in some part of the Greek continent prior to the tenth century before Christ. By the seventh century we find the Greeks have acquired the art of writing, generally; and the language which they speak, though very closely resembling Sanskrit in its sounds and structure, nevertheless has the Semitic string of letters, and not the Sanskrit system. Whence, then, did this alphabet come, if not from these Phœnicians? We know the Greeks were a long way behind the

Phœnicians in civilisation, that is, at the time of which I have just been speaking, and there is no violence in supposing that they were willing to learn from their acknowledged superiors. They would gradually find that their connection with the Phœnicians brought them into contact with the commerce and trade of the world, and they would not be slow to perceive the advantage of this. Thus, the Phœnician system of writing would gradually displace the original Greek system, if such existed; and the Greeks would then gradually adopt the Phœnician alphabet for expressing their own—the Greek—language. Precisely the same thing has happened to us English: we have discarded our own alphabet, and now express our own language in the Roman character.

For the purpose of comparing the usual Semitic system of letters, or alphabet, with the Greek and with modern European alphabets, I have selected the Hebrew alphabet to represent the Semitic system for the reason stated above. Moreover, the exact Phœnician alphabet is a matter of conjecture, but it is known that the Hebrew alphabet closely resembles it both in the order of the letters and in the powers of the letters. I have selected the French alphabet, for obvious reasons, as more convenient than the English, of which it is the father, for the purpose of this comparison.

	HEBREW.			GREEK.			FRENCH.
1.	א	Aleph	......	α	Alpha	......	a
2.	ב	Beth	......	β	Beta	......	b
3.	ג	Gimel	......	γ	Gamma	......	c
4.	ד	Daleth	......	δ	Delta	......	d
5.	ה	Hé	......	ε	Epsilon	......	e
6.	ו	Vau	......		Digamma	......	f
7.	ז	Zayin	......	ζ	Zeta	......	g
8.	ח	Cheth	......	η	Eta	......	h
9.	ט	Teth	......	θ	Theta	......	—
10.	י	Yod	......	ι	Iota	......	i
11.	כ	Khaph	......	κ	Kappa	...	k

	HEBREW.			GREEK.			FRENCH.
12.	ל	Lamedh	......	λ	Lambda	......	l
13.	מ	Mem	......	μ	Mu	......	m
14.	נ	Nun	.....	ν	Nu	.. ...	n
15.	ס	Samekh	......	ξ	Xi	......	—
16.	ע	Ayin	......	ο	Omicron	......	o
17.	פ	Pé	......	π	Pi	......	p
18.	צ	Sadeh	......	—		......	—
19.	ק	Koph	......	—		......	q
20.	ר	Resh	......	ρ	Rho	......	r
21.	ש	Sin (Shin)	......	σ	Sigma	......	s
22.	ת	Tau	......	τ	Tau	. ....	t

In adapting the Semitic alphabet for expressing their own language, the Greeks would be met by two chief difficulties. First, there are no letters in Semitic languages for representing vowel sounds; second, there are in all Semitic languages at least three sounds which do not occur in Greek—namely, the sounds represented by the Hebrew letters ח (cheth), ע (ayin), ק (koph).* We shall see how this difficulty was dealt with.

The first Hebrew letter is the nearest approach to a vowel that Semitic languages admitted; yet it is not a vowel, but closely resembles the "smooth breathing" of the Greek language. It represents the effort made in the throat on pronouncing any of the vowel sounds ă, ĭ, ŏ. The Greeks have turned this into the short vowel a, as in our word "and," and the corresponding letter in French closely resembles it in sound. The power of the second Hebrew letter is that of our b; that of the second Greek letter, as pronounced by modern Greeks, is v, and that of the second French letter corresponds with the Hebrew letter. It is probable, however, that the ancient Greeks pronounced their β as we pronounce our b. The power of the third Hebrew letter is g (hard), that of the third Greek letter the same, while the corresponding French

* In Arabic there are five sounds foreign to Aryan languages — namely, ح, ع, غ, ق, and the Hemzeh. Each of these sounds is unpronounceable by Europeans, except after long and arduous practice.

letter is sometimes pronounced like s, sometimes like k. The third letter in the Anglo-Saxon alphabet was always pronounced k, the surd sound corresponding to the sonant g. The power of the fourth Hebrew letter is d, that of the fourth Greek letter the same, and that of the fourth French letter the same. The similarity of the Hebrew names of the first four letters with the Greek names should be noticed. With regard to the fifth Hebrew letter, its power is precisely that of our h. How is it, then, that the Greeks have turned it into ε? Epsilon, it should be noticed, is properly pronounced as the French e, not as our e. The answer seems to lie in the strong indisposition of the Greeks to the sound h; they had no letter representing this sound, they had only the "rough breathing;" and, further, the simple aspirate never occurs in Greek words except initially. Now, the Hebrew Hé ה is found initially, medially, and terminally in Hebrew words, there fore the Greeks could not employ the letter in the same way as the Hebrews. It will be noticed that the corresponding Greek letter is a vowel, and is pronounced precisely in the same part of the throat as the Hebrew ה; so that they have got as near to the Hebrew sound as the genius of their language would permit. The power of the sixth Hebrew letter is that of our v, and the old Greek Digamma (discarded before the Greek alphabet was settled) was pronounced either like our w or v. The corresponding French letter is f, a letter closely allied in power to v. The power of the seventh Hebrew letter, Zayin, is that of our z. The Greek Zeta has the same power, and the corresponding French letter, when sounded soft, closely resembles it. The eighth Hebrew letter, Cheth, is the guttural aspirate, perhaps the most difficult of the Hebrew sounds for Europeans to acquire. The corresponding Greek letter is a vowel, pronounced precisely as our ee. Here the Aryan throats of the Greeks rejected the foreign guttural aspirate, but in its place they put a sound which, as in the case of Epsilon, is pronounced in precisely the same part of the throat as the Hebrew ח. The Romans, who seemed to tolerate the sound h more than the Greeks, rejected the Greek vowel, and put the letter h, the simple aspirate, in its place. The ninth Hebrew letter, Teth, becomes the Greek Theta, the two letters being very similar in power. This letter has no corresponding one in the French alphabet. The tenth Hebrew letter, Yod, the Greek Iota, and the French i are very similar to one another in power. The same remark applies to the eleventh, twelfth, thirteenth, and fourteenth Hebrew letters and the corresponding letters in Greek and French. As regards the fifteenth Hebrew letter, Samekh, the Greek letter Xi has no great resemblance to it in point of power; the latter letter, however, is partly sibilant. Ayin, the sixteenth Hebrew letter, is a pure guttural, and the Greeks treated it precisely in the same way as they treated the guttural aspirate ח; they turned it into a vowel, Omicron, the sound being made in just the same part of the throat as the Hebrew guttural, and the corresponding letter in French has the same power as the Greek letter. The seventeenth Hebrew letter, Pé, appears with the same power in Greek and French. As regards Sadeh, the eighteenth Hebrew letter, there is no corresponding letter either in Greek or French. Neither is there in Greek a letter to correspond with the nineteenth Hebrew letter, Koph. This is a guttural sound, very difficult of acquisition by Europeans, and it is not strange that the Greeks did not turn it to use, seeing they already had the letter Kappa. Curiously enough, though, the letter is represented in French by q; but this letter is not pronounced gutturally. The letter is redundant. The three last Hebrew letters are represented in Greek and French by corresponding letters of precisely similar power. The remaining letters of the Greek alphabet, after τ, were added from time to time, as the necessity for having such symbols became apparent.

In conclusion, a study of early Greek history and a comparison of the above three alphabets would seem to put it beyond doubt that our modern English alphabet, which came to us from the Latin language, through the French, is derived from some Semitic language, and that this is most probably the Phœnician language.

The Wild Plants of Foreign Barley Fields.

By James G. Wells.

(*Read before the Society, January 6th,* 1888.)

A FEW years ago, my friend Mr. F. W. Andrews, in the course of his malting labours, was struck by the variety and beauty of the seeds which were separated from the various barleys in the process of screening, and he commenced collecting them. So interesting and beautiful were many of them in form and colour, and so admirably were most of them adapted for dispersion by birds, or animals, that we came to the conclusion that the plants which produced such wonder-exciting fruits should be of sufficient interest to repay the trouble of growing them from the seeds. Unfortunately, my friend's removal to one of the colonies put an end to our joint labours, so that I am deprived of his aid in laying before you some of the results of the cultivation of these seeds. The seeds were sown in the open ground in a rich soil during April, 1886, and were exposed to the ordinary conditions of temperature. Every farmer grumbles at the effect the weather has on his crops, so must I grumble at the effect the weather has had on the growth of my plants. Many interesting seeds have come to nothing, and many plants are, undoubtedly, dwarfed, but I trust that the specimens I have on the table will be productive of some interest. I cannot, of course, claim that I shall give, in any degree, a complete list of the weeds of foreign barley-fields, but only of such, the seeds of which have escaped the preliminary cleaning of the grain, and have been removed by the screens of our maltings.

For the purpose of comparison, I will briefly enumerate the wild plants of our own corn-fields before I enlarge on those of our neighbours.

Foremost, at any rate in abundance, we must place the ubiquitous poppy (*Papaver*), which is inseparable from our ideas of corn-fields; then follow thistles, the corn marigold (*Chrysanthemum segetum*), the chamomile (*Anthemis arvensis*), the pretty pink-petalled cockle (*Lichnis Githago*), whilst hidden from casual observation we shall find the little blue mousetail (*Myosurus minimus*), the wild pansy (*Viola tricolor*), and the pimpernel (*Anagallis arvensis*), which, in the colour of its petals, is almost unique amongst our wild plants. Very common in some districts is the lovely corn-flower (*Centaurea Cyanus*), but almost unknown in others, amongst which the country around Burton must be classed. Besides these, we have the charlock (*Raphanus Raphanistrum*), the corn crowfoot (*Ranunculus arvensis*), and, occasionally, the wild convolvulus (*Convolvulus arvensis*). These, then, are, briefly, the wildlings of our own corn-fields; let us now turn to those of foreign ones.

Among the seeds which occur in French barleys is the formidably spined cremocarp of *Caucalis daucoides*, one of the umbellate family. It is rather common, and is one of the few seeds not entirely removed by the process of screening, being only separated from the barley during the steeping. It will be readily seen that this seed is admirably adapted for dispersion by animal agency, armed as it is with such clinging spines.

French beans (*Phaseolus vulgaris*), of many hues, are a striking feature, while very numerous are the broken fruits of three or four species of the wild radish. The fruit of *Ranunculus arvensis*, or of a near ally to it, is very common, and escapes removal by the screens to a great extent. The blue pimpernel occurs; the difference between it and the red variety is easily seen on comparing the two specimens. The interesting pods of the *Medicago* genus make their appearance here, but they are only of the smaller species. I shall dwell on them later in my paper. The pea family is well represented; the most interesting species being *Lathyrus aphaca* with its pretty cordate, opposite leaves, and its small, yellow flowers. I have also found the seeds of the flax, asparagus, wild oat, thistles, poppies, and others which occur in our own barley.

Austrian barleys are almost identical, with respect to the seeds they contain, with French barleys. *Ranunculus arvensis* would appear to be a very common weed from the number of its seeds which occur.

In Smyrna barleys I have found many interesting and curious seeds, and have, fortunately, been able to cultivate most of them. One of the most common and, at the same time, one of the most striking seeds is a large prickly coiled pod which, on cultivation, turns out to be a member of the pea tribe; it is, however, wanting in the general characteristic of that tribe—the habit of climbing, It is *Scorpiurus sulcata*, an ally of that pretty *Lathyrus* which we found in the French barley.

It is here that we meet with the Medicagoes in their greatest beauty, so that I will now dwell on all the species I have come across. The fruits consist of many variations of a coiled pod, from a small, flat, compressed spiral to a large, ball-like spiral, covered with spines. Between these two extremes there exist many gradations; thus, the fruit of one species is a small, rather flat spiral, of two or three rings, having the edges adorned with spines; another has a larger spiral, with the spines absent; while a similar sized spiral, having spines, exists. There is also a species with a very large, flat, compressed spiral, which is termed *Medicago orbiculata;* in another species the outside edge of the smooth pod curves upwards, forming a cabbage-like spiral. This last species I have not succeeded in growing; specimens of all the others are exhibited. To non-botanical eyes there seems to be no difference between the plants, and even to botanists it must be a matter of wonder that so small a difference in the structure of the plant should correspond to so great a difference in the fruit. I have also mounted a specimen of one of our own Medicagoes, in order to show the greater advancement in the development of the foreign species. The number of spines with which most of them are provided will account for their prevalence, forming, as these do, such an admirable provision for clinging to whatever comes in their way.

Another interesting plant occurring in Smyrna barley is a peculiarly-fruited composite, which is probably a *Calendula*, the nearest ally of which in our own flora is *Hypochœris*. Its capitulum, with its curved seeds, is, to say the least, interesting. Amongst the other seeds will be noticed the heads of a composite, several vetches, — I have mounted a specimen of a yellow-flowered one, probably a *Lathyrus* — thistle-heads, poppy capsules, and other seeds common to most barleys.

A rather large fruit is the acorn of the Turkish oak (*Quercus cerris*).

In Chilian barley, maize, not only of the ordinary kind, but having grains ornamented with gorgeous stripes, is plentiful. Here, too, we meet with the Medicagoes, but they are not so large as in the Smyrna grain. Radish pods, peas, beans, and the heads of a member of the daisy family are among the larger seeds, while among the smaller ones are a number of plants of interest. Standing first in beauty is an ally of the field madder (*Sherardia arvensis*), a plant very bushy in habit, and having vivid blue flowers, which are extremely showy; in fact, it is worth cultivating as a border plant for the flower garden. The beauty of the flower has been lost in drying, so that the specimen does not do the plant justice. A species of *Galium* and two of the pea tribe not found with us occur, as do two species of *Brassica* and a *Crucifer*. I was particularly successful in raising several fine species of grasses from the seeds from this barley, and I cannot do better than let them tell their own tale, as I am unable to do more than surmise at the genus to which most of them belong, nearly all of them being new to us.

In the sample I have from Algerian barley, will be recognised several seeds which I have described as occurring in the French sample. The head of a large composite is the only marked feature in the sample.

With Algerian I come to the end of the varieties of barley from which I have been able to obtain seeds ; and, in conclusion, I can only trust that I have shown that the screenings of our maltings are not quite so destitute of interest as many people would perhaps imagine from a cursory glance at the baskets in which the screenings are received, and that I have given you some slight idea of the weeds which have as their habitat foreign barley-fields.

The Influence of Temperature on the Progress of Vegetation in the early months of the Year.

By Thomas Gibbs.

(*Read before the Society, January 6th*, 1888.)

As the Calendar of Nature has been a regular feature in our Annual Report since 1878, it has been thought desirable that a summary with some notes thereon should be embodied in this Volume of Transactions, and I have undertaken the preparation of such a summary.

The Calendar of Nature was started by Mr. C. U. Tripp, one of the founders of this Society and its first Secretary, during the time when the Society had its head-quarters at the Grammar School; and, until Mr. Tripp left Burton in 1883, a large proportion of the observations were contributed by the scholars. Since then it has been continued by a few members of the Society, the principal being the Rev. C. F. Thornewill and Messrs. F. W. Andrews, J. E. Nowers, J. G. Wells, and myself; the observations of these few are, however, if not quite so numerous, at any rate more systematic and reliable than those of the first few years.

For this summary I have prepared the two following tables, the first of which refers to the dates of flowering of nineteen plants which have been most regularly observed, and the second to a few miscellaneous phenomena, such as the singing of birds and appearance of insects, and including also the leafing of the Hawthorn, which I have here inserted as the only tree whose leafing has been at all regularly observed :—

I.—DATES OF FLOWERING.

	AVERAGE.	EARLIEST.	LATEST.
Hazel (Corylus avellana)............	Feb. 3	Jan. 6, 1884	Feb. 22, 1879
Snowdrop (Galanthus nivalis) ...	,, 7	,, 25, 1884	Mar. 3, 1879
Coltsfoot (Tussilago farfara)	,, 27	Feb. 4, 1883	,, 15, 1879
Dog's Mercury (Mercurialis perennis)	Mar. 1	Jan. 26, 1884	April 4, 1886
Lesser Celandine (Ranunculus ficaria)	,, 5	Feb. 9, 1884	Mar. 27, 1887
Sallow (Salix caprea)	,, 15	,, 26, 1884	,, 28, 1886
Anemone (Anemone nemorosa)...	,, 29	Mar. 9, 1878	April 14, 1879
Marsh Marigold (Caltha palustris)	April 13	,, 18, 1882	May 24, 1879
Wild Cherry (Prunus avium)	,, 23	April 5, 1884	,, 7, 1887
Blackthorn (Prunus spinosa)	,, 23	Mar. 27, 1884	,, 12, 1879
Cowslip (Primula officinalis)	,, 23	,, 23, 1878	,, 10, 1887
Red Campion (Lychnis diurna) ...	,, 26	,, 18, 1882	,, 24, 1879
Stitchwort (Stellaria holostea) ...	,, 27	April 1, 1882	,, 24, 1879
Wild Hyacinth (Scilla nutans) ...	,, 28	,, 4, 1884	,, 25, 1879
Lady's Smock (Cardamine pratensis)	May 3	,, 16, 1882	,, 14, 1887
Weazel Snout (Lamium galeobdolon)	,, 17	,, 20, 1882	June 2, 1879
Hawthorn (Cratægus oxyacantha)	,, 20	May 6, 1882	,, 6, 1879
Herb Robert (Geranium robertianum)..................................	,, 23	,, 14, 1884	,, 2, 1879
Dog Rose (Rosa canina)	June 22	June 15, 1884	July 3, 1879

II.—MISCELLANEOUS PHENOMENA.

	AVERAGE.	EARLIEST.	LATEST.
Thrush (Turdus musicus), singing	Jan. 21	Jan. 1 {1883, 1884}	Feb. 4, 1881
Skylark (Alauda arvensis), singing	Feb. 8	,, 19, 1884	,, 21, 1880
Chiff-chaff (Sylvia rufa), singing...	April 10	Mar. 25, 1884	April 22, 1885
Swallow (Hirundo rustica), seen..	,, 12	,, 27, 1880	,, 22, 1886
Cuckoo (Cuculus canorus), heard	,, 24	Ap. 15 {1881, 1883}	May 5, 1878
Corncrake (Rallus crex), heard ...	,, 30	,, 10, 1879	,, 8 {1883, 1887}
Bee, seen	Mar. 10	Feb. 12, 1882	April 7, 1883
Early Moth (Hybernia rupicapraria), seen	Feb. 24	Jan. 11, 1882	Mar. 22, 1886
Tortoiseshell Butterfly (Vanessa urticæ), seen	Mar. 24	Feb. 12, 1879	April 23, 1886
Small White Butterfly (Pieris rapæ), seen	April 4	,, 2, 1878	May 8, 1887
Orange Tip Butterfly (Anthocharis cardamines), seen	May 26	May 10, 1884	June 6, 1885
Brimstone Moth (Rumia luteolata). seen	June 3	,, 24, 1880	,, 12, 1879
Hawthorn (Cratægus oxyacantha), leaf	Mar. 10	Feb. 16, 1882	April 8, 1881

These two tables show the average date, and also the earliest and latest dates recorded for the first flowering of the plants named, and for the occurrence of the other phenomena.

Out of the nineteen plants which I have selected as having been most regularly observed, only two have a note in each of the ten years, some of the others having been unobserved in as many as four years. This has, of course, led to some inaccuracy in the dates given for the average time of flowering, but I have corrected this in some measure by adding or subtracting a day or two where no observation was taken in an exceptional year; however, when all precautions have been taken, a considerable element of error must enter into observations of this nature, so that the dates and results must be considered as approximate only.

The observations for 1882, 1883, 1884, 1885, and 1887 are very full and, I think, reliable; in 1878, 1879, 1880, and 1881 the observations are few and not always to be relied on, being probably rather behind the real dates. The observations in 1886 were few, and as the number of observers was small, they are probably slightly behind the real dates.

With regard to the second table, I do not consider that the observations contained in it have so much value as those in the first table, as on comparing the results obtained I have found them very irregular and inconsistent. This irregularity is no doubt caused by the appearance of birds and insects, especially the former, being affected more by temporary causes, such as an occasional warm or sunny day, than by the general weather of the season.

The principal point I have considered in all these observations is their bearing on the question of the effect of temperature on plant life. To illustrate this relation I have prepared the following table, which shows the mean temperature of the first four months in each of the ten years, and the number of degrees each was above or below the average of the ten years; side by side with the number of days each year was before or behind the average in dates of flowering of the plants given in Table I :—

	Difference from Average in Date of Flowering of Plants.	Mean Temperature of first Four Months.	Difference from Average.
1884	16 days before.	43°	+ 3
1882	14 ,, ,,	42°	+ 2
1878	6 ,, ,,	42°	+ 2
1883	5 ,, ,,	39°	− 1
1880	1 ,, ,,	41°	+ 1
1885	0 ,, ,,	41°	+ 1
1881	6 ,, after.	37°	− 3
1887	9 ,, ,,	38°	− 2
1886	11 ,, ,,	37°	− 3
1879	20 ,, ,,	37°	− 3

The temperatures given are from the observations taken at Burton and published in this Society's Annual Reports; those for 1878 and 1879 were not so published, and are taken, the latter from a sheet which was printed separately by Mr. C. U. Tripp, F. R. Met. S., and the former from notes with which he has kindly supplied me for this purpose.

This table shows a difference of 36 days between the most forward and the most backward year. In the case of some plants the difference was more than this, for instance, I have seen the Wild Hyacinth in flower as early as 4th April, while in 1887, I did not see it out till 22nd May, or seven weeks later; on the other hand, those plants which do not flower till the summer vary very little in their time of flowering, on account probably of their not being exposed to such great differences of temperature as those which flower in the early months.

It will be seen from this table that the order in which the years stand in the forwardness of vegetation corresponds in a great measure, though not completely, with that of the mean temperatures; the earliest years, 1884, 1882, and 1878, being also those which had the warmest early months, and the latest season, 1879, having, with 1881 and 1886, the coldest early months.

The two principal points in which the order of temperatures differs from that of forwardness of vegetation are the positions of the years 1881 and 1883. A short consideration of these years will, I think, make clear the meaning of their exceptional positions.

The mean temperature of the first four months of 1881 was one degree lower than that of the same period in 1887, so that we might expect to find the season of 1887 more forward than that of 1881; but, instead of this being the case, 1881 was the earlier by three days, being six days behind the average, while 1887 was nine days behind.

In order to explain this it will be necessary to compare the weather of the early months of the two years. The year 1881 began with the coldest January of which, I think, we have any record, the mean temperature being as low as 27·3 degrees. The four following months were not exceptional in their temperature, none differing more than 2 degrees from the average, and their mean being about the average. In 1887 the first three months were each below the average, but, while January was much warmer, March was considerably colder than those months in 1881; April and May were both colder, the latter by several degrees, than in 1881.

From these figures I think it appears that a very cold January, if followed by a comparatively mild February, March, and April, has less effect in retarding vegetation than when the temperature is more evenly distributed, though the mean of the four months is the same.

With regard to the year 1883, it is shown in the table to have been five days before the average in the forwardness of vegetation, being earlier than either 1880 or 1885, which both had warmer early months.

The explanation of this lies, I think, in the fact that in 1883 a mild January and February was followed by a March, the coldest of which I have a record, the mean temperature being as low as 34 degrees, or 6 degrees below the average of the ten years. It seems to point to the conclusion that after plants have, by a long spell of mild weather, been brought on to an advanced stage, a few weeks of frost have less effect in retarding them than might have been expected.

Having thus stated the results obtained from a comparison of our recorded observations, I will make some suggestions for more systematic work in the future.

The observations on birds and insects are, as I have already mentioned, not to be relied on as a criterion of the comparative forwardness of a season, so that the preference should be given to observations on the dates of first flowering of common plants. A list should be drawn up of a moderate number of common and well-known plants, such as those included in my first table, and these should be carefully noted each year by, if possible, several observers.

Next, similar observations should be made of the dates of leafing of our common trees. This department has been much neglected among us, as, in looking through our records for the ten years, I found only five notes of the Oak, three of the Ash, five of the Horse Chestnut, and of others even fewer ; the only tree which has been at all regularly observed is the Hawthorn, which was noted in each of the ten years. The principal reason for this neglect is, probably, the difficulty in saying when a tree really is in leaf, the progress being so gradual. The best plan, in my opinion, is to make the observation directly the leaf bud has burst.

With regard to the leafing of trees, a method, which commends itself to me as being both simple and accurate, is to note a particular tree or particular trees each year, so as to get rid of local and individual differences. This method might also be applied to the flowering of trees, but could not conveniently be applied to herbaceous plants ; with regard to them, however, an analogous plan might be adopted of observing them as nearly as possible in the same spot each year. Careful note should in all cases be made of the locality of each observation, as so much depends on aspect, soil, and altitude.

A Grain of Barley.

(With Five Plates.)

By Horace T. Brown, F.G.S., F.C.S., F.I.C.

(*Presidential Address, delivered November 2nd*, 1888.)

WHEN, for the second time, you did me the honour of electing me your President, and it became once more necessary for me to prepare an Annual Address, I thought I could not do better than select as my subject, "A Grain of Barley," for I considered that if it were possible anywhere in the world to arouse interest in such a common-place subject, it ought to be here, since it is not too much to say that this small and insignificant barley-corn has, in its collective form, a greater importance for our community than for any other, and that without it, our thriving town, with its forty to fifty thousand inhabitants, would probably not have emerged from the primitive state of a country hamlet.

I have no intention of giving you this evening a dissertation upon barley-growing, or upon malting, but I shall confine my remarks as far as possible to a short sketch of the structure and development of this wonderful little grain, and of the relation which its various parts bear to those of the fruits and seeds of the flowering plants generally; and shall incidentally touch upon some of the chemical changes which attend its growth and development.

My remarks will be in the main addressed to those who have not paid any great amount of attention to such subjects, consequently, if I go over ground which is already very familiar to the more scientific of our Members, I must crave their indulgence and patience, for the sake of a few interesting facts to which I shall allude, and which are either new or comparatively unknown.

If we carefully examine a grain of ripe barley, we see that it may be described in general terms as *fusiform*, or spindle-shaped, and that this little yellow spindle, which is about one-third of an inch in length, terminates in a more regular and much sharper point at one end than at the other. At the sharper end there can always be distinguished a small scar, which marks the point of attachment of the grain to the spikelet of the ear; this is consequently the lower end of the corn.

Down the whole length of one side of the grain runs a deep but narrow furrow (Plate I., Fig. 1, *c*), in the lower half of which can be seen, even with the naked eye, but better with a pocket lens, a fine *bristle* (Fig. 1, *d*), furnished with some still finer lateral hairs. This is the so-called "basal bristle," which lies deep in the furrow, and has its point of attachment at the base of the grain. It is, morphologically speaking, the prolongation of the axis of the spikelet from which the grain springs.

The general contour of the side of the grain we are considering is, notwithstanding the furrow, very convex both in a lateral and longitudinal direction, and hence is known as the *ventral* side (Plate I., Fig. 1, *b*). This is the side which always faces inwards towards the straw when the grain is still attached to the ear. The outer, or *dorsal* side of the barley grain (Plate I., Fig. 1, *a*) is much flatter than the ventral, although somewhat convex, and the evenness of its curved surface is broken by five thin little ribs which run in the direction of the length of the grain, and mark the position of as many vascular bundles, or nourishing vessels, of the outer coating. When the grain is viewed in cross section these vascular bundles cause the dorsal side to appear bounded by four almost straight lines. (See Plate I., Fig. 3).

In order to see more than this we must strip off the outer coating of the grain, which can readily be done if it has been previously soaked in water for a day or two. We then find that this outer skin consists of two leaf-like tissues, one of which is closely adherent to the dorsal side, and the other to the ventral, the former slightly overlapping the latter. Properly speaking these do not belong to the grain at all, but are the remnants of the *flowering glumes* or *paleæ*, the protecting envelopes of the flower, which have become permanently attached to the grain during its growth. In most cereals, as in wheat and rye, these paleæ, are not permanently attached to the grain, but readily separate from it on ripening, in the form of "chaff." In some varieties of barley, the so-called skinless barleys, this is also the case, but in most barley the "chaff" is permanently adherent to the grain.

The outermost and largest of the two paleæ in barley (Palea inferior) (Plate I., Fig. 2, *p.i.*) is the one which wraps round the "back" of the grain, and its upward prolongation forms the *beard* or *awn* with which most varieties are furnished. (Plate I., Figs. 1 and 2, *aw.*) The innermost of the two flowering glumes, the one which adheres to the ventral side of the barley corn, is the *palea superior*. (Plate I., Fig. 2, *p.s*)

If we remove the palea from the dorsal side, we can readily discern at the base of the grain, through the inner transparent skin, a small bud-like organ of a light yellow colour and wax-like appearance. This is the *germ* or *embryo*, which under favourable conditions will develop into the young barley plant. When this is dissected out with the sharp point of a knife and examined with a pocket lens, we can clearly distinguish the different portions of the germ from which, in the course of time, will proceed the stem and roots of the young plant.

Whilst the inner palea, which envelops the furrowed or ventral side of the grain, is still supposed to be attached, I wish to call your attention to two curious little transparent scales, which spring from the point of attachment of the inner palea to the floral axis, and wrap closely round the front of the germ like two little folding hands. These are the so-called *lodicules*, one of which is shown, very much enlarged, in Plate I., Fig. 4. Some observers have imagined that these little scales, in conjunction with the basal-bristle which lies in the ventral furrow of the outer coating, have an important function in absorbing and conducting water to the germ, and of hastening its growth when the grain is placed under favourable conditions for germination. Direct experiment has, however, failed to support this somewhat attractive idea, and the comparative study of the flowers of other members of the great natural order of Grasses to which Barley belongs, clearly indicates that these scale-like lodicules correspond to the calyx and corolla of other flowering plants; they may, in fact, be looked upon as a *perianth*, or more strictly a *perigonium*. They are found fully developed in the flower of the barley before the fertilization of the pistil, and only persist in the ripe grain as these minute dried-up scales, which are without any further function in the economy of the plant.

When we have carefully stripped off the whole of the outer coating of the barley grain, consisting of the two adherent and folding paleæ, we find the grain still covered with a very thin skin, which, when looked at with a good pocket lens, appears finely striated in the direction of the length of the grain. This apparent striation is due to the outermost cell layers being arranged longitudinally.

If we cut the grain across in various places we see that the barley-corn, with the exception of the small germ which is situated at the base of the grain on the dorsal side, is, for the most part, filled with a white mealy-looking substance, the *endosperm* or *albumen*. The germ, or embryo, which is in reality the baby plantlet, occupies only about $\frac{1}{30}$ of the total volume of the corn, but it is this portion alone which is endowed with any vitality. The whole future potentiality of the plant resides in the embryo, the function of the endosperm or "albumen" being merely that of a storehouse or reservoir of nutritive material to supply the young plant with food until it is sufficiently developed to gain its own sustenance from the air and soil.

The embryo and endosperm are enclosed in the same integuments, but there is no true organic connection between the two. One side of the embryo is in very close contact with the endosperm, but no vascular bundles or nourishing vessels of any kind bind the two together, so that there is no difficulty in separating these two essential parts of the grain without the rupture of any of the tissues of either. How, under these circumstances, the embryo can avail itself of the stored up material of the endosperm we shall see later on.

A microscopical examination of the grain is necessary if we wish to study its various parts in greater detail. In order to do this we must cut sections of the grain in various directions, and of such a degree of thinness that they may be examined as transparent objects under high powers. The cutting of such sections from the ungerminated grain offers no difficulties. It is sufficient to soften it in water for a day or two, to embed the grain in paraffin or some other suitable medium, and to cut very thin slices with the aid of a sharp razor. The sections are then treated with various re-agents and staining solutions, and examined in water, or better still in glycerine. Such a series of sections is before you on the table and can be examined at your leisure later in the evening.

Plate I., Fig. 2, is a sketch representing a longitudinal section of a barley grain, and you see, at the base of the corn, the germ or embryo, *em*, in which can be distinguished the rudimentary buds destined to develop into the stem and roots of the young plant. The embryo, as you see, occupies only a small portion of the grain, the greater part of which is made up of cellular tissue, packed very closely with grains of starch. Lying close to the ventral side is the "basal hair" or bristle *d*, which is closely attached to the inner palea, and lies in the furrow of the grain. The various integuments are better seen in Fig. 3, which represents a transverse section of the grain taken across the middle. The inner part of the section is taken up with the starch-containing cells of the endosperm, which are surrounded by a triple layer of thick-walled, rectangular cells, *al*, not shown in detail in this Figure. These are the so-called *aleurone cells*; they contain a very finely granulated substance which is very different in composition from starch, and they form the outer layer of the endosperm, that great reservoir of material whose function it is to supply food to the growing embryo.

Surrounding this aleurone layer we find the true covering of the seed, the testa, *t*, and outside this, and closely adherent to it, is another thin coating, *p*, corresponding to the covering of the *fruit* in other plants, and hence called the *pericarp*. The pericarp and testa can each in their turn be differentiated into various layers, but for my present purpose it is not necessary that I should more minutely describe them. I wish you to notice very particularly in this section, that both the *testa* and *pericarp* have a common point of origin, *f.p.*, which in the transverse section of a barley-grain is marked by a very distinct reddish yellow spot. This is the cross section of a well-marked line of tissue, which runs along the entire length of the grain, and is the so-called "pigment-string," the true nature of which will be rendered clear later on.

Outside the pericarp we have the thick outer skin, formed by the two over-lapping paleæ, *p.i.* and *p.s.*

In Plate II. you have all these structures shown in a more highly magnified form, the drawing representing very accurately the various tissues of the lower part of a grain of barley as seen in a longitudinal section under a fairly high power. I shall revert to this Plate presently, but before we can fully understand it in all its details it is necessary to examine with great minuteness the development of the flower of the barley plant from its period of blossoming to the ripening of the grain.

From books and drawings only it is impossible to obtain perfectly clear and complete ideas upon these points, and I wish to impress upon your minds the necessity of studying the actual objects themselves if you wish to make yourself fully acquainted with the meaning of everything you can see in the ripe grain of barley. Procure specimens of the flower and grain at different periods of growth, and, after having divested

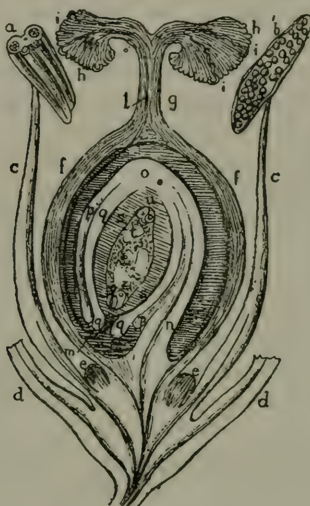


DIAGRAM OF A VERY SIMPLE FLOWER IN LONGITUDINAL SECTION.

a, transverse section of an anther before its dehiscence; *b*, an anther dehiscing longitudinally with pollen; *c*, filament; *d*, base of floral leaves; *e*, nectaries; *f*, wall of carpels; *g*, style; *h*, stigma; *i*, germinating pollen-grains; *k*, *l*, *m*, a pollen-tube which has reached and entered the micropyle of the ovule; *n*, funicle of ovule; *o*, its base; *p*, outer; *q*, inner integument; *s*, nucellus of ovule; *t*, cavity of the embryo-sac; *u*, its basal portion with the antipodal cells; *v*, synergidæ; *z*, oosphere (after Sachs).

them of their protecting glumes, immerse them in strong alcohol for a time to harden them, then put them in a mixture of alcohol and glycerine and allow the alcohol to evaporate spontaneously. In this way you will obtain the delicate little specimens in a semi-transparent state, and in a condition admirably suited for cutting into extremely thin sections for the microscope.

I will now describe briefly the structure of the flower and give you a short sketch of its subsequent development; but in order to render my remarks more intelligible to those who have not any previous knowledge of structural botany, I will first of all call your attention to a diagram which represents a longitudinal section through a very simple flower.

This does not represent any one particular flower, but expresses in a diagrammatic form the general features of most of the ordinary hermaphrodite flowers.

The floral envelopes, the calyx and the corolla, are supposed to be cut away, leaving only those parts of the flower which are essential to the reproduction of the plant.

The two filaments, *c*, *c*, which stand up on either side are the *stamens*, carrying at their extremities the *anthers*, *a*, *b*, with their pollen-sacs filled with pollen-grains. The central portion is the *carpel*, of which the essential parts are the *ovary*, *f*, the *style*, *g*, and the *stigma*, *h*. The function of the stigma, whose surface is generally viscid, is to receive the grains of pollen from the opening anthers. These grains of pollen may either be derived from the anthers of the same flower, or from the anthers of another flower of the same species, either by the agency of the wind or of insects.

The *ovule*, *o*, which is contained in the ovary, is the *immature seed*, and is connected with the base of the carpel by an attachment known as the *funicle*, *n*. The point of attachment of the ovule to the funicle is the *hilum*, and this, no matter what its position may be, is considered the base of the ovule, the opposite extremity being its apex. In the early stages of development the ovule forms a direct continuation of the line of the funiculus, but in many plants it ultimately becomes bent back, as shown in the Figure. Such an ovule is said to be *anatropous*.

The ovule, which is enclosed by the ovary, consists of a central cellular portion, the *nucleus*, *s*, surrounded by two somewhat thick integuments, an outer, *p*, and an inner, *q*. These grow from the base of the nucleus, which they completely envelop, except at the apex, where both integuments are perforated by a canal-like entrance, the *micropyle*, *m*. At an early stage of the development of the flower there is one cell within the nucleus which enlarges considerably at the expense of the others. This cell, which is situated near the micropyle, is the *embryo-sac*, *t*, and by the time the anthers are ready to shed their grains of pollen it has considerably increased in magnitude, and has developed within itself, at the end towards the apex, a minute cell, the *oosphere*, *z*, which is fertilised by the pollen in the following manner. The pollen grains which have attached themselves to the stigma undergo a sort of germination, and protrude their contents in the form of extremely minute tubes, *k*, *l*, *m*, which find their way down the style, and along the walls of the ovary or ovule until they reach the micropyle. Through this aperture they enter the embryo-sac, and mingle their contents with the *oosphere*. This is the act of fertilization, which is immediately followed by a development of the oosphere by spontaneous division until it forms the embryo of the seed. Whilst this is going on the whole embryo-sac gradually enlarges, and its internal walls become lined with a thin layer of *endosperm*, the material laid up for the future use of the young embryo. The endosperm generally extends inwards until the whole cavity of the embryo-sac is filled up. In the so-called exalbuminous seeds, such as peas, beans, walnuts, hazel-nuts, acorns, &c., we find no endosperm when the fruit is fully ripened, the whole seed being entirely filled with the embryo. In all such cases, however, the seed contained endosperm in the earlier stages of its development, but this has been completely absorbed and replaced by the embryo before the period of ripening.

The developed embryo-sac, with its embryo and endosperm, as it increases in size and replaces the nucleus, becomes closely united with the walls of the ovule, whose inner wall is, as a rule, completely absorbed. Some portion, however, of the outer integument of the ovule remains, and by its union with the wall of the enlarged embryo-sac, forms the *testa*, or integument of the seed.

Whilst the ovule is thus developing into the seed the walls and tissues of the retaining ovary undergo considerable transformation. In some cases they become hard and dry, as in the shell of the hazel-nut and almond, whilst in others certain portions of the ovary walls become soft and succulent, as in the plum, cherry, apple, &c., and constitute the fleshy part of these fruits.

After these general explanations you will more readily understand the development of the flower of the barley-plant to which I will now draw your attention.

Like all the members of the Natural Order of the *Gramineæ*, or Grasses, to which Barley belongs, the flower of this plant is very inconspicuous, and is sheathed by two scale-like bracts or glumes; these are the two paleæ to which frequent reference has been made, and on opening these, or better still by removing the outer palea, which is furnished in most cases with a long awn, the minute ovary is exposed to view. This, as you see from the sketch, Plate I., Fig. 5, is divided right and left into two well-marked lobes, each one of which is surmounted by a style, *s*, furnished with feathery stigmatic hairs, extremely well adapted for catching and retaining the minute pollen-grains.

There are three stamens attached to the base of the ovary, each carrying, on a very delicate filament, an anther with pollen-sacs charged with pollen grains; these are not shown in the Figure.

Surrounding the ovary are two transparent scales of extreme tenuity, the *lodicules*, Plate I., Fig. 4, to which I have already referred as being found under the outer skin of the ripe barley grain. These lodicules do not develop with the fertilized ovary, and, as far as we know, are of no use to the flower. We may conclude from analogy that they represent the perianth or true floral envelopes of other flowers. These, as we know, develop brilliantly coloured petals in most of the higher flowering plants, and are a great source of attraction for insects which are instrumental in fertilizing the flower by a transference of pollen. The flowers of the grasses, however, do not require the aid of insects for fertilization, the pollen being transferred from flower to flower by the wind, or the flower being self-fertilized; hence the necessity of attracting insects is not important, and we consequently find the floral envelopes existing in the lodicules in an inconspicuous form which we must look upon either as rudimentary or vestigial.

Long-continued observations and experiments have convinced botanists that the transference of pollen from the anthers of one flower to the pistil of another of the same species results in the production of plants which are more vigorous, and better fitted for the struggle for existence, than those produced by the self-fertilization of a flower by its own pollen. We find, almost everywhere, most wonderful contrivances for ensuring cross-fertilization and for preventing self-fertilization. Sometimes the male and female flowers grow on different individual plants, at others the structure of the flower is such as to render self-fertilization difficult or even impossible, whilst again, the male and female portions of the same flower arrive at maturity at different times. Almost everywhere in the vegetable kingdom there is overwhelming evidence of the truth of Darwin's doctrine that "Nature abhors perpetual self-fertilization," and it is consequently with some surprise that we find in the barley-plant an apparent exception to this principle. The pistils and stamens of barley are so closely invested by the overlapping glumes or paleæ that, at first sight it would scarcely appear possible that any transference of pollen could take place from flower to flower, as is manifestly so frequently the case in most of the other cereals. In the ordinary two-rowed barley self-fertilization is unquestionably the rule, but we find, even in this variety, that a few of the flowers occasionally expand for a very short time in the early morning, and allow the ripe anthers to protrude and scatter their pollen. This pollen is disseminated by the wind, and, in my opinion, its access to the pistils of the other flowers is much facilitated by the swaying of the awn or beard producing a leverage action, which tends to draw the paleæ slightly apart at their apex.

The ovary of barley before fertilization is a very small object, scarcely exceeding in size the head of a moderate-sized pin. It is not particularly easy to make sections through it which will exhibit its structure, but with care and patience this can be done. Plate III. exhibits the principal points which are brought out by the examination under a high magnifying power of its longitudinal and transverse sections.

You see that the ovary is mainly composed of soft, thin-walled tissue, or *parenchyma* (see description of Plates at end) as it is called, enclosing a solitary ovule with double envelopes. The interior of this ovule is the *nucleus*, and, just as in the typical flower which I described a little time ago, we find that one cell of this nucleus is very much larger than the others —this is the *embryo-sac*. Observe the canal-like opening, the micropyle, at the apex of the ovule, with the embryo-sac extending almost into its mouth. The ovule is inverted, its apex, marked by the micropyle, pointing downward, as in the typical case we considered; it is consequently *anatropous*. The attachment of the ovule to the ovary claims our special attention. You will see, by an examination of the two sections, that the ovule lies perfectly free within the cavity of the ovary, except along a narrow line on the ventral side. This line represents the *funicle* or attachment of the ovule to the inner walls of the ovary. The thick walls of the ovary itself are almost colourless except in one layer, which is coloured bright green. The cells of this layer contain a considerable amount of chlorophyll, the remarkable substance which gives the green colour to foliage leaves, and enables the plant to assimilate food from the carbonic acid of the air.

When the pollen grains are shed by the anthers, and come into contact with the hairy stigmas with which the upper part of the ovary is furnished, one of which is depicted in Plate III., Fig. 9, the minute tubes which are extended from the pollen-grains find their way along the substance of the styles to the conducting tissue of the upper part of the ovary, and growing down this and along the outer walls of the ovule, one of them finally enters the micropyle, and after piercing the wall of the embryo-sac mingles its contents with those of the oosphere, a cell situated at the apex of the embryo-sac. The act of fertilization is consequently exactly similar to the typical case I have already described.

After fertilization great, and comparatively rapid, changes take place in both ovule and ovary, both of which increase very much in size, and become much more elongated in shape.

First with regard to the embryo-sac. The fertilized *oosphere* commences to divide and sub-divide into a great number of cells which, in their collective form, ultimately become the embryo, whilst at the same time the other parts of the sac become filled with thin walled cells, filled with protoplasm, out of which starch granules are slowly elaborated. These starch-containing cells constitute the greater part of the contents of the embryo-sac, but on the inner wall of the sac, and external to these starch-containing cells, is a triple row of rectangular cells with granulated contents. The starch-containing cells, and the rectangular cells, together constitute the *endosperm*, the white mealy looking substance which constitutes by far the greater portion of the barley grain. We see, therefore, that by far the most important portions of the barley grain, the white floury endosperm, and the embryo, *both originate in the embryo-sac*, and if we follow the development of this sac, from the period immediately subsequent to fertilization, to the full ripening of the grain, we find it gradually increasing at the expense of all other parts. First of all during its enlargement, it gradually displaces the whole of the nucleus, with the exception of the merest remnant. The inner integument of the ovule is also absorbed, and the thin retaining wall of the embryo-sac becomes firmly united with the outer integument of the ovule. I have mentioned that during the ripening of the seeds of many fruits, *e.g.*, cherries, plums, &c., a portion of the walls of the ovary increases in thickness and becomes very succulent, forming the sweet pulpy portion of the fruits. In the Order of Grasses the very reverse of this is the case. The walls of the ovary, which are comparatively thick, and very soft in the early stages of growth, become partially absorbed and highly compressed as the development of the seed goes on, until finally, when the grain has been ripened, the tissues of the ovary are represented only by a very thin skin, the *pericarp*, covering the thin-walled ovule with its contents.

We can now turn once more to the sections of ripe barley to which I drew your attention earlier in the evening, and I think we are now in a better position to understand their main features. (See Plate II.)

First of all our enquiry has taught us that both the germ or embryo, and the white starchy matter which form the endosperm, and together make up the greater part of the contents of the grain, are derived directly from the *embryo-sac*, which itself sprang from a single cell in the interior of the ovule. The extremely thin epidermis of the enlarged embryo-sac can still be made out in the ripe barley, as a layer of extreme tenuity, in close contact with the square-shaped cells which form the outer layer of the endosperm. (See Plate II., *ep. nuc.*)

You will notice in Plate I., Fig. 3 that the endosperm itself, owing to the tension to which it has been subjected during its growth, has been deeply indented on one side. This indentation extends longitudinally the whole length of the endosperm, and reaches almost to the centre, giving the contents of the grain a two-lobed appearance. The outward expression of this indentation is found in the furrow, which is so evident on the ventral side of a grain of barley. In the deepest portions of this fold in the endosperm lie some empty sheaf-like cells, (Fig. 3, *n*), the only remnants of the nucleus which have escaped absorption by the growing embryo-sac. (Compare Plate III., Fig. 8, *ph.*)

Completely enveloping the whole endosperm, we have the remnant of the outer integument of the ovule, now forming the testa, or true envelope of the seed (Plate I., Figs. 1 and 2, *t*, and Plate II., *t*.), and outside this again is the thin skin of the pericarp (*p* in Plates I. and II.) which represents all that is left of the once thick-walled ovary. We can now readily understand that the point of union of these two integuments, which is marked by the bright coloured "pigment-string" to which I have previously referred, is really the remnant of the *funicle*, the line of attachment of the ovule to the walls of the ovary.

Outside the true grain we have the paleæ or glumes (Plate I. and II., *p.i.* and *p.s.*) which only become adherent to the pericarp at a comparatively late stage of development.

Thus we see that what we term the "grain" of barley really includes the united product of both ovule and ovary: in other words it represents *both seed and fruit*; the fruit portion, the product of the ovary, being reduced to a very thin integument. Such a combination of seed and fruit is called by botanists a *caryopsis*.

Fig. 11, Plate IV., is a photo-micrograph of a section taken through the integuments of a barley-grain, and includes a small portion of the enclosed endosperm. Fig. 13, Plate V., represents a similar section of a wheat grain, but in the latter case the integuments consist only of testa and pericarp, the paleæ being non-adherent in the case of wheat. The rectangular cells, of which there are three rows in barley, but only a single row in wheat, are the "aleurone" cells, and they constitute the peripheral portion of the endosperm. I have already referred in general terms to the two essentially different kinds of cells of which the endosperm of ripe barley is made up, the starch-containing and the aleurone cells, but I must now describe them a little more in detail. The starch-containing cells are arranged with their larger dimensions parallel with the axis of the grain. When viewed in transverse section they are seen to have a general radial arrangement. See Plate I., Fig. 3.

By the direct observation of very thin sections under the microscope we can detect nothing in them except tightly-packed starch granules, but if these are carefully dissolved out by suitable re-agents, we find, on staining the preparation with iodine, that the little grains of starch are embedded in a very fine network of proteid material, which is the remnant of the protoplasm, that wonderful formative material out of which both cell-walls and cell-contents have been produced. In the case of the wheat-grain this remnant of cell protoplasm is left behind, on kneading and crushing the flour, in the form of a sticky tenacious mass, known as *gluten*. It has a very complex composition, and may be separated into several distinct substances, having somewhat different properties, but all belonging to the *albuminous* class of bodies, of which the white of egg may be taken as a type. One great characteristic of all these albuminous bodies is that they contain a large percentage (13 to 15) of nitrogen.

The three rows of cells in the outermost or peripheral portions of the endosperm, which, as I have just shown you, are represented by only one row in the case of wheat, are very different in appearance from the inner starch-containing cells. Unlike the latter, they are, when seen in transverse and longitudinal sections, nearly rectangular in form, and have very thick cell walls, which swell up somewhat under the action of water. They do not contain a trace of starch, but are filled with closely packed, very minute, yellowish granules, the so-called *aleurone* grains. It is only of late that we have begun to understand that these do not consist of one homogeneous substance as do the starch-granules; but that the aleurone-cells contain a mixture of several distinct substances in the granular form. To convince oneself of this, it is necessary to take tangential sections of a grain deprived of its outer husk, and to treat them with various chemical re-agents.

Plate V., Fig. 12, is a photo-micrograph of such a tangential section through the aleurone layer of barley.

In the first place, we can prove beyond doubt that some of the minute granules are simply spherules of *fat* or *oil*. Then again, whilst others dissolve readily in water and behave like true vegetable albumin, others belong to the class of *globulins*, whilst a large portion of the "aleurone" consists of a form of albuminoid which is only soluble in dilute potash.

Aleurone grains, which in the main consist of proteids belonging to the class of globulins, are found in many other seeds, but generally speaking, they occur in the same cell as the starch grains. This is the case, for instance, in the cotyledons of the bean, the pea, and the lupin, and in fact in the seeds of leguminous plants generally. In the Order of Grasses, however, the aleurone grains and the starch grains occur in distinct cells. What end is gained in the plant economy by this differentiation remains yet to be shown by future research.

Whilst on the subject of these aleurone cells, I may perhaps be pardoned for making a small digression, which possibly may not be altogether uninteresting to some of you.

When *wheat* is ground, the object of the miller is to remove, as far as possible, the outer integuments of the grain in the form of *bran*, and to produce a very white flour from the inner starchy portions. The bran consists mainly of the pericarp and testa, but since the adhesion of the testa to the endosperm is very great, the layer of aleurone-cells is always removed with it. Now, as we have seen in the case of barley, the contents of the aleurone-cells consist of highly nitrogenous substances, and as such substances, generally speaking, are very nutritious, many people have condemned the use of the higher grades of flour, maintaining that the rejection of the whole of the bran is very wasteful, and that we ought to eat "whole meal" bread. I must say that the chemistry of the subject goes rather against these people, but quite recently very considerable light has been thrown upon the matter by a very remarkable series of experiments carried out upon himself by M. Aimé Girard,* a well-known French chemist. The result of these experiments is to show very conclusively that the nitrogenous substances in the aleurone-cells of wheat are digestible by man to a very small extent only. We may consequently continue to enjoy our white bread without any pangs of conscience, and may be content to leave the bran to the lower animals who, with their stronger digestive organs, are able to make a great deal better use of it than it is possible for us to do.

To return once more to our grain of barley. We must not lose sight of the fact that the primary object in view in storing up the starch and proteids in the grain is, not to afford to man the material for his bread and beer, but to give sustenance to the embryonic plant, until it can get its head above the ground and look after itself.

Most of the higher plants, all of those in fact which have a green colour, obtain the carbon which forms such an important part of their dry substance, from the carbonic acid of the air. This carbonic acid, which only amounts to about 3 parts per 10,000 of air, is decomposed in the green portions of the plants, oxygen being evolved and the carbon retained in combination with the elements of water. This assimilation of carbon is brought about in the tissues of the plants only under the action of *light*, and the chemical processes involved require the presence of a particular substance, *chlorophyll*, which exists in all green plants. We may take it for certain that those plants which are not green, that is which contain no chlorophyll, are incapable of assimilating carbon from the atmosphere. We know, however, that there are many plants such as fungi, and even a few of the higher plants, which do not contain any chlorophyll, and yet are capable under favourable circumstances of vigorous growth. We find on close examination that such plants, incapable as they are of using directly the carbonic acid of the air, grow either upon

* Composition Chimique et Valeur Alimentaire des diverses parties du grain de Froment. (Ann. Chim. Phys. (6) Vol. 3, p. 289, 1884.)

other plants or on the products of their decay, from which they absorb the organic carbon compounds which in the first instance have been assimilated from the air by the green parts of the plants which form their host.

A plant which thus obtains its nourishment from a living host is called a *parasite*, whilst, if it flourishes on the host when dead and decaying, we call it a *saprophyte*.

The young embryo of the barley seed does not contain any chlorophyll, and even if it did it would be no use to it as long as the grain was buried in the ground beyond the influence of light. Under these circumstances the embryo, in its early stages of growth, in fact until it has produced green leaves above the ground, *leads the life of a true parasitic plant*. Its host is the endosperm, with its contents of starch cellulose and proteids, and from this reservoir of material the young plant draws its supplies, until, by the time they are exhausted, its green leaves are able to assimilate for themselves.

I cannot too strongly emphasize the fact of the parasitic nature of the embryo, as this enables us better to understand its subsequent development. The connection between the embryo and the endosperm is not so close as that between many parasites and their host. As I have said before, we find nothing approaching to an organic connection between the two, and there are no processes or prolongations of the tissue of one into the other. We find that the embryo can be dissected out from the mealy endosperm without rupturing the tissue of either, and that the position of the two with regard to each other is *only one of very close and intimate apposition*. This is well shewn in the photo-micrograph, Fig. 10, Plate IV.

Turning to the large longitudinal section of the grain, and also to the photograph just referred to, we see that the limiting surface of the embryo, which is turned towards the centre of the grain, is a layer of palisade-like cells, set at right angles to the surface, and forming a well-marked *epithelium*.

This is in the closest possible contact with several layers of compressed and empty cells of the endosperm, whose existence calls for a word of explanation. During the later stage of the development of the contents of the embryo-sac, which comprehend, you will remember, both embryo and endosperm, the development of the embryo goes on at the expense of some portion of the starch-containing cells of the endosperm. As these are emptied of their contents, they are gradually compressed by the expanding embryo, and we find them in the ripe grain as we have them depicted here.

The portion of the embryo furnished with this palisade-like epithelium is known as the *scutellum*, or "little shield" of the embryo, and it is manifest that the nutritive contents of the endosperm, in order to be of any use to the embryo, must pass through the layers of compressed empty cells, and the epithelium of the scutellum. The cell-walls of all these tissues, and of the cells containing the reserve starch and proteids, have no apertures of any kind in their substance, and it now becomes necessary to consider how, under these apparently difficult circumstances, the solid reserve material can find its way to the embryo.

In the first place, it is manifest that these solid reserve bodies must pass through the cell walls in the state of solution; but although starch and proteids are, under favourable circumstances, to some extent soluble in water, they belong to a class of bodies incapable of readily passing through a moist membrane; they are, in other words, very *non-diffusible*. To bring them into a state in which they can readily pass through even a thin cell wall, they must undergo very considerable chemical alteration. In all germinating seeds we find that great chemical changes take place in the reserve materials, under the influence of warmth, moisture, and access of air, and it is to these that I must now briefly draw your attention.

We perhaps know more about the transformation of the important reserve material *starch* than any of the others, and we will consider that first of all, as it forms the bulk of the contents of the barley endosperm.

It has long been known that during the complex chemical changes which go on during the germination of starch-containing seeds, a peculiar soluble ferment, *diastase*, is produced.* This ferment, under certain well ascertained conditions, is able to convert starch into sugar, and the nature of this sugar, which is known as *maltose*, was first established by the well-known work of our respected Member, Mr. C. O'Sullivan, F.R.S. It is to the presence of this sugar maltose that malt-wort mainly owes its sweet taste and fermentability. During the first process of brewing, the *mashing*, (which consists, as you know, in infusing the malt with hot water), the *diastase* acts upon the starch of the grain, and converts it to a great extent into *maltose*. This chemical change, which is brought about with great rapidity at the comparatively high temperature of the mashing process, is carried on more slowly, but still very completely, during the germination of our barley grain; and if we allow the growth to continue we find that the endosperm is gradually emptied of all its starch, which has passed into the tissues of the young plant in the form of sugar.

It is generally supposed that the active ferment diastase, which produces this transformation of the starch, has its origin in the growing embryo. If this is the case it must make its way through the epithelial layer of the scutellum, and the adjoining layers of compressed and emptied cells of the endosperm before it can reach the starch-containing cells. There are certain difficulties connected with this explanation of the facts, of which by far the greatest is the extreme non-diffusibility of diastase. It may be after all that the ferment which breaks down the starch-granules has its origin in the starch-containing cells themselves, by a change in the residual protoplasm of these cells. It is not improbable that the initiating cause of this change may prove to reside in the small quantity of vegetable

* *Diastase* exists ready formed in most starch-containing seeds, but it always increases in amount on germination.

acid which always makes its appearance during the growth of the embryo.

The experimental evidence on these points is, however, at the present time too meagre for us to decide between these two views.

I will now show you on the screen the appearance which the starch granules present when being acted upon in a natural way during germination. Exactly similar corrosion and solution can be produced in the laboratory by the action of prepared diastase upon starch granules.

Although the sugar which is first produced in all these re-actions is, as I have said, *maltose*, it is a very remarkable fact that the sugar which is found in partially germinated grain, and which has, so to speak, been intercepted between the reserve-starch and the growing tissue of the young plant, is chiefly *cane-sugar*, and we have yet to learn how and where this apparent transformation of maltose into cane-sugar takes place. This is not an isolated fact in vegetable physiology. We find exactly the same thing in other parts of plants where starch, which has been laid up temporarily in reserve, is again dissolved and rendered diffusible. There seems to be in the vegetable economy some very direct way of transforming maltose into cane-sugar, which, when thoroughly understood, will probably result in the artificial production of cane-sugar from starch, and a complete revolution in the sugar-industry throughout the world.

I have said hitherto but little about the nitrogenous matters which are necessary for the growth and development of plants. Whilst in green plants the necessary carbon is derived from the air, the equally necessary ash-constituents and nitrogenous substances owe their origin to the *soil*, and enter the plant through its roots, in solution, in the large quantity of water which it is also the function of the roots to absorb.

The nitrogenous food of plants consists of nitrates and ammonia-salts, which all good vegetable soils contain in small quantities. How these nitrogen-containing bodies come to exist in soils we cannot for the moment stop to consider, but it is sufficient for our present purpose to know that the fertility of soils to a great extent depends upon the fact of their containing such nitrogen capable of ready assimilation. Before the seedling plant has developed its roots sufficiently to gain the requisite nitrogen from the soil, it must necessarily be dependent upon the reserve-nitrogen contained in the seed. This, as we have already seen in the case of barley, is stored up in two distinct parts of the grain, in the aleurone cells of the peripheral portion of the endosperm, and as residual protoplasm in the starch-containing cells.

The nitrogenous substances, like starch, are non-diffusible, and must be chemically changed before they can pass through their containing cell-walls and reach the growing embryo. That they readily do this can be experimentally proved beyond all doubt. I have found for instance, by direct determination of nitrogen in the growing embryo and in the endosperm, that during eleven days germination of barley, 40 per cent. of the total reserve nitrogen originally present in the endosperm passes through the scutellum to the young growing plant.

In the case of barley we have at present but little positive information as to the way in which the reserve proteids are broken down and rendered capable of diffusing through the cell-walls. Considerable advances have, however, been made in our knowledge of similar phenomena attending the germination of certain leguminous plants, and these clearly indicate the agency of a ferment somewhat analogous to the pancreatic ferment of animals.

The pancreatic ferment is instrumental in the processes of animal digestion in breaking down the complex albuminous substances into the comparatively simple and readily diffusible amido-bodies, *e.g.*, leucin and tyrosin—these bodies readily contributing to the building up of protoplasm, and the consequent formation of new tissue. In those seeds in which the agency of some such ferment as this has been proved to take part it has been shown to be present in the form of a *zymogen*, that is a *potential ferment* which is only brought into full activity by the presence of a small quantity of acid. The acid requisite for this quickening into activity of the ferment is derived under natural circumstances from the growing embryo. The complex nitrogenous contents of the endosperm cells are broken down to *leucin*, *tyrosin*, and perhaps *asparagin*, and can in this form readily permeate from cell to cell until they finally reach the growing embryo and contribute to the development of the young plantlet.

Besides the disappearance of the starch and proteids of the germinating grain, as they are gradually laid under contribution by the growing embryo, we note that even the walls of the starch-containing cells themselves are attacked and ultimately disappear. Whether this solution of *cellulose* is brought about by the action of diastase, or of a special ferment, is not at all clear at present. The solution of cellulose under these circumstances is, however, not by any means an isolated case. In some seeds, such as the *date*, for instance, the reserve-material of the endosperm consists entirely of cellulose, which is slowly dissolved and absorbed by the young plant as it grows.

The case of the fruit of the Ivory Palm (*Phytelephas macrocarpa*) is even more remarkable. The endosperm of this nut consists of a mass of cellulose so extremely hard that it is known as "vegetable ivory," yet the whole of this is absorbed during germination, and serves as the first nourishment of the embryo.

I have now very briefly sketched some of the chief physiological processes involved in the germination of our little barley grain, but many of them are still very obscure, and require long and patient research to thoroughly elucidate them. The work that is being done in other Orders of plants is throwing a great deal of side light upon them, but with our present knowledge of the minute anatomy of the grain, which is far in advance of the physiology, we are, I think, in a fairly good position to attack these problems from a different standpoint from that usually taken. In analyses of the barley grain, and of the malt resulting from it, it has been customary for chemists to treat the grain as a whole, and to estimate the various constituents, and their products of transformation, regardless of their distribution in the grain. In my opinion no true progress can be made in this way. It is almost as reasonable to hope that serious advances can be made in animal chemistry by taking the entire body of an animal, estimating the various chemical substances it contains at different periods, and then expecting to explain the complex physiological processes involved in its life and growth.

The time has come when we must cease to treat the germinating grain in this crude way, but must previously dissect out its various portions and determine the distribution of their constituents, and the changes they undergo. This is a matter requiring, it is true, time and great patience, but it is, I am sure, the only rational course to take.

These problems have been dealt with hitherto by purely analytical and micro-chemical processes, but I must now bring to your notice a new method which is capable of dealing with them *synthetically*.

From the time when I first fully grasped the important fact that the germ or embryo of the seed does not form part of the endosperm but is parasitic upon it, I have always looked upon it as possible that the embryo might be severed from its natural host and brought up with an *artificial endosperm*. It is comparatively easy to carry this idea out experimentally, and I find that when barley embryos are carefully dissected out of the grain they can be put out to "wet nurse," as it were, and successfully reared through their plant childhood by the aid of an artificial foster-mother, consisting of solutions of perfectly definite and known composition. You have before you on the table the results of some of these experiments, the excised embryos of barley having been placed upon thin porous tiles which are partially immersed in various nutritive solutions. The solutions employed in these particular cases are those of cane-sugar, maltose, and glycerine, of a low degree of concentration; and alongside these are some embryos which have been cultivated for the same time upon a tile moistened with water only. You will notice, where water only has been employed that the growth has been of the feeblest possible character, whilst in the other cases a vigorous growth has taken place, which is the most pronounced in the case of the cane-sugar, and the least advanced in the glycerine solution. By endless variations of experiments of this nature I have already obtained a considerable amount of information about the carbohydrates and other non-nitrogenous substances which best favour the growth of the embryo, and I am equally confident that the method will throw considerable light upon the condition of the nitrogenous bodies best adapted to the same end, and that this, a purely synthetical method of experiment, will help to explain, in conjunction with analytical processes, a great deal that is now obscure in the chemistry of germination.

Whilst on this subject I may say that it is quite possible, and in fact comparatively easy, to transfer the germ of one grain of barley to the endosperm of another, and to produce by this false grafting, plants which are in every way as healthy and vigorous as those derived from perfectly intact grains. For the success of these experiments it is necessary that the germ should be placed with its scutellum downwards on the new endosperm, and that it should be held firmly in its new position by a loop of very thin platinum or silver wire passed round the integuments.

When I commenced to prepare this Address I had the intention of bringing before you very much more than I have been able to do this evening. Amongst other things I had intended to give you some description of the principal varieties of barley, and their variations under the changing influences of soil and climate, and to have examined into what is known historically as to their origin. I feel, however, that I have already trespassed far too much upon your time and patience, but if the subject has proved of sufficient interest to you I hope at some future time to say something further on these matters, and to give you also a brief sketch of the life history of the barley-plant and its relation to its surroundings. As it is, I have been obliged to limit my remarks to the anatomy of the grain, and to the main physiological processes involved in the first stages of its growth, but in treating of these I have been able to touch the mere fringe of a great subject, and one in which very much still remains to be done. It is true that the histology, that is the minute anatomy, of the grain has been pretty nearly worked out, mainly by Johannsen, Holzner, and Lermer, but with regard to the complex phenomena attending germination, and the absorption of the stored-up materials of the endosperm, we stand only upon the threshold of knowledge. There is in this direction a vast and comparatively untried field for research, and the results to be obtained cannot but throw a great deal of light upon some of the most dark and difficult problems in vegetable physiology. They must, besides, add materially to the applications of science to the industrial process of malting. This art, based, as it no doubt is, upon a safe and solid foundation of experience, has hitherto derived as little substantial aid from science as did the art of brewing itself before the chemical transformations of starch were understood, and the genius of Pasteur had placed the phenomena of fermentation upon a true scientific basis.

DESCRIPTION OF PLATES.

N.B.—Plates I., II., and III. have been reduced from the drawings of Holzner in his "Beiträge zur Kentniss der Gerste." The Photo-micrographs of the sections of barley were prepared for me by Dr. G. H. Morris. The section of the wheat grain is after Aimé Girard.

PLATE I.

Fig. 1.—Grain of Barley.

a. Dorsal view. *b.* Ventral view. *c.* Ventral furrow. *d.* Basal bristle.

Fig. 2.—Sketch of longitudinal section through Barley grain.

p.s. Palea superior. *p.i.* Palea inferior. *p.* Pericarp. *t.* Testa. *al.* Aleurone layer. *end.* Endosperm. *em.* Embryo. *d.* Basal bristle. *aw.* Awn.

Fig. 1.

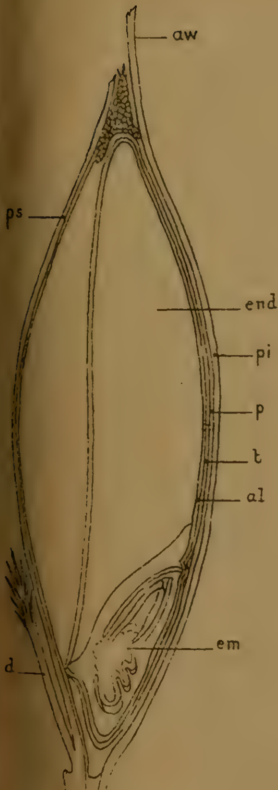


Fig. 2.

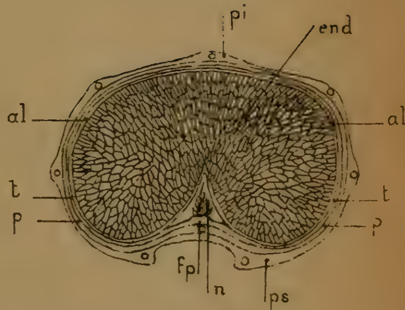


Fig. 3.

Fig. 4.

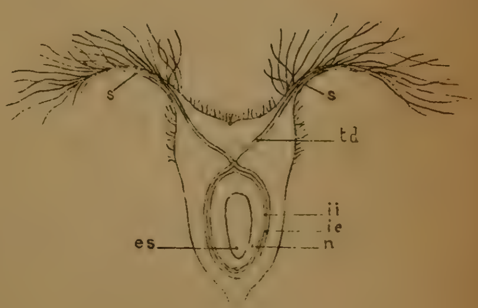


Fig. 5.

After Holzner

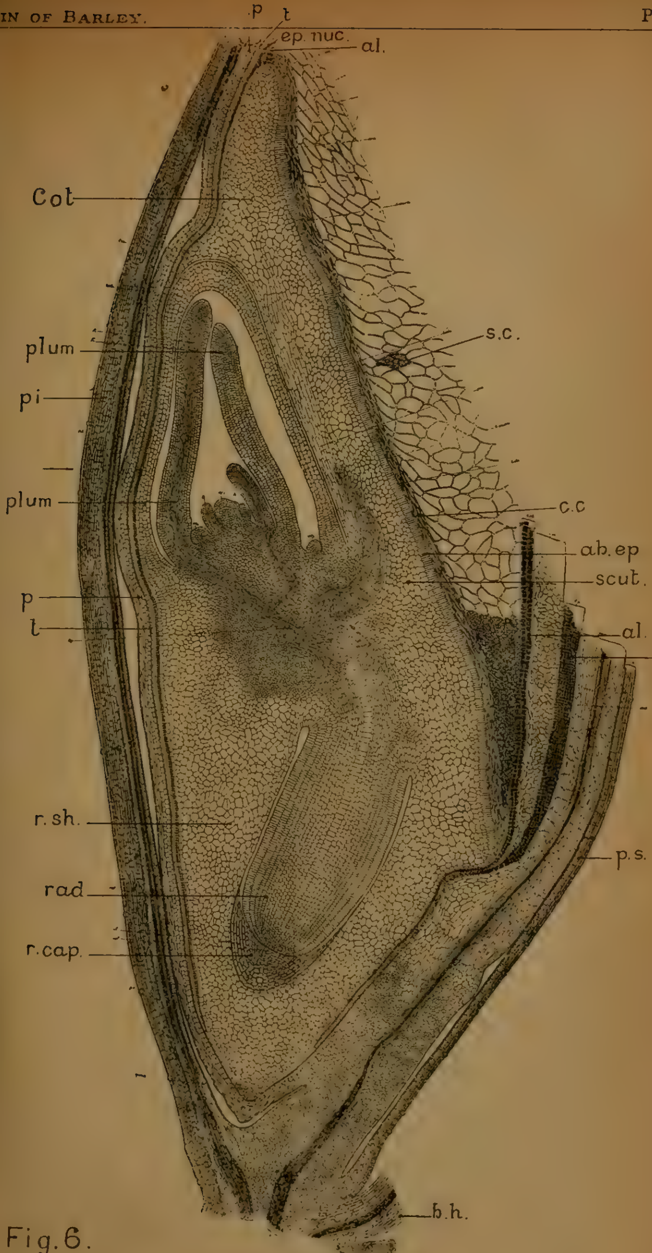


Fig. 6.

AFTER HOLZNER

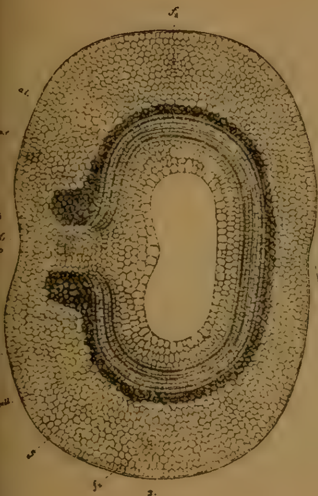


Fig 8.

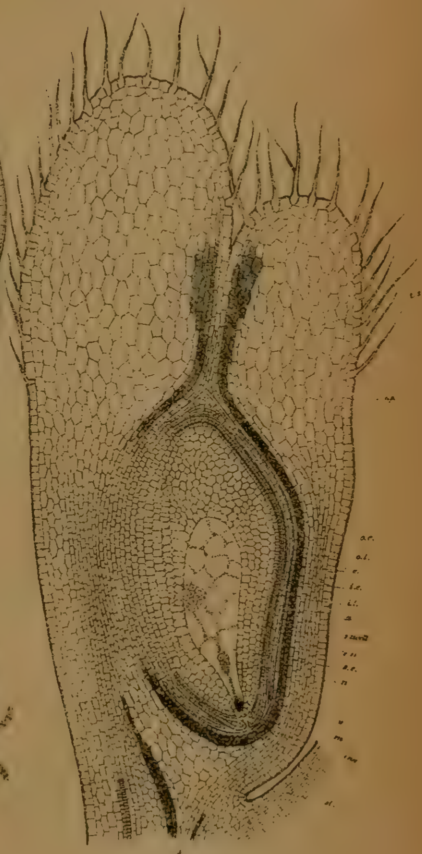
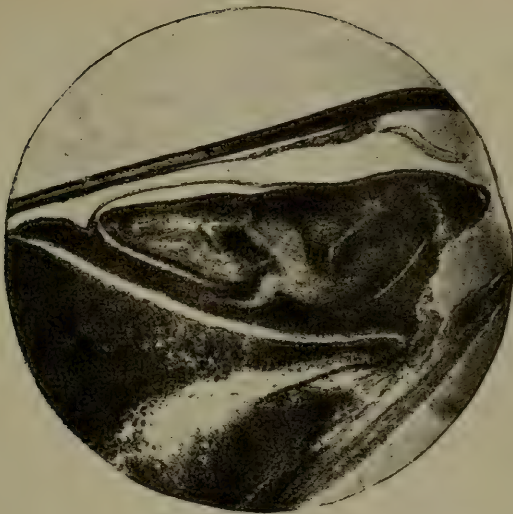


Fig.7.

Fig 9.

AFTER HOLZNER.

FIG. 10.



LONGITUDINAL SECTION OF BARLEY, SHOWING EMBRYO.
x 45.

FIG. 11.

LONGITUDINAL SECTION OF BARLEY, SHOWING ENDOSPERM, ALEURONE CELLS, TESTA, PERICARP, AND PALEA.
x 350.

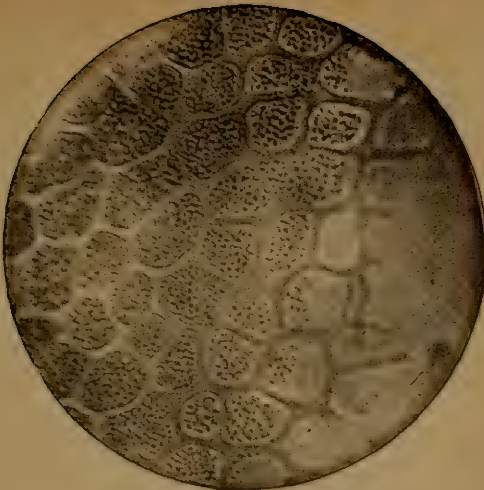


FIG. 12.

TANGENTIAL SECTION THROUGH ALEURONE CELLS OF BARLEY, SHOWING GRANULAR CONTENTS.

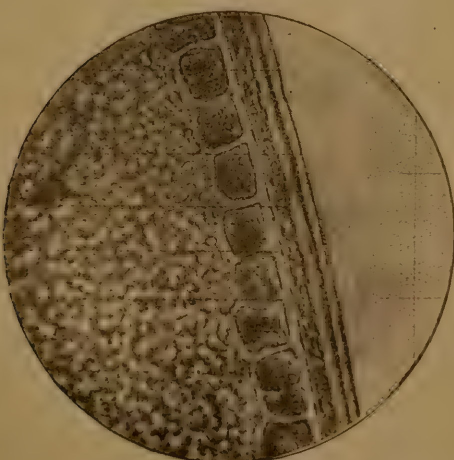


FIG. 13.

LONGITUDINAL SECTION THROUGH INTEGUMENTS OF WHEAT GRAIN.

Fig. 3.—Transverse section through Barley grain.

n. Remnant of nucleus (cf. Plate III., Fig. 8, *ph*). *f.p.* Section of "pigment string" (funiculus). Others parts lettered as in Fig. 2.

Fig. 4.—One of the two lodicules.

Fig. 5.—Sketch of longitudinal section through ovary of Barley at time of fertilization.

s. Style. *t.d.* Conducting tissue for pollen-tubes. *n.* Nucleus of ovule. *i.i.* Inner integument of ovule. *i.e.* Outer integument of ovule. *e.s.* Embryo-sac.

PLATE II.

Fig. 6—Longitudinal section through lower part of a grain of ripe Barley.

Embryo. { *scut.* Scutellum. *ab. ep.* Absorptive epithelium of scutellum. *cot.* Cotyledon. *plum.* Plumula. *rad.* Radicle. *r. cap.* Root-cap. *r.sh.* Root-sheath.

s.c. Starch-containing cells of endosperm. *c.c.* Emptied and compressed cells of endosperm. *a.l.* Aleurone cells of endosperm. *ep. nucell.* Remains of epidermis of nucleus. *t.* Testa, developed from outer integument of the ovule (cf. Plate III., Figs. 7 and 8, *i.e.*) *p.* Pericarp, developed from walls of ovary. *p.i.* Inferior palea. *p.s.* Superior palea, *b.h.* Part of basal hair. *f.p.* Funiculus, the common line of origin of testa and pericarp.

PLATE III.

Fig. 7.—Longitudinal section through ovary of Barley.

s.t. Lower end of one of the three stamens. *o.c.* Outer part of walls of ovary. *o.i.* Inner chlorophyll layer of walls of ovary. *e.* Epithelium lining ovarian cavity. *i.e.* Outer integument. *i.i.* Inner integument of ovule. *e.n.* Epidermis of nucleus. *end.* Micropyle. *nucell.* Nucleus. *s.c.* Embryo-sac. *v.* Oosphere and Synergides. *a.* Antipodal cells.

Fig. 8.—Transverse section through ovary of Barley.

f. 1, *f.* 2, Vascular bundles. *tp.* Cells, which in the ripe grain are coloured brownish-yellow—"pigment string" or funiculus. *ph.* Cells of the nucleus which can still be recognized in the ripe grain (cf. Plate I., Fig. 3, *n*). Other letters same as in Fig. 7.

Fig. 9.—Stigma and stigmatic hairs of flower of Barley.

PLATE IV.

Fig. 10.—Longitudinal section through embryo of Barley.

Fig. 11.—Longitudinal section through integuments of Barley-grain highly magnified—shows also aleurone and starch-containing cells of endosperm.

PLATE V.

Fig. 12.—Tangential section through aleurone cells of Barley—shows granular contents.

Fig. 13.—Longitudinal section through integuments of Wheat-grain.

The Lepidoptera of Burton-on-Trent and Neighbourhood.

THE following list of the Macro-lepidopterous fauna of the Burton-on-Trent district is founded on a list compiled by the Entomological Section of this Society, and published in the "Entomologist" during 1885.

The members have had the advantage of using two old lists—one by that renowned entomologist, Mr. Edwin Brown, and contained in Sir O. Mosley's "History of Tutbury"; the other by Mr. W. Garneys, and embodied in his work, "The Fauna and Flora of Repton." To these are added the observations of about a dozen living collectors, each contribution being distinguished by the initials of its finder's name. The district covered is rather a wide one, extending from fifteen to twenty miles round Burton in every direction, and has not been worked, so far as we are aware, by any other Society. It includes two famous localities—Cannock Chase, the original British habitat of *Lasiocampa ilicifolia*, and Chartley Park, the southernmost limit of *Cœnonympha typhon*; the river Trent passing through the centre. The "Entomologist" List has been followed throughout.

The observers, whose initials appear in our local list, are as follows:—E. Brown, W. Garneys, J. T. Harris, G. Baker, P. B. Mason, C. F. Thornewill, G. A. Smallwood, T. Gibbs, J. E. Nowers, G. H. Whitlock, W. M. Anderson, H. F. Gibson, C. G. Barratt, and E. Blagg. Mr. R. Freer, of Rugeley, has also furnished some valuable notes on the Cannock Chase district; and one or two contributions have been received from Mr. Blatch, of Birmingham, and Mr. J. R. B. Masefield, of Cheadle.

Not much has been done at sugar, and a large proportion of the species have been bred from larvæ. Mr. Smallwood is the only member who has practised pupa-digging to any appreciable extent.

Since the publication in the "Entomologist" considerable additions have been made, both by the discovery of species hitherto unrecorded in the district, and of new localities for recorded species; and by the confirmation of old or doubtful records. In one or two cases it has been necessary to correct the old list by striking out records which were found to rest on a mistake, or on insufficient authority.

Advantage has been taken of a recent report of the North Staffordshire Naturalists' Field Club, in which there are some valuable notes on the Staffordshire Lepidoptera by Mr. E. Blagg, of Cheadle, and the well-known entomologist, Mr. C. G. Barratt.

The species which have been added to the list are as follows:

Lithosia mesomella, Cannock Chase (T. G.).

Lophopteryx cucullina, Rugeley (R. F.).

Acronycta menyanthidis, Chartley (E. Blagg).

Heliophobus hispidus, Rugeley (R. F.).

Noctua glareosa, Cheadle (E. Blagg).

Noctua dahlii, Cheadle (E. Blagg).

Calocampa solidaginis, Cannock Chase (E. Blagg).

Larentia flavicinctata, Dovedale (E. Blagg).

Larentia olivata, Dovedale (R. G. Lynams).

Thera firmata, Cannock Chase (C. F. T.)

Eucosmia undulata, Cannock Chase (C. G. B.).

The following remarks upon the geological features of the locality have been prepared by Mr. Frank E. Lott, A.R.S.M.

It is impossible to give an extended geological notice of the district included in this paper, it having an area of 1,000 square miles. We may, however, mention some of the broad features of the district; and this, with a list of the principal localities, geologically classified, may perhaps be of some service, as indicating the influence of Geology on comparative Entomology.

In the first place there is a *valley area* of over 300 square miles, watered by the Trent and its tributaries—the Derwent, Dove, Tame, and Soar.

Secondly, with Burton as a centre, there are the following *elevated areas* :—Needwood Forest, on the north-west, about thirty square miles of well-wooded land, from 300 feet to 500 feet above sea-level. Cannock Chase, a heather-covered upland, about twenty square miles, from 350 feet to 600 feet, lies still more to the west. Charnwood Forest, in the east, is a rocky district, of some twenty square miles, irregular in outline and elevation, rising in parts, such as Bardon Hill and Breedon to as much as 800 feet. The Weaver Hills, 800 feet, and Thorp Cloud, in the north, are really portions of the great limestone plateau of Derbyshire.

The prevailing geological formation is New Red, both Bunter and Keuper being represented, the former chiefly as Middle Bunter—the mottled sandstone occurring but sparingly—the latter largely, as Upper Keuper marls and Lower Keuper sandstone.

The great anticlinal of the Pennine Range extends across the Trent Valley, causing the inliers of limestone (partially dolomitized) at Ticknall and Breedon, and ending with the mass of Archæan rocks, forming Charnwood Forest.

There are five coalfields, more or less, included—the whole of the Leicestershire and portions of the Warwickshire, North and South Staffordshire, and Derbyshire. The soil of much of this district is formed from the boulder-clay and drift gravels, but little modified by the underlying formations.

FORMATIONS, ROCKS, ETC.	LOCALITIES IN LIST.
Archæan.	Charnwood Forest.
Intrusive greenstone.	Bardon Hill.
Mountain limestone.	Dovedale, Ticknall.
Mountain limestone and Upper Keuper marls.	Breedon Cloud Wood, Calke Abbey.
Yoredale Shales and Bunter conglomerate and alluvium.	Ashborne and Okeover.

FORMATIONS, ROCKS, ETC.	LOCALITIES IN LIST.
Yoredale Shales, Gritstone, with alluvium.	Little Eaton.
Gritstone.	Breadsall Moor and Belper.
Gritstone and Bunter conglomerate.	Repton Rocks and Shrubs and Bretby Park.
Coal measures.	Ashby, Newhall, Cheadle, Cannock, Ilkeston.
Bunter conglomerate.	Cannock Chase, Repton, Milton, Seal Wood.
Lower Keuper sandstone.	Winshill, Brizlincote.
Lower Keuper sandstone, Bunter conglomerate, with alluvium.	Rugeley.
Keuper marl with alluvium.	Burton, Branstone, Barrow, Willington, Rollestone, Egginton, Derby, Long Eaton, Loughboro', Drakelow, Cauldwell, Horninglow, Stafford, Rugeley.
Keuper marl.	Somershall, Cubley, Marchington, Chartley Park, Etwall, Findern, Grange Wood, Tatenhill, Atherstone.
Keuper marl and boulder-clay.	Sinai Park, The Oaks, Knightley Park, Hoar Cross.
Rhœtic beds and boulder-clay.	Needwood Forest, Swilcar Wood, and Bagot's Park.

RHOPALOCERA.

Aporia cratægi, a nest of larvæ found by Rev. F. M. Spilsbury, in his garden at Barrow-upon-Trent, feeding on apple.

Pieris brassicæ, *P. rapæ*, *P. napi*, common throughout the district.

Euchloë cardamines, common throughout the district.

Colias edusa, clover fields at Repton (W. G.), Horninglow, Newton Solney, and Brizlincote (J. T. H.), Winshill (G. B.), Branstone (J. E. N.), Ashby (G. A. S.). Variety *helice*, clover fields at Repton (W. G.).

Gonopteryx rhamni, Seal Wood and Dovedale (J. T. H.), Repton Shrubs (G. B.), Egginton (W. M. A.).

Argynnis selene, Bagot's Park (C. F. T.), Dovedale and Chartley (J. T. H.), Charnwood Forest (J. E. N.) *A. euphrosyne*, formerly in Repton Shrubs and Seal Wood (E. B. and J. T. H.) *A. aglaia*, abundant on Cannock Chase (J. E. N. and C. F. T.). *A. paphia*, Repton Shrubs and Seal Wood (E. B.), formerly in Repton Shrubs (J. T. H.), formerly in Anker Church (W. G.).

Melitæa aurinia (*artemis*), Charnwood Forest (E. B.), one at Burton (G. H. W.).

Vanessa c-album, Repton Shrubs and Seal Wood (E. B.), Repton (W. G.), Bardon Hill (J. T. H.), Calke Abbey (H. A. Stowell), *V. polychloros*, scarce (E. B.). Needwood Forest and Dovedale (J. T. H.), one at Burton (W. J. Pickering), one at Barrow (G A. S.). *V. urticæ*, common throughout the district. *V. io*, occurs occasionally throughout the district. *V. antiopa*, once at Milton (W. G.). *V. atalanta*, occurs throughout the district, some years abundantly. *V. cardui*, abundant throughout the district some years.

Pararge ægeria. Seal Wood (E. B.), Repton Shrubs (W. G.), Bardon Hill (J. T. H.). *P. megæra*, common (E. B.), scarce since 1861 (W. G.), Forest banks, Needwood (J. T. H.), Charnwood Forest (J. T. H.).

Satyrus semele, Bunster Hill, Dovedale (J. T. H.).

Epinephele ianira, common throughout the district. *E. tithonus*, common (E. B. and W. G.), Sinai Park (G. B.), Charnwood (J. T. H.). *E. hyperanthes*, common in woods (E. B.), Repton Shrubs (W. G. and G. B.), Seal Wood (W. G. and J. T. H.), Needwood Forest (T. G.).

Cænonympha typhon (*davus*), Chartley Moss (J. T. H. and C. F. T.). *C. pamphilus*, Chartley Park and Charnwood Forest, abundant (J. T. H.), Bagot's Park, abundant (C. F. T.), Cannock Chase, abundant (J. T. H.).

Thecla betulæ, taken on Cannock Chase (R. F.). *T. w-album*, Burton-on-Trent and Brizlincote, but rare (E. B.), Repton Shrubs, abundant (G. B.), Hoofies Wood (T. G.), Seal Wood (J. E. N.), Knightley Park (C. F. T.). *T. quercus*, Repton Shrubs (E. B.), Seal Wood (G. B.), Charnwood Forest (J. T. H.). *T. rubi*, Dovedale, plentiful formerly (J. T. H.), Cannock Chase, abundant (J. E. N. and R. F.).

Polyommatus phlœas, common (E. B. and W. G.), Tatenhill (W. M. A.), Chartley Park (J. T. H.), Cannock Chase (C. F. T.), Bretby Park, Repton Rocks, and near Repton Shrubs (T. G.).

Lycæna astrarche (agestis), Dovedale (E. B.). *L. icarus (alexis)*, generally distributed throughout the district. *L. argiolus*, scarce round Repton (W. G.), abundant in Needwood Forest. *L. minima (alsus)*, common in Dovedale (J. T. H.).

Nisoniades tages, Dovedale (E. B. and J. T. H.).

Hesperia thaumas (linea), not uncommon (E. B.). *H. sylvanus*, not uncommon (E. B.), Bagot's Park, common (C. F. T.), Chartley (J. T. H.). *H. comma*, Chartley (J. T. H.).

HETEROCERA.—SPHINGES.

Acherontia atropos, larvæ on potato and tea tree (E. B.), occasionally in some abundance (W. G.), Willington (F. M. S.), occurs occasionally throughout the district.

Sphinx convolvuli, occurs occasionally (E. B.), Repton, some years ago in some abundance (W. G.), Barrow (G. A. S.), several specimens recently taken in Burton. *S. ligustri*, not unfrequent (E. B. and W. A.), Findern (G. A. S.), one larva at Stapenhill (C. F. T.).

Chœrocampa celerio, one taken in Bass & Co.'s yard, November, 1880 (G. B.). *C. porcellus*, single specimens taken in Rugeley several years (R. F.), larva at Oakedge, 1887 (C. F. T.). *C. elpenor*, frequent in larval state (E. B.), scarce, larvæ in wet places (W. G.), larva on apple at Barton (C. F. T.), one pupa (G. B.), one larva at Shobnall (J. T. H.). *C. nerii*, one at Burton, 1888 (J. T. H.).

Smerinthus ocellatus, common in orchards (E. B. and W. G.), occasionally on apple (J. E. N.), on *Populus alba* in Bretby Lane

(J. T. H.), larva on plum at Stapenhill, 1887 (C. F. T.). *S. populi*, common throughout the district. *S tiliæ*, Cubley (E. B.).

Macroglossa stellatarum, occurs in abundance some years.

Trochilium apiformis, larvæ on poplars, Findern cover (W. G.). *T. crabroniformis* (*bembeciformis*), in osier beds occasionally (E. B.), osier beds at Repton (W. G.), Burton (J. E. N.), Newton (J. T. H.), Little Eaton (G. B.).

Sesia sphegiformis, several specimens were taken a few years ago in Repton Shrubs among young alders (E. B.), Repton Shrubs (J. T. H.). *S. tipuliformis*, common throughout the district. *S. asiliformis* (*cynipiformis*), some specimens, chiefly females, taken on stumps of trees in Repton Shrubs (W. G.). *S. culiciformis*, Repton and Seal Woods (E. B.), one specimen in Seal Wood (J. T. H.).

Ino statices, frequent in meadows (E. B.), in mowing grass, near Milton (W. G.), in meadow, near Stanton (J. T. H.), Ashborne and Dovedale (J. T. H.).

Zygæna loniceræ, Repton Shrubs (E. B.), in mowing grass on Burnet, &c (W. G.). *Z. filipendulæ*, common (E. B.), in mowing grass on Burnet, &c. (W. G.), Dovedale, common (J. T. H.).

BOMBYCES.

Hylophila prasinana, common throughout the district.

Nola cucullatella, common throughout the district. *N. confusalis*, Burton (E. B.), at rest on trees in Repton Shrubs (W. G.).

Nudaria mundana, scarce (E. B. and W. G.).

Lithosia lurideola (*complanula*), common (E. B.), (W. G.), larva at Willington (C. F. T.). *L. mesomella*, Cannock Chase, 1885 (T. G.).

Deiopeia pulchella, said to have once occurred at Repton ("Entomologist," xvii. 141).

Euchelia jacobææ, occurred some years ago in a garden at Burton (E. B.), plentiful on Charnwood Forest (E. B. and J. T. H.).

Nemeophila russula, Chartley Moss (J. T. H.), Cannock Chase, common (R. F.). *N. plantaginis*, Dovedale (E. B. and G. B.), Bardon Hill (J. T. H.), Cannock Chase, 1885 (T. G.).

Arctia caia, common throughout the district.

Spilosoma fuliginosa, Newton Solney and Dovedale (E. B.), once at Willington (W. G.), Chartley and Bardon Hill (J. T. H.), Cannock Chase (R. F.), once at Little Eaton (G. S.). *S. lubricipeda* and *S. menthastri*, common throughout the district. *S. mendica*, near Marchington (E. B.). *S. urticæ,* larvæ found once near Burton (E. B.).

Hepialus humuli, common throughout the district. *H. sylvanus*, common (E. B.), Tatenhill (J. T. H.), common in Bretby Park (T. G. and J. T. H.), Cannock Chase (R. F.). *H. velleda*, Seal Wood (E. B.), one in Repton Shrubs (W. G.), common at Bretby (T. G.), common on Cannock Chase (T. G.). Variety *gallicus*, common at Bretby (T. G.). *H. lupulinus* and *H. hectus*, common throughout the district.

Cossus ligniperda, generally distributed throughout the district.

Zeuzera pyrina (*æsculi*), Yoxall (E. B.), Newton Solney, *in cop.* (J. T. H.), larva in pear at Rolleston (G. B.), larva in quince at Burton (C. F. T.), once at Burton (S. R. Hallam), one at Bretby, 1888 (H. F. G.).

Porthesia similis (*auriflua*), common throughout the district.

Leucoma salicis, Burton (E. B.), Burton, abundant (G. B.), on poplars at Findern (W. G.).

Dasychira pudibunda, Henhurst, but rare (E. B.), scarce (W. G.), Findern (G. A. S.), larva at Bladon (G. B.).

Orgyia gonostigma, one larva taken at Rugeley (R. F.). *O. antiqua*, common throughout the district.

Trichiura cratægi, rare (E. B.), larvæ on highest shoots of hawthorn (W. G.), Tutbury Road (G. B.), Willington (J. E. N. and G. A. S.), one near Ashby-de-la-Zouch (G. A. S.).

Pœcilocampa populi, occurs occasionally (E. B.), Needwood Forest (J. T. H.), near Repton (P. B. M.), Repton village (C. F. T.), Ashby (G. A. S.).

Eriogaster lanestris common (E. B. and W. G.), Needwood Forest and Willington (J. E. N.).

Bombyx rubi, Dovedale (E. B.), plentiful in Dovedale (J. T. H.), Cannock Chase (G. W. Blatch). *B. quercus*, not common (E. B.), occurs occasionally throughout the district.

Odonestis potatoria, common throughout the district.

Lasiocampa quercifolia, a few larvæ taken near Rugeley (R.F.). *L. ilicifolia*, Cannock Chase (E. B. and R. F.).

Saturnia pavonia (*carpini*), one larva at Tatenhill (E. B.), common on Cannock Chase (J. T. H. and R. F.).

Drepana lacertinaria, near Ashby (G. A. S.), Oakedge Park (T. G., &c.). *D. falcataria*, Seal Wood (E. B. and G. H. W.), Chartley (J. T. H.), Oakedge Park (T. G., &c.), larva in Repton Shrubs (C. F. T.).

Cilix glaucata (*spinula*), common throughout the district.

Dicranura bicuspis, on alder, but rare, Egginton, &c. (E. B.), Rolleston Park (C. F. T.), empty cocoon on alder, Cannock Chase (C. F. T.). *D. furcula*, on willows, but not common (E. B.), Repton (P. B. M.), Repton Shrubs (G. B.), Barrow-on-Trent (G. A. S.), Charnwood Forest (E. H. Todd). *D. bifida*, fairly common throughout the district. *D. vinula*, common throughout the district.

Pterostoma palpina, Seal Wood and Repton Shrubs (E. B.), Burton (G. B.), Barrow (G. A. S.).

Lophopteryx camelina, common throughout the district. *L. cucullina*, Rugeley (R. F.).

Notodonta dictæa, Seal Wood and Burton (E. B.), near Repton (W. G.), Stapenhill (J. T. H. and G. B.), Derby (G. A. S.), near Ashborne (H. F. G.), Cannock Chase (C. F. T.). *N. dictæoides*, once at light, at Derby (G. B.), Cannock Chase (C. F. T.). *N. dromedarius*, Repton Shrubs and Derby (G. B.), near Ashby (G. A. S.), Cannock Chase (C. F. T.). *N. ziczac*, Seal Wood (E. B.), near Repton (W. G.), Repton Shrubs (G. B.), Derby (H. F. G.), one near Barrow (G. A. S.) *N. chaonia*, Repton Shrubs (G. B.). *N. trimacula* (*dodonea*), Seal Wood (E. B.), Repton Shrubs (G. B.).

Phalera bucephala, common throughout the district.

Pygæra curtula, Burton (E. B.).

Thyatira derasa and *T. batis*, fairly common throughout the district.

Cymatophora duplaris, Henhurst (E. B.), Cannock Chase (G. B.).

Asphalia diluta, Henhurst (E. B.), near Ingleby (W. G.). *A. flavicornis*, Repton Shrubs (J. T. H. and G. B.), one at Burton (W. J. Pickering), Barrow (G. A. S.), common in Birch Valley, Cannock Chase (R. F.).

NOCTUÆ.

Bryophila perla, Burton (E. B., W. G., and J. T. H.), Branston (J. E. N.), not common at Bretby (T. G.), common at Derby (G. B.), near Ashborne (H. F. G.) common at Rugeley (R. F.).

Demas coryli, Dovedale (G. B.).

Acronycta tridens, common (E. B.), fairly common at Burton (G. B.), Barrow (G. A. S.). *A. psi*, common throughout the district. *A. leporina*, one near Willington (W. G.), Burton (P. B. M.), Stapenhill (G. B.), Ashby (G. A. S.), larvæ on Cannock Chase (R. F.). *A. megacephala*, tolerably common where poplars are found. *A. alni*, one at Knightley Park (E. B.), two larvæ taken (W. G.), one at Burton (C. F. T.), Stapenhill (G. B.), Egginton (Arthur Marshall), one in Repton Shrubs (J. E. N.), one in Hoofies Wood, near Hartshorne (T. G.), one at Oakedge (G. W. B.), one on Sallow at Chartley (R. F.), Ashby (G. A. S.) *A. ligustri*, Repton Shrubs, rare (E. B.). *A. rumicis*, common (E. B.). Derby (G. B.), Barrow (G. A. S.), common on Cannock Chase (C. F. T.). *A. menyanthidis* Chartley (E. Blagg).

Diloba cæruleocephala, common throughout the district.

Leucania conigera, The Lawns (E. B.), one larva (G. B.), Burton (J. E. N.), one at Bretby (T. G.), Barrow (G. A. S.), common at Rugeley (R. F.). *L. lithargyria*, Burton (E. B., G. B., J. E. N., and W. G.), Barrow (G. A. S.), one at Bretby (T. G.). *L. comma*, Henhurst, &c. (E. B. and W. G.), Burton (J. E. N. and G. B.), Bretby (T. G.), Barrow (G. A. S.), near Derby (H. F. G.), at light, at Rugeley (R. F.). *L. impura* and *L. pallens*, common throughout the district.

Cænobia rufa (*despecta*), Henhurst (E. B.), Little Eaton (G. B.).

Tapinostola fulva, common (E. B. and W. G.), Burton (G. B.), Bagot's Park (C. F. T.), Bretby, very local (T. G.).

Nonagria arundinis (*typhæ*), common throughout the district. *N. lutosa*, Willington (E. B.). Burton, at light (G. B.).

Gortyna ochracea (*flavago*), common throughout the district.

Hydrœcia nictitans, Henhurst (E. B.), Burton (G. B.), Bretby (T. G.), Rugeley, at light (R. F.). *H. micacea*, Burton, common (E. B. and W. G.), Burton, at light (C. F. T., &c.), one at Bretby (T. G.), Barrow (G. A. S.). *H. petasitis*, Newton Road, 1888 (G. B.)

Axylia putris, common throughout the district.

Xylophasia rurea, common throughout the district. *X. lithoxylea*, The Oaks (E. B.), common on lime blossoms at Burton (C. F. T.), Burton (G. B.), Bretby (T. G.), near Derby (H. F. G.), Barrow (G. A. S.), Rugeley, common (R. F.). *X. sublustris* (?), one at Willington (W. G.). *X. monoglypha* (*polyodon*), common throughout the district. *X. hepatica*, Henhurst, common (E. B. and W. G.), Burton (G. B.), Bretby (T. G.), Barrow (G. A. S.). *X. scolopacina*, Knightley and Bretby (E. B.), near Ingleby (W. G.), once at Shobnall (J. E. N.).

Neuria reticulata, Henhurst and Repton Shrubs (E. B.), once at Barrow (G. A. S.).

Neuronia popularis, Burton (E. B. and W. G.), twice at Bretby (T. G.), very common at Derby (G. B.), Rugeley (R. F.).

Heliophobus hispidus, Rugeley (R. F.).

Charæas graminis, Bretby (E. B., T. G., and W. G.), Derby (G. B.), Cannock Chase, common (J. E. N. and R. F.), Charnwood Forest (J. T. H.).

Cerigo matura (*cytherea*), Knightley (E. B.), one at Barrow (G. A. S.).

Luperina testacea, Henhurst (E. B. and W. G.), Burton and Derby (G. B.), one at light, at Burton (J. E. N. and C. F. T.), Bretby (T. G.).

Mamestra anceps, Burton, at sugar (G. B.), Bretby, at sugar (T. G.), Barrow (G. A. S.). *M. brassicæ*, common throughout the district. *M. persicariæ*, near Derby (E. B.), common at Derby (G. B. and H. F. G.), Burton (C. F. T., J. E. N., &c.), common at Rugeley (R. F.).

Apamea basilinea and *A. gemina*, common throughout the district. *A. unanimis*, common at Burton (G. B.). *A. didyma* (*oculea*), common throughout the district.

Miana strigilis and *M. fasciuncula*, common throughout the district. *M. literosa*, Willington (W. G.), Derby (G B.), Barrow (G. A. S.), Bretby (T. G.). *M. arcuosa*, Henhurst (E. B. and W. G.), Bretby (T. G.), Repton Shrubs (G. B.), Drakelow (J. E. N.).

Grammesia trigammica (*trilinea*), common (E. B. and W. G.), Burton (J. E. N. and G. B.), Derby (G. B.), Bretby (T. G.), Barrow (G. A. S.), Ashborne (H. F. G.). Variety *bilinea*, Derby (G. B.).

Stilbia anomala (?), one at Findern (W. G.).

Caradrina morpheus, common throughout the district. *C. alsines*, Barrow (G. A. S.). *C. taraxaci* (*blanda*), Derby (G. B.), Barrow (G. A. S.), Bretby (T. G.). *C. quadripunctata* (*cubicularis*), common throughout the district.

Rusina tenebrosa, one in Repton Shrubs (W. G.), Cannock Chase common (T. G.).

Agrotis suffusa, common some years. *A. saucia*, Somershall, rare (E. B.), one near Willington (W. G.), Burton, at sugar (C. F. T.). *A. segetum* and *A. exclamationis*, common throughout the district. *A. nigricans*, Derby (G. B.), Barrow (G. A. S.), two at Bretby, 1884 (T. G.). *A. tritici*, Barrow (G. A. S.). *A. aquilina*, The Lawns (E. B.), one specimen (W. G.), once at Bretby (T. G.). *A. obelisca*, bred from larvæ taken at Derby (G. B.). *A. agathina*, Breadsall Moors (G. B.). *A. strigula* (*porphyrea*), Cannock Chase (C. F. T.), Breadsall Moors (G. B.). *A. obscura* (*ravida*), Burton, rare (E. B.), Barrow (G. A. S.). *A. simulans* (*pyrophila*), Somershall, rare (E. B.).

Noctua glareosa, Cheadle (E. Blagg). *N. augur*, common throughout the district. Variety *helvetina*, has occurred near Derby (G. B.). *N. plecta* and *N. c-nigrum*, common throughout the district. *N. triangulum*, Henhurst (E. B. and W. G.), once at Bretby (T. G.), larvæ common in spring (G. B.). *N. brunnea*, Henhurst (E. B.), Willington (W. G.), Burton (C. F. T.), Little Eaton, common (J. E. N.), one at Bretby (T. G.), larvæ found in spring (G. B.). *N. festiva*, common throughout the district. *N.*

dahlii, Cheadle (E. Blagg). *N. subrosea*, once at Little Eaton (G. B.) *N. rubi*, common throughout the district. *N. umbrosa*, larvæ on seeds of wild hyacinth (W. G.), at sugar at Burton (C. F. T. and J. T. H.), Bretby, common (T. G.), Barrow (G. A. S.), Little Eaton (H. F. G.). *N. baia*, The Oaks and Henhurst (E. B. and W. G.), Bretby, at sugar (T. G.), once at Barrow (G. A. S.). *N. xanthographa*, common throughout the district.

Triphæna ianthina, Henhurst (E. B.), Burton (G. B.), fairly common at Bretby (T. G.), Barrow (G. A. S.), fairly common at Rugeley (R. F.), frequently flying by day (W. G.). *T. fimbria*, Henhurst (E. B.), Willington (W. G.), larvæ at Waterloo Clump, Repton Shrubs, and Tatenhill (G. B.), occasionally at Bretby (T. G.), Little Eaton (H. F. G.), Rugeley, but rare (R. F.), one at Newton Road, 1887 (G. B.). *T. interjecta*, Willington (E. B.), scarce (W. G.), Burton (G. B.), one at Bretby, 1887 (T. G.), Barrow (G. A. S.), Rugeley, but rare (R. F.). *T. comes* (*orbona*) and *T. pronuba*, common throughout the district.

Amphipyra pyramidea, Burton (E. B. and J. T. H.), Repton (W. G.). *A. tragopogonis*, common throughout the district.

Mania typica and *M. maura*, common throughout the district.

Panolis piniperda, one at Knightley Park (J. T. H.), larvæ on Cannock Chase, 1887 (C. F. T.).

Pachnobia rubricosa, Burton Churchyard (C. F. T.), Bretby (T. G.), Repton Shrubs (J. E. N.), Little Eaton, common (G. B.). *Tæniocampa gothica* and *T. incerta* (*instabilis*), common throughout the district. *T. populeti*, Henhurst (E. B.), near Branston (J. T. H. and J. E. N.), near Brizlincote (G. B.), Bretby, common (T. G.), one pupa in Bretby Park (C. F. T.), Barrow (G. A. S.). *T. stabilis*, common throughout the district. *T. gracilis*, Burton, but rare (E. B.), Willington (W. G.), Branstone, osier-beds (C. F. T.), near Branstone (J. T. H.), Derby and Little Eaton (G. B.). *T. munda*, Henhurst (E. B. and C. F. T.), Repton (W. G. and C. F. T.). *T. pulverulenta* (*cruda*), common throughout the district.

Orthosia upsilon, common in the larva state. *O. lota*, Henhurst (E. B. and W. G.), Burton, at sugar (C. F. T.), Drakelow

(J. H. T.), Repton (G. B.), one at Bretby (T. G.). *O. suspecta* Sherbrooke Valley, Cannock Chase (C. F. T.).

Anchocelis rufina, Henhurst, common (E. B.). *A. pistacina*, common throughout the district. *A. lunosa*, Barrow (G. A. S.). *A. litura*, fairly common throughout the district.

Cerastis vaccinii, Henhurst, very common (E. B.), Willington (W. G.), Henhurst (C. F. T.), Bretby (T. G.), Derby (G. B.), Ashborne (H. F. G.). *C. spadicea*, Henhurst, common (E. B.), formerly at Burton (J. T. H.), Willington (W. G.), Derby (G. B.), Barrow (G. A. S.).

Scopelosoma satellitia, common throughout the district.

Xanthia citrago, near Repton (W. G.), Bretby Park and Repton Shrubs (G. B.), Hoofies Wood (T. G.). *X. fulvago*, common throughout the district. Variety *flavescens*, occurs occasionally throughout the district. *X. flavago*, common throughout the district. *X. gilvago*, Burton and Derby (E B. and W. G.), Derby, very common (G. B.), Barrow and Findern (G. A. S.). *X. circellaris* (*ferruginea*), common throughout the district.

Cirrhœdia xerampelina, Repton, Willington, and Burton (E. B.), one near Willington (W. G.), larvæ common at Barrow (G. A. S.), larvæ at Burton and Willington (C. F. T.), common at Derby (G. B.), Dovedale (J. T. H.), one at Bretby, 1887 (H. F. G.), larvæ at Newton Road and Horninglow, 1887 (J. E. N.).

Tethea subtusa, Henhurst (E. B.), Barrow (G. A. S.), Bretby (T. G), larvæ at Bretby (C. F. T.), common among poplars (G. B.)

Calymnia trapezina, common throughout the district. *C. diffinis*, Burton (E. B.), Etwall (W. G.). *C. affinis*, Burton (J. E. N.), Derby (G. B.), Barrow (G. A. S.), Bretby and Repton Shrubs (T. G.).

Dianthœcia capsincola, Burton (E. B. and W. G.), Shobnall (J. E. N.), Barrow (G. A. S.), common in larvæ state (G. B.). *D. cucubali*, Burton (E. B., G. B., J. T. H.), common at Burton (C. F. T.). *D. carpophaga*, Shobnall (E. B.), Burton (C. F. T.), Bretby, common (G. B.).

Polia chi, Burton (E. B. and W. G.), Barrow (G. A. S.), Little

Eaton, common (G. B.), near Ashborne (H. F. G.), Rugeley (R. F.), Bretby (H. F. G. and T. G.), Colwich (C. F. T.). *P. flavicincta*, once at Derby (G. B.).

Dasypolia templi, one at light at Derby (G. B.).

Cleoceris viminalis, Henhurst (E. B., J. T. H., and G. B.), Chartley (E. Blagg).

Miselia oxyacanthæ, common throughout the district. Variety *capucina*, occurs occasionally throughout the district.

Agriopis aprilina, Burton (E. B.), Repton (W. G. and G. B.), Barrow (G. A. S.), Derby (G. B.), Henhurst (J. T. H.), Bardon Hill, common (C. F. T.), Rugeley (R. T.), Okeover, near Ashborne (H. F. G.), one in Bretby Park (T. G.).

Euplexia lucipara and *Phlogophora meticulosa*, common throughout the district.

Aplecta prasina, occurs occasionally throughout the district. *A. occulta*, once at Drakelow (G. B.), three at sugar at Bretby, 1881 (T. G.). *A. nebulosa*, common throughout the district.

Hadena adusta, Henhurst (E. B.), Willington (W. G.), Burton (G. B. and J. E. N.), larvæ at Cloud lime quarry (C. F. T.). *H. protea*, fairly common throughout the district. *H. glauca*, Cannock Chase (E. B. and C. F. T.). *H. dentina*, common throughout the district. *H. trifolii* (*chenopodii*), Stapenhill (J. T. H.), common (G. B.). *H. dissimilis* (*suasa*), Henhurst and Repton Shrubs (E. B. and W. G.), larvæ at Burton (C. F. T.), once at Derby (G. B.), Barrow (G. A. S.). *H. oleracea*, common throughout the district. *H. pisi*, Bretby (T. G.), larvæ at Repton Rocks (T. G.), Ashby (G. A. S.), Little Eaton, common (G. B.). *H. thalassina*, common throughout the district. *H. contigua*, common in larva state on Cannock Chase (G. B.), Cannock Chase, common (C. G. B.).

Xylocampa areola (*lithoriza*), on sallow blossoms (W. G.).

Calocampa vetusta, Henhurst (E. B), Burton (C. F. T.), once at Bretby (T. G.). *C. exoleta*, Henhurst (E. B. and J. T. H.), Willington (W. G.), Barrow (G. A. S.), once at Bretby (T. G.). *C. solidaginis*, Cannock Chase, common (E. Blagg).

Asteroscopus sphinx (*cassinea*), on lamps on Burton Bridge (E. B.), larvæ in Hoofies Wood, 1888 (C. F. T.).

Cucullia verbasci, Ticknall lime quarries (C. F. T.), larvæ at Derby (G. B.), Newton Solney (J. T. H.). *C. chamomillæ* (?), larvæ at Willington (W. G.). *C. umbratica*, common (E. B. and W. G.), Burton (C. F. T.), Drakelow Park palings (J. T. H.), Bretby (T. G.), one at Barrow (G. A. S.), Derby (G. B.), Rugeley, common (R. F.).

Gonoptera libatrix, common throughout the district.

Habrostola tripartita (*urticæ*), Burton (E. B. and W. G.), Barrow (G. A. S.), Derby (G. B.). *H. triplasia*, common throughout the district.

Plusia chrysitis, common throughout the district. *P. festucæ*, one at Burton, 1887 (C. F. T.). near Derby (W. G.), one at Barrow (G. A. S.), common near Trent Valley Station (R. F.). *P. iota*, common throughout the district. *P. pulchrina*, occurs throughout the district. *P. gamma*, common throughout the district. *P. interrogationis*, Cannock Chase (E. B. and C. F. T.).

Anarta myrtilli, Cannock Chase (E. B. and J. T. H.), Breadsall Moors (G. B.).

Heliaca tenebrata (*arbuti*), common (E. B. and W. G.), Barrow (G. A. S.), Breadsall Moors (G. B.).

Heliothis dipsacea and *Chariclea umbra* (*marginata*), once at Breadsall Moors (G. B.).

Phytometra viridaria (*ænea*), Cannock Chase (E. B.), Bladon Hill (J. T. H.), Derby (G. B.).

Euclidia mi, The Lawns (E. B.), Dovedale (J. T. H.), Chartley (T. G.).

Catocala fraxini, occurred once in Burton (E. B.).

Zanclognatha grisealis, Henhurst (E. B. and W. G.), Repton Shrubs (C. F. T.), Bretby (T. G.). *Z. tarsipennalis*, Repton Shrubs (E. B. and J. E. N.).

Pechypogon barbalis, Grange Wood (E. B. and J. T. H.), near Ashby (C. F. T.).

Hypena proboscidalis, common throughout the district.

Brephos parthenias seen flying round birches in Repton Shrubs, 1882 (T. G.).

Geometræ.

Uropteryx sambucaria, common throughout the district.

Epione apiciaria, Henhurst and Burton (E. B.), osier beds at Repton (W. G.), Winshill Lane (G. B.), once at Bretby (T. G.), once at Barrow (G. A. S.), Osmaston Lane, near Derby (H. F. G.), Little Eaton (G. B.). *E. advenaria*, Willington (E. B.).

Rumia luteolata (*cratægata*), common throughout the district.

Venilia maculata, Dovedale (E. B.), Dyden Wood, near Ashborne (H. F. G.), Charnwood Forest (J. T. H.).

Metrocampa margaritaria, occurs throughout the district.

Ellopia prosapiaria (*fasciaria*), Breadsall Moors (G. B.), larvæ on Cannock Chase (C. F. T.).

Eurymene dolabraria, Henhurst, &c. (E. B.), near Repton (W. G.), Repton Shrubs (G. B. and C. F. T.), Derby (G. B.), once at Barrow (G. A. S.), near Ashborne (H. F. G.).

Pericallia syringaria, Rolleston (E. B.), scarce (W. G.), Burton (C. F. T.), Derby (G. B.), Barrow (G. A. S.).

Selenia bilunaria, common throughout the district. *S. lunaria*, Henhurst (E. B.), one at Repton Shrubs (W. G.), Derby (G. B.), Stafford (C. G. B.). *S. tetralunaria* (*illustraria*), once at Osmaston, near Derby (H. F. G.).

Odontopera bidentata and *Crocallis elinguaria*, common throughout the district.

Eugonia alniaria (*tiliaria*), Burton, not rare (E. B. and W. G.), Burton, at light (J. T. H., &c.), Ashborne (H. F. G.), common (G. B.), larvæ at Oakedge, 1887 (C. F. T.). *E. fuscantaria*, Burton (E. B.), one near Egginton (W. G.), Egginton and Derby (G. B.), Barrow (G. A. S.). *E. erosaria* Burton, but rare (E. B.), larvæ at Repton Shrubs (G. B.), Little Eaton, 1887 (G. B.). *E. quercinaria* (*angularia*), occurs throughout the district.

Himera pennaria, Henhurst (E. B. and W. G.), Repton Shrubs, common (C. F. T.), Barrow (G. A. S.).

Phigalia pedaria (*pilosaria*), common throughout the district.

Nyssia hispidaria, Repton Shrubs (E. B.), larvæ in Repton Shrubs (G. B.), one female in Repton Shrubs (J. E. N.).

Biston hirtaria, Rugeley (R. F.).

Amphidasys strataria (*prodromaria*), Burton and Repton Shrubs (E. B.), one at Findern (W. G.), Repton Shrubs (G. B.), Newton Road (J. T. H.), one in Drakelow Park (G. H. W.), Cannock Chase (C. F. T.). *A. betularia*, common throughout the district. Variety *double dayaria*, occurs throughout the district.

Hemerophila abruptaria, Burton (E. B., C. F. T., &c.), Willington (W. G. and G. A. S.). Osmaston, near Derby (H. F. G.), Bretby, 1887 (T. G.).

Cleora lichenaria, Henhurst (E. B. and W. G.).

Boarmia repandata, occurs throughout the district. *B. gemmaria* (*rhomboidaria*), common throughout the district.

Tephrosia crepuscularia, Barrow (G. A. S.), Cannock Chase (C. F. T.). *T. biundularia*, common throughout the district. *T. punctularia*, near Repton (W. G.), Repton Shrubs (G. B.), Little Eaton (G. B.), Cannock Chase (C. F. T.).

Pseudoterpna pruinata (*cytisaria*), once at Willington (W. G.).

Geometra papilionaria, Burton, &c. (E. B.), Burton (G. H. W.), Repton and Willington (W. G.), Repton Shrubs and Derby (G. B.), Caldwell (J. T. H.), once near Barrow (G. A. S.), Oakedge (C. F. T.).

Phorodesma pustulata (*bajularia*), once at Shobnall marl pit (J. T. H.).

Iodis lactearia, common throughout the district.

Hemithea strigata, Henhurst (E. B.), formerly near Burton (J. T. H.), near Ashborne (H. F. G.).

Zonosoma punctaria, Repton Shrubs (C. F. T., &c.), near Ashborne (H. F. G.), Cannock Chase (C. G. B.).

Asthena luteata, Derby (G. B.), Repton Shrubs (C. F. T.), Oakedge (T. G.). *A. candidata*, Henhurst (E. B., J. T. H., and J. E. N.), Repton Shrubs (C. F. T.), Seal Wood (G. B.). *A. sylvata*, Henhurst (E. B.), once near Repton (W. G.), once in Repton Shrubs (G. B.), Cannock Chase (C. F. T.). *A. blomeri*, Shobnall (E. B.), once near Repton (W. G.), wood near Hoar Cross (J. E. N.), Swilcar Wood, Needwood Forest (W. M. A.), common some seasons in Hoofies Wood, near Hartshorne (T. G.).

Eupisteria obliterata (*heparata*), Repton and Seal Woods (E. B.), Repton Shrubs (W. G., C. F. T., &c.), Repton Rocks (T. G.), Barrow (G. A. S.), Oakedge, common (T. G.).

Acidalia dimidiata (*scutulata*), common (E. B. and W. G.), Bretby (T. G.), Barrow (G. A. S.), Derby (G. B.). *A. bisetata*, occurs throughout the district. *A. virgularia*, common (E. B.), beaten out of ivy (W. G.), Burton, common (C. F. T.), Barrow (G. A. S.), once at Breadsall Moors (G. B.). *A. subsericeata*, Dovedale (G. B.). *A. remutaria*, Shobnall, &c. (E. B.), Henhurst (W. G.), Repton Shrubs (W. G., G. B., &c.). *A. fumata*, Dovedale (G. B.), Chartley (T. G.). *A. imitaria*, Burton (E B. and W. G.), Barrow (G. A. S.), once at Derby (G. B.). *A. aversata*, common throughout the district. *A. emarginata*, Burton (E. B. and W. G.), Barrow (G. A. S.).

Timandra amataria, Henhurst, &c. (E. B. and W. G.), Tatenhill (J. E. N. and T. G.), near Ashby (C. F. T.), Barrow (G. A. S.), Osmaston, near Derby (H. F. G.), Rugeley, common (R. F.), Egginton (G. B.).

Cabera pusaria and *C. exanthemaria*, common throughout the district.

Bapta temerata, Henhurst (E. B.), scarce (W. G.), Shobnall Road (J. T. H.).

Macaria liturata, Seal Wood (J. E. N.), Breadsall Moors (G. B.), Cannock Chase (C. F. T.).

Halia vauaria (*wavaria*), common throughout the district.

Panagra petraria, Willington (W. G.), Parson's Brake (C. F. T., &c.), Cannock Chase (C. F. T.), Bretby Park (T. G. and J. E. N.), Repton Shrubs (W. G., G. B., &c.), Breadsall Moors (G. B.).

Numeria pulveraria, Henhurst (E. B.), once near Bretby (T. G.), Breadsall Moors (G. B.).

Scodiona belgiaria, Cannock Chase (T. G.).

Ematurga atomaria, Cannock Chase (E. B., C. F. T., &c.), once in Bretby Park (T. G.), Chartley Moss, abundant (J. T. H.), Breadsall Moors (H. F. G.).

Bupalus piniaria, Seal Wood (E. B.), one at Willington (W. G.), Cannock Chase (C. F. T.), Breadsall Moors, common (G. B. and J. E. N.), Variety *flavescens*, Breadsall Moors (G. B. and J. E. N.).

Aspilates strigillaria, Cannock Chase (E. B. and T. G.), Chartley (T. G.).

Abraxas grossulariata and *A. sylvata*, common throughout the district.

Ligdia adustata, near Ashby (G. A. S.).

Lomaspilis marginata, *Hybernia rupicapraria*, and *H. leucophearia*, common throughout the district. *H. aurantiaria*, abundant in Repton Shrubs. *H. marginaria* and *H. defoliaria*, common throughout the district.

Anisopteryx æscularia, generally distributed throughout the district.

Cheimatobia brumata, common throughout the district. *C. boreata*, fairly common in Repton Shrubs, Cannock Chase (C. F. T.).

Oporabia dilutata, common throughout the district.

Larentia didymata, common throughout the district. *L. multistrigaria*, Breadsall Moors (G. B.). *L. cæsiata*, Dovedale, common (H. F. G.). *L. flavicinctata*, Dovedale (E. Blagg). *L. olivata*, one in Dovedale, 1886 (R. G. Lynams). *L. viridaria* (*pectinitaria*), generally distributed throughout the district.

Emmelesia affinitata, common throughout the district. *E. alchemillata*, Seal and Grange Woods (E. B.), Burton (C. F. T.), Bretby (J. E. N.), Barrow (G. A. S.). *E. albulata*, Barrow (G. A. S.), Anslow (C. F. T.), Seal Wood (J. T. H.), Bretby and Repton Rocks (T. G.). *E. decolorata*, common throughout the district. *E. tæniata*, Dovedale (F. M. Spilsbury).

Eupithecia venosata, Shobnall (E. B.), Shobnall marl pit (J. T. H.), Repton and Little Eaton (G. B.). *E. linariata*, Barrow (G. A. S.), railway banks at Willington (G. B.), Breadsall Moors (G. B.). *E pulchellata*, Shobnall (E. B.), Repton Shrubs and Derby (G. B.), Barrow (G. A. S.), Cannock Chase (T. G.). *E. oblongata* (*centaureata*), Burton (C. F. T.), Repton Shrubs and Derby (G. B.), near Ashby (G. A. S.). *E. subfulvata* Winshill

(G. B.), Barrow (G. A. S.), common on Railway banks near Little Eaton (G. B.). *E. plumbeolata*, Little Eaton, common (G. B.), Cannock Chase (C. F. T.). *E. isogrammaria*, one at Burton (G. B.), Derby and Breadsall (G. B.). *E. castigata*, occurs throughout the district. *E. trisignaria*, Repton Shrubs, common (G. B.), Cloud Wood, common (C. F. T.). *E. fraxinata*, Burton and Derby (G. B.), Burton, at light (C. F. T.), Barrow (G. A. S.). *E. pimpinellata*, Derby (G. B.). *E. valerianata*, Repton Shrubs, common (G. B.), Derby (G. B.), Egginton, common (G. B.). *E. indigata*, Breadsall Moors (G. B.), Oakedge (G. F. T.). *E. nanata*, Breadsall Moors, common (G. B.), Cannock Chase (G. B.). *E. subnotata* and *vulgata*, common throughout the district. *E. albipunctata*, Repton Shrubs and Breadsall Moors, common (G. B.). *E. absinthiata*, Willington, on ragwort (C. F. T.), Cloud lime quarry, on tansy (C. F. T.), Barrow (G. A. S.), Breadsall Moors (G. B.). *E. minutata*, Breadsall Moors, common (G. B.). *E. assimilata*, Burton (E. B.), Branstone Road (C. F. T.), Newton Road (J. T. H.), Bretby (G. B.), Linton (J. T. H.), one at Barrow (G. A. S.), Stafford (C. G. B.). *E. tenuiata*, one in Repton Shrubs (C. F. T.), Breadsall Moors (G. B.). *E. lariciata*, Bretby (T. G.), Hoofies Wood (C. F. T.), once in Seal Wood (G. B.), Breadsall Moors, common (G. B.), Cannock Chase, common (T. G.). *E. abbreviata*, Burton (E. B. and W. G.), Repton Shrubs (G. B. and C. F. T.). *E. exiguata*, common throughout the district. *E. sobrinata*, Burton (E. B. and C. F. T.). Derby (C. F. T. and G. B.), Ashby (G. A. S.). *E. pumilata*, Derby, on ragwort (G. B.). *E. rectangulata*, common throughout the district.

Lobophora halterata (*hexapterata*), Henhurst (E. B. and W. G.), Repton Shrubs (G. B. and J. T. H.). *L. viretata*, Parsons Brake (J. E. N.). *L. carpinata* (*lobulata*), Henhurst (E. B.), Hopwas Wood (J. E. N.).

Thera variata one on Branston Bridge (J. E. N.), Breadsall Moors, common (G. B.), Cannock Chase (C. F. T.). *T. firmata*, Cannock Chase (C. F. T.).

Hypsipetes ruberata, one in Hoofies Wood (C. F. T.), Winshill

Lane (G. B.). *H. trifasciata*, Burton (E. B.), Newborough, common (J. T. H.), Repton Shrubs, common (G. B.), Repton Rocks (T. G.), Barrow (G. A. S.), Oakedge, common (C. F. T.). *H. sordidata* (*elutata*), common throughout the district.

Melanthia bicolorata (*rubiginata*), Knightley Park (E. B.), Seal Wood (J. T. H.), Repton Shrubs, common (G. B.), Repton Brook (W. G.), Barrow (G. A. S.), Oakedge Park (T. G.). *M. ocellata*, Henhurst (E. B.), Branston Road and Bretby Park (J. E. N.), Barrow (G. A. S.), Breadsall Moors (G. B.), Burton (C. F. T.), Rugeley, common (R. F.), Cannock Chase (T. G.). *M. albicillata*, Knightley Park (E. B. and W. G.), Repton Shrubs (C. F. T., &c.), Seal Wood (J. T. H. and J. E. N.), Decoy Plantation, Bretby (T. G.), Ashby (G. A. S.), near Ashborne (H. F. G.).

Melanippe hastata, Seal Wood (E. B. and J. T. H.), Rugeley, not common (R. F.). *M. tristata*, Rugeley, common (R. F.), Chartley (C. F. T.). *M. sociata* (*subtristata*), common throughout the district. *M. montanata*, common throughout the district. *M. galiata*, Breadsall Moors, scarce (G. B.). *M. fluctuata*, common throughout the district.

Anticlea rubidata, Barrow (G. A. S.). *A. badiata*, common throughout the district. *A. nigrofasciaria* (*derivata*), Burton (E. B. and W. G.), Tatenhill Lane (C. F. T.), Ashby (G. A. S.), Derby (G. B.), Bretby, not common (T. G.), near Ashborne (H. F. G.).

Coremia designata (*propugnata*), occurs throughout the district. *C. ferrugata*, Burton (E. B. and W. G.), one in Burton churchyard (J. T. H.), Barrow (G. A. S.), Derby (G. B.). *C. unidentaria*, common throughout the district.

Camptogramma bilineata. common throughout the district. *C. fluviata*, some specimens taken by the Rev. F. M. Spilsbury, near Willington (J. T. H.).

Phibalapteryx vittata (*lignata*), formerly at Willington (W. G.), taken by Peel's Cut, Burton, some years ago (J. T. H.), Little Eaton (G. B.), one at Burton (C. F. T.).

Triphosa dubitata, common throughout the district.

Eucosmia certata, Burton (C. F. T.), one at Barrow (G. A. S.). *E. undulata*, Cannock Chase (C. G. B.).

Scotosia rhamnata, Dovedale (E. B. and G. B.).

Cidaria miata, Dovedale (G. B.). *C. corylata*, Bretby Park (C. F. T.), Hoofies Wood (G. B.), Repton Shrubs (G. B. and T. G.), Cannock Chase (C. G. B.). *C. truncata* (*russata*) and *C. immanata*, common throughout the district. *C. suffumata*, occurs throughout the district. *C. silaceata*, Henhurst (E. B., J. T. H., and W. G.), Repton Shrubs (G. B.), Decoy plantation, Bretby (T. G.), Knightley Park (T. G.). *C. prunata*, Burton, common (E. B.), in gardens (W. G.), formerly at Burton (C. F. T.), occasionally (J. T. H.), Ashborne (H. F. G.), Colwich (C. F. T.). *C. testata*, Barrow (G A. S.), Breadsall Moors (G. B.). *C. populata*, Burton (E. B.), Breadsall Moors, common (G. B.). *C. fulvata*, common throughout the district. *C. dotata*, Burton (E. B. and W. G.), Barrow (G. A. S.), one in Henhurst (G. B.), fairly common at Bretby (T. G.). *C. associata* (*dotata*), common in gardens.

Pelurga comitata, Burton (E. B.), Shobnall (J. T. H.), Stapenhill and Willington (C. F. T.), common (G. B.).

Eubolia cervinata, not uncommon (E. B. and W. G.), Burton (C. F. T.), Shobnall, common (J. T. H.), Barrow (G. A. S.), Brizlingcote (G. B.). *E. limitata* (*mensuraria*), common throughout the district. *E. plumbaria*, Cannock Chase and Dovedale (E. B.), Barrow (G. A. S.), Tatenhill (T. G.), Breadsall Moors (G. B.). *E. bipunctaria*, Dovedale (E. B. and J. T. H.).

Carsia paludata, sparingly at Dovedale (J. T. H.), Chartley (J. R. B. Masefield).

Anaitis plagiata, Ashby (G. A. S.), Cloud lime quarry (C. F. T.), Dovedale (H. F. G.), once on Breadsall Moors (G. B.), Gresley, 1886 (J. E. N.).

Chesias spartiata, Burton (E. B.), on railway banks at Willington (J. E. N.), formerly at Stenson Gorse (C F. T.). *C. rufata*, one at light, at Burton (P. B. M.).

Tanagra atrata (*chærophyllata*), Henhurst, common (E. B.), in mowing grass (W. G.), canal bank, near Willington (J. E. N.), Bretby and Bagot's Parks (T. G.), very abundant near Ticknall (J. T. H.), Dovedale, common (G. B.), Dyden Wood, near Ashborne (H. F. G.).

Pyralides.

Aglossa pinguinalis, common in stables.

Pyralis glaucinalis, Burton (E. B.), Branstone Road, abundant (J. T. H.), abundant at Willington, 1865 (W. G.), once at Derby (G. B.). *P. farinalis*, common throughout the district.

Scoparia ambigualis, common throughout the district. *S. cembræ*, Bretby, common (J. T. H. and T. G.), one on Ashby Road (G. B.). *S. dubitalis* (W. G.), Cannock Chase, common (T. G.), Bretby Park (T. G.). *S. ulmella*, Repton Shrubs (G. B.), wood near Uttoxeter (J. Sang). *S. murana*, Burton (E. B. and J. T. H.), Cannock Chase, abundant (C. F. T. and T. G.). *S. ingratella*, Parsons Brake [?] (C. F. T.). *S. mercurella*, Burton (E. B.), Bretby (T. G.). *S. truncicolella*, (G. B.). *S. pallida*, railway cuttings (W. G.).

Nomophila noctuella (*hybridalis*), in pastures at Newton (W. G.), in clover fields at Newton (J. T. H.), once at Burton (G. B.), once in Bretby Park (T. G.).

Pyrausta aurata (*punicealis*), Dovedale (G. B.). *P. purpuralis*, Knightley Park (E. B.).

Herbula cespitalis, Repton Park (W. G.).

Ennychia cingulata, Dovedale (E. B.).

Endotricha flammealis, once at Derby (G. B.).

Eurrhypara urticata, common throughout the district.

Scopula lutealis S. olivalis and *S. prunalis*, common throughout the district. *S. ferrugalis*, once at Willington, October, 1865 (W. G.).

Botys ruralis (*verticalis*), common throughout the district. *B. fuscalis*, Drakelow (E. B.), scarce (W. G.), common at Derby (G. B.).

Ebulea crocealis, Drakelow (E. B.). *E. sambucalis*, common throughout the district.

Pionea forficalis, and *Cataclysta lemnata*, common throughout the district.

Paraponyx stratiotata, Burton (E. B. and C. F. T.), Repton (W. G.), Derby (G. B.), common (J. T. H.).

Hydrocampa nymphæata and *H. stagnata*, common throughout the district.

Acentropus niveus, Trent, near Burton (E. B.), Trent, at Willington (W. G.), abundant some years on Trent, at Burton (C. F. T.).

PTEROPHORI.

Chrysocoris festaliella, Henhurst (E. B.).

Platyptilia ochrodactyla (W. G.). *P. gonodactyla* (*trigonodactyla*), near Gresley Common (J. T. H.), Ashby Road, abundant (G. B.), Bretby, abundant (T. G.).

Amblyptilia acanthodactyla, one at Willington (W. G.), one at Burton (G. B.), Cannock Chase (C. F. T.).

Mimæseoptilus bipunctidactylus, (W. G.). *M. pterodactylus*, Burton (E. B.), Shobnall marl pit, common (G. B.).

Œdematophorus lithodactylus, Drakelow (E. B. and G. B.), near Burton (W. G.).

Pterophorus monodactylus, common throughout the district.

Leioptilus tephradactylus, Breadsall Moors (G. B.).

Aciptilia tetradactyla, Burton (E. B.). *A. pentadactyla*, common throughout the district.

Alucita hexadactyla (*polydactyla*), common throughout the district.

Cyclones.

(With One Plate.)

By Adrian J. Brown, F.I.C., F.C.S.

(*Read before the Society, February 1st*, 1889.)

IN the year 1643, an Italian named Torricelli, a pupil of Galileo, the great astronomer, took a glass tube, closed at one end but open at the other, and filled it with quicksilver. After putting his finger firmly on the open end of the tube to prevent the escape of the metal, he turned that end downwards and plunged it underneath the surface of quicksilver in another vessel. In this position, of course no air could possibly get into the tube. On removing his finger from the end of the tube, the quicksilver at once sank a certain distance, and then remained steady, leaving a column of the metal about 30 inches in height standing in the tube. I will now repeat this experiment. At first sight this experiment looks curious, for why does not the whole of this heavy metal run out of the tube? Part of it has gone, as we see; why does not the rest follow? Torricelli accounted for the phenomenon by saying that the air, which, like everything else in this world, possesses weight, pressed so heavily on the quicksilver outside the tube, that it only allowed the metal to escape until the column of quicksilver inside the tube sank to such a point that the weight of it, pressing downwards, was exactly equal to the weight of the air pressing on the quicksilver outside, and that in this way they balanced each other. This theory of Torricelli's was eventually proved to be quite true by Pascal, a Frenchman. Pascal argued in this manner: he said, if the weight of the column of air above us really supports the column of quicksilver in this tube, then, if I carry the tube up the side of a mountain, the higher I go the less must become the column of air above me, therefore the column of quicksilver ought to gradually sink as I rise. Pascal actually performed this experiment, by climbing one of the Auvergne mountains with his tube of quicksilver, and he found that the quicksilver in the tube did sink lower and lower in exact proportion to the height he climbed. So in this way Torricelli's theory, *that the height of the column of quicksilver in the tube was an exact measure of the weight or pressure of the air outside*, was proved to be true. We cannot now go up the side of a mountain to repeat Pascal's experiment, but I have a simple experiment here which will perhaps do as well. Here is a tube of quicksilver similar to the one I made just now, with the column of quicksilver standing at the same height in it. But you will notice that the vessel of quicksilver into which the tube dips is underneath this bell-glass, which is placed above an air-pump. Now, if with this air-pump I remove some of the air from the bell-glass, then there will be less air pressing on the surface of the quicksilver, and we should expect the column of metal in the tube to sink, if it is true that it is kept up by the pressure or weight of the air. [Experiment made.] You see the column of quicksilver begins to sink as soon as the pump begins to remove the air from the bell-glass. This, then, is another way of proving that the column of quicksilver in the tube is kept up by the pressure of the air outside.

The early experimenters with these tubes of quicksilver, or barometers, as we will now call them, for that is what they are, soon noticed that the height of the quicksilver standing in the tubes was not always constant in the same place, but that it varied, sometimes even to the extent of $2\frac{1}{2}$ inches; therefore, of course, it followed *that the weight or pressure of the air in any one place was variable.* When the column of quicksilver was noticed to sink much below the usual 30 inches—that is to say, when the air became much lighter than usual, bad weather often followed; and when the column of quicksilver stood much above 30 inches—that is to say, when the air became heavier than usual, fair weather was the rule. It was in this way, then, that the quicksilver tube, or barometer, first began to be used for meteorological purposes, and is still so used by most of us.

For a long time, although the number of observers and recorders of the barometer was constantly increasing, nothing definite about the real distribution of atmospheric pressure over the world was known, and there seemed a danger of the science of meteorology being smothered with its own observations. But very quickly a change came, with the introduction of synchronous* weather maps, and principally through the knowledge gained from them meteorology became a real science. To explain what I mean by synchronous weather maps, I must refer to a map here (see Plate I. Fig. 3,). You know that, scattered over this country and the Continent, there are numerous meteorological observers who record at a given hour, say six o'clock in the evening, the height of the barometer, the temperature, strength and direction of the wind, etc., and all these observations are telegraphed to a central office in London. Now, suppose we take all the different readings of the height of the barometer, observed, as I say, exactly at one and the same hour everywhere, and mark these different readings down in their own proper geographical position upon a map of Western Europe; then, suppose we draw a dotted black line connecting all those places which have a similar height of barometer, or air pressure; for instance, suppose we draw a line connecting all those places in which the barometer is standing at 28·9, you then will see a result like Fig. 3, in which we have a number of curved black lines running over the map. These black lines, therefore, mean that all along the length of any one of them at the given hour of observation, six o'clock, *the height of the barometer*—that is to say, *the weight of the air*—is exactly the same; and if it were possible to run along the length of one of the lines, with a barometer in one's hand, the height of the mercury column would remain constant the whole distance. For convenience, it is usual in most synchronous weather maps only to mark those lines of barometric pressure

* Synchronous: Greek, σύν, together, and χρόνος, time.

that are separated from each other by $\frac{2}{10}$ or 0·2 of an inch (see Fig. 3).

Now let us consider the direction of the wind, which has also been telegraphed to the central office in London. This direction of the wind is marked on the map by the arrows, which are drawn pointing in the *same* direction that the wind is blowing (see Fig. 3). To give a representation also on our map of the strength with which the wind is blowing at the time of observation, the wind-arrows are differently formed, as you will see. For instance, a light breeze is marked by an arrow with half a head to it; a strong breeze, by an arrow with a complete head; a gale is shown by one feather on each side the arrow; a strong gale by two feathers, and so on.

We see, then, by looking at this synchronous weather-map an accurate chart of the weight or pressure of the air over all this part of the world, and also the direction and force with which the wind was blowing at the time of observation. Now let us look more closely at one portion of the map (Fig. 3), where these black lines that show the pressure or weight of the air are in a circular form. If we look at the figures which show the height of the barometer on the particular lines on which they are placed, we find that near the centre of the circle the barometer stands at 28·7; at the next line the height is 28·9, that is to say, $\frac{2}{10}$ of an inch higher, therefore the pressure of the air is higher on the second line than on the first. The next line shows the pressure is still $\frac{2}{10}$ higher, that is to say, the weight or pressure of the air is still greater; and so on you see the height of the barometer *increasing* as we go away from the centre of this circle. So you see, in this circle we have a certain portion of the world's surface over which the *weight or pressure* of the air is gradually increasing from the centre to the outside. Now, what would be natural to expect if we managed to build up with air a construction of this sort, and after surrounding it with an unlimited amount of air outside at an even pressure, left it to itself? (Fig. 1 represents an imaginary cyclone of this nature.) Why, of course, as the outer layer is heavier than the next inside one, it will press and run against it, and the next layer against the next lighter one, and so on, thus establishing a motion of the air from the outside towards the centre, which would show itself to our senses as a wind blowing towards this centre, and in a short time the pressure throughout the whole of these circles would be the same as the outside, and thus our built up construction of air would cease to exist But now suppose we have made our construction again, and this time established a large

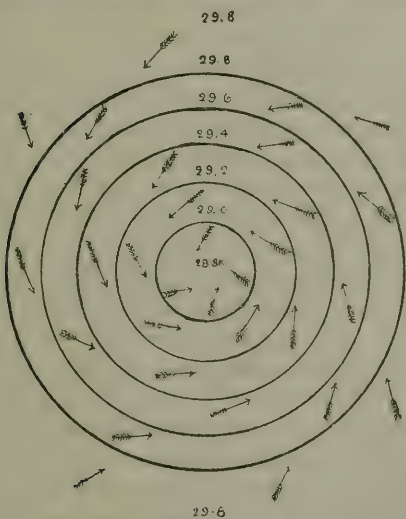


FIG. 1.—DIAGRAMMATIC REPRESENTATION OF A CYCLONE.

air-pump in the centre, which is able to draw off the air as fast as it comes in from the outside, so keeping the weight of the air on these lines constant. This time, it is true, the air, or wind, might commence to blow straight towards the centre, and so get sucked through our big air-pump; but mathematicians would tell you that this could not last long, as the whole system is in what is called "unstable equilibrium." What would happen would be that the air or wind pressing in from the outside would commence to run round the centre of our circle in a spiral line that would only gradually take it towards our air-pump (see Fig. 1); *in fact, a whirlpool would be established in the air.* Now let us look at the real weather-map again. (Plate I., Fig. 3). Here we notice going on exactly what we imagined just now. The arrows which mark the course of the wind, you will notice, are all pointing round the circle—not quite parallel to the lines of equal barometric pressure, but a little inwards, showing that the wind is blowing, not only round, but, also, gradually towards the centre. The air-pump I must leave to your imagination. That there is something of the sort is shown, however, by the fact that these circular systems of pressure exist for days; and we have seen just now that if there was not something at the centre to remove the air as fast as it blew in, the whole system would quickly cease to exist, owing to being filled up to an even pressure with air from the outside. Now what becomes of the air which is constantly blowing in towards the centre? We see that it must escape somehow. As we know the air blows in at the sides, this leaves only the top and bottom of our circle for its exit; the bottom is, of course, impossible, therefore upwards is its only way of escape; and this, in fact, is what happens. Observation shows that the air flowing in towards the centre, there ascends into the higher regions of our atmosphere.

This system of air pressure and wind motion, which I have just described to you, is what is known as a Cyclone, or "Depression." A Cyclone, so far as we have gone at present, is, then, a gigantic eddy, or whirlpool, in the air, often many hundred miles across, at the centre of which the air pressure is always lower than at the sides; and towards this centre the wind blows in a spiral course, and afterwards is carried upwards into the higher regions of the atmosphere.

We will now examine more minutely the properties of these Cyclones. In the first place, if a series of weather-maps are examined for a number of consecutive days (by referring to the daily weather-maps in the *Times*, for instance), it will be found that these Cyclones are hardly ever stationary over any one portion of the earth, but are almost always moving at a considerable velocity, varying from ten to fifty miles an hour. Further, the direction of this movement will in the greater number of cases, be from the west, or south-west, towards the east, or north-east. Sometimes they move from the north to the south, less frequently from the south to the north, and only rarely from east to west. Figs. 5 and 6, Plate I., show very clearly the progression of a Cyclone from west to east. During the twenty-four hours which divides the time between the two maps, it will be noticed that the Cyclone has advanced about five hundred miles, that is, that it must have been travelling at the rate of twenty-one miles an hour.

Another point of great importance is to be noticed on the weather-maps. I said a little time ago that the strength or velocity of the wind was marked on these charts by differences in the drawings of the arrows. Now, if we look at the arrows in Fig. 3, Plate I., we find those between the lines of barometric pressure, which approach the closest to each other, show that there the wind is blowing stronger than where the lines of pressure are more widely apart. This is a general law with Cyclones, "that the closer the lines of barometric pressure approach each other, the wind blows with greater force."

The weather maps teach another invariable law about Cyclones, and that is that the wind always blows round them in one particular direction, that direction being (as viewed in our maps) *in an opposite direction to the way the hands of a watch turn*. This law of the direction of rotation of the wind round an area of low pressure, or Cyclone, is a most important one to bear in mind. For instance, it enables anyone when out in a storm of wind to find out in what direction the centre of low pressure in the Cyclone must be. Let us look at this map (Fig. 3, Plate I.) and imagine ourselves near a wind-arrow on the right hand side of the Cyclone, and standing so that our *backs* are towards the wind. Then you will notice that the area of lowest pressure lies on our left-hand side. Now let us imagine ourselves on the left-hand side of the Cyclone, still with our backs to the wind; here again you will notice that the lowest pressure is still to our left-hand; indeed, you must easily see for yourselves that in whatever part of a Cyclone you are standing (remembering that the wind always rotates in one and the same direction round it), that of necessity your left side must be towards the lowest pressure when your back is turned towards the wind. In the Eastern seas of India and China very furious Cyclones, which there are called Typhoons, are often experienced at certain times of the year. They are really rather small but very severe Cyclones, whose violence increases very much towards the middle ; at the actual centre there is, however, a dead calm. Now you will easily understand that it is most important for the safety of ships that they should be kept as far as possible from the centres of these terrible storms. In order to do this there is a regular code of rules drawn up for ships sailing in the Eastern seas, which are based entirely on the law of the rotation of wind round the centre of a Cyclone. I will not trouble you with these now, but only mention them as an instance of the use of the study of the laws of Cyclones.

Before leaving the subject of Typhoons I should like to mention again the extraordinary calm which is experienced in the centre of these destructive circular storms. The comparative few who have been in this centre and come out again alive, describe the calm as absolute, and above the blue sky is clearly seen. This calm and spot of clear sky above is supposed to be the place where most of the air which has rushed round and into the Typhoon, is carried upwards into the higher regions of the atmosphere. I have spoken of this up-rush of air in Cyclones before, but I believe that in the large size l Cyclones which pass over us here in Europe, the calm centre so well marked in Typhoons is not very marked. At any rate it is not sufficient to lead to a mistake once made by a mariner not used to Typhoons, who, after running his sailing vessel safely into the middle calm spot of one, there hoisted all his sails, thinking fair weather had come at last. The result of this experiment may be imagined when the Typhoon had moved on a little.

Now that we know a little about the constitution of Cyclones, I should like to say something about the weather, which usually accompanies them in their passage over us. If you will refer to

Fig. 2, which I have taken from Abercromby's most valuable book called "Weather," you will notice various words which I will attempt to explain. First I must say that this Cyclone is moving in the direction of the large arrow marked across it in a north-easterly direction, and for simplicity only two lines of barometric pressure are marked, one showing a height of the mercury column of 30·0 inches, the other and inner one 29·0 inches. The arrows show the direction of the wind as usual.

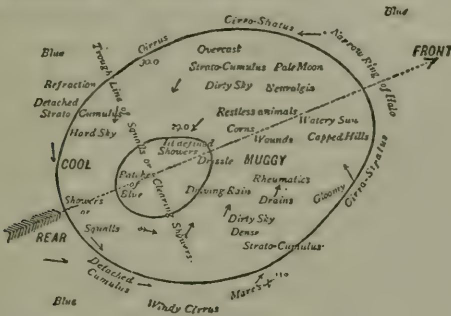


FIG. 2.—CYCLONE PROGNOSTICS (AFTER ABERCROMBY).

Suppose we begin at the front of this map first, which would be the part that would first pass over us if we were in its line of movement. In front, then, we find the words, "Narrow Ring of Halo," this refers to the Halo we so often see round the sun and moon, before a change for bad weather comes on. Also notice the words "Cirro-Stratus"; these refer to clouds of that name, but are more commonly known as "Mares' Tails" by most of us; these of course we often see before storms. Further back we find "Pale Moon" and "Watery Sun" also bad signs. Then we find "Neuralgia," "Rheumatics," and "Corns." Sufferers from these misfortunes often feel them when a change of weather is in prospect. Most of us know someone who has a corn that is better than any barometer in his opinion. The word "Muggy" means that oppressive state of the air so often preceding storms. We now get nearer to the centre of the Cyclone, and here we find rain, beginning first with a "Drizzle." Now we come to the centre of the Cyclone, and here, stretching quite across it, and at right angles to its line of movement, is the "Trough line of squalls and clearing showers." After passing this line, the Barometer, which up to now must have been falling, will again commence to rise, and it is here that the most dangerous squalls of wind are usually met with, the direction of the wind also changes more rapidly at this point as a general rule. Further back in the Cyclone we come to "showers or squalls," with a north or north-west wind, and "cool," marking the cold, dry, bracing air, generally felt at the rear of Cyclones. This cool north-west wind, and rising barometer at the back of Cyclones, explains the meaning of the proverb, "Do business with men when the wind is in the north-west"—the falling barometer, neuralgia, rheumatism, and corns, that accompany the front of a Cyclone, are evidently not calculated to improve men's tempers.

The weather that may be expected during the passage of a Cyclone, it must be borne in mind, varies very much in *intensity*, and this intensity is strictly dependent on the closeness or the reverse, of the lines of equal barometric pressure. I have shown before how the strength of the wind depends on the closeness of these lines. In fact there is no difference between Cyclones which cause storms, and those which cause ordinary unsettled weather, but *intensity*, and this, I repeat, is caused by the relative closeness of the lines of equal barometric pressure. I may observe here that the word "Depression" is more often used now in our weather reports, than "Cyclone"; they both, however, mean exactly the same thing. A "deep depression" means a Cyclone with the pressure very low in the middle in comparison to the outside, consequently the lines of barometric pressure are usually close together, so bringing high winds and storms.

I should now like to call your attention to what happens to the *direction* of the wind at any one spot, say here in Burton, as a Cyclone goes by us. Let us first take the most common case, in which a Cyclone from the Atlantic Ocean, and moving from south-west to north-east, passes with its centre to the north of us. Look at Fig. 1, and imagine instead of the Cyclone moving in a north-easterly direction over Burton, that we move Burton in a south-westerly direction across the Cyclone (below its centre), which for our present purpose will amount to exactly the same thing. Now move the point of a pencil representing Burton in a south-westerly direction across the Cyclone. Where the pencil first enters the Cyclone, from the wind arrows marked on it you will notice that the wind will be blowing from about the south-east; as the pencil is moved on, the arrows will be noticed to alter slowly to the south, further on to the south-west, then to the west, and finally to the north-west. This changing of the wind, or "veering" as it is called (that is to say, following the course of the sun from east to west), is then a sign that a Cyclone is passing us with its centre to the north of the point at which we are stationed.

Now let us see what happens if a Cyclone passes us with its centre south of Burton; in this case, draw the point of a pencil across the Cyclone in a south-westerly direction, but keeping the line north of the centre. Now we see the wind begins to blow from the south-east pretty much as in the first case, but this time the wind alters its direction gradually to the east, then to north-east, and finally to north. This movement of the direction of the wind is called "backing," as it is in an opposite direction to the movement of the sun. It would take too much time to describe the changes of the wind, due to Cyclones moving in all possible directions, but the two cases given are far the most common. The other changes can easily be worked out in a similar manner to the above; further, a good knowledge of these changes is very valuable, as it often enables a solitary weather observer by this means, and his barometer also, to ascertain the direction Cyclones in his vicinity are moving, and, consequently, to forecast the weather.

I had wished to confine this paper entirely to Cyclones, but I find it impossible not to refer to Anti-Cyclones without leaving the subject in a very unsatisfactory state. When I first spoke of Cyclones, I stated that the air after revolving round them towards the centre, was carried upwards from the surface of the earth to the higher regions of the atmosphere. Well, obviously, this sort of thing could not go on for ever without the air coming down again in some way. Now Anti-Cyclones, the exact antitheses of Cyclones, are the places in which the air carried up by Cyclones again returns to the surface of the earth. In the map (Fig. 4, Plate I.) you will notice circles of equal air-pressure somewhat similar on first appearance to Cyclones, but on looking at the height of the barometer marked on these lines, you will see this great difference, viz., that the *highest* pressure is in the middle, and it gradually decreases towards the outside. Then look at the wind arrows, these point to a rotation of the wind exactly opposite to that in a Cyclone; they turn, as you see, in the *same* direction as the hands of a watch. You will also notice that the wind arrows point slightly to the outside, not to the inside as in Cyclones. Everything is then reversed in the Anti-Cyclone as compared with the Cyclone, even the weather, which usually is fine and dry and the wind light (owing to the lines of barometric pressure being usually far apart). The motion of the whole system is again different; it is slower and much more irregular than Cyclones, in fact, sometimes for days together it occupies the same place. In a general way, Anti-Cyclones are as desirable for our general comfort as Cyclones are undesirable. There is one serious objection to Anti-Cyclones in winter, however, and that is, that the dense fogs we often get at this time of year are generally due to them. These are caused by the very cold air coming down from the higher regions of our atmosphere, condensing the moisture in the damper and warmer air near the surface of the earth.

Referring to Cyclones and Anti-Cyclones together, we may look upon the one as feeder to the other—the Cyclone takes the air up to the higher regions of our atmosphere and the Anti-Cyclone brings it down again. It is found by the study of weather charts that a Cyclone and Anti-Cyclone are generally in pretty close proximity to each other.

By far the greater proportion of "weather" we experience in these Islands is what is known to meteorologists as Cyclonic, that is to say, it is dependent on the passage of Cyclones, either over us or somewhere in our neighbourhood, and to this fact we may put down the wonderful changeability of climate that we experience more often to our sorrow than our joy. Of course, if we could be forewarned in good time of approaching changes for the worse in weather our sorrow would often be mitigated. Now this is what the Meteorological Office in London is attempting to do at present, as you know, and I think there are few people who read the morning papers who do not look at the weather forecast for the day. As I frequently hear grumbles against the London forecasters (often without reason, however), I should like to mention one of the great difficulties they experience, owing to the situation of these Islands. I said just now that our weather is chiefly Cyclonic. Now Cyclones, as we have seen before, almost always come to us direct from the Atlantic Ocean, often moving at the rate of forty miles or more an hour. Further, the only safe indication of the approach of a Cyclone is the fall of the barometer; this fall may have been preceded shortly by certain well-known cloud and sky appearances, but these are not to be relied on thoroughly. From the west of Ireland, looking west or south-west on the map, nothing but the ocean is to be found until the continent of America is reached. Now this ocean is the birthplace of many of the Cyclones that come over us. How then can it be possible for our meteorologists to know anything about their approach to our shores until their very edge is actually touching part of this kingdom, and so causing the barometers there to fall? Consider further, as I said before, that the Cyclones sometimes move at the rate of forty miles or more an hour, and I think then instead of blaming the London Office for a few bad forecasts, we shall only be surprised at the great accuracy to which they generally attain (83 per cent. of their forecasts of weather are correct). On the Continent, in Germany for instance, the meteorologists are much better placed than here, for they have the advantage that Cyclones which reach them must first pass in far the greater number of cases either over this country or France, so that they can get timely telegraphic notice of what is coming. With us we have nothing but sea from whence the Cyclone comes. If it were only possible to have floating meteorological stations some hundreds of miles out in the oeean to the west and south-west of Ireland, these stations being in telegraphic communication with this country, our weather fore-casters would have a much easier task. At present we are always liable to be taken by surprise by some extra fast-moving and destructive Cyclone. To us living far from the sea this may not appear a matter of much importance, but to our sailors and fishermen it is only too serious a matter, which may and has caused much loss of life.

I spoke before of Cyclones frequently travelling very long distances indeed ; I now show you the track of one marked on this map. It originated near the Philippine Islands, crossed the Pacific Ocean, then passed over the northern part of North America, crossed the Atlantic Ocean, passed over France, and finally died away near Stockholm, in Sweden, after having run a course of 14,000 nautical miles. This Cyclone has, I believe, the longest course of any one yet satisfactorily traced ; but it is by no means uncommon for a Cyclone from the continent of North America to reach us ; the majority, however, of our Cyclones are born in the Atlantic Ocean, somewhere about latitude 40°. So it is hardly fair to put all our bad weather down to our American friends.

I have described to you already how the wind always circulates round a Cyclone in one particular direction ; that direction being opposite to the movement of the hands of a watch. I will now try to explain why this movement is always in this one particular direction. The circumference of the earth, as you know, is about 24,900 miles at the equator. Now, as the earth turns completely round once in twenty-four hours, it follows, of course, that anything apparently at rest on the equator is really moving through the distance of 24,900 miles in twenty-four hours, that is to say, it is moving at the rate of 1,036 miles an hour. If we move now up to latitude 60°, to the Shetland Islands, say, we shall find on measuring round the earth on that latitude, that the circumference of the earth there is exactly half the distance that it is round the equator. Being only half this distance, it follows, then, that anything apparently at rest on latitude 60° is really moving at half the rate that anything on the equator is moving, that is to say, it is moving round at the rate of 518 miles an hour instead of 1,036 miles. The earth rotates from the west towards the east, as you know; suppose, therefore, something, say a mass of air, which is travelling at the equator at the rate of 1,036 miles an hour towards the east, to be suddenly tranferred to latitude 60°, still having its original motion, it would there travel *twice* as fast to the east as the earth is moving; consequently, to anyone standing on the earth there the motion of the air would be felt as a terrific wind blowing from west to east, at the rate of 518 miles an hour; that is to say, it would be blowing with a force far exceeding the greatest hurricane that ever blew. Now, of course, it is impossible to transfer anything from the equator to latitude 60° in the way I have supposed; but from this exaggerated case I wished to show you, as clearly as I could, that anything, even being slowly moved from the equator towards the north pole, must be inclined to take a direction towards the east, owing to the fact that it is always leaving a portion of the earth's surface, which is moving faster, for a portion that is moving slower. Every step taken from the equator towards the north pole must take one to a more slowly moving spot. Now it follows, from what I have said, that any wind starting in the northern hemisphere to blow from the south towards the north *must* gradually change its course towards the east, that is to say, a south wind *must* become a south-westerly wind. (By "south westerly wind" here is meant any wind near that point, not of necessity a wind due south-west.) We have so far only spoken of movement on the earth from the south northwards; now let us consider the reverse movement, *i.e*, from north to south. It will be readily seen now that we have movement from a *more slowly* rotating portion of the earth to a *quicker* one. In this case, therefore, the change in the course of the wind will be reversed. A north wind starting to blow south will have, as it were, the earth running against it, thus converting a due north wind into a north-easterly one. A good illustration of this is found in the well-known north-east trade winds. These winds, which blow from about latitude 30° north towards the equator (to fill the vacuum caused by the rising of the heated air over that portion of the earth), would be due north winds if it were not for the rotation of the earth, which converts them into north-easterly winds. It is, then, evident that all winds blowing from the south are always inclining to a south-westerly direction, and all winds from the north are inclining to a north-easterly direction. (East and west winds will not be affected by the earth's rotation, as they keep to a portion of the earth that is moving at a constant speed.) Now let us consider a Cyclone just formed, in which, as I have shown, air is rushing towards the centre from all directions. It will be easily seen, then, that all the wind coming in towards the Cyclone from the south must have a general inclination to press *towards* the east of the Cyclone (from the reasons I have just given), and all the wind coming from the north must have an inclination to press towards the west. Now imagine, for a moment, that the Cyclone (Fig. 1) is a cart wheel that easily turns on its axis. On the south side of it press it *towards* the east, as the south winds will do, and on the north of it press it *towards* the west, as the north winds will do, you will then see that the whole system would commence to turn round in an *opposite direction to the hands of a watch.* The rotation of the earth is, then, the cause of the direction of rotation of the wind round a Cyclone.

So far I have only spoken of Cyclonic wind movements in the northern hemisphere of our world. But if we go south of the equator, we must expect different movements of the wind in Cyclones. For here the movement of wind, from the equator towards the south pole, will, owing to the rotation of the earth, be changed from north to a north-westerly wind; and from the same cause the wind blowing from the south will become south-easterly. If you will consider for a moment what the effect of these directions of the wind will be on a Cyclone just formed, you will find that the rotation of the wind round the Cyclone would be in the *same*

Thursday, March 29, 8 a.m.

FIG. 3.

Saturday, January 7, 8 a.m.

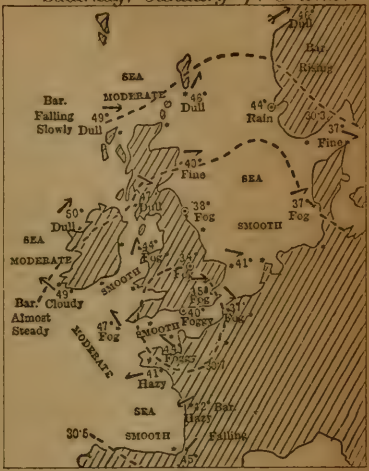


FIG. 4.

Thursday, December 20, 6 p.m.

FIG. 5.

Friday, December 21, 6 p.m.

FIG. 6.

direction as the movement of the hands of a watch. Now this is what is observed in all Cyclones in the southern hemisphere.

In Anti-Cyclones in which, as you will remember, the wind blows from the centre towards the outside (that is exactly opposite to the flow of air in Cyclones), the rotation of the earth will, of course, act in an exactly opposite direction upon their course, hence the rotation of the wind round Anti-Cyclones is in a contrary direction to that of Cyclones in the same hemisphere.

In conclusion, let me quote one of the golden rules in meteorology. "Wind *always* blows from where the air pressure is high to where it is lower," as water always runs down hill, and for a somewhat similar reason.

Report on the Stapenhill Explorations.

(With Frontispiece and Ten Plates.)

By John Heron,

Hon. Secretary of the Exploration Committee.

THE following report of the Stapenhill Explorations, which is a revised and enlarged edition of the one presented to the Burton-on-Trent Natural History and Archæological Society at their meeting held on Tuesday, February 28th, 1882, has been drawn up at the request of the Committee for publication in the transactions of the Society.

For several reasons it has been deemed advisable that all doubtful questions and theories should be avoided as much as possible, and that this report should simply take the form of a record of the work done by the Exploration Committee, giving as accurate a description as possible of the various graves and their contents.

PART I.

The Stapenhill Explorations.

The Site.—That portion of ground in which the remains about to be described were discovered, is a fine breezy upland, situated on the crest of an undulating ridge of hills on the Derbyshire side of the river Trent, at an elevation of 120 feet above the level of that river and 300 feet above the sea level. It lies at the southern end of Stapenhill village, about half-a-mile S.S.E. of the Parish Church and just within the boundary line of the borough of Burton-on-Trent, and is immediately skirted on its eastern side by the Stanton Road, whilst the Rosliston Road runs close by it on the west; a little further off, towards the north, the Trent lazily pursues its course, separating Stapenhill from Burton-on-Trent.

It seems extremely probable that a Roman road or highway, or possibly a British trackway, ran close past this site and on to the ford at Stapenhill, thence to Branstone, where it joined another road running at right angles to it, and which connected the British towns of Burton and Branston.

It occupies a most prominent position in the landscape, commanding extensive views of the surrounding country. On a clear day, far away in the distant south-west, may be clearly discerned the spire of Lichfield Cathedral; towards the west, Needwood Forest with Hanbury Church tower can be seen, whilst further off still lies Cannock Chase. In the north-west Thorpe Cloud and the Weaver Hills bound the horizon, and towards the north is seen Crich Stand and the commencement of the Pennine Chain. On the east the Derbyshire colliery towns of Newhall, Gresley, Swadlincote, Stanton, etc., cut off further view.

This is just such a spot as might well be chosen in those early times for the burying place of the clans or tribes whose settlements lay scattered through this part of the Trent valley.

The immediate site of these explorations occupies 1,226 square yards; its greatest length being 150 feet, and width 96 feet, and is at present (1882) in the occupation of Messrs. Chamberlain and Ballard respectively, being used by them as a brickfield. The clay, which is a fine red marl of the new red sandstone formation, being very stiff, tenacious, and almost impervious to moisture, and well adapted for the manufacture of bricks, formed a capital medium for protecting the remains from damp and decay, most of the skeletons when found being perfect and in an excellent state of preservation. The ground had also the appearance of not having been cultivated for centuries, if, indeed, it ever had been, so that the bodies were unearthed in just the exact positions in which they had been deposited there hundreds of years before.

A reference to the shaded portion of the Index plan (Plate II.) shows the exact position of the site, whilst Plate III., the plan of the site, shows the positions of the different finds and the directions in which the various bodies lay.

ORIGIN OF THE DISCOVERY.—On the 1st of February, 1881, as some workmen were getting out clay for brickmaking in Mr. Chamberlain's portion of the field, they suddenly struck across two earthenware pots of large size, one of which was more or less fractured. Unfortunately, but a few fragments of either of these have been preserved, as they were broken to pieces by the workmen in the vain hope of finding gold therein; judging, however, from the fragments which are now in the Society's museum, these vessels must have been of large size, and were very beautifully ornamented. Some burnt bones were enclosed in one if not in both of them, and there is now little doubt but that both of these vessels were cinerary urns of the Pagan Saxon period. Photographs of some of the pieces are shown on Plate VI., Figs. 8 and 9. Near these urns was also found an iron javelin head, 6 inches in length (Plate VIII., Fig. 17).

ACTION TAKEN BY THE SOCIETY.—Shortly after finding these urns, the workmen came upon the remains of at least two bodies lying full length; near the head of one of them was an iron spear head, eleven inches in length (Plate VIII., Fig. 22). Later on three or more bodies were unearthed; Mr. Chamberlain being present when these remains were discovered, and seeing that a careful investigation would probably lead to some very interesting results, at once put a stop to any further excavations in that portion of the field by the brickmakers, very promptly and thoughtfully communicated the facts thus brought to light to our Society, and most freely and cordially gave the Society permission to carry on any explorations they might choose to make in his brickfield; whilst at the same time Mr. Ballard kindly accorded permission to the Society to explore his ground as well.

Accordingly, a Provisional Committee, consisting of Messrs. W. Boden, W. Canning, S. Evershed, F. E. Lott, G R. Strachan, R. Thornewill, C. U. Tripp, T. N. Whitehead, with C. Perks

(Chairman), H. Partridge (Hon. Treasurer), and J. Heron (Hon. Secretary), was appointed for the purpose of carrying on further explorations, and an account of these investigations is given in the following pages.

THE SOCIETY'S OPERATIONS.—Operations were commenced by digging trenches 3 feet wide and about the same depth in different directions, starting from the spot where the body with the accompanying spear head was found.

As a result of these excavations the remains of upwards of thirty-six bodies were discovered, accompanied in some cases by personal ornaments, small iron knives, or weapons of such a character as to prove most conclusively that this was a burial-place of the Pagan Anglo-Saxons, or Pagan English, as they are now preferably termed, and that, at the time at which these interments took place, those people were in quiet and undisputed possession of the surrounding country.

The accompanying table shows at a glance the nature and positions of the various finds.

TABLE.

Bodies lying extended on back	14
,, ,, ,, right side	1
,, ,, ,, left side	1
,, ,, contracted on right side ..	0
,, ,, ,, left side	5
,, positions undetermined	10
Bodies which had undergone cremation ...	5
Total	36
Cinerary urns	5
Food vessels and drinking cups	9
Total	14
Articles of bronze	12

Articles of iron—

Spear heads	... ...	1
Javelin heads	... ...	3
Knives	... ...	5
Buckles	... ...	1
Boss of shield	... ...	1
Lumps of iron	... ...	3
		14

There is every reason for believing that this cemetery was of much greater extent than the present explorations would lead us to suppose, for it has been ascertained, as a positive fact, from enquiries made of Mr. Haynes and of several of the men employed in these brickfields, that human bones and vessels of pottery have been exposed from time to time in the course of their excavations for clay; and Mr. Haynes has described to us a large circular hole, some three feet in depth, discovered at about the spot marked C on the plan, containing fragments of pottery and bones, and at the bottom of it a dark, unctuous-looking kind of clay: this hole or well had no doubt served as the crematorium of this burial-ground. At a meeting of our society, held Jan. 2, 1877, the late Mr. Molyneux exhibited some horns of the red deer, and bones of the horse, sheep, and *Bos longifrons* which he had found in a clay bed near Stapenhill, with fragments of British (?) and Roman pottery. These I find were discovered somewhere about the same time as the crematorium mentioned by Mr. Haynes, and in same locality. I think, therefore, we might approximately estimate the extent of this cemetery as reaching from A on the north to F on the south, and from E on the east to B on the west, as shown on Plate II.; but it seems extremely probable that this was the burial-place of only one particular tribe or clan, and that other cemeteries of greater or less magnitude extended all along this elevated ridge, perhaps for miles; anyway, judging from the numerous relics, Roman and Saxon, which have been found all round this district from time to time—and many of which are referred to in the works of Sir Tonman Mosley, Mr.

Molyneux, and others—the Trent Valley must have been comparatively thickly populated even at this somewhat remote period. But this should not be surprising to us when we consider that close by stands Repton, once the chief town of the celebrated and powerful kingdom of Mercia, and the residence and burial-place of many of her famous kings and warriors.

DESCRIPTION OF THE "FINDS."—Much cannot be said of the "finds" numbered 1, 2, and 3 in the catalogue, and which were discovered by the workmen—their positions, however, are shown as at 1, 2, and 3 on plan—so that in this report we shall commence our detailed description with *find No.* 4, the first which was brought to light by the Exploration Committee.

Find No. 4, *February* 14*th*, 1881.—This was the body of a female of middle age (see Frontispiece), height 5 ft. 10 inches; the skeleton, which was in perfect preservation, was lying on the back with the head pointing towards the west, the right arm was stretched out by the side, the left arm lay across the chest, the legs were straight, not crossed. Close to the left side of the head was a very beautiful urn (drinking vessel) (Plate IV., Fig. 1) of dark-coloured fine earthenware, only partially baked, but richly embossed and ornamented. It measured 5½ inches in height, 5 inches diameter at widest part, and 3½ inches across the mouth. The clay with which the urn was filled appeared blackened towards the bottom, and coarser than that nearer the top, as if it had been impregnated with some organic substance, probably mead, the favourite drink of the early English, with which, no doubt, the vessel had been filled at the time of burial.

On either shoulder was a fibula of the cruciform or Roman type (Plate VII., Fig. 12), made of gilded bronze, the head of each consisted of a trefoil with a small tongue-shaped pattern forming a border along the edge. Round the neck was a chaplet of twenty or more beads, eight of which were of that dark-blue glass so characteristic of the beads of the Roman period, and circular in shape; one was of white glass, very much resembling the white Venetian glass beads of the present day; four consisted of amber, roughly fashioned in the form of a spindle, whilst one consisted of a garnet pierced with a hole; the rest were composed of terra-cotta inlaid with coloured pastes of various shapes—circular, square, and oblong—and unquestionably of Saxon origin. Near these beads were several pieces of tubular bronze, which must have served as a fastening for the necklace; on the chest were several small flat pieces of bronze, which on being fitted together formed part of a bar, $1\frac{1}{2}$ in. long by $\frac{1}{2}$ in. wide, and was evidently part of a band or clasp. Near the waist was an iron buckle, 2 inches in diameter (Plate VIII., Fig. 23 *a* and *b*), used as a fastening for the leathern girdle worn round the waist. Close to it were two articles of bronze, which have long puzzled archæologists as to what purpose they served, but it is now generally agreed that they probably formed part of the framework of a leathern bag or purse, or portion of a chatelaine (Plate VII., Fig. 14); near the right arm was a spindle-whorl of Kimmeridge coal (Plate V., Fig. 7).

Find No. 5.—The only human remains discovered in this grave were the teeth of a child, but from the position of the articles which accompanied them, there can be little doubt that burial by inhumation had taken place, although it is highly probable that partial cremation was practised; near the teeth was a small urn, height $3\frac{3}{4}$ inches, diameter $3\frac{1}{2}$ inches (Plate V., Fig. 3), very rude and coarsely fashioned, but so highly burnt that portions of it had become vitrified and of a red colour; at a short distance from this, and at the spot the shoulders would have occupied, was found a small gilded bronze fibula as shown in Plate VII., Fig. 11; between this and the teeth were four beads, two of them were of light green glass, large in size, embossed and ribbed, and Roman in character (Plate IX., Fig. 27, *a* and *c*). The other two were coloured pastes and much smaller; one of them is exceedingly well wrought, and in a splendid state of preservation (Plate IX., Fig. 27, *b*), in fact the most beautiful and perfect of any that were discovered. The style of ornament and general finish would point to Egypt as its origin.

Find No. 6 consisted of an urn only, of medium size, and very coarse and rude in style (Plate V., Fig. 5), height 3¼ inches, diameter 4½ inches.

Find No. 7 was a skeleton of a young person in a very bad state of preservation, facing east. Near it was a piece of linden wood, evidently roughly shaped with a knife into the form of a double wedge, and probably used as a fastening for a girdle or belt.

Find No. 8 was an urn only, very rude and coarse in make; height 8½ inches.

Find No. 9 was the body of a child in a very bad state of preservation, lying east and west, head pointing towards the west. Accompanying this were a circular bronze buckle (Plate VII., Fig. 13) and four beads of terra cotta, very much disintegrated and worn. With the beads was one of those small Roman copper coins of the Constantine period, pierced with a hole. It had obviously been worn suspended by a string from the neck along with the beads. On the obverse were the words, URBS ROMA; and on the reverse, the twins Romulus and Remus suckled by the wolf; date 327 A.D.

Find No. 10 was a large cinerary urn, ornamented with four rude and shallow circles, and a pattern showing a square divided into sixteen smaller squares (Plate VI., Fig. 10). Inside it were burnt human bones. Near this and towards the south-east was another large urn, *Find No.* 11, ornamented with five rude and deep circular lines, also containing burnt human bones. Lying underneath the bones was a spindle whorl, or more probably an amulet, made of deer's horn, and beautifully ornamented on one side with a series of circles, each enclosing two smaller and concentric ones (Plate V., Fig. 6).

Find No. 12 was the body of a man in the prime of life, lying full length on the back, the left leg was crossed over the right, the arms were folded, the right being crossed over the left, the head was much higher than the rest of the body, and was resting on a block of sandstone. No article of any kind accompanied this interment.

Find No. 13 was the body of a young female lying on the left side, head pointing towards the west, the arms extended by the side, and the legs bent at the knee at an angle of 120°. Near the left side of the head was a small iron knife, 3¼ inches long (Plate VIII., Fig. 18), and by the waist was an oblong piece of bronze, which had been rivetted to an iron buckle of the same shape.

Find No. 14 was the body of a man, lying full length on the back, head pointing north-west; the right arm lay extended by the right side, the left hand lay on the chest, and the legs were not crossed. No article of any kind accompanied this interment.

Find No. 15, which was accidentally exposed by the brickfield men in digging for clay, was the body of a female adult, lying on the left side, with the head pointing towards the west-north-west; the arms were extended towards the north-north-east, and the legs were in rather a contracted position. Under the head was an iron knife, 3¼ ins. long. Trenches were dug in the direction of this find later on.

Find No. 16 consisted of portions of an urn and fragments of charcoal, carbonised cloth, etc.

Hitherto only one body had been interred in each grave, accompanied in most cases with one or more articles of ornament or defence, and vessels of pottery. Up to the present, no flint flakes or pieces of broken pottery or charcoal were discovered in connection with any of the interments by inhumation; it is just possible, however, that every grave did contain some of these, but that such were overlooked by the workmen employed in the excavations; for, as will be noted, from this time forth, a much more diligent and careful search being instituted, some fragments of pottery and flints were found to accompany each interment by inhumation.

Find No. 17.—This was the first grave in which more than one body was interred, no less than three bodies being discovered, each lying full length, with the arms extended by the side, and with the legs not crossed. One body, 17A, was 2 ft. 6 in. below the surface, the head pointing towards west-north-west; the second body, 17B, lay at right angles to the first, about 1 ft. 6 in. below the surface; its feet overlay those of the first, and the head pointed towards the east-north-east. Only a few bones of the third body were found, and these bore traces of having been subjected to the action of fire.

In close conjunction to these bodies, and encircling them, was a large quantity of charcoal, black humus, and carbonised remains of what appeared to be cloth. The bodies were in a bad state of preservation, and all had doubtless been more or less exposed to the action of fire. Several fragments of pottery, old and water-worn, were found in close proximity to these bodies, some of them being of Saxon origin, but others as undoubtedly Romano-British. A number of teeth and bones of domestic animals, principally of the horse and ox, with a few of the pig, many of them showing unmistakably the action of fire, were also found in this grave.

Near this interment was found a large horseshoe, of ancient pattern, but we have been unable to determine the period to which it belonged; any way, it appears to be of a much later date.

Find No. 18 was the skeleton of a male adult, in a very bad state of preservation; with it was a bronze pin, three inches long, and a little to the west of it were two lumps of molten or slaggy iron, which had evidently been exposed to a very high degree of heat.

Find No. 19.—Whilst these explorations were being carried on in the neighbourhood of *No.* 18, the brickmakers, excavating for clay about 350 ft. to the west of this spot, exposed a skeleton at the point marked 19; with it were two flint flakes. Depth of skeleton, 4 ft. 2 in., and facing west.

Find No. 20 was the body of an adult, lying on the left side, with the head pointing towards north-north-west; the arms were bent at the elbows so that the hands were directed towards the head; the legs were rather contracted. Accompanying this body were some very coarse potsherds and three flint flakes.

Find No. 21 was a skeleton of a male adult, lying full length on back; the head, pointing towards north-north-west, was raised much higher than the rest of the body; the hands were crossed over the waist, the left being uppermost; the legs were not crossed. On the lower half of the left arm was the iron boss or umbo of a shield, diam. $5\frac{1}{2}$ ins. (Plate IX., Figs. 24 and 25), and judging from the length of the iron nails which were in the rim, the thickness of the wood was about $\frac{3}{4}$ inch. On the right side of the head was an iron spear-head, about 5 ins. long (Plate VIII., Fig. 21), and near it a small piece of bronze, which seems to have been a portion of a buckle or fastening. At a short distance from the spear-head was another of those shapeless masses of iron showing traces of fire-action, similar to those accompanying *Find No.* 18.

Find No. 22 was that of a young adult, in a very bad state of preservation, lying full length, head pointing west-north-west; the right arm was extended towards the north-east; the left hand lay over the chest, and pointed in the same direction as the right one; the legs were not crossed. Near the right hand was found the canine tooth of a horse, whilst encircling the body, but more towards the front, was a very large quantity of charcoal and black humus.

Find No. 23 was a male adult, lying nearly full length on the back, with the head pointing west-south-west, the legs being slightly bent at the knees towards the left. The right arm was bent up at the elbow; the left hand lay across the lower part of the chest. Near the right side of the head was an iron spiculum, or javelin-head, $5\frac{1}{2}$ ins. long. In the left hand was an iron knife or dagger, $3\frac{1}{2}$ inches long, in a handle of deer's horn, $2\frac{3}{4}$ ins. long, the total length being $6\frac{1}{4}$ ins. (Plate VIII., Figs. 19 and 20.) Near the waist was a small fragment of bronze, doubtless portion of a buckle.

Finds Nos. 24 and 25 consisted of bones of various domestic animals lying scattered about within a radius of 6 yards. Some fragments of pottery, potsherds, and flint flakes were also found on this spot.

Find No. 26, a photograph of which is shown in Plate I., was the body of a male adult, lying full length on the right side, with the head pointing towards the west; the right arm lay stretched by the side; the left was bent at the elbow, the left hand resting on the right arm; the legs were slightly contracted. Near the left side of the head was an urn of coarse earthenware, with four projecting knobs or ears, about 3 ins. below the rim. (Plate V., Fig. 4.) Near the feet was another similar urn, but without ears; an iron knife, 4 ins. long, was found lying on the left chest. Near to this body were several bones of animals, of the same class as those of *Find No.* 17, with the addition of some bones of the goat and dog.

Find No. 27 was a male adult, lying full length on the back, with the head pointing towards the south-south east; the arms lay straight by the sides; the legs were not crossed. Near the right humerus was a small vessel of coarse earthenware, but harder in texture than any that had been found previously, as if it had been more highly baked or burned. Four flint flakes also accompanied this body.

Find No. 28 was the body of an adult, lying full length on back, but not a trace of the head was to be found, though searched for most carefully.

Find No. 29 was the radial bone of a horse.

Find No. 30 was one of the most interesting, perhaps, of all the finds—a cinerary urn containing burnt human bones, evidently those of an adult. Along with these bones in the urn were a lot of beads, 36 in number, 21 of which were of dark blue glass, of Roman origin, 14 of terra cotta. or coloured pastes, and one of amber; also a bronze fibula, of circular concave-convex form (Plate VII., Fig. 16), the only one of this kind discovered. Some animals' bones were also found near to the above.

Find No. 31 consisted of animals' remains; the horn core of the ox (*Bos longifrons*), and two incisors of the horse.

Find No. 32 was the lower half of a skeleton, lying on left side with legs crossed; the skull, arm-bones, and other parts of the upper half could not be discovered. Near to these bones were a pair of bronze tweezers (Plate VII., Fig. 15), a small iron knife in a sheath, and also portions of the lower and upper jaws of a pig.

Find No. 33* was portion of the scapula of a pig.

Find No. 34 was a complete skeleton, 2 ft. 3 in. below the surface, lying on the left side, its head pointing towards the south-south-east. The left arm lay stretched out at right angles to the body, the right one was bent at the elbow, the hand resting on the left elbow. The right leg was crossed over the left one, and bent at the knees to an angle of about 30 degrees. Accompanying this were fragments of pottery and some flint flakes.

Just about this spot a large number of animals' bones, fragments of pottery, and flint flakes occurred, and which are marked in the catalogue as *Finds* 35, 36, 37, and 38, but are not shown on the plan.

THE DITCH.—From here a trench 3 ft. deep was then dug in a westerly direction, but no more bodies or relics of any kind were discovered until, at the spot marked D on the plan (Plate II.), a portion of a ditch was met with. This was very carefully excavated, and was found to run in a slightly curved form nearly due north and south; it was 92 ft. long, and was at the southern end 5 ft. 9 in. deep, but at the northern one only 2 ft. 6 in. (Plate X.) No human bones whatever were discovered in this ditch, but several hundreds of animals' bones, such as those of the ox, horse, pig, goat, hare, and dog were met with; also numerous fragments of pottery of Saxon, Romano-British, and Roman origin, and a few probably even of Celtic; some flint flakes, a few fragments of bronze, some pieces of coal or anthracite, and an earthy substance, orange-red in colour, doubtless some kind of pigment

I have made a minute and detailed examination of all the articles found in this ditch, dividing them off into layers each one foot in depth, and have obtained the following results:—

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* *Finds Nos.* 30, 31, 32, *and* 33 were all near each other. A large quantity of charcoal and humus was also found about here, as if a huge funeral pyre had been erected on this spot.

Depth beneath the surface of the ground.	Fragments of Pottery.		Flints.	Animals' Bones.
	Saxon.	Roman.		
0 ft. to 2 ft. ...	19	40	28	23
2 " " 3 " ...	0	25	26	39
3 " " 4 " ...	0	46	14	67
4 " " 5 " ...	0	23	10	26
5 " " 6 " ...	0	10	5	30

The flints found in this ditch were, for the most part, rough and water-worn, and may have been chippings or flakes, and, as is seen in the table, were found at all depths, the greatest number, however, occurring near the surface. Only one, and that at a depth of five to six feet, could with any degree of certainty be called a genuine flake or arrowhead.

The bones belonged to various animals, such as the pig, goat, horse, and ox; but those of the last were met with in the greatest abundance, especially in the deeper portions of the ditch.

Of the pottery, one very remarkable feature was the very few water-worn shards that were met with; no whole vessel of any kind was found, but all the fragments had the appearance of being cleanly broken very shortly before they got into the ditch. With the exception of a few of Saxon origin which were met with near the surface, they were all of Roman or Romano-British manufacture. Several rims of those white ware vessels, which are so common and so characteristic of the Roman period, and known as Mortaria, occurred in this ditch; a few pieces of Samian ware, and many pieces of redware, roughly made, as in imitation of Samian, were found; but by far the larger number of pieces met with were of all shades of greenish or brownish grey to black. Amongst these there were a few fragments which, from the style of ornamentation, might at first sight pass for Celtic, but the texture, colour, and material would seem to point to Romano-British. One piece of very fine texture and material, and carefully finished, was undoubtedly Roman, and certainly not manufactured in Britain.

At a depth of about $4\frac{1}{2}$ to 5 feet, and nearly midways, as shown by X in the plan and sections of the ditch (Plate X.), a very interesting discovery was made; this consisted of three lumps of molten iron, very similar in appearance to those accompanying *Find No.* 18, five lumps of anthracite coal, several lumps of red clay or pigment, and the skeleton of a dog, which was pronounced by the late Dr. Woodward, of the British Museum, to be that of the common house-dog of the Romans. A copper coin (Plate IX., Fig. 26) was found near the remains of this dog, and which Dr. John Evans, F.R.S, determines to be a barbarous imitation of one of those coins which were struck in honour of Antonia, the mother of Claudius, and to have been probably manufactured in Britain.

Although at this point the explorations as carried out by our Society have had to be abandoned, partly owing to the field being wanted by the owner for meadowing, and partly through lack of funds, yet a few more finds have yet to be recorded. These were discovered near Mr. Ballard's fence, but on Mr. Chamberlain's ground, as his men were digging out the clay for bricks on October 17th and following days.

Find 39 was the skeleton of a male adult, head pointing west-south-west; length of body nearly six feet. It was lying on its back, with its left forearm crossed over on chest, its right arm stretched out beside the body, and its legs not crossed.

Find 40 was a skeleton in a very decayed state, so that it was not possible to determine its exact position.

Finds 41 and 42 were urns of coarse earthenware, the latter being in a very shattered condition; the former is shown in Plate V., Fig. 2.

Find No. 43 was a skeleton 5 ft. 6 ins. in length, lying on its back with its head pointing west-south-west, its arms stretched out by the sides, and its right leg crossed over the left.

Find No. 44 was a skeleton lying on its left side, with the head

Find 26.—Male Adult Skeleton with two Urns and Knife.

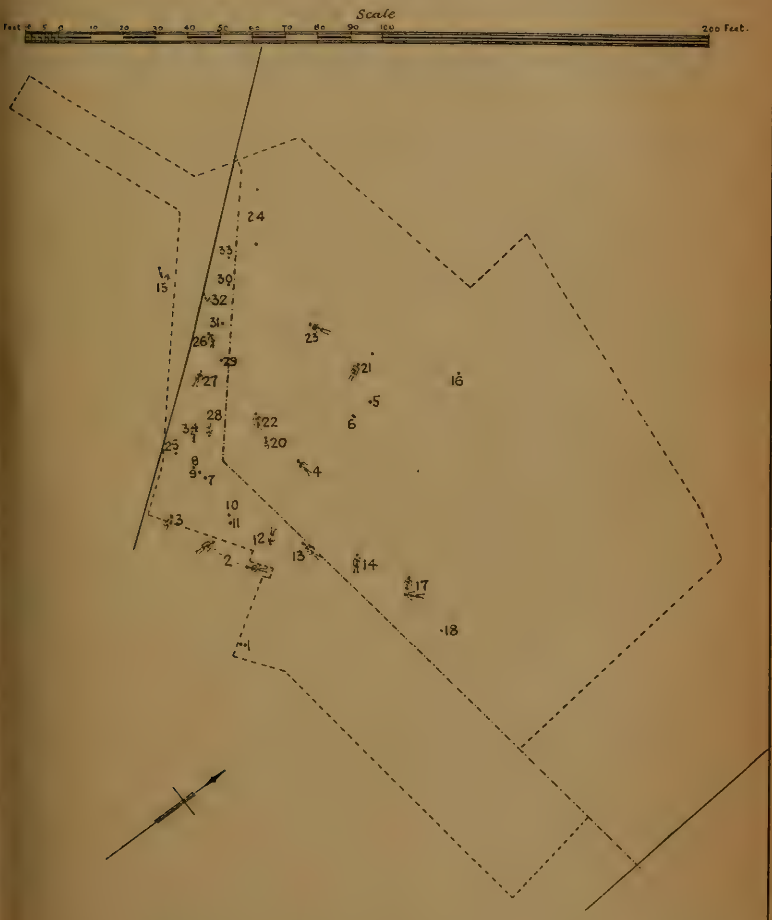
Bemrose & Sons, Photo-Tint. London & Derby.

INDEX PLAN.

Scale 8 Chains to an Inch.

STAPENHILL EXPLORATIONS.

Plan.



NOTE.—*The figures indicate the numbers of the "Finds."*

BEMROSE & SONS, PHOTO-LITHO. DERBY & LONDON.

FIG. 1.

MROSE & SONS PHOTO-TINT. LONDON & DERBY.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

[illegible] & Sons Photo-Tin London & Derby.

FIG. 9.

FIG. 8.

FIG. 10.

Fig. 11. Fig. 14. Fig. 12. Fig. 13. Fig. 15. Fig. 16.

FIG. 17.

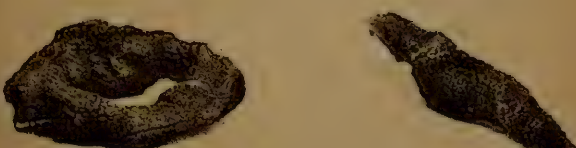
FIG. 18.

FIG. 19.

FIG. 22.

FIG. 20.

FIG. 21.



a *b*

FIG. 23.

ROSE & SONS PHOTO-TINT. LONDON & DERBY.

FIG. 24.

FIG. 25.

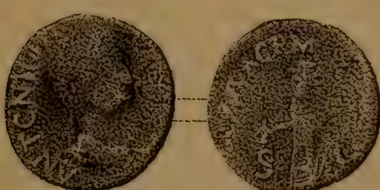
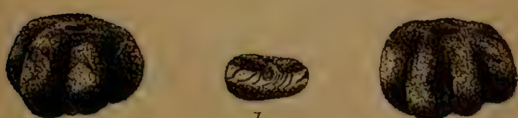


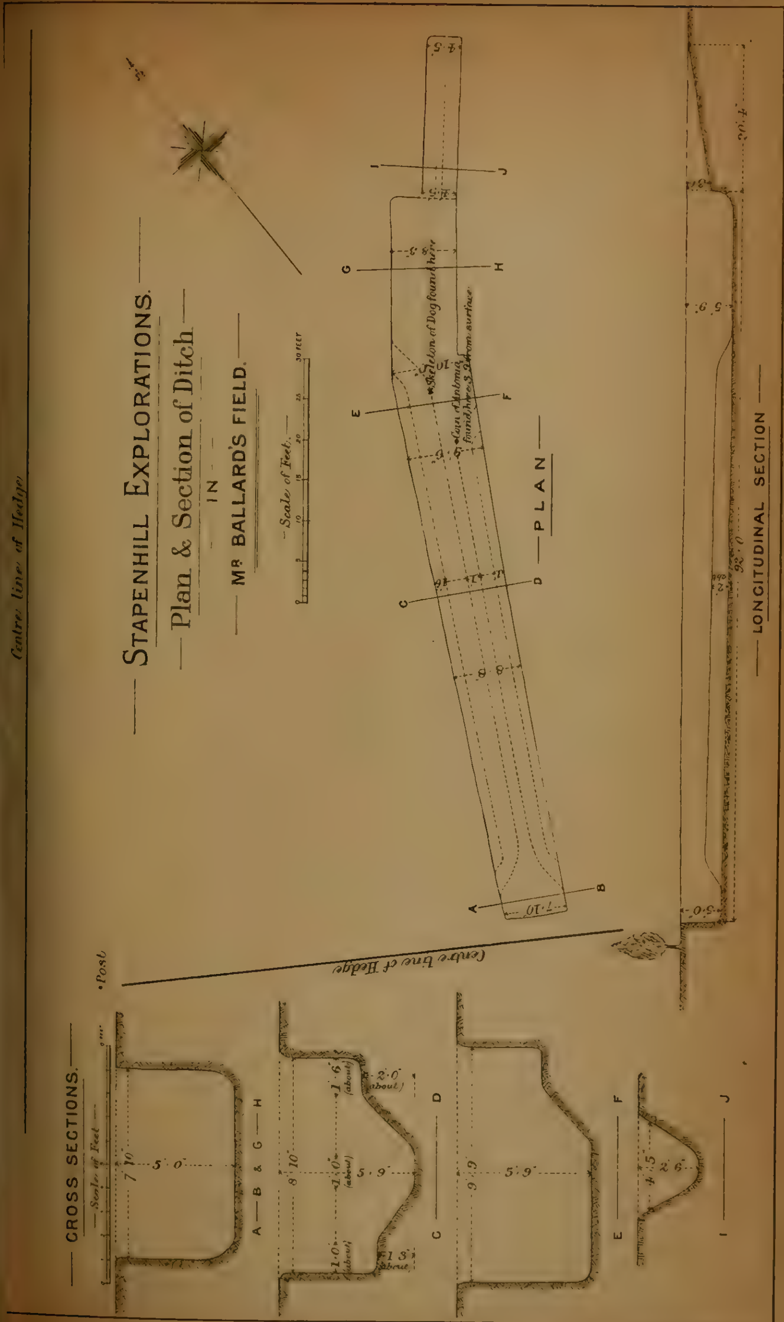
FIG. 26.



a *b* *c*

FIG. 27.

MROSE & SONS, PHOTO-TINT. LONDON & DERBY.



STAPENHILL EXPLORATIONS.
Plan & Section of Ditch
IN
MR BALLARD'S FIELD.
Scale of Feet.
PLAN
LONGITUDINAL SECTION
CROSS SECTIONS.
Scale of Feet
Centre line of Hedge
Post
Skeleton of Dog found here
A — B & G — H
C — D
E — F
I — J

pointing to south-west; its legs were slightly contracted, and its right arm from the elbow lay at right angles to the body.

So far, then, have these explorations been carried, and, as this record goes to show, yielded most valuable results, giving us much information as to the habits and customs of some of the tribes of that race which contributed so much to the making of England, as well as throwing considerable light upon the history of the district; and we have reason to believe that this work of our Society is regarded by archæologists generally as one of the most interesting discoveries of its kind that has been made for many years past.

The relics which the Society holds in its possession have been carefully cleaned, preserved, and mounted, and are deposited in the Society's room.

It would have been exceedingly interesting to have explored other localities in this neighbourhood, as well as to have traced further the course of the ditch, and to have determined its extent, as to whether it encircled the burial ground, or, as was more probably the case, merely served as a receptacle for the remains of animals sacrificed at funeral feasts, for the fragments of those vessels, chiefly of Roman origin, out of which the funeral libations were drunk, and for the refuse resulting from those ceremonies practised at the burials of the Pagan English.

Whether these explorations are to remain *in statu quo*, or be carried out to a successful termination, rests with the Natural History and Archæological Society primarily, and generally with the people of the historic town of Burton-on-Trent.

In conclusion I must express my best thanks to many members of the Society for much help given me in the drawing up of this record, but more especially to Mr. G. R. Strachan for the very excellent maps and plans made by him of the scene of the Committee's operations.

PART II.

The Bearing of the Stapenhill Discoveries on our Knowledge of Pagan English Burials.

As I mentioned in the introductory note to this paper, it was thought advisable, for many reasons, that the Report itself of the Stapenhill Explorations should be substantially as exact a description as possible of the several bodies which were discovered, and the articles accompanying them, as well as a record of the facts observed, as appertaining to each particular "Find." But in order that this Report may fulfil a greater, and perhaps more instructive, purpose than a mere record of facts, in order rather that the interest of it to the members of our own, as well as other Societies, may be further enhanced, and that we may be able to appreciate to the full extent the teachings of such a record, I have attempted in the pages following to give as briefly as possible a description of the Pagan English, or Anglo-Saxon, burial places, and of their contents generally; and for much information on such a subject I am indebted to the following works:—

AUTHOR.	WORK.
Akermann ...	... Archæological Index to Remains of Antiquity.
,, ...	... Remains of Pagan Saxondom.
Bateman ...	... Ten Years' Diggings.
,, ...	... Vestiges of the Antiquities of Derbyshire.
Birch ...	... Ancient Pottery.
Boyd Dawkins	... Cave Hunting.
,, ...	... Early Man in Britain.
Borlase ...	... Nenia Corumbiæ.
Davis ...	... Ancient British Barrows.
,, ...	... Crania Britannica.
Douglas ...	... Nenia Britannica.
Evans ...	... Flint Chips.

AUTHOR.	WORK.
Evans ...	... Ancient Stone Implements.
Freeman ...	... Early History of England.
Green ...	... History of the English People.
,, ...	... The Making of England.
Greenwell ...	... British Barrows.
Jewitt ...	... Half-Hours with English Antiquities.
Kemble ...	... Saxons in England.
Kemble and Franks	Horæ Ferales.
Lubbock, Sir J.	... Pre-historic Times.
Meyrick and Skelton	Ancient Armour.
Molyneux ...	... History of Burton-on-Trent.
Mosley, Sir T.	.. History of Tutbury.
Neville ...	... Saxon Obsequies.
Pennington, R.	... Bone Caves of Derbyshire
Peschel, O. ...	... Races of Man.
Roach Smith	... Archæologia.
,, ...	... Reliquiæ Antiquæ.
,, ...	... Collectanea Antiqua.
Taylor, Isaac	... Words and Places.
Tylor ...	... Anthropology.
,, ...	... Primitive Culture.
Wright, T. ...	... Wanderings of an Antiquary.
,, ...	... Celt, Roman, and Saxon.
Wylie ...	... Fairford Graves.

Proceedings of the Society of Antiquaries.

Journals of the British Archæological Association.

Archæological Journal.

The Antiquary.

The Reliquary.

British Association Reports.

Transactions of the Ethnological Society.

,, of the Cambridge Antiquarian Society.

,, of the Somerset Archæological Society.

,, of the Archæological Institute.

Journal of the Derbyshire Archæological Society.

On the Downs, and other elevated and generally waste lands, in various parts of England, but more particularly in the south-eastern districts, are to be seen extensive groups of small cone-shaped mounds, which have been termed Tumuli, or Barrows, and which, from the nature of their contents, have been ascribed to the Anglo-Saxon period.

Allowing for the fact that many of the barrows of this period have been somewhat abridged of their original height, due, doubtless, to aerial denudation, arising from their exposed situation, while others have been so by accident; yet they are on the whole very inferior in size to those of the Celtic or early British period; indeed, in some localities their construction more nearly approaches to the form of grave of the present day; namely, a small raised narrow mound, so that they are, strictly speaking, series of grave-hills.

There is little externally to distinguish the larger Anglo-Saxon barrows from many of those of the British. Where they are found intact, they generally consist of a conical mound thirteen to thirty-five feet in circumference, surrounded by a shallow trench. Beneath such a mound is a rectangular grave, varying in depth from one to six feet; the body is usually found lying full-length on its back with the feet pointing towards the north.

By the earlier archæologists it was conjectured that these barrows were the graves of those slain in battle; but the more careful investigations of the last twenty years or more have added many new and interesting facts to those already revealed, and which go to prove beyond a doubt that these barrows are the last resting places of a people in quiet possession of the country. Such barrows, then, may be said to date from the time of the first arrival of the Saxons or English in Britain up to the middle of the eighth century, when Christian sepulture was admitted within the walls of towns and monasteries, and the Pagan mode of interment was abandoned.

Numerous interments have been discovered which have been undistinguished by barrows, and possessing no external indications of sepulture; such have occurred at Barrow Furlong in

Nottinghamshire, Fairford in Gloucestershire, Little Wilbraham in Cambridgeshire, Harnham, near Salisbury, and at Stapenhill, near Burton-on-Trent. In these localities no traces of barrows or tumuli were perceived, but we must not, therefore, conclude that such never existed. In some of these burial-grounds the bodies were deposited in such close proximity to each other that it would be impossible to erect a tumulus over each one, but there can be no doubt that mounds, though insignificant as compared with the larger barrows, were originally erected over each grave.

In some parts of the country the Saxons frequently took advantage of the previously formed British barrows, and in these interred their dead at a few feet below the surface of the mound. Saxon or Pagan English graves resolve themselves therefore into three classes :—

1. English barrows proper, usually smaller in size than the British.

2. English interments in pre-existing British barrows.

3. Series of very small barrows on elevated lands and corresponding to our cemeteries. These are in all probability of much later date than either of the other forms of barrow, and are generally found near the sites of towns and villages, which were the headquarters of that tribe or community.

The Pagan English, like most other barbarous nations of this period, practised cremation in the burial of their dead, but this does not seem to have prevailed universally, but to have been confined to particular tribes or clans ; for instance, in the cemeteries of Kent and Sussex burial by inhumation appears to have been the almost exclusive practice. In the counties of Norfolk, Cambridge, Northampton, Gloucester, and Derby, the practice of burial by inhumation and cremation would appear to have been contemporaneous; while in some districts of Norfolk, Suffolk, and Derby, burial by cremation seems to have been the sole observance.

The discovery of cemeteries in these places, where cremation seems to have been the almost universal practice, has led many archæologists to the conclusion that cremation was the universal custom of the Pagan Saxons, as of most of the other races of northern Europe of this period, and that this mode of burial preceded that of inhumation, but the later discoveries of such cemeteries as those at Girton College, Cambridge; at Stapenhill, and elsewhere, entirely disproves this assumption, for in these places, as proved by the position of the remains, both forms of burial must have taken place contemporaneously.

Interments by Inhumation.

The ordinary mode of Anglo-Saxon burial was the interment of the deceased fully-dressed, with all his arms and accoutrements. The most usual posture of the body was lying full-length on the back, but this varied considerably—the full-length on the back was the position of those bodies discovered in the burial-grounds at Ozingell, and at Wye Hill in Kent, at West Harnham in Wilts., and at Fairford in Gloucester. Speaking generally, all the burials south of the Thames were in the extended position. As we advance northwards, we find the posture varies considerably; for instance, at Stapenhill, representatives of thirty-six bodies in all were discovered, of these fourteen lay full-length on their backs, one on the right side, and six on the left side, and ten the exact position of which could not be determined, whilst five had been cremated. Of those which lay on the left side, two (Nos. 13 and 44) were in a slightly contracted position, while three others (Nos. 15, 20, and 34) were in a position much more contracted; but in no case was this contraction of the character so common to Early British or Celtic interments. That the Saxons buried their dead sometimes in the contracted position has been shown most conclusively by the researches of Greenwell, Bateman, and others.

The Early British, as a rule, deposited the body in the meridian line with the head to the north, and, consequently, with a south aspect; on the other hand, we find in Anglo-Saxon barrows and cemeteries of the Pagan period the head directed towards the south, the body being still in the meridian line; the feet, and consequently the face, were preferably laid towards the north, where was "the holy place of Teutonic heathendom." Such was the case at Ozingell, Wye Hill, and at Fairford; whilst at West Harnham, and at Brighthampton, in Oxfordshire, the head pointed to the west. In a few cemeteries, as at Linton Heath, and at Girton College and Little Wilbraham, Cambridgeshire, as well as at Stapenhill, the direction of the bodies is by no means uniform, most of them being apparently interred without any regard whatever either to symmetrical arrangement or direction.

It is difficult to imagine what ceremonies were practised at these interments, but certainly they entailed the use of fire. Fire amongst the Pagan races of northern Europe was the great resolver of all things, the purifier of the spirit from the earthly dross surrounding it; for as the smoke and flame of the funeral pyre ascended to the heavens, so might the relatives of the deceased imagine that the spirit thus set free winged its flight to those happy hunting-grounds where he might unceasingly pursue the unending chase, or, in the halls of Thor or Odin, quaff draughts illimitable of sparkling mead from the shadowy skulls of his conquered enemies.

In many of these cemeteries ditches several yards in length, and from three to nine feet wide, and sometimes reaching a depth of six or more feet, occur. Such was the case at Fairford, and at Stapenhill, and at first sight it would appear as if these cemeteries had originally been surrounded by a moat or ditch. I cannot find in any of the reports of explorations of Saxon cemeteries which have been published, a detailed account of these ditches, and I think it is extremely probable that if any cemetery had been encircled by such a moat or other earthwork, such a fact would certainly be recorded by at least one explorer.

The only reference by Wylie to the ditch at Fairford Cemetery is as follows:—

"Came to a spot which caused us much delay in the excavations. It was an accumulation of rich soil about three feet deep, in which were interspersed fragments of pottery, bones, animals' teeth, etc., that had mostly undergone the action of fire. . . . . It seemed the limit of the cemetery in that direction. We found much broken pottery, Saxon and Roman, animals' teeth and horns, very many burnt stones, etc. The ground had clearly been disturbed; one kind of pottery of a fine reddish-brown stoneware was new to me; the teeth of animals were those of the horse, ox, hog, and sheep."

This ditch at Fairford resembles very closely the one at Stapenhill (see *ante*, p. 168), and I think we must dismiss from our minds the idea first entertained, that the ditch at Stapenhill was portion of an earthwork which surrounded the cemetery, but must rather regard it as a ditch in the ordinary acceptation of the term, and which served merely as a convenient receptacle for the bones of those animals whose flesh was cooked and eaten at the funeral feasts, as well as for various other waste and refuse arising from the burial customs of our Pagan English ancestors.

In a large number of burials by inhumation there are signs of partial cremation also; the body was not reduced to ashes, but only partially burnt, sometimes, perhaps, merely singed. Indeed, a close and careful examination goes to show that very few burials, north of the Thames, actually took place without fire. In no other way, I think, can the occurrence of charcoal in close proximity to the body, in greater or less quantity, be accounted for.

In these Anglo-Saxon graves various articles are found accompanying the bodies; thus in the graves of the men we often find axes, straight swords, spears, javelins, knives, centres or bosses of shields, all of iron; whilst in the graves of females and children beads of glass, terra-cotta, or coloured pastes, brooches of gold, or bronze gilded over, and ornamented with filagree work and various devices, bronze pins, tweezers, ivory combs, small iron knives, and an almost endless variety of other small trinkets.

This custom of depositing various articles in the grave with the deceased has been usually accounted for by the explanation that it was the result of a belief in an after state of existence somewhat of the same nature as that which had just terminated, and where such things would again be required. Be this as it may, there is no doubt that this custom has been of inestimable service to Archæological Science, for were it not for the presence of these articles in Anglo-Saxon graves, we should have known absolutely nothing of the "wondrous skill of our forefathers in goldsmith's work, of their knowledge of the manufacture of glass into beads and drinking vessels, of their high cultivation of art, and of their great practical acquaintance with the mystery of the smith."

Weapons of Warfare.

The most frequent accompaniment of the Saxon warrior are his spear and shield. The spear was generally laid by the right side of the body; it is specially characterised by the elongated cusp and split socket. Along with the handle, which was made of linden or ash, it measured about 6 feet. The butt end was sometimes shod with a spike so that it could, in emergency, be planted obliquely in the ground as a defence against charges of cavalry. Perhaps it may be worth noting here that the spears of the Anglo-Saxons were invariably deposited in their graves with the points towards the head, whilst those in the cemetery of the Franks at Selzen, in Germany, were as constantly in the reverse position. Javelins are sometimes found with the remains presumably of boys or young men; they have frequently been mistaken for arrow-heads by the earlier archæologists, but there is no evidence whatever to lead us to suppose that the Saxons used the bow and arrow either as weapons of warfare or of the chase.

The Saxon shield was formed of light wood, such as the ash or linden, and covered with a tough hide; the centre of the shield being furnished with an iron boss or umbo, which, whilst it formed a cavity for the reception of the hand, served also to protect the hand from injury. The shields of the Teutonic races were not borne on the arms, but held at arm's-length. In this way the bearer could break the force of a weapon hurled against him or parry the thrust of a spear. The only part of the shield found in Saxon graves, as one might naturally suppose, is this iron boss, having usually attached to it the rivets or nails which served to fasten it to the wood. The shield was generally laid flat over the middle of the deceased, but sometimes on the knees, as at Fairford, and sometimes on the chest, as at Stapenhill.

The long, straight sword, peculiar to and characteristic of the Anglo-Saxons, is but rarely found in their graves, and it appears very probable that in those graves where a sword has been discovered, the owner of it was a man above the ordinary rank.

Akerman says: "The sword was highly valued amongst the Teutonic races and was generally bequeathed to the next of kin, whilst the spear was regarded as the symbol of sex and the badge of authority. That this was so is shown in the History of the Institutions of the Franks, for when Gonthram made over his kingdom to Childebert, he delivered to him a spear, with the words, 'Hoc est indicium quod tibi omne regnum meum tradidi.' We find also that both spear and shield are mentioned frequently in the Capitularies, but the sword very rarely." The hilt of the sword was usually made of wood; so was the sheath, which was tipped with metal, and it was sometimes covered with, and oftentimes made entirely of, leather. Accompanying the spear and shield is often found a small iron knife or dagger, generally on the left side of the body.

These knives, or similar ones, are also found in the graves of females, and were worn suspended from the girdle with the chatelaine and other sundry articles.

There is one other weapon of warfare, the axe, which, though very rarely found in Saxon graves in England, occurs very frequently in the Merovingian ones. Only about six altogether have been discovered in this country, and of these two at least occurred in Cambridgeshire.

In some graves lumps or masses of molten iron have been found, and for the presence of which it is difficult to account: they are supposed by some archæologists to have been part of horse trappings or weapons of some kind, but I think this very unlikely, and it seems much more probable that some funeral rite necessitated the placing of lumps of scoria or iron ore, or, at any rate, iron of some kind which had been subjected to the action of fire, in the graves of certain persons. Such have been found in two graves at Stapenhill, also at Duffield Castle, and in two graves at Fairford.

Personal Ornaments.

Sometimes, though rarely in the graves of men, but very frequently in those of women and children, are found ornaments of various kinds, such as brooches or fibulæ, buckles, rings, amulets, ear-rings, buleæ or neck pendants, chatelaines, beads, small iron knives, pins or stilettos, tweezers, combs, and numerous other small articles, almost infinite in their variety. In all probability those personal ornaments of the common kind and ruder make were manufactured in Britain, but certainly the more costly articles were imported from the neighbouring Continent, probably from Paris, for several of them show in their style of ornamentation wide deviations from the characteristic Teutonic type, and appertain more to the Byzantine.

The Anglo-Saxon fibulæ are of two very distinct kinds—those of the circular form and those resembling examples of the Roman period, and known as the cruciform pattern. The circular fibulæ, which were often of gold, and highly ornamented with gems and filagree work, may be classed under two heads, and which, for want of a better term, might be denominated the convex and concave. Circular fibulæ of the convex type are very common in the burial-grounds and barrows of Kent, and seem to have been characteristic ornaments of the Jutes.

The circular fibulæ of the concave type, so far as has yet been ascertained, are peculiar to the counties of Gloucester, Oxford, and Buckingham, and mark the settlement in those parts of some of the Saxon tribes.

The cruciform fibulæ are extremely common in the cemeteries and barrows of Derby, Leicester, Nottingham, Northampton, Cambridge, and Yorkshire, as well as in Suffolk and Norfolk;

and, judging from the great numbers of them which have been found in these counties compared with the other forms, they would appear to have been peculiar to the various tribes of Angles or English who peopled these parts.

These fibulæ occur in varying dimensions, from 4 to 10 inches in length, and are of different devices, in gold, or bronze gilt over; they were used to fasten up the drapery of the outer gown or mantle, and are usually found on the chest, or sometimes on the shoulder; sometimes, though not often, occurring in pairs, as at Stapenhill and Stowting, or even in threes, as at Little Wilbraham. In such cases they denote the burial of women of wealth and position.

Buckles, either of bronze or iron, are found near the waist, and, as may be inferred from their position, served to secure the belt from which was suspended the chatelaine and trinkets, or, in the case of men, the sword or dagger. Finger-rings are not of common occurrence, neither are ear-rings. Bronze pins, both plain and ornamented, are frequently found; but perhaps the most numerous of any kinds of personal ornament met with in the graves of Anglo-Saxon women and children are beads, in an almost endless variety of form and from every part of the then known world. For instance, at Stapenhill were found many beads of blue and other coloured glass so characteristic of Roman manufacture; others of Grecian, or possibly Egyptian origin, lying side by side with those of purely Saxon workmanship. These latter are generally of terra-cotta, containing a large proportion of coloured earth in their composition, so that the resulting beads were quite opaque, possessing little or none of that vitreous appearance so peculiar to those of the Romans, and resembling earthenware rather than glass; beads of amethystine quartz, as well as garnets pierced with holes, have been found, also amber beads. The amber is uniformly of the red transparent kind, such as was most highly valued at Rome, never of the pale or honey-coloured variety. It is to be found at the present time in the cliffs or on the shore at Cromer and Holderness, and even as far north as Aberdeen, and its occurrence at these places was well known to the early inhabitants of this island, by whom it was much prized for purposes of ornamentation.

Before the introduction of the spinning-wheel, and when the distaff was in use, the spindle and its accompanying whorl were common domestic appliances. In the process of spinning, the thread was inserted in a nick on the top or side of the spindle so as to keep the part that had been spun firm in its position while the newly-drawn portion of the wool was being twisted ; the thread was then released from the slit, an additional portion wound on the spindle, and a new portion spun or whirled round as before. In order to give the necessary impetus or spin to the yarn in the revolutions that twisted it into thread, a more or less heavy perforated disc was used, and it is this that is termed the "spindle whorl." Through the central hole of the disc was fastened the sharpened end of the wooden or bone spindle, the part below the whorl tapering to a point, so as to be readily twirled between the finger and thumb. Many such spindle-whorls have been found in the graves of Saxon women. These spindle whorls vary much in size and weight, as well as in material, being usually from 1 inch to 1½ inches in diameter, though occasionally as much as even 3 inches, and are composed of bone, glass, crystal, lead, stone, or ware.

One article found at Stapenhill seems to be rather unique in its way. At the bottom of the cinerary urn, *Find No.* 11, was an article made from a deer's horn (Plate V., Fig. 6), and which, for want of a better term, has been described as a spindle-whorl, or amulet. I think it more than probable that it served rather as an amulet or charm worn round the neck than as a whorl ; and the peculiar style of ornament on it seems to confirm this, for a decorated spindle-whorl has rarely, if ever, been found. The following extract from Kemble's *Horæ Ferales* goes very far, I think, to prove my surmise :—

" The recurrence of this particular ornament upon articles of bone or horn at all periods, and in almost all places, is very remarkable. You will find it alike upon Egyptian, Etruscan, and

Greek relics; upon axe heads of horn, taken from the graves which we attribute to the earliest periods of northern European culture; upon discs or combs of bone and ivory on the Continent, as well as in England, at periods which, though not the earliest, still infinitely transcend our own; upon the implements even of the most savage nations of the oceanic race; and as there is nothing in the material itself to define *à priori*, and render, as it were, necessary the kind of figure and the style with which it is to be ornamented; but, on the contrary, any description of lines, whether straight or curved, might with equal facility be scratched upon it. This identity in the taste of times and places so widely apart from one another becomes a problem exceedingly difficult to solve, and suggests questions to which an answer cannot be very readily given; and it is further worth noting that the concentric circles have never, or very rarely, been executed with the free hand; for this, they are much too regular, and one sees at once that they have either been stamped with a punch or produced by some instrument upon the principle of compasses."

Only one other similarly decorated bone disc has been discovered in England, and I am not aware of the occurrence of any other in France or Germany.

Pottery.

Perhaps a more frequent accompaniment of the deceased, whether burnt or unburnt, than either weapon or ornament, is a vessel of earthenware. This, in the case of unburnt bodies, is usually found at the feet, or near the chest or head, and always in the upright position. These vessels, in connection with burnt bodies, are found associated with them in two different ways: they either contain the bones or ashes of the cremated person, or else the bones are gathered up into a heap and the vessel is placed near, or over, or amongst them.

South of the Thames, most of the pottery found in Anglo-Saxon graves is of Roman or Romano-British manufacture, whilst that of purely Saxon origin, found in this country, occurs almost exclusively north of the Thames. This was long classed as British or

Roman; and it is only of late years that the characteristics which determine its Saxon origin have been pointed out.

If anyone carefully compares the pottery of the Anglo-Saxons with that of British, Romano-British, and Roman manufacture, he will see that the distinction between them is as well-defined as it is possible to be in the case of vessels made of clay. In material, shape, colour, and ornamentation, the different wares scarcely possess anything in common. All the Anglo-Saxon pottery seems to have been wrought by the hand without the aid of the lathe or wheel, out of a dark-coloured clay, with which very frequently small fragments of felspar were mixed. The firing of this pottery has been very imperfect; it was probably first dried by exposure to the air and sun, and then burnt, or rather baked, in the ashes of a fire lighted over and around it—probably the funeral fire lighted at the grave of the deceased.

The majority of the vessels found at Stapenhill are of a dark-brown colour passing into black, though a few are so highly burnt as to acquire a reddish-brown tinge, and feel extremely hard to the touch.

These vessels are usually known as Burial Urns, and may be divided into three classes: (1) Cinerary Urns; (2) Food Vessels; (3) Drinking Cups.

(1) Cinerary Urns. These contain, or accompany the bones or ashes of the person cremated; they are of large size, with wide mouths, and approach more nearly in shape to the urn of classical writers than either of the two other kinds. They are generally very highly ornamented, but have not, as a rule, been exposed to a very high heat during firing. In addition to human bones or ashes, they often contain the weapons or ornaments of the deceased.

The second class of burial urns is known as Food Vessels, and vary in size from two to eight or ten inches high, are always wide-mouthed, usually plain, though a few have been found possessing projecting knobs or ears.

The third class are termed Drinking Cups, and occur but rarely; but where found this kind of vessel seems to have had great pains bestowed upon its manufacture, not only by the Saxons, but also by the preceding early British or Celts, and is generally very highly and artistically ornamented.

These last two kinds of urns nearly always accompany burials by inhumation; the food vessel being rarely found, and the drinking cup never, I believe, with burnt bodies. They contained offerings of food and drink, probably the mead for which our ancestors were so celebrated.

The various kinds of ornamentation occurring on these burial urns may be described as straight lines, zig-zag, and curved ones; dots, circles, and impressed patterns. (See Plate VI., Figs. 8, 9, and 10.) The long straight line ornamentation was produced by the impression of a twisted cord or thong; a more regular effect of this kind, as in the case of short lines, was probably obtained by means of a stick obliquely serrated at the edge; it might also have been produced with a pin or bone skewer. Impressed markings, such as circles, angles, series of dots, were evidently produced in many cases by cross sections of stems of certain plants pressed into the clay whilst in a wet or plastic condition.

The circle is very characteristic of Anglo-Saxon pottery, chiefly occurring in the form of concentric circles, or as a dot surrounded by a circle, or by two or more concentric circles. Their extreme regularity seems to preclude the possibility of their ever having been executed with the free hand; but they must have been stamped with a tube or punch of some kind.

Another form of ornamentation especially characteristic, in fact, I may say peculiar to Saxon pottery, both in England and Germany, is the projecting boss or knob. Most of these bosses have been formed by merely pressing out the sides of the urn with the finger from within whilst the clay was soft; in some cases, however, they were formed of solid lumps of clay stuck on the surface of the vessel. When we come to compare the ornamentation on the different kinds of urns, I think it will be found, more or less, the rule that these bosses or knobs are generally found only on the food vessels, while the zig-zag lines and circles seem to be characteristic of cinerary urns. This is seen very markedly on comparing the urns of *Finds* 1, 10, and 11, with those of 4 and 26.

In studying the contents of Pagan English graves, as described by various observers, we are most forcibly struck with one very prominent feature more or less common to most of these burial-places, viz., the pre-eminently distinctive character given to one particular grave or barrow above all the others in the same burial-place. At Stapenhill, the person buried in grave No. 4 must have been much superior to all the others who have been interred here, for in no other grave have so many, or such various articles been found. The burial urn or drinking cup, for instance, was fashioned in a most artistic manner, and had, evidently, had great care bestowed upon its manufacture; much finer clay was used, and the decoration of it was of the highest type—projecting bosses combined with indented vertical and horizontal lines.

Not only is this particular urn superior to all the others found there, but it belongs to a class of pottery which although comparatively rare in this country, being found only at Girton College, Little Wilbraham, and one or two other localities, is common enough in some parts of North Germany, particularly at Stade-on-the-Elbe; hence it seems reasonable enough to conclude either that these tribes, whose remains have been found at Stapenhill and other places in England just mentioned, have come, originally, from one of these districts in North Germany, or that those particular urns were brought from Germany for burial in the respective graves.

In addition to the urn, this grave was also marked by the presence of several amber beads and one garnet, also by two fibulæ of the cruciform pattern, instead of one, as is usually the case. Again, just as at Stapenhill, we find that at Stowting and Fairford in Kent, and at Little Wilbraham in Cambridgeshire, one or two graves, and those the graves of females, were particularly distinguished by the richness and number of the articles found in these graves, as compared with those found in any of the other graves in these cemeteries; indeed, the contents of grave No. 2 at Stowting, and of grave No. 9

at Fairford, bear so close a resemblance to *Find No.* 4 at Stapenhill, that the same description might apply equally to all of them.

We occasionally find the body of the deceased in Pagan English burials unaccompanied by personal relics of any kind whatever; this may be accounted for in three ways. We may suppose either that there were special reasons for the deceased being buried without the usual observances, or that the person was too poor to possess such things, or that the Teutonic race generally did not believe in a future state.

Into the various arguments that can be adduced for and against this latter surmise I cannot now enter, but must refer those interested in the subject to Lubbock's "Prehistoric Times," and Green's "Making of England"; suffice it to say that there are very few cases of interments which have come under my notice in which I have found anything like approaching to a complete set of articles which might be of use to the dead in the other world, and, for my part, I choose rather to believe that the various articles we find in Pagan Saxon graves were deposited there according to the fancy of the surviving friends of the deceased, and as tokens of individual affection. A similar custom prevails amongst ourselves even now-a-days, when we place wreaths of flowers on the coffin or grave of our departed friends.

But although in some cases no personal relics occur, nevertheless, a careful examination, not only of such a grave, but of every grave, even though containing numerous personal relics, reveals the presence amongst the earth in immediate contact with the body, of two or three or more bits of flint, and usually accompanying these are found a few shards of pottery of an earlier period, old and water-worn.

The graves at Fairford contained shards of pottery, chiefly Roman, of 7 or 8 varieties, including even Samian ware, and fragments of mortaria, all clearly pieces of different vessels, and not parts of such as had been used for the funeral libations, and then broken on the spot. Again, at Stapenhill, in nearly every grave were found bits of flint, and shards of pottery, some of Roman, others of Saxon manufacture, all old and weathered; no doubt superstition required they should be of that description and not fractured for the express purpose. They evidently appertain to some curious ancient Pagan custom. Canon Greenwell refers in his book on British Barrows, to the finding of flints and shards under somewhat similar conditions in the graves of the early British; and, that this practice prevailed at the graves of suicides for a considerable period after the introduction of Christianity, may be inferred from that passage in Shakespeare's "Hamlet," when, at the grave of Ophelia, in answer to Laertes' question, "What ceremony else?" the priest answers

> "Her obsequies have been as far enlarged
> As we have warranty; her death was doubtful
> And, but that great command o'ersways the order
> She should in ground unsanctified have lodged
> Till the last trumpet: for charitable prayers,
> Shards, flints, and pebbles should be thrown on her."

The Samian ware found in Britain was manufactured abroad, chiefly in France; this ware is of a beautiful deep-red colour, and of an extremely delicate texture, having somewhat the appearance of red sealing-wax. The vessels composed of it are of all sizes and shapes, but very fragile, so that it is extremely rare to find one intact; these vessels are generally ornamented in relief with figures of animals and men as well as foliage, fruit, and conventional subjects. Large numbers of the vessels have also the potter's name stamped upon them in a label, usually at the bottom, and are generally of Gallic or German origin. A very crude imitation of this ware is often found, no doubt manufactured in Britain, for that the Romans during their sojourn in this island manufactured various kinds of pottery there is ample proof, several sites of, and in some cases complete pottery kilns having been discovered just as they were left by their owners, at Castor, Northamptonshire; Brosely, Salop; Upchurch, Kent; and Shepton Mallet, Somerset.

The pottery made at Upchurch and Castor, which were, perhaps, the largest and most celebrated Roman potteries in Britain, was fine and hard in texture, and elegant in shape and pattern. Its prevailing colour was blue-black, and was produced by suffocating the fire of the kiln when its contents had acquired sufficient heat to give the proper colour. The clay from which these vessels were made was mixed with chaff or other organic matter. This blue ware loses its blue colour and becomes red if it is exposed to a higher temperature in an open fire.

Bones of animals, especially those of the head as well as the teeth, are found in great abundance in our Pagan Saxon burial grounds. Their presence may be accounted for by the existence of a practice which largely prevailed throughout ancient Pagandom, and which still exists in many countries, that is to say, the custom of offering sacrifices at the graves of the dead.

The bones generally found are those which contained marrow, and are always broken or split open. The flesh of the bodies only, was eaten; the heads were placed upon poles or stakes as offerings to the gods. I might here draw attention to the fact that the sacrificial meat of the Teutonic races was not roast, but boiled.

Perhaps before concluding this paper it would not be out of place to say a few words on the cranial characteristics of our English ancestors. A careful examination of the skulls of various races reveals to us many differences as regards contour, shape, and structure, and hence it is possible to classify them according to their several characteristics. Perhaps the most convenient classification of skulls is that adopted by Dr. Thurnam and Professor Huxley, and based on what is known as the "*cephalic index*." This term, introduced by Broca, indicates the ratio of the greatest transverse to the greatest longitudinal diameter of the skull, the latter measurement being taken as 100. All skulls, then, may be classified according to their cephalic index. If this index be high as ·80 or more, such skulls are termed Brachycephalic, or round-headed; and if on the other hand this index be as low as ·73 or less, such skulls are termed Dolichocephalic.

The averages of a number of measurements of British, Romano-British, and English skulls, made by Davis and Thurnam, give the following results:—

Mean of	30 English (Saxon) men	... ·75
,,	30 Romano-British men	... ·78
,,	30 British (Celtic) men	... ·80

Previous to the occupation of Britain by the Celts, who were a round-headed, fair-haired people, Britain was peopled by a low-statured, dark-haired, long-headed race, known to us as the Iberians, the cephalic index of whose skulls reaches as low a number in some instances as ·70; the great length of head in this case being due to a very large development of the occiput. On the other hand the Saxons were also a long-headed race, but their length of head was due to a frontal rather than an occipital development. The typical English or Anglo-Saxon skull is defined by Dr. Thurnam as prognathous (lower jaw projecting), with large facial bones, and a cephalic index averaging ·75; and these characteristics are equally to be found in the Gothic, Frankish, and Scandinavian skulls. Perhaps it would be as well to emphasize here the fact that no round skulls (as indicating Early British or Celtic origin) have been found in any true English or Saxon barrow in any part of England; all the skulls that have been met with belong to what we may call the Dolichocephalic Teutonic type. It seems strange at first sight that this should be so, as one would think that intermarriages would have taken place between the conquerors and the conquered; but this does not appear to have been the case; and I think it serves to show most conclusively how completely the English exterminated the British wherever they went, ruthlessly and mercilessly driving before them, and, where resistance was offered, slaughtering men, women, and children.

It cannot fail to be observed that the contents of the burial grounds which have as yet been recorded bear no proportion to the population which may be assumed to have once occupied these respective localities; whilst the number of cemeteries at present known are, with the exception of those in the eastern parts of Kent, extremely few. There can be no doubt that many such in the operations of agriculture and manufactures have been discovered, and most ruthlessly and wantonly destroyed all over the country. Nor is this greatly to be wondered at when we consider how very little real interest is excited when such a discovery is made; in a vast number of cases rare and yet numerous remains of British, Roman, and Saxon occupation having been carelessly and ignorantly tossed into the rubbish cart, or otherwise destroyed.

Yet to archæologists who possess such scanty remnants of the early history of our race, this kind of evidence is most important, as by such means the veil enshrouding the obscure events of the past is in part torn away, revealing, it is true, but a slight glimpse perhaps of the tribes who once held sway in a certain locality, but nevertheless invaluable by the opportunity it affords of comparison with other similar discoveries elsewhere, for it is by thus comparing similar remains found not only in this but in other countries that we can arrive at anything like a correct conclusion as to their character, and trace the connection between the people who used them and their habits, manners, and customs.

On the other hand, many Pagan cemeteries have probably been absorbed or destroyed by succeeding generations. This must evidently have been the case at such places as Canterbury and Repton, and many others throughout the country, where numerous Anglo-Saxon populations must have been located in these early times, and where their kings held court in rude magnificence, but where at the present day only a few isolated relics have been found insufficient in themselves to mark such places as scenes of former greatness, victory, and conquest.

That churches were built in the immediate vicinity, if not on the actual site, of Pagan temples and burial places, we have very decisive proofs at Mentmore in Buckinghamshire, at Lewes in

Sussex, and at Stapenhill and Repton in Derbyshire, and elsewhere. There are various reasons why new or Christian churchyards should be placed on the sites of old Pagan ones. One of the first principles impressed upon the Roman missionaries to Britain in the sixth century was, to take advantage wherever they could of the "*religio loci.*" Pope Gregory distinctly ordered Augustine not to destroy the heathen temples, but to consecrate and devote them to the service of the true God, hence if they consecrated the heathen temples there is no reason why they should not also consecrate their cemeteries.

In conclusion the exploration of Anglo-Saxon burial-places proves to us most conclusively that the conquest of Britain by the Saxons and the English was a very slow but sure one ; that it was an exterminative one in the sense that the Britons were driven off the soil, not slaughtered on it, except where they offered determined resistance ; that the invaders did not all come over in a body, but in small clans or tribes, at frequent intervals, and that they were all Pagans ; that various funeral observances were peculiar to and characteristic of different tribes. That they were far removed from savagery, and almost from barbarism, we have ample proof, for we can trace true art and beauty in their ornaments of gold and bronze ; we see the high degree of skill to which the worker in glass had attained, and we recognise the economy of force and power in their weapons of iron, skilfully forged by their cunning blacksmiths. It is only in their sepulchral pottery that we find traces of rudeness, and which is the only vestige of the savagery from which our ancestors had sprung.

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BURTON-ON-TRENT

NATURAL HISTORY & ARCHÆOLOGICAL SOCIETY.

The Lepidoptera of Burton-on-Trent and Neighbourhood.

PART II.—MICRO-LEPIDOPTERA.

Compiled by J. T. HARRIS, F.E.S., and PHILIP B. MASON, M.R.C.S., F.L.S., F.Z.S., F.E.S., &c.

THE following, which forms the second part of the list of Lepidoptera for Burton-on-Trent and district, has been compiled by two of the members of the Entomological Section of the Society. The district covered is the same as that adopted for the list of the Macro-lepidoptera, to which reference should be made.*

The following are the authorities quoted in the present list, with the abbreviations adopted:—C. G. Barrett (C. G. B.), Edwin Brown (E. B.), George Baker (G. B.), W. Garneys (W. G.), J. T. Harris (J. T. H.), Philip B. Mason (P. B. M.), Rev. F. Spilsbury (F. S.), John Sang (J. S.)

CRAMBI.

CHILIDÆ, *Gn.*

SCHŒNOBIUS, *Dup.*—*Forficellus*, *Thnb.*, Willington (E. B.), Burton (J. T. H.) *Mucronellus*, *Schiff.*, Shobnall Canal (E. B.),

* Transactions of the Society, vol. I., pp. 114-138.

(J. T. H.) *Gigantellus*, *Schiff.*, Burton (J. T. H.), Peel's Cut (P. B. M.)

CRAMBIDÆ, *Gn.*

CRAMBUS, *Fb.*—*Falsellus*, *Schiff.*, Burton (E. B.), (J. T. H.) *Pratellus*, *L.*, Burton (E. B.), common (J. S.), Cannock Chase (C. G. B.) *Pascuellus*, *L.*, Burton (E. B.) *Pinellus*, *L.*, Cannock Chase (C. G. B.) *Perlellus*, *Scop.*, Burton (E. B.), (J. T. H.), Lawns (P. B. M.) *Tristellus*, *Fb.*, Burton, common (E. B.), (J. T. H.), (J. S.), (P. B. M.) *Inquinatellus*, *Schiff.*, Sinai Park (J. T. H.) *Culmellus*, *L.*, Burton, common (E. B), (J. S.), (P. B. M.) *Hortuellus*, *Hb.*, Burton, common (E. B.), (J. S.)

PHYCIDÆ, *Gn.*

EPHESTIA, *Gn.*—*Elutella*, *Hb.*, Burton (E. B.), Derby (W. G.)

EUZOPHERA, *Zell.*—*Pinguis*, *Haw.*, near Derby (G. B.) *Cinerosella*, *Zell.*, Etwall Hall (W. G.)

PLODIA, *Gn.*—*Interpunctella*, *Hb.*, in grocers' warehouses, Derby (F. S.)

CRYPTOBLABES, *Zell.*—*Bistriga*, *Haw.*, Repton Shrubs (G. B.)

PHYCIS, *Fb.*—*Fusca*, *Haw.*, Cannock Chase, common (C. G. B.), Little Eaton (G. B.)

RODOPHÆA, *Gn.*—*Consociella*, *Hb.*, one at Newhall (F. S.)

APHOMIA, *Hb.*—*Sociella*, *L.*, Repton (E. B.)

ACHRŒA, *Hb.*—*Grisella*, *Fb.*, Burton (J. T. H.), Ticknall (F. S.)

TORTRICES.

TORTRICIDÆ, *Gn.*

TORTRIX, *L.*—*Podana*, *Scop.*, Burton, common (E. B.), (J. T. H.), (P. B. M.), (J. S.) *Xylosteana*, *L.*, Burton (E. B.), (J. S.) *Sorbiana*, *Hb.*, The Oaks, &c. (E. B.), Burton (J. S.) *Rosana*, *L.*, Burton, common (E. B.), (J. S.) *Cinnamomeana*, *Tr.*, Whitwick (J. S.), Hopwas Wood (J. S.) *Ribeana*, *Hb.*, Burton, common (E. B.), (J. S.), (P. B. M.) *Corylana*, *Dup.*, Henhurst (E. B.), Burton (J. S.) *Unifasciana*, *Dup.*, Burton (E. B.), (J. T. H.), (J. S.) *Costana*, *Fb.*, Henhurst (E. B.), Buxton

(J. T. H.), (J. S.) *Viburnana, Fb.*, Burton, rare (E. B.), Cannock Chase (C. G. B.) *Palleana, Hb.*, Burton, rare (E. B.), (J. S.) *Viridana, L.*, Burton, common (E. B.), (J. S.) *Ministrana, L.*, Bretby (E. B.), Drakelow (J. T. H.), Cannock Chase (C. G. B.) *v. ferrugana, Hb.*, Burton (P. B. M.) *Forsterana, Fb.*, Burton, common (E. B.), (J. T. H.), (J. S.)

LEPTOGRAMMA, *Curt.*—*Literana, L.*, Burton, rare (E. B.)

PERONEA, *Curt.*—*Sponsana, Fb.*, Drakelowe (E. B.) *Rufana, Schiff.*, Burton (E. B.), (J. S.) *Schalleriana, L.*, Burton, common (E. B.), (J. S.) *Comparana, Hb.*, Repton (F. S.) *Variegana, Schiff.*, Burton (E. B.), (J. T. H.), (J. S.) *Ferrugana, Tr.*, Burton (E. B.), (J. S.), (J. T. H.)

RHACODIA, *Hb.*—*Caudana, Fb.*, Henhurst, common (E. B.), Burton (J. T. H), (J. S.)

TERAS, *Tr.*—*Contaminana, Hb.*, Burton, common (E. B.), (J. T. H.)

DICTYOPTERYX, *St.*—*Lœflingiana, Dup.*, Henhurst (E. B.), Burton (J. T. H.), (J. S.) *Holmiana, L.*, Henhurst (E. B.), Burton (J. T. H.), (J. S.) *Bergmanniana, L.*, Burton, common (E. B.), (J. T. H.), (J. S.) *Forskaleana, L.*, Burton, common (E. B.), (J. T. H.), (J. S.)

ARGYROTOZA, *St.*—*Conwayana, Fb.*, Burton, common (E. B.), (J. T. H.), (J. S.)

PTYCHOLOMA, *St.*—*Lecheana, L.*, Seal Wood (E. B.), Cannock Chase (C. G. B.), Repton Shrubs (F. S.), (J. S.)

PENTHINIDÆ, *Gn.*

PENTHINA, *Tr.*—*Corticana, Hb.*, Seal Wood (J. S.) *Betulætana, Haw.*, Burton (E. B.) (J S), *Pruniana, Hb*, Burton (E. B.), (J. T. H.), (J. S.) *Variegana, Hb.*, Burton (E. B.), (J. S.) *Marginana, Haw.*, Burton, rare (E. B.) *Fuligana, Haw.*, Burton (E. B.), rare.

SPILONOTIDÆ, *Gn.*

HEDYA.—*Ocellana, Fb.*, Burton (E. B.), (J. S.) *Lariciana, Zell*, Whitwick (J. S.) *Dealbana, Fröl.*, Seal Wood (J. S.), (J. T. H.) *Neglectana, Dup.*, Burton (E. B.)

SPILONOTA.—*Trimaculana*, *Haw.*, Burton (E. B.) *Rosæcolana*, *Dbl.*, Burton (E. B.), (J. T. H.) *Roborana*, *Tr.*, Burton (E. B.), (J. T. H.), (J. S.)

SERICORIDÆ, *Gn.*

ASPIS, *Tr.*—*Udmanniana*, *L.*, Henhurst (E. B.), (J. T. H.), Burton (J. S.)

SIDERIA, *Gn.*—*Rivulana*, *Scop.*, Burton (E. B.), *Lacunana*, *Dup.*, Burton (E. B.), (J. T. H.), (J. S.), very common, Cannock Chase (C. G. B.)

ROXANA, *St.*—*Arcuana*, *Clerck.*, *L.*, Seal Wood (E. B.)

ORTHOTÆNIA, *St.*—*Striana*, *Schiff.*, Burton, rare (E. B.), (J. S.)

PHTHEOCROA, *St.*—*Rugosana*, *Hb.*, Burton (E. B.), (J. T. H.)

CNEPHASIA, *Curt.*—*Musculana*, *Hb.*, Burton (E. B.), (J. T. H.), (J. S.), Cannock Chase (C. G. B.)

SCIAPHILA, *Tr.*—*Nubilana*, *Hb.*, Burton (E B.) *Subjectana*, *Gn.*, Burton (E. B.), (J. T. H.), (J. S.) *Virgaureana*, *Tr.*, Burton (E. B.), (J. T. H.), (J. S.) *Chrysantheana*, *Dup.*, Repton (F. S.) *Sinuana*, *St.*, Seal Wood (J. S.), Repton Shrubs (P. B. M.) *Hybridana*, *Hb.*, Burton (E. B.), (J. T. H.), (J. S.)

SPHALEROPTERA, *Gn.*—*Ictericana*, *Haw.*, Repton (F. S.)

CAPUA, *St.*—*Favillaceana*, *Hb.*, Cannock Chase (C. G. B.)

CLEPSIS, *Gn.*—*Rusticana*, *Tr.*, Cannock Chase (C. G. B.)

GRAPHOLITHIDÆ, *Gn.*

BACTRA, *St.*—*Lanceolana*, *Hb.*, Drakelow (E. B.), (J. T. H.), (J. S.), Cannock Chase (C. G. B.)

PHOXOPTERYX, *Tr.*—*Biarcuana*, *St.*, Potlock Covert (F. S.) *Myrtillana*, *Tr.*, Cannock Chase, abundant (C. G. B.) *Lundana*, *Fb.*, Burton (E. B.), (J. T. H.), (J. S.) *Diminutana*, *Haw.*, Burton (E. B.) *Mitterpacheriana*, *Schiff.*, Burton (E B.), (J. S.), Repton (F. S.)

GRAPHOLITHA, *Tr.*—*Ramella*, *L.*, Burton (E. B.) *Nisella*, *Clerck.*, Burton (E. B.), (J. T. H.) *Subocellana*, *Don.*, Burton (E. B.), (J. S.) *Trimaculana*, *Don.*, *Wilk.*, Burton (E. B.),

(J. T. H.), (J. S.), common. *Penkleriana, Fisch.*, Burton (E. B.) *Obtusana, Haw.*, Repton (F. S.) *Nævana, Hb.*, Repton (F. S.)

PHLŒODES, *Gn.—Tetraquetrana, Haw.*, Burton (E. B.), (J. S.), Cannock Chase (C. G. B.) *Immundana, Fisch.*, Repton (F. S.)

HYPERMECIA, *Gn.—Angustana, Hb.*, Henhurst (E. B.)

BATODES, *Gn.—Angustiorana, Haw.*, Burton (E. B.), (J. S.), Repton, on yew (F. S.)

PÆDISCA, *Tr., Gn.—Bilunana, Haw.*, Cannock Chase (C. G. B.) *Ratzeburghiana, Rtz.*, Burton (E. B.), (J. T. H.), (J. S.), The Oaks, on spruce firs. *Corticana, Hb.*, Henhurst, Repton Shrubs (E. B.), (J. S.) *Opthalmicana, Hb.*, Repton Shrubs (J. T. H.) *Occultana, Dougl.*, Grace Dieu (J. S.) *Solandriana, L.*, Henhurst (E. B.), (J. S.) *Sordidana, Hb.*, Repton (F. S.)

EPHIPPIPHORA, *Gn.—Similana, Hb.*, Repton (F. S.), *Pflugiana, Haw.*, Burton (E. B.), (J. S.), Cannock Chase (C. G. B.) *Brunnichiana, Fröl.*, Burton (E. B.), (J. S.) *Fœnella, L.*, Cannock Chase (C. G. B.) *Nigricostana, Haw.*, Burton (E. B.), (J. S.), Findern Covert (F. S.) *Tetragonana, St.*, Burton (E. B.)

OLINDIA, *Gn.—Ulmana, Hb.*, Repton Shrubs (E. B.) *Ianthinana, Dup.*, Burton (E. B.), (J. S) *Rufillana, Wilk., Zell.*, Burton (E. B.) *Wæberiana, Schiff.*, Burton (E. B.), (J. T. H.), (P. B. M.) *Argyrana, Hb*, Cannock Chase (C. G. B.), Needwood (P. B. M.), Findern (F. S.) *Tædella, Clerck., L.*, Burton (E. B.), (J. S.), Milford (C. G. B.) *Nanana, Tr.*, Burton (E. B.), (J. S.)

RETINIA, *Gn.—Buoliana, Schiff.*, Burton (P. B. M.), Bretby Park (J. S.) *Pinivorana, Zell.*, between Willington and Etwall (F. S.)

CARPOCAPSA, *Tr.—Pomonella, L.*, Burton (E. B.)

ENDOPISA, *Gn.—Nigricana, St.*, Burton (E. B.)

STIGMONOTA, *Gn.—Coniferana. Ratzb.*, The Oaks, Burton (E. B.) *Perlepidana, Haw*, Burton (E. B.), Repton (F. S.) *Nitidana, Fb.*, Burton (E. B.) *Roseticolana, Zell.*, Burton (E. B.)

DICRORAMPHA, *Gn.*—*Sequana*, *Hb.*, Burton (J. S.) *Petiverella*, *L.*, Burton (E. B.), (J. S.) *Plumbana*, *Scop.*, Burton (J. S.) *Saturnana*, *Gn.*, Burton (E. B.) ? *Plumbagana*, *Tr.*, Burton (E. B.)

PYRODES, *Gn.*—*Rheediella*, *Clerck.*, *L.*, Repton (F. S.)

CATOPTRIA, *Gn.*—*Ulicetana*, *Haw.*, Burton (E. B.), (J. S.), *Hypericana*, *Hb.*, Burton (E. B.), (J. S.) *Cana*, *Haw.*, The Oaks (J. S.), Repton (F. S.) *Scopoliana*, *Haw.*, The Oaks (E. B.) *Expallidana*, *Haw.*, The Oaks, Burton (E. B.)

TRYCHERIS, *Gn.*—*Aurana*, *Fb.*, Burton (E. B.), Repton (F. S.)

PYRALOIDIDÆ, *Gn.*

CHOREUTES, *Hb.*—*Myllerana*, *Fb.*, Bretby Park (E. B.)

SYMÆTHIS, *Leach.* — *Oxyacanthella*, *L.*, Burton (E. B.), (P. B. M.), (J. S.), very common.

CONCHYLIDÆ, *Gn.*

EUPŒCILIA, *St.*—*Nana*, *Haw.*, The Oaks, Burton (E. B.), Cannock Chase (C. G. B.) *Maculosana*, *Haw.*, Repton Shrubs (F. S.) *Hybridella*, *Hb.*, The Oaks, Burton (E. B.) *Angustana*, *Hb.*, The Oaks, Burton (E. B.) *Roseana*, *Haw.*, Burton (E. B.), Shobnall Marl Pit, on Teasel (J. T. H.), Repton Shrubs and Findern (F. S.)

XANTHOSETIA. *St.*—*Zoegana*, *L.*, Burton (E. B.), (J. S.), Bretby Park (E. B.), Sinai Park (J. T. H.) *Hamana*, *L.*, Burton, (E. B.), (J. S.), (P. B. M.)

ARGYROLEPIA, *St.*—*Zephyrana*, *Tr.*, Henhurst (E. B.) ? *Badiana*, *Hb.*, The Oaks, Burton (E. B.) *Cnicana*, *Dbl.*, The Oaks, Burton (E. B.), Cannock Chase (C. G. B.)

CONCHYLIS, *Tr.*—*Straminea*, *Haw.*, Repton (F. S.) ?

APHELIIDÆ, *Gn.*

APHELIA, *Curt.*—*Osseana*, *Scop.*, Burton (P. B. M.), Repton (F. S.)

TORTICODES, *Gn.*—*Hyemana*, *Hb.*, Henhurst, Repton Shrubs (E. B.), (J. T. H.), (J. S.), Findern (F. S.)

TINEÆ.

Epigraphiidæ, *Gn.*

Lemnatophila, *Tr.*—*Phryganella*, *Hb.*, Repton Shrubs (E. B.), (J. T. H.), Potlock Covert (F. S.)

Exapate, *Hb.*—*Congelatella*, *Clerck.*, Hopwas Wood (E. B.), Repton (F. S.)

Diurnea, *Haw.*—*Fagella*, *Haw.*, Burton (E. B.), Repton Shrubs (J. T. H.)

Epigraphia, *Curt.*—*Steinkellneriana*, *Sta.*, Henhurst (E. B.), Repton (F. S.)

Psychidæ, *Brd.*

Talæporia, *Hb.*—*Pseudo-Bombycella*, *Hb.*, Cannock Chase (C. G. B.)

Fumea, *Hb.*—*Intermediella*, *Brd.*, Cannock Chase (C. G. B.)

Psychoides, *Brd.*—*Verhuellelia*, *Heyd.*, Wirksworth (G. B.)

Tineidæ, *Sta.*

Diplodoma, *Zell.*—*Marginepunctella*, *St.*, Cannock Chase (C. G. B.), Wirksworth (G. B.)

Ochsenheimeria, *Hb.*—*Birdella*, *Curt.*, Repton (F. S.) *Vaculella*, *Fisch.*, Repton (F. S.)

Scardia, *Tr.*, *Gn.*—*Corticella*, *Curt.*, Drakelow Park (J. S.) *Granella*, *L.*, Burton (J. T. H.) *Cloacella*, *Haw.*, Burton (E. B.), (J. S.), Cannock Chase (C. G. B.) *Arcella*, *Fb.*, Henhurst (E. B.)

Blabophanes, *Zell.*—*Rusticella*, *Hb.*, Burton (E. B.), (J. S.), (P. B. M.), Cannock Chase (C. G. B.)

Tinea, *Zell.*—*Fulvimitrella*, *Sodof.*, Burton (E.B.), (J. S.), Bretby (P. B. M.), Cannock Chase (C. G. B.) *Tapetzella*, *L.*, *Sta.*, Burton (E. B.), (J. S.), (J. T. H.) *Misella*, *Zell.*, *Sta.*, Tatenhill (E. B.), Henhurst, common (J. S.) *Pellionella*, *L.*, *Sta.*, Burton (J. S.), Repton (F. S.) *Fuscipunctella*, *Haw.*, Tatenhill and Burton (E. B.), (J. S.) *Pallescentella*, *Sta.*, Burton (J. S.) *Lapella*, *Hb.*, *Sta.*, Burton (E. B.) *Merdella*, *Zell.*, *H. S.*, Burton

(P. B. M.) *Semifulvella*, *Haw.*, Henhurst (E. B.), Burton (J. S.), Repton Shrubs (J. T. H.)

PHYLLOPORIA, *Hein.*—*Bistrigella*, *Haw.*, *Sta.*, Grange Wood (J. S.)

LAMPRONIA, *Zell.*—*Luzella*, *Hb.*, *St.*, *Sta.*, Burton (E. B.) *Prælatella*, *Schiff.*, *Sta.*, Sinai Park (E. B.)

INCURVARIA, *Haw.*—*Muscalella*, *Fb.*, *Sta.*, Henhurst (E. B.), Cannock Chase (C. G. B.) *Oehlmanniella*, *Hb.*, *Tr.*, Repton (F. S.)

MICROPTERYX, *Hb.*—*Calthella*, *L.*, *Sta.*, Burton (E. B.), (J. T. H.), (J. S.), Repton (F. S.), common. *Seppella*, *Fb.*, *Sta.*, Henhurst (E. B.) *Aureatella*, *Scop.*, Burton (E. B.), Seal Wood (J. T. H.), Cannock Chase (C. G. B.) *Thunbergella*, *Fb.*, *Sta.*, Henhurst (E. B.) *Fastuosella*, *Zell.*, *Frey.*, Burton (P. B. M.), Repton Shrubs (J. S.) *Subpurpurella*, *Haw.*, Henhurst (E. B.), Repton Shrubs (J. T. H), Burton (J. S.)

NEMOPHORA, *Hb.*—*Swammerdammella*, *L.*, Burton (E. B.), Cannock Chase (C. G. B.) *Schwarziella*, *Zell.*, Burton (E B.), Cannock Chase (C. G. B.) *Metaxella*, *Hb.*, Burton (E. B.)

ADELIDÆ.

ADELA, *Latr.*—*Fibulella*, *Fb.*, Grange Wood (E. B.), (J. T. H.), Repton (F. S.) *Rufimitrella*, *Scop.*, Needwood, common (J. S.), Repton (F. S.) *Crœsella*, *Scop.*, Cannock Chase (C. G. B.) *Degeerella*, *L.*, *Sta.*, Repton Shrubs (E. B.), (J. T. H.), (W. G.), Seal Wood (J. T. H.), Cannock Chase (C. G. B.) *Viridella*, *L.*, *Scop.*, *Sta.*, Repton Shrubs (E. B.), (W. G.), Cannock Chase (C. G. B.)

HYPONOMEUTIDÆ, *St.*

SWAMMERDAMMIA, *Hb.*—*Combinella*, *Hb.*, Henhurst (E. B.) *Cæsiella*, *Hb.*, Henhurst (E. B.) *Oxyacanthella*, *Dup.*, Burton (J. S.) *Pyrella*, *Vill.*, Burton (E. B.) *Spiniella*, *Hb.*, Burton (J. S.)

HYPONOMEUTA, *Latr.*—*Padellus*, *L.*, *Sta.*, Burton, common. *Cagnagellus*, *Hb.*, Burton (E. B.) ? Repton (F. S.) *Evonymellus*, *L.*, near Uttoxeter (E. B).

PRAYS, *Hb.*—*Curtisellus*, *Don.*, Henhurst (E. B.)

PLUTELLIDÆ, *Sta.*

PLUTELLA, *Schr.—Cruciferarum*, *Zell.*, Burton (E. B.), common, Cannock Chase (C. G. B.) *Porrectella*, *L.*, *Sta.*, Burton, rare (P. B. M.)

CEROSTOMA, *Latr.—Sequella*, *Clerck.*, Bretby, rare (P. B. M.) *Vittella*, *L.*, *Sta.*, Henhurst (E. B.) *Radiatella*, *Don.*, *Sta.*, Henhurst and Repton Shrubs (E. B.) *Costella*, *Fb.*, *Sta.*, Henhurst and Repton Shrubs (E. B.) *Alpella*, *Schiff.*, Ravenstone (Sydney Webb).

HARPIPTERYX, *Tr. Nemorella*, *L.*, *St.*, *Sta.*, Henhurst, scarce (E. B.) *Xylostella*, *L.*, *Sta.*, Henhurst (E. B.), common.

GELECHIIDÆ, *Sta.*

ORTHOTELIA, *St.—Sparganella*, *Thnb.*, *Sta.*, Burton (J. T. H.)

PHIBALOCERA, *St.—Quercana*, *Fb.*, *Sta.*, Burton (E. B.), (J. T. H.), (P. B. M.)

DEPRESSARIA, *Haw.—Costosa*, *Haw.*, Burton (E. B.) *Flavella*, *Hb.*, Burton (E. B.) *Umbellana*, *St.*, *Sta.*, Repton (F. S.) *Assimilella*, *Tr.*, *Sta.*, Repton (F. S.) *Arenella*, *Schiff.*, Henhurst, common. *Propinquella*, *Tr.*, *Sta.*, Henhurst, common. *Subpropinquella*, *Sta.*, Repton (F. S.) *Alstrœmeriana*, *Clerck.*, Henhurst, common. *Purpurea*, *Haw.*, *Sta.*, Henhurst (E. B.) *Liturella*, *Hb.*, The Oaks, Burton (E. B.) *Angelicella*, *Hb.*, *Sta.*, Henhurst (E. B.) *Ocellana*, *Fb.*, *Sta.*, Henhurst (J. T. H.) *Applana*, *Fb.*, *Sta.*, Burton, common. *Ciliella*, *Sta.*, Henhurst (E. B.) *Chærophylli*, *Zell.*, *Sta.*, Repton (F. S.) *Ultimella*, *Sta.*, Repton (F. S.) *Heracleana*, *De Geer*, Burton (E. B.)

GELECHIA, *Sta.—Malvella*, *Hb.*, Burton (E. B.) *Velocella*, *Fisch.*, Cannock Chase (C. G. B.) *Ericetella*, *Hb.*, Cannock Chase, swarming (C. G. B.) *Sororculella*, *Hb.*, Burton (E. B.) *Longicornis*, *Curt.*, Cannock Chase (C. G. B.) *Diffinis*, *Haw.*, *Sta.*, Cannock Chase (C. G. B.)

BRACHMIA, *Hein.—Mouffetella*, *Schiff.*, Burton (E. B.)

BRYOTROPHA, *Hein.—Terrella*, *Hb.*, *Sta.*, Burton (E. B.), Cannock Chase (C. G. B.) *Politella*, *Dougl.*, Cannock Chase (C. G. B.) *Senectella*, *Zell.*, *Sta.*, Burton (E. B.), (J. S.)

Affinis, *Dougl.*, *Sta.*, Burton (E. B.) *Domestica*, *Haw.*, *Sta.*, Burton E. B.)

LITA, *Tr.*—*Artemisiella*, *Tr.*, *Sta.*, Burton (E B.) *Viscariella*, *Logan*, *Sta.*, Stapenhill (J. S.) *Maculea*, *Haw.*, Burton (E. B.) *Tricolorella*, *Haw.*, *Sta.*, Seal Wood (J. S.), Tatenhill, common (J. S.) *Fraternella*, *Dougl.*, Burton (E. B.) Whitwick (J. S.) *Maculiferella*, *Dougl.*, Burton (—.) *Hübneri*, *Haw.*, Burton (E. B.), Hopwas Wood (J. S.) *Atriplicella*, *Fisch.*, *Sta.*, Burton (E. B.)

TELEIA, *Hein.*—*Proximella*, *Hb.*, Repton (F. S.) Cannock Chase (C. G. B.) *Notatella*, *Hb.*, *Sta.*, Burton (E. B.) *Vulgella*, *Hb.*, Burton (E. B.) *Luculella*, *Hb.*, Repton Shrubs (F. S.), Cannock Chase (C. G. B.) *Fugitivella*, *Zell.*, *Sta.*, Burton (E. B.)

NANNODIA, *Hein.*—*Hermannella*, *Fb.*, *Sta.*, Burton (E. B.)

PTOCHEUUSA, *Hein.*—*Subocellea*, *St.*, Burton (E. B.)

DORYPHORA, *Hein.*—*Lucidella*, *St.*, *Sta.*, Bretby Park (F. S.), Burton (E. B.) *Lutulentella*, *Zell.*, Repton, heads of larger cuckoo weed in September (F. S.)

MONOCHROA, *Hein.*—*Tenebrella*, *Hb.*, Burton (E. B.)

LAMPROTES, *Hein.*—*Atrella*, *Haw.*, Burton (E. B.)

ANACAMPSIS, *Curt.*—*Ligulella*, *Zell.*, Burton (E. B.) Bretby Park (F. S.) *Anthyllidella*, *Hb.*, *Sta.*, Burton (E. B.)

TACHYPTILIA, *Hein.*—*Populella*, *Clerck.*, *L.*, Repton (F. S.)

BRACHYCROSSATA, *Hein.*—*Cinerella*, *Clerck.*, Burton (E. B.)

CERATOPHORA, *Hein.*—*Rufescens*, *Haw.*, Burton (E. B.)

CHELARIA, *Haw.*—*Hübnerella*, *Don.*, Henhurst (E. B.)

ANARSIA, *Zell.*—*Spartiella*, *Schr.*, *Sta.*, Railway Cuttings (F. S.)

HYPSILOPHUS, *Fb.*—*Schmidiellus*, *Heyd.*, Willington (F. S.) *Marginellus*, *Fb.*, *Sta.*, Burton (E. B.)

PLEUROTA, *Hb.*—*Bicostella*, *Clerck.*, Cannock Chase common, (C. G. B.)

HARPELLA, *Schr.*—*Geoffrella*, *L.*, Burton (E. B.), (J. T. H.)

DASYCERA, *Haw.*—*Sulphurella*, *Fb.*, Burton, common; Cannock Chase (C. G. B.)

ŒCOPHORA, *Zell.*—*Minutella*, *L.*, Henhurst (E. B.) *Fulviguttella*, *Zell.*, Henhurst (E. B.) *Stipella*, *L.*, Cannock Chase (C. G. B.) *Fuscescens*, *Haw.*, Burton (E. B.) *Pseudospretella*, *Sta.*, Burton (E. B.), (J. T. H.)

ŒCOGENIA, *Sta.*, *Gn.*—*Quadripunctata*, *Haw*, *Sta.*, Repton (F. S.)

BUTALIS, *Tr.*—*Fusco-cuprea*, *Haw.*, *Sta.*, Repton (F. S.) *Variella*, *St.*, *Sta.*, Repton, abundant in wild raspberries (F. S.)

GLYPHIPTERYGIDÆ, *Sta.*

GLYPHIPTERYX, *Hb.*—*Fuscoviridella*, *Haw.*, Burton (E. B.), Cannock Chase (C. G. B.) *Thrasonella*, *Scop.*, *Sta.*, Repton Shrubs ? (F. S.) *Equitella*, *Scop.*, Burton (E. B.) *Fischeriella*, *Zell.*, Burton (E. B.), (J. T. H.), Repton Shrubs (F. S.)

HELIOZELE, *H.-S.*—*Sericiella*, *Haw.*, Henhurst (E. B.), Repton Shrubs (F. S.)

ARGYRESTHIIDÆ, *Sta.*

ARGYRESTHIA, *Hb.*—*Ephippella*, *Fb.*, Stapenhill, &c. (J. S.) *Nitidella*, *Fb.*, *Sta.*, Henhurst, &c. (E. B.), Cannock Chase (J. S.) *Spiniella*, *Zell.*, *Sta.*, Burton (E. B.) *Albistria*, *Haw.*, Henhurst (E. B.), Tutbury Road (P. B. M.) *Semifusca*, *Haw.*, Henhurst (E. B.), Whitwick (J. S.) *Glaucinella*, *Zell.*, Bradgate Park (J. S.) *Retinella*, *Zell.*, Burton (E. B.) *Dilectella*, *Zell.*, Stapenhill (J. S.) *Curvella*, *L.*, The Oaks, Burton (E. B.), Repton (F. S.) *Pygmæella*, *Hb.*, Henhurst, &c. (E. B.) *Gœdartella*, *L.*, Henhurst, &c. (E. B.) *Brochella*, *Hb.*, *Sta.*, Henhurst, &c. (E. B.)

OCNEROSTOMA, *Zell.*—*Piniariella*, *Zell.*, *Sta.*, Repton (F. S.)

ZELLERIA, *Sta.*—*Insignipennella*, *Sta.*, Henhurst (E. B.), Shobnall, Burton (J. T. H.)

GRACILARIIDÆ, *Sta.*

GRACILARIA, *Zell.*—*Alchimiella*, *Scop.*, Henhurst, &c. (E. B.) *Stigmatella*, *Fb.*, Henhurst (E. B.) *Hemidactylella*, *Fb.*, Henhurst (E. B.) *Elongella*, *L.*, Burton (E. B.), (J. T. H.), Cannock

Chase (C. G. B.) *Tringipennella*, *Zell.*, Repton (W. G.) *Syringella*, *Fb.*, Burton (E. B.), Repton Shrubs (J. S.) *Auroguttella*, *St.*, Henhurst (E. B.)

CORISCIUM, *Zell.—Cuculipennellum*, *Hb.*, Henhurst (E. B.)

ORNIX, *Zell.—Angelicella*, *Sta.*, Burton (E. B.), Grange Wood (J. S.), Cannock Chase (C. G. B.) *Torquillella*, *Sta.*, Burton (E. B.), Whitwick (J. S.) *Guttea*, *Haw.*, Findern (F. S.)

COLEOPHORIDÆ, *Sta.*

COLEOPHORA, *Zell.—Fabriciella*, *Vill.*, *Sta.*, Drakelowe (E. B.) *Alcyonipennella*, *Kol.*, *Sta.*, Repton (W. G.) *Paripennella*, *Zell.*, Burton, &c. (J. S.) *Anatipennella*, *Hb.*, *Sta.*, Repton (F. S.) *Discordella*, *Zell.*, Repton (F. S.) *Onosmella*, *Brahm*, *Sta.*, Repton (F. S.) *Murinipennella*, *Fisch*, Burton (E. B.)? *Cæspitititella*, Cannock Chase (C. G. B.), Burton (E. B.), (J. S.) *Laripennella*, *Zell.*, Henhurst (E. B.), Burton (J. S.) *Argentula*, *Zell.*, Burton (E. B.) *Albitarsella*, *Zell.*, Burton (J. T. H.), (J. S.) *Nigricella*, *St.*, *Sta.*, Cannock Chase (C. G. B.) *Fuscedinella*, *Zell.*, Burton (E. B.), (J. S.) *Gryphipennella*, *Bouché*, Burton (E. B.), (J. S.) *Siccifolia*, *Sta.*, Tutbury Road (J. S.) *Viminetella*, *Heyd.*, Burton (E. B.) *Badiipennella*, *Fisch.*, Burton (E. B.), (J. S.)

ELACHISTIDÆ, *Sta.*

BATRACHEDRA, *Sta.—Præangusta*, *Haw.*, Burton (J. S.) *Pinicolella*, *Dup.*, Grace Dieu (J. S.)

CHAULIODUS, *Tr.—Illigerellus*, *Hb.*, Burton (E. B.) *Chærophyllellus*, *Göze*, Repton (F. S.)

LAVERNA, *Curt.*, *Sta.—Propinquella*, *Sta.*, Burton (E. B.)? *Epilobiella*, *Schr.*, Burton (E. B.) *Ochraceella*, *Curt.*, *Sta.*, Repton (F. S.) *Decorella*, *St.*, Burton (E. B.) *Vinolentella*, *H.-S.*, Burton (P. B. M.) *Atra*, *Haw.*, Burton (E. B.)

CHRYSOCLYSTA, *Sta.—Linneella*, *Clerck.*, Repton Shrubs and Bretby Park (E. B.) *Schrankella*, *Hb.*, *Sta.*, Repton (F. S.) *Aurifrontella*, *Hb.*, Burton (E. B.), (J. S.)

ASYCHNA, *Sta.—Terminella*, *Dale*, Repton Shrubs and Rosliston Road (J. S.)

ELACHISTA, *Sta.*—*Magnificella*, *Tgstr.*, Burton (E. B.) ? ? *Albifrontella*, *Hb.*, The Oaks (E. B.), Burton (J. S.) *Atricomella*, *Sta.*, Burton (E. B.) *Luticomella*, *Zell.*, *Sta.*, The Oaks, Burton (E. B.), Henhurst (J. S.) *Monticola*, *Wk.*, Drakelow Mill (J. S.) *Cinereopunctella*, *Haw.*, *St.*, *Sta.*, Repton (W. G.) *Nigrella*, *Hb.*, Burton (E. B.) ? *Subnigrella*, *Dougl.* *Humilis*, *Zell.*, Burton (E. B.) ? *Perplexella*, *Sta.*, Burton (E. B.), (J. S.) *Obscurella*, *Sta.*, Burton (J. T. H.), (J. S.), Cannock Chase (C. G. B.) *Zonariella*, *Tgstr.*, Burton (E. B.) *Megerlella*, *Zell*, Burton (E. B.), (J. S.) *Cerussella*, *H. B.*, *St.*, *Sta.*, Burton (E B.), (J. S.) *Paludum*, *Frey.*, Drakelow Mill (J. S.) *Rufocinerea*, *Haw.*, Burton, very common (E. B.), (J. S.) *Argentella*, *Clerck.*, The Oaks, &c. (E. B.)

TISCHERIA, *Zell.*—*Complanella*, *Hb.*, Burton (E. B.), (J. S.), Cannock Chase (C. G. B.), Repton Shrubs (F. S.) *Marginea*, *Haw.*, Burton (E. B.)

LITHOCOLLETIDÆ, *St.*

LITHOCOLLETIS, *Zell.*—*Roboris*, *Zell.*, Cannock Chase (C. G. B.) *Pomifoliella*, *Zell.*, Burton (E. B.), (J. S.) *Coryli*, *Nic.*, Burton (J. S.) *Aucupariella*, Whitwick (J. S.) *Spinicolella*, *Kol.*, Rolleston Road (J. S.) *Faginella*, *Mann.*, Burton (E. B.), (J. S.) *Salicicolella*, *Sircom.*, Burton (E. B.) *Ulmifoliella*, *Hb.*, Burton (J. T. H.), (J. S.), Cannock Chase (C. G. B.) *Spinolella*, *Dup.*, Burton (E. B.), *Quercifoliella*, (J. S.) *Fisch.*, Burton (E. B.), (J. S.), Cannock Chase (C. G. B.) *Messaniella*, *Zell.*, Burton (E.B.) *Corylifoliella*, *Haw.*, Burton (E. B.), (J. S.) *Viminiella*, *Sircom.*, *Sta.*, Burton (E. B.), (J. S.) *Alnifoliella*, *Hb.*, Burton (E. B.), (J. S.) *Heergeriella*, *Zell.*, Burton (E. B.) *Cramerella*, *Fb.*, Burton (E.B.), (J. S.), Cannock Chase (C. G. B.) *Sylvella*, *Haw.*, Burton (E.B.) *Emberizæpennella*, *Bouché*, Grange Wood (J. S.) *Nicellii*, *Zell.*, Burton, common (J. S.) *Tristrigella*, *Haw.*, Burton (E. B.) *Trifasciella*, *Haw.*, Burton (E. B.)

LYONETIIDÆ, *Sta.*

LYONETIA, *Hb.*—*Clerckella*, *L.*, Henhurst (E. B.), Burton (J. S.)

PHYLLOCNISTIS, *Zell.—Suffusella*, *Zell.*, *Sta.*, Repton (F. S.)

CEMIOSTOMA, *Zell.—Spartifoliella*, *Hb.*, Burton (E. B.) *Laburnella*, *Heyd.*, *Sta.*, Burton, common (J. S.) *Scitella*, *Zell.*, Burton (E. B.), (J. S.)

BUCCULATRIX, *Zell.—Cidarella*, *Fisch*, *Sta.*, Repton (F. S.) *Ulmella*, *Mann.*, Burton (E. B.) *Cratægi*, *Zell.*, Burton (E. B.) *Boyerella*, *Dup.*, Burton (E. B.) *Thoracella*, *Thnb.*, Burton (E. B.)

NEPTICULIDÆ, *Sta.*

NEPTICULA, *Zell.—Ruficapitella*, *Haw.*, Burton (E. B.), (J. S.) *Anomalella*, *Göze.*, Burton (J. S.) *Pygmæella*, *Haw.*, Burton (J. S.) *Oxyacanthella*, Sta., Burton (J. S.) *Aucupariæ*, *Frey.*, Whitwick (J. S.) *Intimella*, *Zell.* Burton (E. B.), (J. S.) *Subbimaculella*, *Haw.*, Burton (J. S.) *Trimaculella*, *Haw.*, Burton (J. S.) *Floslactella*, *Haw.*, Burton (E. B.), (J. S.) *Myrtillella*, *Edl.*, Cannock Chase (C. G. B.) *Microtheriella*, *Wing.*, Burton (J. S.) *Betulicola*, *St.*, Whitwick (J. S.) *Ignobilella*, *Sta.*, Burton (E. B.), (J. S.) *Argentipedella*, *Zell.*, Burton (E. B.), (J. S.), Whitwick (J. S.) *Plagicolella*, *Sta.*, Henhurst (J. S.) *Tityrella*, *Dougl.*, Branstone (J. S.) *Malella*, *Sta.*, Burton (J. S.) *Angulifasciella*, *Sta.*, Burton (E.B.), (J. S) *Gratiosella*, *Sta.*, Burton (E. B.), (J. S.) *Marginicolella*, *Sta.*, Burton (J. S.) *Aurella*, *Fb.*, Burton (E. B.), (J. S.) *Splendidissimella*, *H.-S.*, Repton (P. B. M.), Burton (J. S.) *Luteella*, *Sta.*, Whitwick (J. S.)

The Functions of a Local Natural History Society, with special reference to the study of Plant Galls.

By Philip B. Mason, M.R.C.S., F.Z.S., F.L.S., &c.

(*Presidential Address delivered November 8th*, 1889.)

I THINK that it may not be out of place to consider briefly the functions which a perfectly organised local Society should fulfil, the objects of its study, and the means by which these studies can best be carried out, and to do this, I must first rapidly run over the subjects included in the words Archæology and Natural History.

Of course the foremost place is occupied by Geology, for without the earth itself, there could be no Archæology or Natural History to investigate. This includes the character and succession of the strata in the neighbourhood, the conditions under which each bed has been formed, their palæontology, or the knowledge of the animals and plants which inhabited the land at each successive epoch, as far as their remains have been preserved in the rocks. Chemistry and Physics are also necessary to examine the constituents of the various formations, and show how the metamorphosis of the *debris* coming from the primitive rocks into their existing forms has taken place ; while Meteorology enables us to understand how, during the long series of ages, the surface of the land has been carved into its present condition of hill and dale, and how the process is still being carried on at the present time by the agency of wind, rain, and frost disintegrating the rocks and carrying the *debris* by the rivers into sea and lake to form fresh geological formations, and how the ceaseless change goes on, until combined with the movements of elevation and depression of the earth's crust, its results are that, "Where stood the mountain rolls the sea."

Then there is Anthropology, or the knowledge of the highest of the animal creation, "man." This is a most comprehensive study, and includes the accumulation of data about the race as it now exists, the averages of height, weight, shape of skull, and many other points in his condition, both physical and mental; his written history, customs, folklore, traditions, poetry, and language. This is a most important field of work, for in these days, when distance is almost annihilated, and such rapid changes take place in the composition of the population, due to emigration, gravitation to great cities, and other causes, all these facts will, unless now recorded, soon fade and be lost in the uniformity produced by universal admixture. Even within my memory in this district, local distinctions of race which have existed from the days of the Vikings have been almost obliterated, and even the preservation of a few local and archaic words may be of inestimable value to students in ages to come.

Artists, photographers, and cartographers, should make a permanent record of the state of things now existing, so that in future every change in the contour of the land and in the buildings of a locality may be clearly traced; also changes in its dress and customs. Think of what value to us now would have been the use of a few cameras in every town in the middle ages; we should not now have been reduced to hunting through the rude representations on old monuments and sepulchral brasses for many details of weapons and dress. Many curious costumes are only represented on a single brass, and this almost obliterated by the wear of the feet of many generations, and also liable to be lost by carelessness in church restoration; and I am sorry to say they are lost to the locality in other ways, as a loose brass and opportunity leads in certain minds to an acute attack of kleptomania;

and the result is that, after the lapse of some years, it is found that the brass has emigrated bodily, either to the Continent or America. As well as the written history, everything possible should be learnt of the prehistoric inhabitants, their modes of life, etc.—this is the more important when we recollect, as Professor Boyd Dawkins truly said, that the descendants of the men and women who were dug up in the Stapenhill explorations are still among us. The scientific genealogy traces the effects of each fresh admixture of races, and how the various factors have produced the present average man.

Then Zoology and Botany examine and record every species of animal and plant found in the neighbourhood, the time of the year in which each appears, the habits, food, and instincts of the animals, and the kind of soil in which each species of plant flourishes. Sportsmen, even with no knowledge of systematic natural history, may aid us here, for no one can be a successful sportsman who is not a keen observer of the habits of the animals and fishes that he pursues; and it is a misfortune that so many mute, inglorious Miltons have passed away, leaving no record of the knowledge they have thus gained. In this neighbourhood *feræ naturæ* have become extinct almost within living memory, as the deer and badgers of Needwood Forest. The lower creation as well as man is susceptible to changes of habit from its environment, the loss of its accustomed food, from drainage, building operations, enclosure of waste lands, etc. These altered conditions affect the struggle for existence, giving one species an advantage and leading another to destruction, unless it can adapt itself to the change. Not only the systematic Botanist and Zoologist, but also the Anatomist and Physiologist are wanted with scalpel and microscope to investigate the structure of the tissues and organs, and determine their uses, and also to examine the changes occurring in the development or embryology of each animal and plant. Anatomy is also useful to the systematic naturalist, and, on the one hand, enables a Professor Owen, from the careful study of a single fossil bone, to reconstruct the entire animal and show its place in the scale of creation, and on the other, determines the character of the ancient vegetation, the remains of which are now so necessary to us in the shape of coal.

In fact there is no living thing the careful study of which would not add to our knowledge, and no one can predicate when and where this knowledge may prove useful to mankind. Who could have expected that the patient study under the microscope of what at the time were considered mere curiosities, viz., the Bacteria, would have thrown so much light on the nature of the greatest scourge of civilised races—consumption—as well as the causes, prevention and even cure of many other diseases, or that it would have been fraught with so much importance to Burton. No doubt Burton was famed for its beer when even the words microscope and bacterium as well as the things themselves were unknown; but I think that brewers, both practical and scientific, will bear me out in the statement that our staple manufacture now vitally depends on an intimate knowledge of the form and physiology of the Bacteria.

You will say that this rapid and imperfect sketch covers an extensive field, and that there is room enough for all observers and thinkers to aid us in our work, and I hope that many more such will join our ranks, and give us, not only pecuniary aid—for even the work of Science cannot be carried out without money—but also that each one will enable us to record a few accurate observations. The widest generalisations depend on the patient accumulation of facts, and these facts may be gathered even within the narrowest limits. I can give no better example of this than by citing the epoch-making labour of the illustrious Charles Darwin—the Newton of natural history—who for many years scarcely went beyond the precincts of his own garden.

Such being our territory, how shall we best attain the aims and objects of the Society?

In the first place, our great aim should be to do local work, and, while by no means excluding subjects of general scientific interest for our mutual instruction, and descriptions of foreign travel, with the physical formation, manners, and customs of foreign countries and districts, devote our chief energies to the record of facts observed in our own immediate neighbourhood.

In carrying out this work, of course the foremost place must be given to the reading of papers. No one can write a paper to communicate his knowledge or ideas to others without learning much himself. He will almost certainly be obliged to look into matters of which he had only a hazy notion beforehand, and some of his hearers, at all events, will carry away fresh ideas. Not only formal papers should be read, but a part of the business of the meeting should be the exhibition of specimens, and short notes of interesting observations made by any of the members, in order that they may be recorded in the Minutes of the Society. And although I have always used the word "he," I have not meant to exclude ladies, whose papers and notes are always welcome.

Secondly I place the compilation of complete lists of the Fauna and Flora of the district. In this our Society has made an excellent beginning by the publication of the catalogue of Macro-Lepidoptera, and I hope that before the termination of this session this list may be followed by that of the Micro-Lepidoptera, for which the materials have been accumulating for some time. It is the more incumbent on us to carry out this work because we have such an admirable foundation upon which to build in the "Natural History of Tutbury," by Sir Oswald Mosley, where the late Mr. Edwin Brown gave, almost single-handed, such comprehensive lists of the Fauna and Flora of Burton-on-Trent; and, in addition to this, we have the "Fauna and Flora of Repton," which owed so much to the labours of the late Mr. William Gurneys, a former member of our Society. For a century past this neighbourhood has never been without its naturalists, from the time when Erasmus Darwin, living in Lichfield, sang, "The Loves of the Plants," and formed one of a Lichfield society which published what was then a very valuable work on systematic botany.

Perhaps I may be allowed to read two short extracts from his poems, which, although couched in the stilted and pedantic language of the period, show that he was an accurate observer of nature.

"Sylphs ! on each oakbud wound the wormy galls
With pigmy spears, or crush the venomed balls ;
Fright the green locust from his foamy bed,
Unweave the caterpillar's fleecy thread ;
Chase the fierce earwig, scare the bloated toad ;
Arrest the snail upon his slimy road ;
Arm with sharp thorns the sweetbriar's tender wood,
And dash the Cynips from her damask bud ;
Steep in ambrosial dews the woodbine's bells,
And drive the night moth from her honey'd cells."

"Four of the giant brood with Ilex stand,
Each grasps a thousand arrows in his hand ;
A thousand steely points on every scale
Form the bright terrors of his bristly mail.—
So armed, immortal Moore uncharmed the spell,
And slew the wily dragon of the well.—
Sudden with rage their *injur'd* bosoms burn,
Unwrong'd, as gentle as the breeze that sweeps
Retort the insult, on the wound return ;
The unbending harvests or undimpled deeps,
They guard, the Kings of Needwood's wide domains,
Their sister wives and fair infantine trains ;
Lead the lone pilgrim through the trackless glade,
Or guide in leafy wilds the wandering maid."

You must not imagine that I think it possible for all this to be done at once, if so, we might as well sit down and fold our hands, dismayed by the magnitude of the task ; but "art is long, though time be fleeting," and if members of similar pursuits will only form sections, differing at different times, each of which will furnish lists of their captures, to be presented to the Society at the close of each session, in time a complete Fauna and Flora can be published from these lists.

In the third place, as a necessity for the perfect working of such a Society, I put the formation of a good library of reference. Alas, with means as limited as ours are, this can only be accomplished by degrees and slowly, for the formation of such a library is a most expensive matter. This want can only be supplied by each one of us putting at the service of other members such books as he may possess.

Fourthly, and in an ideal society with the command of sufficient funds, one of the most important objects to pursue would be the formation of a museum. But there are various types of museums, intended for different purposes. I am putting aside the old-fashioned museum, as it is not the object of anyone now to get together a miscellaneous jumble of odds and ends gathered from all the four quarters of the globe, and over which a suitable inscription would have been "Rubbish may be shot here." There is first the great National Museum, which should contain not only as perfect a collection as possible of objects of art, archæology, manufactures, objects illustrating the manners and customs of different nations, specimens of minerals and rocks, and of all the orders of the two kingdoms of nature, both recent and fossil, stored away for reference by students, but also typical collections of all groups, with full and accurate descriptions, exposed for the purposes of instruction. There is also that most useful form of museum called the Technical Museum, which contains specimens of the raw materials, and illustrations of all processes bearing on the staple industry of a town. But the museum of such a Society as ours would have much more limited aims. It should be strictly local in character, and however interesting and beautiful in themselves other things might be, I would rigorously exclude them. In it would be stored all local antiquities, both prehistoric and historic, drawings and photographs of old buildings, maps, geological sections, copies of old charters and old parish registers, of old houses and monuments, the coins of local mints and tradesmens' tokens, and all such objects of local interest. Not only should the archæology be illustrated, but also the rocks, animals, and plants, both recent and fossil; in it every indigenous species finding place, and each specimen should be carefully labelled with all particulars as to its capture, etc., or at least bear a reference to a careful register which would be kept, so that any errors in the determination of a species could at any time be corrected, in fact, the specimens in the museum would be the authority for the lists published by the Society. The only exception I would make to this rule would be to place those types of species which may be expected to occur in the neighbourhood with a conspicuous ticket showing their origin. In this town, however, the subject of museums is rather a sore one, and one in which there has been woeful retrogression. Rather more than twenty years ago we had a museum which really in many departments it would be difficult to surpass. This, however, was private property, but the owners, who are all now dead, and who were principally three, viz., Sir Oswald Mosley, Mr. R. Thornewill, and Mr. Edwin Brown, offered to present it to the town on the condition that the cost of the rent of the house and its maintenance should be defrayed. This generous offer was declined ! and rooms were built at Rolleston to contain Sir Oswald Mosley's fine collection of birds, etc. Another opportunity, also, was allowed to pass by, for when the Institute was built there was no provision made for a museum, and I believe that now all the rooms there are fully occupied. I hope, however, that this loss may be repaired at some future time, and that, although we can never expect to get so complete a collection of birds, especially of birds of prey and waders, which, thanks to drainage, enclosure, and the gamekeeper, are much rarer than they were, we may yet have a useful museum, and I think that when there is another re-arrangement of the expenditure of the town charities, a claim may fairly be made for this purpose. It is quite useless to attempt to establish a museum without the command of sufficient money, for when the cost of the rooms, cases, and cabinets is defrayed, an efficient curator is an absolute necessity, for, unfortunately, natural history specimens require constant care for their preservation, and I have frequently seen dreadful examples of the fate experienced by collections of birds, insects, and plants deposited in provincial museums, a prey to moths, mites, damp, and dust, which render them absolutely valueless.

And, lastly, in many societies an important part of the work is the planning of excursions and soirées, by which a pleasant day's amusement is added to increase of knowledge ; for we cannot explore either ancient buildings or scenes of natural beauty without learning something.

Having described at length the general aims of a local society, I will now turn to a special instance of the work which should be undertaken by the members. As an example, I will take a subject which has been greatly neglected both in England and abroad, but especially in England; and which, therefore, offers the certainty of fresh discoveries, interesting to naturalists generally, and which, in addition, requires that botanists and entomologists should both co-operate. This subject is the collection of Plant Galls, a record of the species of plants on which they occur, and the determination of the creatures which give rise to their formation, and which feed on them. When once formed, the galls serve as food, not only to the gall-producer, but also to other insects which are called Inquilines. I do not suppose that a tithe of the different kinds of galls to be found in Great Britain have yet been described. In Kaltenbach's "Pflanzenfeinde," published fifteen years ago, more species of Cynipidæ are named as producing galls on the oak alone, than all the number of species of that family yet recorded in Great Britain as causing galls on all our seventeen hundred and odd species of flowering plants.

Now what is a Plant Gall? Vegetable galls are excrescences or deformities of living plants, caused by animal influence, and serving for the protection and sustenance of animal brood. Their formation always takes place while the plant is still growing, but their functions do not always cease with the decay of the plant, the juices of which helped to form them. It happens in many instances that the ripe gall becomes detached, and continues to afford shelter and food to its inhabitants; this is particularly the case with the galls originally formed on the organs of deciduous trees or low plants of annual growth. Very few families of plants are altogether free from these parasitic growths, but I believe that none have yet been detected on mosses and fungi. Galls occur on all vegetable organs—root, stem, branch, bud, leaf, blossom, fruit, all are liable to be injured in this way, and to have their own sap diverted to the support of another organism. A gall is, therefore, an excrescence or swelling on some part of a plant, produced by the puncture and irritation of some member of creation, for I may say, in passing, that all pathological swellings on plants are not galls. This irritation gives rise to a local over-growth of the cellular tissue of the plant, and this over-growth assumes, in each case, a form distinctive of the species which produced it. Into this puncture an egg is laid, and when hatched the larva feeds on the abnormal growth. These galls may assume all sorts of forms, as rounded, in the common oak-apple; flattened, in the oak spangle ; stalked, like a fruit from the axil of a leaf, as in a specimen which I found in Switzerland, in which the shoots of a sallow seemed to be bearing a currant-like fruit from each leaf; or feathered, like the beautiful bedeguar of the rose. In all these forms the galls look as if they were only attached to the plant, but in a vast number of cases the gall is a local thickening, as in the knobs produced by the Phylloxera on the root, by some of the longicorn beetles on the stem, and by the Rhodites in the irregular thickenings of the edges of the leaves in the Burnet rose. The colours of some of the galls are very brilliant, and where this is the case, the colour is generally some shade of red, while in others the normal colour of the chlorophyll of the plant is not affected.

Some of the gall-makers are of vast economic importance, as the nut-gall of the oak, from which writing ink is manufactured, and which is also of medicinal value, and, on the other hand, some are almost unrivalled in their powers of destruction, as the Phylloxera of the vine, which has almost destroyed many of the French vineyards.

What are the gall-makers ? The vast majority are insects, but galls are also produced by minute worms, and even by mites. The galls produced by mites differ considerably in their structure from those of insects ; those of insects having a more or less solid structure, which, when cut open, shows the larva living in a closed cavity, while in those produced by mites, which all belong to the family of the Phytoptidæ, there is always an opening connecting the interior of the gall with the external world. For example :—To take two galls very much alike externally, viz., the nail galls of the lime and those of the American vine, the former the work of mites, and the other of a dipterous insect or Cecidomya, both being formed on the upper surface of the leaves. On cutting them open, it will be found that while the cavity of the insect-gall contains only one larva, the mites always form a large colony. Some of these mite-galls resemble externally those of insects, while others look like dust or powder, and at one time, as no grub could be found in any of them, the mites being so minute and transparent that it is necessary to break them up, tease them out in water, and examine the washings under the microscope to find them, it was supposed that these formations were due to the fungi, and the different kinds were described by fungologists as the genus Erineum. A common example of the mite-galls is the so-called clusters of the ash, in which the mites have attacked the pistils of the flower bud, and the irritation has produced such a growth of woody tissue that when dry they require a saw to divide them.

Among insects, gall-makers are found in the following orders, viz.:--Hymenoptera, Diptera, Coleoptera, Hemiptera, and Lepidoptera ; but before giving examples of these, there are a few general facts to which I should like to direct your attention. Of course, the ravages of the gall insects affect the health of the plant itself, and frequently destroy the branch or bud which is attacked ; but, as in every other animal and plant, Nature provides means of checking their excessive development and consequent destruction of the food-plant, they being all subject to the attacks of parasites, and thus the balance of nature is preserved.

I have already spoken of the Inquilines or insects which take advantage of the gall already produced to lay their eggs in, and so procure suitable food for their larvæ, as is done in this country in the common oak apple by the Tortrix, *Coccyx obscurana*. But in addition to this, all these larvæ are subject to the attacks of small parasitic Hymenoptera, the females of which are provided with long ovipositors ; these are inserted into the galls, and the skin of the larvæ pierced sufficiently to allow one or more eggs to be introduced ; these hatch, and while the host larva is feeding on the substance of the gall, the parasite is feeding on its tissues, the vital organs not being attacked until the parasite is ready to undergo its own transformation. Some of these parasites are so minute that several eggs of one species are deposited in the single egg of a butterfly, but it is not yet known whether this is so in the case of the eggs of any of the gall insects. From this it follows that when insects are bred from galls it is by no means certain that the insect emerging is the progeny of the original gall-maker, and especially the Cynipidæ and Cecidomyidæ, nearly allied insects, take advantage of the formation of the gall to provide pabulum for their own larvæ; and, to make the confusion more complete, even insects belonging to groups which are generally parasitic in their habits sometimes make galls themselves, as in the instance of Emytorica among the Chalcididæ.

The chief biological interest, however, of the gall-makers centres in two groups, one belonging to the Hymenoptera, viz., the Cynipidæ, and the other to the Hemiptera, viz., the Aphidæ. The life histories of these groups are, in many cases, involved in great obscurity, and require the most patient investigation to work out, since they apparently offer examples of two of the most curious methods known in the reproduction of species, viz., parthenogenesis and the alternation of generations. I will try, in as few words as possible, to explain what is meant by these two phrases, as they may not be familiar to everyone.

The term parthenogenesis, or the production of young by virgin, or rather, imperfect insects, is applied to those cases in which reproduction goes on for successive generations from female insects only, or at least from individuals which are capable of laying eggs which develop into perfect insects, a well-known example of which is the aphis, or insect which produces the honeydew. In one case, where specimens of *Aphis dianthi* were brought into a warm room and kept there, this process went on through many broods in a year for four years, and there seemed no reason then why it should not go on indefinitely; male insects being only produced out of doors at the approach of cold weather. To this group belong *Eriosoma pyri*, which produces galls, like potatoes, on the roots of apple trees just beneath the surface of the ground, the animal and the Phylloxeræ; these are also subject to an alternation of generations. Some of the gall mites also offer examples of this curious process, as fully formed eggs are to be found in the nymph, or that stage which answers to the pupa of a moth.

The other term, "alternation of generations," is applied to those cases in which the offspring is something quite different from the parent; perhaps one of the best known and simplest cases of this is found in the history of the common tapeworn, to secure the full development of which two different species of animal hosts are necessary. The eggs of the mature worm have to be swallowed by a pig, from the stomach of which the embryoes, set free by the action of the gastric juice, bore their way into the muscular and other tissues, where they develop into small sac-like creatures known under the name of measles, and these undergo no further development as long as the host lives, but these measles, when swallowed in imperfectly cooked pork by a human being, are developed into the perfect tapeworm. Another instance is the destructive fluke of the sheep's liver, the life history of which is still more complicated, the creature undergoing part of its transformations free in the water, part in a small water snail, the *Limnoea truncata*, and the mature worm lives in the gall ducts of the sheep's liver, and in this process the single egg would give rise to a multitude of individuals if all were to come to maturity.

Now, in some of the species of the gall-making Hymenoptera, of the group of the Cynipidæ, especially in one of the commonest, viz., that which produces the oak apple, only female insects are known, and this ignorance is not due to want of looking, for one observer collected 28,000 galls and bred from them 10,000 females without a single male. To explain this fact, three theories are alone possible, either, firstly, that the insect is produced parthenogetically; secondly, the male lives in galls on another species of plant, and differs in form and habits from the female; or, thirdly, that it is a case of alternation of generations, the progeny of the Cynips of the oak-gall being something which is described as quite a different genus and species. There is already some evidence to support the last theory. Interesting instances of this form of development are the Phylloxera and Pemphigus, belonging to the Aphis group of the Hemiptera, and their transformations. In these cases there are actually two forms of winged insects of the same species living on different plants. The gall caused by these insects produces an emigrant form like the summer broods of aphis, which gives birth to a true sexual progeny. The female of this progeny creeps into a crevice of the tree and dies there, the body protecting the solitary egg, which hatches in the spring and reproduces the original gall. Nearly all these hemipterous gall-makers of the elm and poplar require two different food plants to enable them to complete the cycle of life.

There are many interesting questions connected with other species, the satisfactory solution of which would not only be most interesting to the observer himself, but would contribute a stone for the construction of the great temple of knowledge.

In conclusion, a very few words on the special methods to be employed in the collection and examination of plant galls. To begin at the beginning, it is first necessary to examine plants and collect their galls, and then to breed the perfect insects from them, Now, this is not a matter of much labour. If the galls be collected fairly mature, all that is necessary is to put them, according to size, in glass capped boxes, or lamp glasses closed at each end by a cork, or, if not very mature, to put the end of the branch bearing the gall in damp sand, and cover with a bell glass and wait the course of events. I need hardly say that when gathered, or when fully mature, a careful description should be made of the external peculiarities of the gall, its section and structure, and the name of the plant on which it was formed. A specimen of the gall should be carefully preserved by appropriate means, either by drying or by immersion in alcohol—the latter is the only method to adopt with soft galls. When the perfect insect has appeared, it should be killed and carded in the usual way, and its name determined when possible. So little is really known of these insects that no one should be discouraged if this cannot be done at once; the preservation of the gall and the insect, and the accurate description of its appearance when fresh, being the chief part of the work, and the one which will materially help future workers on the various species of gall-producing insects.

Some Varieties of Huskless Barley from Thibet.

By Horace T. Brown, F.R.S., F.G.S., F.I.C., &c.

(*Read before the Society, January* 10*th*, 1890.)

A FEW years ago, whilst examining the very fine collection of cereals in the Museum of Kew Gardens, my attention was particularly attracted by two curious specimens of barley, which were labelled as coming from Sahàranpur, in the North-West Province of India. Both these varieties were huskless, or skinless barleys, that is to say, the *paleæ*, or glumes, instead of being permanently adherent to the grain, as in ordinary barley, are so loosely attached that they readily fall off on ripening, just as in the case of wheat or rye.

One of the specimens was of the usual colour, but the other was of a dark chocolate tint, and presented altogether a most unusual appearance. Through the kindness of Mr. Thiselton Dyer, the Director of Kew Gardens, I had some of this barley put into my hands for examination, and was also put into communication with Mr. Duthie, of the Sahàranpur Botanical Gardens, who has recently sent me a large quantity of three different kinds of huskless barley, which were grown under his direction. One of these is white, another a dull green, and the third a dark chocolate.

Mr. Duthie informs me that all three of these varieties were introduced into the Punjab about the year 1881, the seed having been procured from Poo, in Thibet.

The cultivation of the white huskless variety has been carried on with considerable success in the Punjab, where it is known as *wheat-barley*. You will notice how very closely it resembles wheat in its general appearance—so closely, in fact, that it quite deceived one of my friends, who has had a large experience in corn. So convinced was he that it was wheat, and not barley, that he took a sample away with him with the intention of growing it, and proving me wrong.

This similarity to wheat is certainly not without its dangers, and, in fact, grave objections to its cultivation have been made by some of the Indian authorities, on account of the ready manner in which it can be fraudulently mixed with the native wheats. Whether this objection is a serious one or not I cannot say.

This white skinless barley just described is a two-rowed barley, as you may see from the specimens of the complete plant, which Mr. Duthie has sent to me from India.

The second variety, the green barley, is four-rowed, and grows on a very short spike. The *paleæ* of this barley are somewhat more adherent to the grain than are those of the other two kinds.

The chocolate barley, from the same district, is very remarkable. It is a two-rowed barley, with a very slender straw, and the peculiar colour is not confined to the grain only, but occurs also in the nodes of the straw, which even at an early period of growth are coloured a very dark purple. The ear itself is two-rowed.

The colour is not diffused through the *paleæ*, as it is in black Abyssinian or black Scotch barley, but is confined to the integuments of the caryopsis. When microscopically examined, the inner portions of the pericarp (endocarp) immediately adjacent to the testa are seen to be charged with a very dark purple pigment, appearing in mass almost black. This pigment is fairly soluble in water, and probably consists of modified chlorophyll.

I have cultivated both the white and black varieties of barley during the summer of 1890 with variable results, and have succeeded in raising from the latter a sufficient quantity of seed for future experiments in a similar direction.

The Irish Aran.

(WITH SEVEN PLATES.)

From photographs taken by [illegible]
James [illegible] Wells [illegible] Kent.

BY PHILIP B. MASON, M.R.C.S., F.Z.S., F.L.S., &c.

(*Presidential Address* (*condensed*) *delivered Nov.* 13*th*, 1890.)

THE Islands constituting the Irish Aran lie off the West Coast of Ireland, and are practically in the Atlantic Ocean, although within sight of the coasts of Connemara and Clare. Their nearest point is 28 miles from the Quay of Galway, and they lie off the entrance of the fjord which is now called Galway Bay or Loch Lurgan. Aran is supposed at one time to have been connected on the north with Connemara, on the south-east with Clare, and to have thus formed the western boundary of a lake. The magnificent cliffs of Moher, in Clare, which rise sheer out of the sea to a height of 800 feet, are a striking object from these islands on the one side, and the mountains called the Twelve Pins of Connemara on the other.

The journey to Aran is in itself an interesting one, the route lying through North Wales to Holyhead and thence across the Channel to Dublin. The sail up Dublin Bay is very fine, with the picturesque hill of Howth on the one side, and the beautiful Wicklow Mountains on the other. Dublin itself is a striking city, containing many fine buildings.

We next cross the monotonous central bog of Ireland, where the railway runs for 40 to 50 miles parallel to a canal, pass Maynooth and cross the Shannon at Athlone, entering into Connaught; then, passing Ballinasloe, noted for its great sheep fair, and through the blood-stained district around Woodford, we end our railway journey in the city of Galway. To judge from the number of fortalices scattered about on both sides of the line, life must have been very insecure in the good old days, as these towers have evidently been built for purposes of defence.

The city of Galway itself has almost the appearance of a foreign town from its narrow streets and the architecture, which has been much influenced by the great intercourse which at one time existed between this port and Spain. This has all ceased now, and the great warehouses in which were stored rich cargoes of wine and other goods lie mouldering to decay, and its once busy quays are silent. Near the quays is the queer-looking Claddagh or fishing settlement, consisting of rows of white-washed cabins. The fishermen living here form a common-wealth of themselves, and are governed by a Mayor, elected annually, who exercises his authority quite outside the sanction of the law.

Through the city itself flows the short river Corrib, carrying the drainage of Lough Corrib into the sea. Standing on the bridge in Galway over this river, we may see at the same time hundreds of salmon lying in the stream, waiting until there is enough water in the ladder to allow them to ascend to their breeding-ground in the Lough. One wonders how they can lie almost motionless in the swiftly-running current.

The two modes of reaching Aran from Galway are by steamer and by sailing-boat. The steamer is advertised to sail once or twice a week in the summer, but anyone trusting to it is very likely to be left stranded in Galway, as it may make only one or two trips in the season. If we sail there is a choice between engaging a passage in the Post-boat, which starts three times a week, "weather permitting," or to engage one of the decked fishing boats, called hookers. In fine weather, and with a fair wind, the sail to Kilronan past the Blackhead of Clare is very pleasant; not so pleasant, however, if caught in a sudden gale, or if deserted by the wind and left to drift with the tide.

The islands may also be reached from the Connemara coast—in fact my first visit was made from Roundstone. When approaching Aran, the boatman, whom I had been employing for several weeks, said: "This is a great place for enchantments, sor." I suppose that I smiled, for he immediately added, "You don't believe in enchantments," and on my replying in the negative, completely posed me by the question, "Then why does Dr. Johnson, in his dictionary, say that Mab was Queen of the Fairies?" "To what strange uses may we come at last!" Fancy Dr. Johnson being triumphantly brought forward to prove the existence of enchantments. On this occasion I was landed at Kilronan on a little quay, in front of a small building dignified by the name of the "Atlantic Hotel," and the first object which met my eye was an upright stone fixed in the quay, "convaynient for the painters of boats," the inscription on which showed that its original use was that of a gravestone.

The Islands are three in number, and it is supposed derived their name from the Irish word Ara, a kidney, which the great island remotely resembles in shape. The names are Ara Mor, the Great Island; Innis Maan, the Middle Island; and Innis Heer, the Eastern Island, this is usually called the South Island. The length of the Great Island is nine miles, of the Middle three, and of the southern one two and a half miles. They contain about 11,288 acres, only 700 of which are productive, and support more than 3,000 people, with the help of an occasional relief fund, one of which was being administered during my last visit there. I said that only 700 acres are productive, and while approaching the islands one wonders how they can support any living thing, for they present the appearance of undulating stone fields.

The islands are entirely composed of metamorphosed limestone, and the rainfall is excessive from the fact that the islands are the first land struck by the westerly winds which have swept over the Atlantic, thus becoming saturated with moisture ; the result of the excessive rainfall is that the surface of the limestone is dissolved away with such rapidity that no spore of moss or other green thing can find lodgment for a sufficient time to germinate. The barren appearance is intensified by the fact that the numerous divisions between the fields consist of loose stone walls like those of North Derbyshire.

On walking over these fields, however, we find that the limestone is extensively fissured, the fissures running more or less in the same direction, and these fissures having been deepened by the solvent action of water to the depth of several feet, contain an abundant Flora, of course of lime-loving plants. I have nowhere seen more luxuriant specimens of many ferns, such as the Ceterach, Scolopendrium, Asplenium Ruta-muraria and Trichomanes, Adiantum nigrum and marinum, and last, but not least, the true British Maidenhair, Adiantum Capillus-Veneris. Of the latter fern, I should think that there are more plants growing here than in the remainder of the three kingdoms put together. The wind, however, and the cattle between them cut off these plants to the level of the surface of the rock, so that no green shows at a distance. The only parts that can really be cultivated are the slopes, where talus can lodge, and the places which have been covered by the drifting sand. I was quite surprised to see a fine crop of grass in a small circular enclosure which had been built on the flat, bare rock, near the beach at the north point of the Great Island, and in which a thick layer of sand and seaweed had been placed. Excellent potatoes are grown in this sand manured by seaweed, as is also the case in the Channel Islands.

A peculiarity of the stone walls is that no gates or openings are left in them, so that when a cow has to be brought from a distant field to the road, five or six walls have to be pulled down and rebuilt.

When calcareous rocks are in contact with the sea, it is usual to find many caverns excavated by the action of the water, but in Aran there are very few. In many places the lower part of the lofty cliffs has been excavated, leaving ledges, on which perch innumerable guillemots, mingled with a few puffins, razorbills, gulls, and choughs, the latter rare bird breeding here. The only place where there is anything in the nature of a cavern is in the south cliff of Ara Mor, where two tunnels have been formed about 150 feet long, the roofs at the inner end of which have fallen in, leaving openings through which water is driven during gales, gaining for them the local names of puffing holes.

Traces are still left here of one of the glacial epochs, when this part of the world was covered by an ice-sheet, and fine examples are to be found of erratic boulders or "roches percés" of granite, brought from the Connemara district, and left by the retreating ice on the limestone. On the opposite shore, on the slopes of Errisbeg, near Roundstone, there are to be seen rocks planed by the action of the ice, and grooved by the stones carried beneath it, as the glacier ground them in its slow advance. Of course in Aran itself all such grooves and scratches have long been dissolved away by the effects of the abundant rainfall on a soluble rock.

On some parts of the shore are found large accumulations of sand, which are drifted about by the winds, at one time fresh drifts being formed, covering gardens, etc., while at another old accumulations are carried away.

Of course, situated as these islands are in the broad Atlantic, they feel the full force of the winds and waves, and often when the sea looks as smooth as a mill pond, the waters break on the cliffs with such force as to send up showers of spray fully 100 feet in height. In stormy weather the effect is magnificent. I saw great balks of timber which had been thrown up on cliffs nearly 200 feet high, and here so much seaweed had been thrown up, that men were collecting it for the purpose of burning into kelp: there was enough Laminaria or Tangle to repay their trouble. A place on the Middle Island was pointed out to me on which the body of a man had been thrown up on cliffs quite as high as those just mentioned, and left many yards inland; and I was shown a place where a few years ago three men had been blown off the cliffs while fishing, and drowned. The most striking example I saw of the power which may be exerted by water driven by the wind, was a block of stone, situated about half-tide mark, which, as shown by the grooves in the flat-topped rocks, had been moved between 50 and 100 feet. I measured this block roughly, and found it to contain about 48 cubic yards of stone. Mr. Nowers, however, measured it more exactly, and calculated that it weighed about 103 tons.

The land Fauna is a scanty one, as might be expected from its insular position and lack of trees and streams.

There is one very curious fact in connection with the Fauna. The common banded snails, *Helix nemoralis* and *hortensis* are of comparatively enormous size and great thickness, being quite double the size of ordinary specimens, while the flat *Helix ericetorum* has the shell much thinner than usual, a very remarkable contrast considering that they both occur on the calcareous rocks. The marine Fauna is no doubt a very rich one, but, owing to the stormy character of the sea, not very easy to investigate. Foraminifera are thrown up on the strand in enormous numbers.

The Flora is restricted in number of species, but interesting in many ways. I have already spoken of the ferns. Among other noticeable plants are *Gentiana verna*; sea kale growing among the loose stones of the shingle banks; and the common ragwort, or *Senecio Jacobæa*; the latter is noticeable from the fact that in the majority of specimens the flowers are without the ordinary bright yellow ray, and at first it requires a little examination to convince oneself that a new and strange species has not been discovered.

Many of the references I have now to make to the earlier history of Aran are taken from an account compiled by Martin Havarty of an excursion to Aran by the Ethnological Section of the British Association in the year 1857.

The earliest reference to the pre-Christian history of Aran is to be found in the account of the battle of Moyturey, in which the Firbolgs, having been defeated by the Juatha de Dananus, were driven for refuge to the islands off the west coasts of Scotland and Ireland. It is probable that the date of the erection of the Doo Caher, or Black Fort of Aran, was shortly after this period. This battle is supposed to have taken place considerably more than 1,000 years before the birth of Christ. At all events, this structure is evidently of much older date than the other forts which I shall presently mention, and the date of which can be fixed pretty definitely as the first century of the Christian era, and which were built by the same sept of Firbolgs, who about this time were driven out of the Scottish islands by the Picts or Chrithmians. The Firbolgs under their chieftains Conchovar, Ængus, and Mil, the three sons of Uamore, returned to Ireland, the country of their ancestors, and settled for a time in Leinster. They were, however, compelled to relinquish the land they held there by the exorbitant rent exacted for it by Cairbre, the king of Tara, and crossed the Shannon into Connaught, where a great part of the population still belonged to their own ancient race. Here they were well received by Queen Maeve, who granted them the Islands of Aran, where they immediately fortified themselves in great stone duns, or forts, which must at that time have been almost impregnable, and the remains of which are, at the present day, probably the grandest ruins of the kind to be found in the world. The names of those chieftains are still to be found in the names Dun Ængus, Dun Conchovar, and Muirveagh Mil, or sea plain of Mil. I need hardly say that the early facts of Irish history are no more to be accepted without the proverbial grain of salt than those of other countries, but there seems to be at all events some foundation for most of the statements which I have now made. The authorities for these statements are to be found in O'Flaherty's "Ogygia and Jar-Connaught," and in an Irish MSS. tract by McFribis on the Firbolgs, who refers to the older authorities.

This is a convenient place in which to attempt some description of the duns or forts, which are more or less circular in outline, and built up of loose stones laid one on the other. The limestone of which they are constructed weathers and splits in more or less flattened slabs, which are easily piled up. The general plan is that of an inner enclosure with two outer concentric walls, the latter being protected by a stone *chevaux de frise*, covering a considerable extent of ground. No two of the duns are planned exactly in the same way, but the largest and most striking specimen is Dun Ængus or Dun Eanes (Plate I., fig. 1). Dun Eanes is built on the brow of the highest precipice in the island, 302 feet above the sea level, and the descent of which is so sheer that the islanders are in the habit of fishing from its edge, with the aid of a short stick or rod, not much more than a yard in length. From the position of this dun on the edge of a cliff, there is no necessity for the completion of the circle of the wall, which is, therefore, built in the shape of a horse-shoe, the space enclosed by which is 150 feet in length, by 142 feet in width. The circuit of the wall of the inner enclosure is the only one of the walls without any other opening than a doorway. The wall is 13 feet wide, and averages 18 feet in height. It is built up on the inner and outer faces of regularly shaped stones, the space between being filled with rubble (Plate I., fig. 2). On the inner side are two stone platforms, reached by flights of stone steps. In this wall there were originally two doorways, one of which is now closed by the inner wall, while the open one has a width of three feet four inches at the top, and a little more at the bottom, the top being formed by large flagstones piled one above the other. In the breadth of the wall on the north-west side there is a passage or chamber. In the enclosure are the remains of stone houses or cloghauns. The outer walls have openings left in them, but the openings in the middle and outer walls are placed at some considerable distance apart, and the whole protected by the sharp stones of the *chevaux de frise* (Plate II., fig. 3). The whole extent of the sea front between the outer walls is 1,150 feet.

Of these duns, there are four in the large island: these are, Dun Ængus, which I have just described; Dun Oghill (Plate II., fig. 4), situated about 400 feet above the sea level, and not far from the highest point of the island; Dun Onacht (Plate III., fig. 5), which is in excellent preservation, the walls being 15 feet in thickness, and their longest diameter being 94 feet; and Doo Caher.

Of the last mentioned dun, Doo Caher, or the Black Fort (Plate III., fig. 6), I have already made some mention when speaking of the first settlement of the Firbolgs at a date which tradition places about 3,000 years ago. This structure is also placed on the edge of a beetling and lofty cliff, and to all appearance is considerably older than the others, the age of which cannot, however, be much less than 2,000 years. While the stones of Dun Ængus, Dun Oghill, and Dun Onacht retain their colour and the sharpness of their edges, those of the Black Fort are much blackened, and give the impression of immense antiquity. There is a look of mystery about this decaying structure, flanked as it is by the remains of an extensive settlement of stone houses, or Firbolgic city, which is wanting in the other three duns, which almost look as if they had been built within living memory.

In the middle island there are two duns; one, Dun Connor, or Conchovar (Plate IV., fig. 7), is very large and perfect; of the other I know nothing except that I saw it from the sea, as the weather never permitted me to land on this island.

On the southern island may be seen the remains of a dun, in the centre of which are the ruins of a mediæval fortress called Furmina Castle.

I have several times mentioned the cloghauns, or stone dwellings, the remains of which are scattered over the island. These are low stone structures of two kinds, the earlier ones being little more than sleeping places, roofed by a flat stone, in which it is impossible to stand upright. Of the second, or beehive-houses, there is still one perfect specimen to be seen by clambering over a succession of stone walls (Plate IV., fig. 8). This is a circular erection, with a roof constructed of circular layers of stone, laid with their edges projecting on the inner side, this being repeated until the space between them can be closed by a single stone. No doubt the roof was made weather tight by placing sods of earth on the stones. The height of this example is sufficient to allow of an upright position, but the only means of entrance is by creeping in on the hands and knees. Near it is still to be seen a heap of broken shells, the contents of which have been used for food— a so-called kitchen midden. It is said that such houses were inhabited here until the commencement of this century.

At the present time these venerable relics of antiquity are in a comparatively good state of preservation; the great danger menacing them is that of rabbits. Rabbits are not very numerous in the islands, and the natives when digging up their burrows are apt to be regardless of other considerations, in fact I saw in several places holes in the roadway quite six feet deep, which had been made in this way. It is a pity that the provisions of the Act for the Protection of Ancient Monuments have not been extended to Ireland.

Before approaching the epoch of the introduction of Christianity into Aran, I have still one other relic to notice—viz., the stump of a round tower, unfortunately now only a stump, four or five feet high, with a circumference of 45 feet round the base. Eighty-eight years ago Dr. Petrie was told by an old islander that it was formerly 82 feet high. These mysterious structures, called round towers, are peculiar to Ireland; they are cylindrical in shape, are from 60 to 90 feet in height, are surmounted by a conical cap, and are destitute of any entrance into the interior. The time when they were erected is uncertain, but it was evidently long after the period of the duns, as they are built up of dressed blocks of masonry, cemented together. Nothing is known with any certainty of the use to which they were devoted, although there are endless theories about them, but there is little doubt that they were connected with religious observances.

I now come to a period in the history of Aran possessing an interest of an entirely different kind, although still full of attraction for the Archæologist. This period is that of the introduction of Christianity into the islands by St. Endeus, in the sixth century. The name of this person is written indifferently Endeus or Enda in the old Latin lives of the saints, and is called Eaney or Eana in the spoken Erse. He belonged to the royal house of Oriel, a territory comprising the present counties of Louth, Armagh, and

Monaghan, and was converted by his sister, St. Fanchea, a nun. He repaired for religious purposes to Italy, where he became the founder or head of a large monastery, and, returning to Ireland after the lapse of many years with a numerous body of monks, obtained through the solicitation of St. Aible, the first Bishop of Cashel, from Ængus, King of Munster, the island of Aran, which had apparently passed from the kingdom of Connaught to that of Munster since the time of Queen Maeve. He found it to be inhabited by a few pagan Firbolgs, who fled in their curraghs without waiting to hear the word of God, and before his death, which took place about the year 542, he founded in Aran no less than ten religious houses. Ara Mor thus became celebrated among all the anchorites of Western Europe. It was divided into two parishes. Over the eastern parish St. Endeus himself presided, while the western was under the jurisdiction of the most eminent of his disciples, St. Breccan, a son of the Prince of Thomond, and the founder of the old diocese of Ardbreccan, in Meath. The names of others of these holy persons are preserved in connection with the religious antiquities of Aran, as St. Benan, or Benignus, St. Kronan, St. Caradoc, who was a Briton, St. McLongius, St. Eperninus, and others. St. Brendan, of Clonfert, the celebrated navigator, visited Aran in the course of his famous Atlantic voyage, and started thence on his supposed trip of discovery to America.

In fact Aran became a great school of asceticism and sanctity, and was constantly resorted to from the Continent for the study of the Sacred Scriptures, and for the practice of the austerities of a hermit's life. An ancient writer states, "That in one small cemetery here the bodies of 120 saints repose," and that more saints are buried in Aran than are known to anyone but God alone, in fact that relics as sacred as those which Catholics travel abroad to venerate in other countries here lie neglected under moss and bramble on our own deserted shores.

About 1645, when Colgan was editing a history of the life of St. Endeus for the "Acta Sanctorum Hiberniæ," he obtained a MSS. compiled by Augustin Magraidan, from an authority which seems to be as old as the days of paganism ; this gives a list of the principal churches in these islands, of which there were three in Inis heer, two in Inis maan, and thirteen in Ara Mor, leaving it to be inferred that there were others of lesser note.

No doubt many of these ecclesiastical buildings had fallen into decay before the time of Cromwell, but the work of destruction was completed by his soldiery in the demolition of the great monastery of St. Eany, the stones of which were used to strengthen Arkin Castle, a ruin of which I shall speak later on.

However, the religious antiquities which have until now escaped the effacing fingers of time and the ravages of man, are of the greatest interest.

They consist of bullauns or baptismal stones, open air altars, like that of St. Eany, holy wells, like St. Eany's, which never dries, and which never contains more than four or five inches of water. There is no doubt that many of these open-air relics were formerly objects of reverence in pagan times, and that in progress of time this reverence has become invested with Christian associations. The other remains are those of monasteries and churches.

The most important ruin is that of the church of St. Benan, or Benignus (Plate V., fig. 9), the gem of early Irish churches. In the interior the length is only 10 feet 10 inches, and the breadth 6 feet 10 inches The original height of the gable was 17 feet. It stands nearly N. and S. and is constructed of huge blocks of stones, one block alone forming nearly the whole of the western side. This church undoubtedly dates back to the sixth century, and the roof was formed by over-lapping stones. Around it have been other churches, especially one dedicated to the Blessed Virgin, and near it is the ruin of St. Benan's humble hermitage, which is partly sunk in the rock. Within a few yards are the ruins of a rude stone cashel containing several chambers, and also a cluster of cloghauns, while at the bottom of the slope below it is seen the remains of St. Eany's monastery. In addition to these, all within an area of less than a quarter of a square mile, are to be found the stump of a round tower, the ruin of an Elizabethan castle, and three curious sepulchral monuments erected about the end of the seventeenth century: making Killeaney a veritable museum of antiquities.

The next ruin to which I shall refer (Plate V., fig. 10) is situated in the private grounds of Mr. Johnstone of Kilmurvey, and is another remarkable example of the cyclopean masonry of the sixth century, some of the stones being 10 feet long and 20 inches thick. The doorway is shaped like that of an Egyptian tomb, and certain of the windows are of extreme antiquity, with lintels formed by two leaning stones. This church is dedicated to St. Colman McDuagh, who founded the diocese of Kilmacduagh, and is also placed among the ruins of monastic buildings. The view of the interior shows work of a much later date, as also do some of the windows.

I will not attempt a description of many of the other churches, but I must refer in a few words to another ancient Irish peculiarity, viz., the tendency to group churches together. In Aran there is the ruin of a group of seven churches all built in a little rocky glen, and within the walls of a small field, with which are also intermingled monastic ruins. I may say that this is not the only place in Ireland where seven churches are built together. The founder of this group was St. Breccan, the grandson of Carthan Finn, the first king of Thomond, who was baptized by St. Patrick himself. About ninety years ago his grave was opened, and in it was found a well-shaped skull, supposed to be that of the saint, and which was carefully reburied. The ruins of Teampul Breccan (Plate VI., fig. 11) now consist of chancel and nave, the chancel being of much more modern date, possibly twelfth century work, the chancel arch and lancet window being very fine pieces of masonry, while the nave is built in a ruder manner with cyclopean windows. Here may also be seen a finely engraved terminal cross, various inscribed stones, one marked "VII Roman," and near them are the well and bed of St. Breccan, two richly carved crosses which have been broken and put together again, on one of which is a Crucifixion, and on the other the knots and interlaced work of the usual Irish type, and another holy well to the north of the ruins.

On the large island the other churches are the beautiful ruin at St. Eany's grave, the two churches of Kilronan and St. Soomey's, the Church of the Four Beautiful Saints, and St. Kierans, near the large mound which marks the site of the great Connaught monastery. The east window of this church is the most perfect specimen of church architecture of its kind now to be found in Ireland. Near it are two stone crosses.

On the middle island are to be seen the ancient oratory of St. Cananagh (Plate VI., fig. 12), this is also of sixth century date. The doorway is constructed of large stones, the lintel is only 19 or 20 inches wide, and the roof was formed by over-lapping stones. There are also the ruins of a church dedicated to the Holy Virgin, the rudely built and nearly destroyed Church of the Seven Kings, and the tomb and holy well of the Virgin St. Kenerga.

On the southern island are the ruins of the Church of St. Gobuet, and the picturesque remains of the Abbey of St. Kevin of Aran.

The mediæval antiquities are not so numerous, the most striking example being Furmina Castle on the south island. There are none on the middle island, and on Ara Mor are only to be seen, near the seven churches, ancient foundations of a small square castle of the sixteenth or seventeenth centuries, the walls of which are of uncommon thickness. St. Martin's Tower, on the south cliff, about which I could get no information, and Arkin Castle, which faces the sea at Killeaney, are the only other ruins. The latter requires some notice, since it enjoys the distinction of being the last stronghold which held out for the Royalist cause during the Parliamentary War; it was not reduced until something like six months after all resistance had ceased elsewhere.

Arkin Castle, now a ruin, was originally built in the time of Elizabeth, but was enlarged and strengthened after it fell into the power of the soldiery of Cromwell at the expense of the material procured by the destruction of the monastery of St. Eany, the only remains of which to be seen at the present day being a handsome cross placed in the middle of a field. This was one of the most important positions in the west of Ireland, giving to its owner the command of the whole trade of Galway, then one of the most important seaports in the kingdom.

About the thirteenth century these islands were in the possession of the O'Briens of Tourea in Thomond, and in subsequent years they were a source of continual warfare between this sept and that of the O'Flaherties of West Connaught, until in the time of Queen Elizabeth, Sir Murrough O'Flaherty succeeded in expelling the O'Briens and obtaining possession of the Great Island, after which the Queen declared both parties to be traitors, and seized Aran as her own; after that time all patents for land in Jar-Connaught were granted to be held as tenants of the Queen's Manor of Arkin.

I now come to the last subject of archæological interest, on which I shall say a few words, viz., that of sepulture and the memorials of the dead. Of prehistoric burial there is little trace, all I saw being a few menhirs, or standing stones as they are called in Cornwall, in the vicinity of the Church of the Four Beautiful Saints, and I believe that no cromlech, kistvaen, or barrow is known to exist on any of the islands. Of course when the old churches were in daily use there were burial places in connection with them, but the grave had generally to be excavated in the solid rock, as is the case at the present day.

Practically, there are only two places now used for burial in Ara Mor, one at Kilmurvey and the other at St. Eany's grave. The latter is situated in the sand dunes just above the sea shore, and, as these sands are moved about by the action of the wind, fragments of coffin boards and whitened bones, especially vertebræ and ribs, are constantly found littered over the adjoining sands; a similar condition of things is also to be seen on the southern island, but at a greater distance from the shore. Although the islanders see no irreverence in stabling their domestic animals in the deserted churches, and crunching the bones of their ancesters under foot, any attempt to carry away these bones would be bitterly resented.

The impossibility of erecting permanent memorials to the dead above the graves themselves has led to the singular custom of erecting these structures along the road sides within the walls of the fields. The monuments are all constructed on the type of the Fitzpatrick memorials (Plate VII., fig. 13), which are the earliest specimens I could find, and which date from 1709. On one of these memorials I saw recorded the patriarchal age of 104 years. I found one curious instance in which an inscription had been cut in a stone lying in the middle of a large field, and there left *in situ*. In several places on the island, fields on the roadside have been selected for monuments of a less pretentious character, the humblest consisting merely of small cairns of stones (Plate VII., fig. 14). I have no doubt that these fields were originally selected from some religious association, but of what nature I am ignorant.

The result of the various immigrations has been the production of a race of people of medium height, but well built and apparently healthy. The men support themselves partly by cultivating the scanty patches where this is possible, and there grow excellent potatoes, by feeding a few animals on the herbage growing naturally in the fissures and elsewhere, and partly by fishing. Coarse fish is very abundant off the shore, and can readily be caught from the rocks, and fish of a better character swarm in the deeper water. These resources are eked out by the manufacture of kelp from the seaweed ; this is collected into heaps, left to dry, and then burnt. It is a picturesque sight on a dark night to watch the figures of men feeding the fires as the kelp is burnt on the shore, as it is necessary to give it constant attention until the mass is completely calcined. The kelp is a source of iodine, but the price realised now is much less than it was formerly.

The islands are badly off in one respect, that is, the total absence of bog. The whole of the fuel—peat—has to be brought across in boats from the Connemara shore, the boats, however, carrying back cargoes of limestone, of which that district is destitute.

These boats are very remarkable, being a survival of the ancient curragh or coracle, and are called canoes by the natives ; they are 16 or 18 feet in length, and without keel ; the woodwork, both longitudinal and transverse, consists of bent narrow strips of wood, which are fastened together, and the bottom covered with tarred canvas instead of the hides formerly used. The boats are propelled by four oars of not more than about four feet in length, and two inches wide in the blade. They are, of course, very easily upset, but if properly managed will ride over the fiercest Atlantic billows. They are so light that they are not left on the beach, but carried up to the cabins. Two men balancing a canoe on their heads can easily run with it. I once saw 20 or 30 men starting on a fishing expedition one evening, the effect being most comical; the men's heads being, of course, concealed, the canoes and men looked like a procession of long-legged crocodiles.

The diet of the people consists almost entirely of fish and potatoes, with a little milk, Indian meal, bacon, and tea. Many of them never taste meat from year's end to year's end, and although a sheep is occasionally killed on the island, I believe that a very large percentage have never tasted beef in the whole course of their lives; still they seem to be hale and healthy, and many live to a good old age.

The cabins are one storied, and often consist of three rooms; in the living room there is always one corner devoted to the pig, and sometimes another to the fowls. The flooring consists of bare earth or the native rock. The pig, however, is not like ours, but is highly educated, and knows how to behave himself, so that he does not interfere with the comfort of the other members of the family.

The women affect highly coloured shawls and petticoats, either red or blue. This is the case in other parts of the West of Ireland, and is supposed to be due to the admixture of Spanish blood which exists here to a considerable extent. The woollen shawl is of universal utility, serving either for bonnet and umbrella, or for the carriage of the baby, a load of peat, etc.

The women and children are generally barefooted, and it is astonishing how they run over sharply pointed rocks which are painful to our well-shod feet. The men nearly all wear a kind of mocassin made of cowhide, with the hair worn outside; they are so fashioned that a single string on each side draws them tight, and fastens them over the top of the foot. These are called pampoutties, and when removed in the evening are put into a

PLATE I.

Fig. 1. DUN ÆNGUS.

HERALD PRESS LITH BIRM^{m}

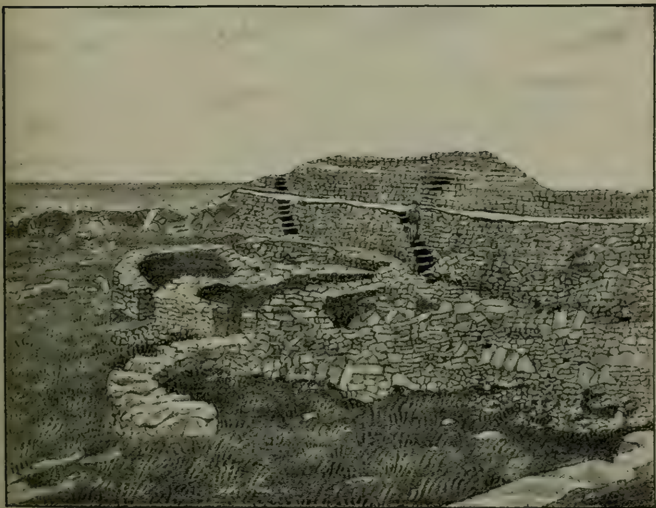
Fig. 2 DUN ÆNGUS
INNER SIDE OF WALL AND DOOR.

Fig. 3. DUN ÆNGUS. CHEVAUX DE FRISE.

Fig. 4. DUN OGHILL.

PLATE III.

Fig. 5. DUN ONACHT.



HERALD PRESS LITH BIRM

Fig. 6. DOO CAHER.

Fig. 7. DUN CONNOR.

HERALD PRESS, LITH BIRM.

Fig. 8. CLOGHAUN NA CARRIGA,
OR STONE HOUSE OF THE ROCK.

Fig. 9. ST. BENAN.

Fig. 10. ST. COLMAN MCDUAGH.

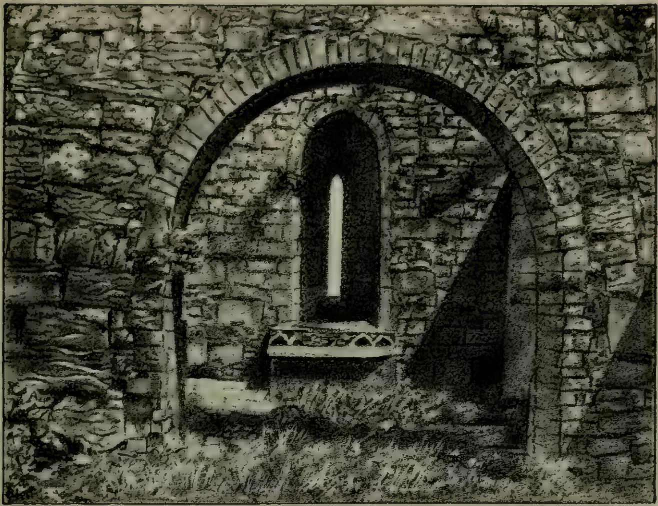


Fig. 11. ST. BRECCAN.

HERALD PRESS LITH BIRM.

Fig. 12. ST. CANANAGH.

PLATE VII.

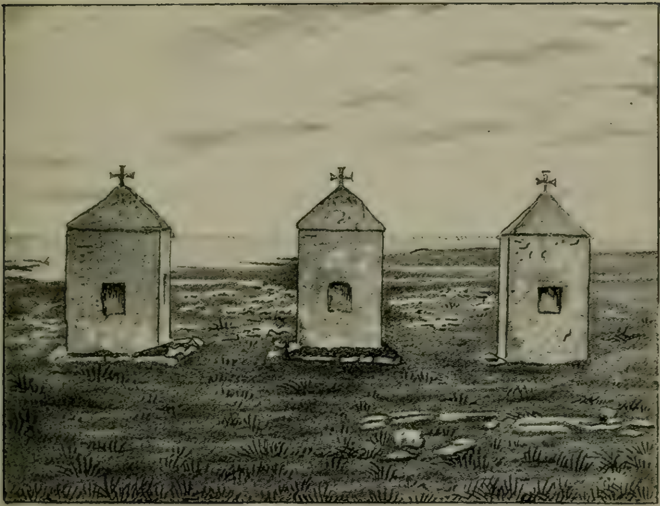


Fig. 13. FITZPATRICK MONUMENTS

Fig. 14. CAMPO SANTO, NEAR KILMURVEY.

bucket of water to keep them pliable and enable them to cling closely to the foot.

The race is a prolific one, and the population is only kept within bounds by emigration to America, certain districts of which are chiefly peopled from these islands. The women mostly stay there, but the men frequently return; they find the streets too wide, and cannot endure the boots—they want their pampoutties again.

We found the people to be as a rule both hospitable and obliging, and the begging propensities mostly confined to the children. We were much indebted to Mr. Kilbride, the Protestant rector, and to Mr. Keen, the only doctor on the three islands, for help and information.

The people are to some extent superstitious, but my ignorance of Erse, which is the only language spoken by many of them, prevented my gaining much knowledge of the folk-lore. I was, however, shown pools said to be inhabited by strange monsters, and told that they very frequently see enchanted lands out in the ocean to the west; probably this is the remnant of a tradition of the fabled continent of Atlantis.

Notes on a Salt-Marsh at Branston.

(WITH ONE PLATE).

By John E. Nowers and James G. Wells.

(*Read before the Society, December 12th*, 1890).

THE existence of saline springs in the neighbourhood of Branston is not by any means a recent discovery, for in Dr. Plot's "Natural History of Staffordshire," published as early as 1686, the following passage occurs, showing that not only was their existence a matter of common knowledge at that time, but that an attempt had actually been made to manufacture salt from the water:—"In Newbold grounds, about midway between Burton and Braunston, there are salt springs, where one Mr. Fownes about ten years since (then owner of the lands) attempted to make salt; but the mixture of freshes proved so unavoidable to him that his laudable endeavours were frustrated."

Braunston, we need hardly say, is one of the many old ways of spelling Branston; and though the Newbold grounds are here stated to be midway between Burton and Branston, there can be no doubt that they are really to the south of the latter place, a farm and cottage there, both adjacent to the salt district we are about to describe, being still designated by the appellation of Newbold.

This passage from Dr. Plot's work is quoted by Shaw in his "History and Antiquities of Staffordshire," published in 1800; and the late Robert Garner, in his work on the "Natural History of the County of Stafford," includes Braunston among the places at which salt springs occur, probably on the same authority. Sir

Oswald Mosley, in the "Natural History of Tutbury," published in 1863, states that "A few weak brine springs also appear near Branston, in the parish of Burton-on-Trent"; and in a "Flora of the Burton-on-Trent District," by the late Mr. Edwin Brown, published with the foregoing, and also in a pamphlet by the same author on the "Geology and Mineral Waters of Burton-on-Trent," the occurrence is recorded for the first time of four maritime or salt-marsh plants at Branston, viz.: *Juncus Gerardi*, *Scirpus maritimus*, *Apium graveolens*, and *Triglochin maritimum*, the author stating that this is a fact strongly "corroborative of the belief that salt springs rising near Dunstall flow across this tract of land." He also records the probable existence in this locality of *Scirpus Tabernæmontani*, another salt-liking plant.

In the course of botanical rambles over this district, we were much struck with the undoubted occurrence, and, in places, luxuriant growth of the maritime plants above mentioned, and of another which we had the good fortune to find there; and we were thus induced to investigate the limits of the area inhabited by these plants, with a view of obtaining some idea of the extent of country over which the brackish springs prevail

One of us has also made a number of analyses of the water of the various ponds and ditches about which these maritime plants occur, with the object of ascertaining whether the presence of these plants is indicative of any unusual salinity of the water, and the results of these have been most satisfactory.

The following are the maritime plants we have found growing at Branston:—

Apium graveolens, the Wild Celery.

Scirpus maritimus, the Salt Marsh Club-rush.

Juncus Gerardi, the Mud Rush.

Scirpus Tabernæmontani, the Glaucous Club-rush.

Samolus Valerandi, the Brookweed.

Rumex maritimus, the Golden Dock.

Of these, the first three are plants inhabiting salt-marshes only, but the others, though preferring salt water, are not entirely confined to saline places. The existence of all these plants at

Branston was first recorded by the late Mr. Edwin Brown, with the exception of *Samolus Valerandi*, which we discovered there in 1889. *Triglochin maritimum*, the Sea Arrow-grass, was also noted by the same observer; but this observation we have been unable to confirm, in spite of very careful search, and we can only imagine that the plant has now become extinct. It is an undoubted maritime plant.

The following detailed account of our investigations of the salt marsh will be rendered more intelligible by the map which accompanies this paper, and which shows the position of each pond and ditch mentioned. The dotted line upon it indicates the boundary within which, we believe, the outcrop of saline water is confined. The analytical results quoted are all expressed as parts per 100,000 of the water.

The village of Branston is immediately skirted on its southern side by an osier bed, which, on examination, was proved to contain no maritime plants whatever; but on the banks of a ditch running along its southern edge, *Rumex maritimus* was growing freely in the autumn of 1888. It has since, however, entirely disappeared.

The ballast pits to the north-west of the Midland Railway contain *Scirpus maritimus* in abundance in places, showing conclusively the salinity of the water.

The adjacent watercourse, known as the Tatenhill brook, is devoid of any trace of maritime plants, but between the railway and the river occur a series of ponds, in most of which evidence is not wanting as to the saline character of the water.

In Pond No. I., *Scirpus maritimus* was found growing, and analysis of the water confirmed this evidence, showing that it contained 15.3 parts of chlorine.

Pond No. II., which drains into the former one, lies with it in the remains of what has apparently been at some time a watercourse. Its maritime flora consists of *Scirpus maritimus* and *Tabernæmontani*, and its water has a faint brackish taste. An analysis in August 1889, gave 22·4 parts of chlorine, and total solids 134 parts, which in October of the present year had decreased to 20·2 and 108·7 parts respectively.

A ditch running at right angles to the direction of the two last ponds, and emptying itself into the river, shows every sign of being fed by springs. Along its banks grow *Samolus Valerandi* and *Apium Graveolens* in abundance, and its water has a slight brackish taste. In August, 1889, it contained 49 parts of chlorine and 241·6 of total solids, and in October this year its chlorine had reached the large figure of 68·2.

Ditch No. II., running nearly parallel to No. I., has *Samolus* growing in it, and its water contains 13·5 parts of chlorine. *Samolus* also occurs on the banks of Ponds III. and IV., but analysis shows, as botanists are aware, that salt is not absolutely essential to the existence of this plant, for the waters contain only 4·6 and 9·0 parts of chlorine respectively.

Pond V. is merely a surface water one, and Pond VI. is but little more, containing as they do but 2·4 and 6·1 parts of chlorine. Repeated search over the land from this line of ponds up to Walton has not brought to light any maritime plants whatever, and on recrossing the railway no trace of salt-marsh plants was found until Ditch III. was reached. This is a wide, marshy ditch, evidently owing its existence to springs, from the ferruginous deposit at intervals in its course, and from the fact that within a few yards it develops from nothing into a marshy ditch of considerable size. It has a peculiar, fetid odour similar to that which is always associated with brackish marshes. It is rich in maritime plants, *Juncus Gerardi*, *Apium Graveolens*, and *Scirpus maritimus* occurring together in abundance, and this unmistakable indication of the saline character of the water is well borne out by analysis, for a sample taken on 18th October last had a strong brackish taste, and a Specific Gravity of no less than 1004·5; its total solids amounted to 539·8 parts, and its chlorine to the large quantity of 169·1. A sample of water was also taken from what was unmistakably a spring at the commencement of the ditch, and it contained 60·3 parts of chlorine, and possessed a slight brackish taste.

The little ditch No. IV., running into the marshy one near its rise, contained *Apium* and *Juncus Gerardi*, this with the last being the only places in which we found this undoubted salt-marsh rush growing. The banks of the Ditches V. and VI., between the last one and the village of Branston, are overrun with plants of the wild celery, and analysis shows that the water of V. contains 106·1 parts of chlorine, and that of VI. 74.5. The water of No. V. tastes strongly brackish, and that of No. VI. slightly so.

We were unable to detect the occurrence of a single maritime plant on the tract of land to the north-west and north of the Lichfield Road with the single exception of *Rumex maritimus*, which was growing in a shallow pit, Pond No. VII., at the back of Branston House. *Rumex*, as we have before remarked, is not absolutely confined to salt water, and analysis decidedly showed this, for the water only contained the merest trace of chlorides. Though a spot to the north of this is marked as "Branston Marsh" on the Ordnance Map, we were unable to find water, let alone marsh plants, owing, it is said, to the pumping operations of Messrs. Bass & Co. at Shobnall. No maritime plants could be found to the east and north-east of Branston, save a solitary plant of *Scirpus Tabernæmontani*, which was found in a pit opposite to Drakelow Hall. Analysis of the water, however, showed that it only contained 2·3 parts of chlorine.

The salt-marsh at Branston seems, then, to be bounded by the following limits:—

On the north by the village of Branston, on the east by the River Trent, on its western side by the Lichfield Road, and on the south by a line about one mile south of Branston. It comprises roughly an area of 140 acres.

The following is a table of the analytical results obtained:—

	Chlorine.	Total Solids.
	Parts per 100,000.	
Ditch No. 3, 1st Sample	169·14	539·8
,, 3, 2nd Sample	114·97	357·1
,, 5	106·14	
,, 6	74·55	
,, 1, 2nd Sample	68·20	
Spring in Ditch No. 3	60·26	
Ditch No. 1, 1st Sample	48·95	241·6

	Chlorine. Parts per 100,000.	Total Solids.
Pond No. 2, 1st Sample	22·44	134·0
,, 2, 2nd Sample	20·17	108·7
,, 1	15·32	
Ditch No. 2	13·54	

A second sample was taken from the marshy Ditch No. III at the spot marked + on the map, for the purpose of making a complete analysis, but during the time that elapsed between the taking of this sample and the former one, a considerable amount of rain had fallen, and hence the chlorides and solid matter are both lower than at first. The analysis serves a useful purpose, though, in showing the composition of the saline constituents.

Specific Gravity, 1002·96.

	Parts per 100,000.
Free Ammonia	·011
Albuminoid Ammonia	·058
Chlorine	114·97
SO_3	83·11
CO_2	7·41
$Si\,O_2$	1·38
Fe_2O_3 and Al_2O_3	0·15
Ca O	42·35
Mg O	6·75
Na_2 74·76, Na_2 O 15·03	89·79
Nitrogen	0·08
	345·99
Total Solids	357·10

These are probably combined as follows :—

Sodic Chloride	189·73
Sodic Sulphate	34·42
Calcic Sulphate	102·85
Magnesic Sulphate	4·83
Magnesic Carbonate	12·55
Silica, Iron, &c.	1·61
	345·99

The geological explanation of the occurrence of these salt springs at Branston is a very simple one, for underlying the surface layer of alluvial gravel is the outcrop of a series of strata of red marl belonging to the new Red Measures. This marl was deposited ages ago from an inland sea, which extended probably across Staffordshire and Cheshire, and had one of its shores at Brizlincote. As a result of its deposition from salt water, it is found that a thin saliniferous layer occasionally occurs amongst the others, and it is to the outcrop of one of these that the brackish springs at Branston are due.

This is, we think, a more probable explanation than that the springs arise at Dunstall and flow across the Branston meadows to the river, for the most saline water we have analysed is unmistakably derived from springs. Such springs occur at several other places on the new Red formation, *e.g.*, at Weston, Shirleywich, Ingestre, and Tixall, at the two former of which salt is being extensively manufactured.

The saline waters at Branston would no doubt be much more concentrated were it not that in passing from the limit of the saliniferous stratum to the surface they suffer dilution by the water in the overlying gravel. The sinking of a tube in the vicinity of Ditch No. III would no doubt yield a strongly saline water, and we hope at some future time to lay before the Society the results of such a boring.

Though we have not demonstrated the possibility, as one or two sanguine friends were ready to imagine, of increasing the resources of the town by adding the manufacture of salt to its present one of beer, we venture to think our paper may not be without value in delimiting the area of the Branston Salt-Marsh; and, secondly, in showing the relationship between the saline constituents of a water and the plants which will inhabit it.

Our investigations have also brought to light one or two interesting facts relating to the appearance and disappearance of plants in a certain locality. As before stated, in the autumn of 1888 *Rumex maritimus* occurred freely in a ditch beside the osier bed next the village of Branston, but in 1889 it had disappeared entirely, and is still absent (Oct., 1891). The author of the "Geology and Mineral Waters of Burton" put forward the query as to whether these maritime plants have continued to exist where they now grow ever since the tidal waves reached as


Branston Canal Bridge
TRENT & MERSEY CANAL
POND No 7
Branston House
Branston
Church
Poplars Farm
Trent House
Sample taken
DITCH No 6
DITCH No 5
DITCH No 4
DITCH No 3
Tatenhill Lock
LICHFIELD ROAD
Tatenhill Brook
BALLAST PITS
POND No 1
POND No 2
Gallow Bridge
Warren Farm
DITCH No 1
DITCH No 2
POND No 6
POND No 5
POND No 4
POND No 3
Newbold Farm
Newbold Cottage
RIVER TRENT
BRANSTON SALT-MARSH.
SCALE.
0 55 110 165 220 330 440 660 880 Yards
1/8 1/4 1/2 Mile
Boundary of Salt-Marsh
J.C.W. del.

high up the valley as Branston, or whether they have developed in congenial soil from the seeds accidently carried by wild fowl up the course of the Trent from the sea-side. The appearance of *Samolus*, first noted in this district in 1889, affords a strong proof of the latter theory, *i.e.*, the carrying by birds, being the correct one, for such a conspicuous plant could hardly have escaped so careful an observer as the late Mr. Brown, and, granting its introduction, its seed must have been brought there by some agency or other, and what more probable a one than that of birds? It now bids fair to become abundant, judging by its rate of increase during the past year.

In conclusion, we cannot refrain from quoting an amusing extract from Dr. Plot's work, which is given as a commentary on the Newbold Springs, and which shows very markedly the amount of credulity which our forefathers possessed. It runs thus:—

"It must be accredited to the saltness of the soil and grass that if any horned cattle of never so deep a black, or other colour, be put to feed in a place called the Clots, in Newbold Grounds, in the parish of Tatenhill, about one mile east of Dunstall, they will certainly change the colour of their coats to a whitish dun (like a daw's head) in a summer's running, and so they will if put on Tatenhill Common, or Black Stew, another parcel of Newbold Grounds: nor does only the grass, but the hay of these grounds will also turn the cattle to this whitish dun, which, it is said, they recover not in two or three years' time, though put into grounds that have nothing of this quality. As for horses, they are improved upon these grounds at a great rate, only they make them dappled, be they of what colour soever. All which proceeds, no doubt, from the saltness of the soil, that not only communicated itself to the grass, but to all the waters thereabout, making them brackish at least, as shown above."

Trout and Grayling.

By G. Morland Day

(*Read before the Society, February 13th*, 1891).

"THE COMPLEAT ANGLER," by Izaak Walton, was first published in 1653, and when it reached its fifth edition an appendix appeared with it, entitled, "Instructions how to Angle for a Trout or a Grayling in a Clear Stream," by a gentleman named Charles Cotton, who lived in Dovedale, and had been adopted as a son by Izaak Walton, whose name is still preserved in Dovedale by the well-known "Izaak Walton" Hotel. Since the days of Izaak Walton, the number of people who take an interest in fish and fishing has increased prodigiously, and there are now so many people who go fishing, that unless some steps were taken to replenish the stock of fish, in some of the rivers there would soon be very few left to catch. There is what is termed a close season for fish, that is, they may not be caught during the time when they are spawning; but besides this it has been found necessary to artificially breed and rear a stock to turn into the rivers. The monks of old were evidently fish culturists, for attached to most of the old ruins of monasteries, remains of fish ponds are to be found; but the fish that were reared in them were principally carp, tench, and fish of that class, and not trout or grayling, which require a clear running water in which to lay their eggs.

The spawning season for trout is, in most parts of England, from about the beginning of November until the end of January; and when the fish are ready to deposit their eggs, they go in pairs to the shallow parts of the streams, and the female fish makes a hole, or rather a sort of trough in the gravel, and then lays her eggs in it. After this, the male fish sheds its milt over the eggs, and they become fertilized. They are then covered by the fish with gravel, and left to hatch out in due course, the time varying from 50 to 80 days, according to the temperature of the water. The number of eggs varies with the size of the fish, but a trout of a pound in weight will lay about 800, and so on in proportion. Many things operate to the disadvantage of the eggs, for they are a favourite food of many fishes; floods will wash them away and destroy them, and mud gets deposited on them, effectually killing them; birds look for and eat them, and the larvæ of some of the water insects destroy a great many more, so that in the end there are not more than about 5 per cent. hatched out. After hatching, the poor little fish are greedily devoured by their larger brethren, so that if, in addition to all this, fishermen are constantly taking fish out of a river, it is obvious that something must be done to keep up the stock.

As is somewhat usual when looking back into the history of things in general, it has been found that the custom of artificially rearing fish was known and practised by the Chinese many centuries ago, and there is little doubt that it was also extensively carried on by the ancient Egyptians. But, although it is recorded that in the fifteenth century a monk, named Dom Pinchon, bred fish by placing the eggs in boxes lined with gravel, and placed in the river; and that a German, named Jacobi, in 1733, also artificially reared fish in much the same way, little or nothing more is heard about it until in 1836, Mr. John Shaw, of Drumlanrig, collected salmon eggs from the natural spawning beds and hatched them artificially, afterwards placing the fry, or young fish, in the river, and from this time the progress of fish culture has been very rapid. It is quite plain that it would be a difficult matter to collect eggs in large quantities from the rivers, so the simplest plan is to keep the fish in ponds and get the eggs from them when they are ready to be laid.

At the village of Milton, close to Repton, there is a remarkably complete fish culture establishment. Here the visitor can see a succession of ponds containing fish of various ages, the oldest of which are from four to nine or ten years old, and these are the breeding stock. When they are ready to lay their eggs, they are taken out of the ponds, and if they are what is termed "ripe," the eggs are squeezed from the female fish into a basin, by a gentle pressure of the hand on each side of its body, and then the milt from the male fish is squeezed out in the same manner and mixed with the eggs, which are at once fertilized. The eggs of the ordinary trout are about $\frac{3}{16}$ inch in diameter, that is, about the size of small peas, and are generally of a pinkish orange colour, but this varies considerably in different fish. They are at first quite soft, but after they have been fertilized and well washed in clear water, they become in about half-an-hour quite firm and elastic, and able to resist a considerable pressure; while, if they are dropped on the ground, they bound like an elastic ball. They are now ready to be taken into the hatching house, where they are placed upon trays made of a framework of wood, with pieces of glass tubing stretching across it at such intervals that the eggs rest on the tubes without falling through Four of these trays, each containing three thousand eggs, are placed in what is called a hatching box, which is a long, shallow wooden trough through which a current of water can be continually kept running. Frank Buckland, that most enthusiastic fish culturist, used to object to the tray arrangement, and said that trout did not find glass rods on the bottom of the rivers to lay their eggs on, but they did find gravel, and he was in favour of using gravel in the boxes and imitating nature as far as possible; but experience has shown that the glass rod arrangement is best, and it is now in use in all the large fish culture establishments. There are at Milton 36 of these boxes, and about 200,000 eggs are placed in them each year, 95 per cent. being successfully hatched, which is a great improvement on the 5 per cent. of Dame Nature. It is most important for the health of the eggs that the water should be quite pure and maintained at an even temperature, which should be from 40 to 50 degrees Fahrenheit, and the time that elapses before the hatching takes place depends entirely upon the temperature of the water. If it is about 42 degrees, the eggs take 70 days to hatch, while at 49 degrees, which is the heat of the spring at Milton, they hatch in 50 days. When they are first laid, if one is held up to the light, it will be seen that it is semi-transparent, and has a sort of luminous spot in the middle; this is the yoke which contains the germ that eventually grows into a fish. In ten days or a fortnight the blood vessels begin to take their proper shape, and appear like a faint line running through the middle of the egg. The next important change takes place about the twenty-fifth day, when two very dark spots put in an appearance, and these eventually become the eyes of the fish. At this stage the circulation of the blood in the egg may be very easily seen with the microscope, and is an extremely beautiful sight. At fifty days the shell bursts, and out comes the little fish, which is now called an alevin. He is a very funny-looking fellow, for attached to his throat is a large bag, nearly as large as the rest of his body, called the umbilical sac, or yolk sac, and it contains the nourishment on which he feeds for the first six or eight weeks of his life, at the end of which time it has been entirely absorbed. Examined under the microscope, you at once see the little heart beating and the blood circulating through the artery and back through the veins. In the sac a number of oil globules are visible, and the rudimentary gills and fins are easily seen; but the most perfect organ it has is the eye, and this is perfectly developed as soon as it is hatched, which is a very necessary provision for the safety of the little fish. During the first portion of time that the eggs are incubating, they must not be touched or handled in any way, as they are easily injured, and if they were not actually killed, the young fish would probably be deformed at their birth. In many cases twins are hatched from one egg, and it is a curious thing that they are generally on the Siamese pattern, with distinct sets of blood vessels, but only one umbilical sac, and one tail; or else they have two heads to one body. It is needless to say that these monstrosities are short-lived, but they sometimes live six or eight weeks, until the yolk sac is absorbed. When the eye spots have appeared the eggs are called "*eyed ova*," and may be handled without fear of hurting them, and they may be packed in damp moss and sent to different parts of the country to be placed in streams and hatched out. As soon as the yolk sac is absorbed, at which stage the young fish are called "*fry*," they begin to require feeding. Their natural food consists of flies, worms, freshwater snails, and shrimps, minnows, and other small fish, but at Milton they are fed upon raw horse flesh, which is chopped up very fine by a machine. The fry are placed in ponds by themselves, and in order to give them their food in pieces small enough for their little mouths, it is washed through a fine wire sieve, so that no fibre of the meat gets into the water. At the end of the year it is generally found that out of about 200,000 fry put into the ponds, there are only about 70,000 that have grown up and become what are called yearlings, and these are from 4 to 6 inches long, and may be looked on as really healthy fish. Each pond has at one end of it a covering of boards as a shelter for the fish.

In another pond at Milton are some splendid grayling which were brought some years ago from Lincolnshire. These fish spawn in the summer, and their eggs are very much smaller than trout eggs, and hatch in from twelve to twenty-five days. The young grayling require almost more care than trout, as the least impurity in the water is fatal, and what is good enough for a trout may not do for the grayling.

The trout and the grayling belong the family known as the *Salmonidæ*, which includes the salmon, all the different sorts of trout. the char, the grayling, and one or two others.

In examining a trout or a grayling, a small fleshy appendage will be found close behind the dorsal fin. This is called the adipose fin, and is common to all the *Salmonidæ*; it does not seem to be of much use to the fish, but is handy for attaching a small label to in order to identify specimens and watch their growth after placing them in a river.

The tail is the fish's organ by which it moves through the water, while the fins act as balances, for if you remove one of his pectoral fins he rolls over to that side, and if both are removed he is unable to keep his head up, while if the dorsal or anal fins are removed, he wobbles about from side to side. The line running along the side is called the lateral line, and it is composed of a row of scales, each with a small hole or tube passing through it, from which mucous matter or slime is excreted, which causes the well known sliminess of a freshly caught fish. The gills answer the same purpose in a fish that the lungs do in the case of the warm-blooded animals, that is, they are the apparatus by means of which the fish procures a supply of oxygen for the purification of its blood. The red appearance under the gill-covers of any fish is really a series of very delicate fringes, and the fish taking gulps of water in at its mouth, forces it through the gills, which extract the oxygen from the water so that it is taken up by the blood as it circulates through these delicate fringes. When the fish is deprived of water, these fringes stick together; it is no longer able to procure oxygen for its blood, and it dies of asphyxiation in exactly the same manner as one of us would do if we were drowned.

The *Salmonidæ* may be roughly divided into two groups, the first consisting of those which, like the salmon and the sea trout, spend part of their lives in the sea and part in the fresh water, and the second group consisting of those which, like the trout and the grayling, spend the whole of their lives in fresh water. They are distributed more or less all over the arctic and temperate portions of the northern hemisphere, but, except in places where they have been artificially introduced, they are practically absent from any part of the southern hemisphere.

The fresh water trout is a most beautifully coloured fish, having purplish sides plentifully sprinkled with black and scarlet spots, with a golden tint on the belly; but its colour varies very much, and depends to a great extent on the locality from which it is taken. I have caught trout within a few yards of one another, one from an open part of the stream, with most brilliant colours, and another from under an old tree root in the water, that was very nearly black when he was landed.

There are several kinds of fresh water trout known to fishermen and naturalists, and the best known form is *Salmo fario*, or common brown trout, which is found in nearly all the brooks and small rivers in the United Kingdom, and is the trout best known to us about here. It is very plentiful in many parts of the river Dove, and there are good numbers of it in some of the brooks close by, notably in Egginton brook, Bretby brook, Drakelow brook, and in the river Blythe. The next best known form is the *Salmo levenensis*, or Loch Leven trout, which takes its name from Loch Leven in Kinross-shire, which is situated about half way between the Firth of Forth and the Firth of Tay. This fish is somewhat slighter in form than the ordinary brown trout, and has the body longer in proportion to its thickness, and is usually found without any red spots upon it. Its colour is silvery, and the spots on its sides are nearly black, and often shaped in the form of a X. By many eminent naturalists this fish is supposed to be quite a distinct species from any other form of trout; and these people also think that the other forms, such as the *Ferox*, or great lake trout, the *Gillaroo*, which is a trout that only inhabits certain lochs in Ireland, such as Lochs Corrib, Derg, and Melvin, and which might appropriately be termed the gizzard trout, on account of the remarkable thickness of the walls of its stomach, are all distinct species. In addition to these, there are, of course, the sea trout—trout which live in the sea like salmon, and run up the rivers to deposit their spawn. There are several forms of these, and they, too, are by many looked upon as distinct species. But Dr. Francis Day, who died a short time ago, and who was looked up to as one of the greatest of all authorities on matters pertaining to fish life, and more particularly as to the *Salmonidæ*, is quite inclined to think that all forms of trout are in reality of the same species, and that the different varieties are due to local circumstances, such as the water they live in and the food they are able to find in it. He found by experiment that when Loch Leven trout are taken to different parts of the country, they very soon lose a good many of their characteristic features, and a number that were introduced into Gloucestershire took to themselves the same colouring as the ordinary brown trout to be found in the neighbourhood. It is also a known fact that when the ordinary brown trout is introduced into salt or brackish waters it assumes the silvery coat of the sea trout, and it is soon very difficult to distinguish one form from the other. Another very strong argument in favour of Dr. Francis Day's idea is that in New Zealand, where the ordinary fresh water trout of England has been introduced into the rivers, it has apparently taken up some of the habits of the sea trout, has put on a beautiful silvery coat, and goes down the rivers into the sea at certain seasons of the year.

There are two other very peculiar kinds of trout that are certainly worthy of passing mention, and they are a race of tailless trout that are found in Loch Islay, and the hunchbacked trout found in the streams on Plinlimmon and the adjacent parts of Wales. It is supposed that as these latter fish are only found in small streams with numerous cascades in them, the eggs are in some way injured by the falling water, and the fish are consequently born with crooked spines.

The *grayling* is in many ways very dissimilar to the trout. It is very different in shape—the head is much smaller, it has comparatively a small mouth, with only very small and few teeth compared with the trout. It has a remarkably large dorsal fin in proportion to its size, a very forked tail, and it also has a very large air bladder. The pupil of the eye is pear-shaped instead of the usual circular shape. Its colour is a beautiful silvery grey, and it some times has numerous black spots all over its body and dorsal fin, but these are often very scarce; its back is a very dark greenish colour, and in certain lights greyish lines are visible running down its sides. These grey lines are supposed, I don't know with how much truth, to be the origin of its name, grayling (grey lines, grayling). Scientifically, it is known as *Salmo thymallus*, because it is supposed to smell strongly of thyme when it is first caught. Some people, however, say that it smells of cucumber, while others declare that they are unable to detect any particular odour about it.

It is supposed to have been introduced into England by the monks of olden times, who wanted a fish in their rivers that would be in season when salmon and trout were out of season, but this, to say the least of it, is doubtful, as grayling are very difficult fish to transport long distances, and it is much more probable that it was present in our rivers at a time when England, Scotland, and Ireland were all part of the European continent, for it is plentiful in many parts of Europe from Italy to Lapland. That the monks found it in the rivers and appreciated it as food there is very little doubt, for it is an exceedingly delicate flavoured fish.

The nervous system of fishes is very small in proportion to the size of their bodies, and it is highly improbable that they know what thirst means, although it is a somewhat common expression to hear that so-and-so drinks like a fish. Dr. Day thinks they do not drink at all, but that the amount of water necessary for their use is absorbed through the skin; and if this is not so, I don't at all see how fish that live in salt water could assuage their thirst if it is at all like ours.

It is generally supposed that the sense of taste is but very slightly developed in all kinds of fishes, and, about fifty years ago, a gentleman named Ronalds, who was a keen sportsman and naturalist, and who wrote an exceedingly good book about the different flies that trout feed upon, made some very interesting experiments upon this and other points connected with trout. He made a small observatory in a favourable position on the banks of the river Blythe somewhere near Uttoxeter, from which he could watch the trout in the river without being seen by them, for they have extremely sharp eyes, and the moment they see a man they are off like a shot. Having procured a supply of ordinary house flies, and arming himself with a tin peashooter, he repaired to his observatory, and looking out saw a good sized trout, which he knew well from its having a small white mark on its nose. He blew a fly through the peashooter to the trout, which, of course, promptly swallowed it. When he had gained the trout's confidence by sending him ten or twelve flies in succession, he sent the next one to him well plastered over with mustard and cayenne pepper to see how he would like it. It was immediately swallowed, and the trout lay watching for the next; and it eventually took no less than thirty of Mr. Ronald's mustardy flies, and in the majority of cases, so keenly was he feeding, the fly was taken at the same moment that it touched the water. The next day he was in the same spot, none the worse for his strange diet, and readily took more flies, whether they were mustarded or not. This certainly looks as if trout at any rate had not a very keen sense of taste. However, if they cannot taste much, they are certainly able to smell, for every now and then a fish may be caught that has by some accident been deprived of its eyesight, and it is generally found to be in just as good condition as the other fish in the river, which is difficult to account for in any other way than that it was able to smell its food. Old angling books all give remarkable prescriptions for anointing worms in order to attract the notice of fish, and the most remarkable one I have come across is as follows, and was published in the *Field* newspaper by a gentleman who had found it in a very old book on angling :—"Take chymical oil of lavender six drops, three drams of assafœtida, Venice turpentine one dram, camphire one dram; make these into an ointment, and anoint the inside of an oaken box with it, and put three or four worms in it, shutting it close, but keep them there not too long, lest the strength of the oil kill them. Then take the oils of camomile, lavender, aniseed, each a quarter of an ounce; heron's grease, the best of assafœtida, each two drams; two scruples of cummin seed; Venice turpentine, camphire, and galbanum each a dram; add two grains of civet, and make them into an unguent. Anoint eight inches of the line above the bait with it, and your expectation will be strangely answered."

The sense of sight in both trout and grayling is very highly developed, and trout particularly are able to detect the least movement of a man who may be on the bank of the river, who does not take great care to keep himself out of the line of the fishes' vision. They are also able to detect the very slightest difference in the colour of a floating fly, and, when there are many sorts of flies upon the water, they usually select one sort only for their meal, and do not take the least notice of any of the others, although to anyone standing on the bank and watching there is no apparent difference in shape or colour. It is an extremely pretty and interesting sight to watch a trout feeding on the very small flies that fishermen call smuts. He lies with his nose about half-an-inch under the surface of the water watching the little flies float over him, and every now and then he gently lifts his head and takes one into his mouth making only the very smallest ripple on the water in doing it. Although all these little flies look exactly alike, he only takes about one in five ; and if you catch a few and examine them, you will find that there are very slight differences in their colour, and that he takes every one of a particular sort that passes over him. Of course, when they are taking the larger flies they are not always so particular, and sometimes will take all they can see. The grayling takes his flies in quite a different way from the trout, and requires almost keener eyesight ; for he always lies pretty close to the bottom of the water, and often where it is three or four feet deep, and as the fly passes over him he rises quickly to the surface, takes it in, and as quickly resumes his old position at the bottom.

The weight attained by trout varies a good deal in different parts of the country. The largest are the *Salmo ferox*, or great lake trout, which have been recorded up to 40 or 50 lbs. in weight, and are usually caught with a large minnow, or even with a good sized trout as bait. From this weight trout are caught of all sizes, down to the little burn trout in Devonshire and Scotland, which seldom attain a greater weight than two or three ounces. Grayling do not grow to so great a size as trout, but in some of the slow running chalk streams in the South of England, such as the Test, they are frequently found up to 3 lbs. in weight; in this immediate district a grayling of $\frac{3}{4}$ lb. is looked on as a good sized fish, while the lucky angler who gets one weighing a pound talks about it for some time.

Angling is one of the most delightful of pursuits, a most healthy recreation, and one that calls into play all the best faculties of mind and body; for nowadays, when rivers are so much fished, careful thought and a good deal of practice are necessary before one can become even a moderately expert fisherman. When sport is bad the riverside is a most pleasant place for a walk; something new may be learnt almost every day, and Nature is seen at her best. To those who have never tried its pleasures, I say begin at once, and I venture to think you will never regret having followed my advice.

Notes on a Summer Tour in Norway.

By Horace T. Brown, F.R.S., F.G.S., etc.

(*Read before the Society*, *March* 13*th*, 1891.)

IN the admirable address delivered to us at the commencement of this session, our President brought before us, in a very attractive manner, the observations he had made during a holiday ramble in a very remote and comparatively unknown part of our Islands. I think the example which was thus set is one which, if followed more frequently by our Members, would conduce materially to the interest of our meetings, and to the welfare of the Society; and it is with the hope that others may be induced to bring before us similar observations that I have ventured to give you this evening some account of a tour in Norway which was made by my wife and myself last July. I do not intend to take up your time with a description of the ordinary incidents of travel, or with a general description of the country and its inhabitants, for Norway is now almost as well known to the British tourist as is Switzerland, and those of you who have not visited Scandinavia will find a multitude of works dealing with these points in a far more attractive manner than I can possibly do. I intend to occupy the short time at my disposal this evening in giving you a brief description of the natural features of the country, and in endeavouring to trace out the complex physical causes which, in bringing about the present conformation of the surface, have given birth to mountain and fjord, snowfield and glacier, deep valley and rushing torrent, all of which combine to form one magnificent picture, unapproached for grandeur or variety by the scenery of any other country in the world.

Although I shall have nothing which is absolutely new to lay before you, yet many of the facts upon which my statements will be based are not readily accessible, and at present scarcely form a part of our general stock of knowledge, for the simple reason that no one has taken the trouble to gather them together out of the numerous books and papers in which they lie hid, and bring them to a focus. I shall have occasion to show that some of the so-called facts in published descriptions of the physiography of Scandinavia, even occasionally in works of acknowledged repute, are very erroneous and misleading, one writer contenting himself with copying from another without taking the trouble to verify the facts for himself.

This great peninsula of Scandinavia extends through 16 degrees of latitude, six of which are within the Arctic Circle. Both its eastern and western coast lines are very tortuous, but the sinuosities of the western side far exceed in complexity and magnitude those of the eastern.

The eastern, or Swedish, side presents, as a rule, a succession of low shores and cliffs of no great height, and in the upper part of the Gulf of Bothnia even great alluvial deposits, which have been brought down by the rivers from the mountains. The western, or Norwegian, side of the peninsula affords a great contrast to this, in possessing a very rocky and precipitous coast, especially towards the north; a coast, also, which is indented by narrow winding rock-bound inlets, or *fjords*, which penetrate in some cases as much as 80 to 100 miles inland. For very long distances "the mainland does not come into direct contact with the sea, girdled as it is by a belt of islands," which form the so-called *skjaergaard*, or "fence of skerries," constituting the outer coast. The islands which form this skjaergaard are extremely numerous, and vary in size from many square miles in area to tiny rocks which just hold their heads above water.

Between the mainland and this wonderful wall of islets, which extends with but very few breaks from almost the southern extremity of Norway to the North Cape, is a series of connected sounds, or *leder* as they are called, through which, sheltered from the boisterous storms of the North Sea, even lightly-built vessels can safely thread their way. These leder are of the highest importance to the coastal navigation of the country.

I shall have something to say about the origin of this chain of islands, and of the fjords whose mouths they guard, but must first for a few minutes direct your attention to the distribution and structure of the mountain masses of the country.

Here I must commence by correcting what I fear is a very wide-spread error, but one which most of our map-makers and many of our geographers have done their best to perpetuate.

If we look at any ordinary educational map of Scandinavia we see distinct chains of mountains marked in the usual conventional manner, drawing their caterpillar-like lengths along, and forming, for a long distance, the boundary between Norway and Sweden. These exquisite pictures of caterpillars, in which map-makers delight, have seldom any resemblance to the plan of the mountains they are supposed to portray, but the idea which they give in this particular case is entirely erroneous. Norway, although justly considered a mountainous country, and possessing heights up to 8,500 feet, has no mountain ranges in the ordinary sense of the word, that is, no structural ranges like the Alps or the Himalayas, in which the general direction of the mountains is closely connected with, and indeed caused by, the earth movements which have folded and converted the strata constituting them.

As I wish you to have a perfectly clear idea of what I mean by a structural range, I will call your attention to the diagram (Fig. 1) representing to true vertical and horizontal scale a section across the Alps. You see that although great masses of rock have been removed from the tops of the folds into which the rocks have been thrown, yet the mountain range still clearly shows in its general conformation the influence of the crumpling,

Fig 1.—Horizontal Section across the Alps to a true vertical and horizontal scale of $\frac{1}{430000}$

Fig 2.—Section from West to East across a portion of the Scandinavian Peninsular in latitude 61° 30″ N.

and the direction of the chain still, to a considerable extent, corresponds with the original axis of elevation.

Now, in Norway we have no indication of the existence of any structural ranges like this. Certainly the rocks which constitute the mountain masses occasionally exhibit signs of vast crumpling and displacement, but this occurred at a time so enormously remote that all the inequalities originally due to this displacement have long since been erased by the ordinary denuding forces of running water, frost, and ice ; and the present mountains do not correspond in any way with these old axes of elevation.

The mountains of Scandinavia are not due to earth crumpling, but have been cut out of a vast elevated plateau, of which the whole peninsula is a part. This plateau, or table land, slopes very gradually on the eastern side to the Plains of Sweden, and terminates in low-lying cliffs on the Gulf of Bothnia, whilst on the western side the plateau, from its highest elevation, of from 7,000 to 8,000 feet, slopes much more rapidly to the North Sea. Those of you who are geologists will understand me when I say that this great plateau is a plain of marine denudation, and has really been at one time the bottom of a very ancient sea. I do not mean the sea in which the Cambrian or Silurian sediment, which constitutes a portion of its mass, was originally laid down—I mean one of much more modern date than that, but, nevertheless, a very ancient one. During and after its elevation to its present height, Nature has been at work upon the plateau with her formidable sculpturing tools of rain, frost, ice, and running water, doing her best to destroy it as fast as it was elevated. Like many other severe struggles, the matter has ended in a compromise, and whilst not succeeding in planing it down to a dead level, the sub-aërial forces have scored it with deep valleys, and divided it into separate mountain masses. The portions of this great table-land which have been thus separated from each other, form isolated mountains and vast, dreary plateaux, which, when they rise above the snow-line, form the gathering-grounds of extensive snow-fields, from which glaciers descend on all sides through the valleys. One of the largest and best known of these isolated plateaux in southern Norway is the Dovrefeld, but as this only has an average elevation of about 3,000 feet, it is not covered with snow throughout the year.

Another is the Folgefond, at the head of the Hardanger Fford, having an area of 108 square miles, whilst the Jostedalsfond, 2° further north, has an area of 580 square miles. Both these fragments of the original table-land are well above the snow line, as is also the great snow-field of the Svartisen, lying just within the Arctic Circle.

These snow-fields, besides being the parents of the great glaciers, also give rise during the spring and summer to the numerous waterfalls which form such a conspicuous feature in Norwegian scenery, and to the mountain torrents which course down the sides of the plateaux and seam them with dark glens and ravines.

Fig. 2 represents a section along a line running almost east and west across a portion of the Scandinavian peninsula, in latitude 61° 30″ N. It exhibits the general contour of the surface from the North Sea to a point where the plains of Sweden commence. You will notice how flat-topped the summits are on the western side, and how a line may be drawn which practically joins them—the line in the figure. This line approximately represents the original limit of the great plain of marine denudation, out of which the mountain masses have been carved. The vast hollows which lie below the line are indications of the enormous amount of rock which has been swept away by rain, river, and ice.

Of the rocks themselves which constitute this table-land, I have but little time to speak to-night. Suffice it to say that the foundation stones of the country are rocks of Archæan age, resembling in every particular the Archæan gneiss of our own North-Western Highlands. Upon the gneiss repose beds of Cambrian and Silurian age, which constitute the higher portions of the table-land, and occupy the more elevated portions of the country. All these rocks, from their bent, compressed, and complicated appearance, give evidence of great mountain-making forces having at one time been extremely active in this part of the world, and that this mountain-making must have occurred, just as in our Highlands, subsequent to Silurian times, is proved by the fact that the Silurian rocks themselves have participated in the great movements as much as the beds underlying them; so that although we have no structural mountains now in Scandinavia, there have been such at a very remote period, a period so remote that, in fact, their foundations only remain, and even these have been planed off almost to a dead level.

I now come to those wonderful fjords which so deeply indent the western coast of Scandinavia. These inlets only differ in point of magnitude from the sea lochs which are so numerous on the western coast of Scotland, and the two have, without doubt, had a common origin. What that may be we have now to consider. The old idea which was current in my school days, and which even now occasionally finds its way into our geographies, was that the fjords, firths, and sea lochs have all been excavated by marine action, and that they occur principally on the western coasts of European countries, because these coasts are more exposed to the battering action of the Atlantic waves. Now, whatever differences of opinion there may still be as to the exact manner in which fjords have been made, all geologists are agreed that they cannot have been formed in this manner, for a close study of marine action clearly proves that the tendency of the sea is to level the rocks which are lashed by its breakers, not to excavate deep and tortuous inlets.

If we sail along a fjord or sea loch until we come to its head, we invariably find that it terminates in a glen or valley, and that no marked line of demarcation can be traced between the land valley watered by its stream and the sea valley filled with tidal water. It irresistibly forces itself on the mind that the agents which have been instrumental in excavating the land valley have also cut the valley in which the fjord now lies, for there is not the slightest line of demarcation in the sloping sides which contain both. If the level of the land were depressed, the fjord would extend farther up the valley; if, on the other hand, elevation of the land took place, the sea lochs and fjords, emptied of their salt-water, would become land valleys.

"If we admit the sub-aërial origin of the glen, we must also grant a similar origin to its seaward prolongation, and every fjord will thus mark the site of a submerged valley. This inference is confirmed by the fact that fjords do not, as a rule, occur singly, but, like glens on land, lie in groups; so that when found intersecting a long line of coast . . . . they serve to show that the land has there sunk down so as to permit the sea to run far up and fill the submerged glens."—*Geikie.*

We have abundant evidence that considerable oscillations of level have taken place. And, in fact, even now are taking place, on the coast of Norway, so that there is nothing at all unnatural, or even unlikely, in the assumption that portions of the sea bottom immediately off the present coast-line formed a land surface a few thousand, or tens of thousands, of years ago.

The occurrence of the Skjaergaard, that extraordinary belt of islands lying off the Norwegian coast, also receives a very simple explanation when we consider the submergence which has brought the salt-water up the land valleys. These islands are not fragments carved from the mainland by the action of the waves, but the tops of hills and mountains which once formed part of the mainland. A further submergence of but a few hundred feet, whilst burying beneath the waves many of the islands of the present Skjaergaard, would give rise to many more towards the east as the present border of the mainland sank below the sea level.

To return once more to the origin of fjords and sea lochs. It might be imagined from what I have said about these occupying the sites of submerged valleys, that the bottom of these fjords would be found gradually deepening and sloping off seawards from the point where the glen meets the head of the fjord. Such, however, is not the case, for in nearly all the fjords of Norway, and in the sea lochs of our own western Highlands, the depth of the fjord exceeds very much that of the sea immediately outside. In other words, the fjords occupy deep rock basins in the valleys, and a uniform elevation of the land would convert them into fresh-water lakes of great depth. In some of our Highland lochs the depth of the loch exceeds that of the sea at its mouth by some 400 or 500 feet, but in Norway the difference is very much greater. There are, in fact, parts of the Sogne-fjord which have a depth of over 3,000 feet below that of the sea bottom immediately at the mouth of the fjord.

It is not only the sea lochs and fjords which lie in such deep-cut hollows as this, but many of the fresh-water lakes are found occupying similar depressions.

Two theories have been advanced to account for these remarkable facts. The first is that the extraordinary deepening of the portion of the submerged valley now occupied by the fjord has been produced by differential subsidence due to earth movements; the second is that the deep rock basins owe their origin to the erosive power of ice.

The theory of subsidence, when tested by the actual facts, is, I think, quite untenable, for it is impossible that such enormous displacements should have taken place in the bottoms of the narrow fjords without leaving abundant evidence in the crumpling and faulting of the rocks which bound their sides, and evidence of this kind is altogether wanting.

It is now about thirty years since Professor Ramsay pointed out that lakes occupying rock basins are exceedingly numerous only in those countries which have been largely under *glacial action*, the number of such lakes being in some measure proportionate to the amount of ice action which can be traced. Ramsay attributed the formation of such lakes and sea lochs, not to subsidence or elevation of the ground, but to the actual erosion of their basins by glaciers.

"Now, no grander display of ice action can be seen than that which the fjords and fjord valleys of Norway present. The smooth and mammillated mountain slopes, the rounded islets that peer above the level of the sea like the backs of great whales, the glittering and highly polished faces of rocks that sweep right down into deep water, the great perched blocks, ranged like sentinels on jutting points and ledges, the huge mounds of morainic *débris* at the heads of the valleys, and the wild disorder of crags and boulders scattered over the former paths of glaciers, combine to make a picture which no after amount of sight-seeing is likely to cause a geologist to forget. The whole country has been moulded, and rubbed, and polished by one immense sheet of ice, which could hardly have been less than 6,000, or even 7,000, feet thick."—*Geikie.*

Now, when we consider that a mass of ice 1,000 feet thick exerts on the subjacent rock by its own weight alone a force of 450 lbs. per square inch, that the ice sheet which covered Scandinavia at the height of the glacial period was six or seven times this thickness, and that the movements of this great mass of ice took place more rapidly, and with irresistible force, down the valleys which were in existence before this great ice mantle covered the country, it does not seem at all improbable that the moving ice, aided by the morainic *débris* attached to its lower surface, and by the flowing of water beneath, would scoop out great hollows in the valleys where the pressure of the ice was greatest and the rocks the softest. Taking everything into consideration, erosion by moving ice accounts best for the occurrence of rock basins in valleys, whether these are now filled by salt or fresh water; there are, however, some difficulties in the way of fully accepting this view; but this would take me into controversial matters, which would occupy your time too much, and, perhaps, result in but little profit. The principal facts which I want you to lay hold of with regard to both the Norwegian fjords and Scottish sea-lochs are, that they occupy *submerged valleys*, and that some parts of these valleys have, in some manner or other, been eroded to an enormous depth by the passage down and across them of the vast sheet of ice which once covered Scandinavia just as it does Greenland in the present day.

Having given you a rapid sketch of the existing physical conditions of the Scandinavian peninsula, and touched upon some of the causes which have led to the present physiography of the country, I will now proceed to describe some of its natural features as they would be seen during a voyage from South to North :—

Our first view of the Norwegian coast was at Skudesnaes, where the steamer first enters that wonderful maze of islands, the Skjaergaard, which exists, with but few breaks, almost to the North Cape, and forms a very welcome shelter against the boisterous storms of the North Sea. All these islands in Southern Norway show, just as do the lower heights of the mainland, most unmistakable signs of having been under the great ice plain. As the eye becomes gradually able to interpret these indications of ice action, they can be traced higher and higher on the steep mountain sides, but less clearly the higher we go.

We now come to the Hardangerfjord, which, with its several branches, penetrates inland for a distance of 75 miles. It is one of the most beautiful of all the Norwegian fjords, and is enclosed by rocky and precipitous mountains from 3,000 to 5,000 feet in height. At the end of one of the principal ramifications, the Sörfjord, stands the beautiful little village of Odde. The village itself is built upon a raised terrace, which consists of the alluvial deposits brought down by the present stream at a time when the land was at a lower level than it is at present, and when the fjord consequently extended much further up the valley. This terrace is one of the numerous indications of a comparatively recent rise of the land, a rise probably well within the historic period. At the present time we have reason to believe that the relative levels of land and sea in this part of Norway are not altering materially, but a few degrees further north it has been well established that an elevation of the land is taking place at the rate of as much as five feet in a century, or more than half an inch in a single year.

To the west of Odde lies, between two arms of the fjord, an isolated portion of that great plateau of Norway to which I have referred, the Folgefond. This, rising as it does above the snow line, is covered all the year round with a thick and spotless mantle of snow, which feeds the glaciers that flow down through several gorges, and from its partial melting in the summer gives rise to magnificent torrents and waterfalls, which come thundering down the mountain sides in all their liquid splendour.

No picture in black and white can give an idea of the beauty of the waterfalls. Owing to the extreme initial purity of the water derived from the melting snows, and to the fact that the course of the stream, besides being short, is over hard and highly-crystalline rocks, from which no impurity is taken up, the water of the Norwegian streams, waterfalls, and rills is of an intense emerald green tint, which, flashing through the white foam, lends a charm of intense colour to the scene which is perfectly indescribable, and which requires the highest art of the painter to realise on canvas.

I will not detain you with any description of Bergen, interesting as the town is from its old Hanseatic associations, and from the fact that it is the great trading centre of Norway, but will carry you to the beautiful stretch of country which lies between the Hardanger and the Sognefjords.

On crossing the water parting between the two fjord systems, we descend towards Gudvangen through the Naerödal, a beautiful glen, which forms the landward continuation of one of the valleys in which the Sognefjord lies. On the left of the valley is the mountain Jordalsnut, whose rounded contour is visible to the very summit, which is 3,600 feet high.

We are now on the Sognefjord, the largest of all these wonderful inlets. It penetrates the country for a distance of 112 miles, and "forms one of the most important highways of traffic in western Norway, and also one of the most convenient avenues to some of the grandest and wildest scenery in the country." It attains in some places the enormous depth of 4,000 feet. As the sea at its mouth does not exceed more than about 300 feet in depth, if we accept the glacial theory of erosion to which I have referred, it means that depressions have been scooped out by ice in the bottom of the old sub-aërial valleys to a depth of upwards of 3,700 feet. It is facts like this which make one pause before accepting such a theory with all its consequences, but no more likely alternative hypothesis has been framed ; at the same time, I confess I am very sceptical as to the time of *one* glacial epoch being sufficient for such a work.

At the northern extremity of one of the ramifications of the fjord, the great Jöstedals glacier descends from the snowfield above, almost to the water's edge.

Between the mouth of the Sognefjord and Molde we pass close under the majestic crag of Hornelen, which rises almost perpendicularly out of the water to a height of 3,000 feet.

For a considerable distance the usual track of the coasting vessels now lies outside the fringe of islands, and anyone who has passed round the promontory of the Stadt with a strong northerly breeze blowing, is the better able to appreciate the shelter which the Skjaergaard affords.

We are now in the Storfjord, which terminates inland in the Geirangerfjord; perhaps the most wonderful of all these natural inlets in Norway. It is a very narrow fjord, bounded by precipitous mountains, rising almost perpendicularly from the water's edge to a height of between 4,000 and 5,000 feet.

On both sides of the fjord are seen numerous waterfalls, some of which, descending in the form of spray or mist, betray their existence only by the disturbed state of the water below.

High up, and as much as 1,600 feet above the fjord, there is a little *gaard* or farm-house, which is built upon a small and apparently inaccessible ledge on the face of the cliff. The children of this farm may be seen disporting themselves on the small patch of green, but carefully tethered, like young goats, to prevent them making a too rapid excursion to the fjord, nearly 1,600 feet below them.

No small ledge of rock where a few square feet of grass can grow appears to be wasted in Norway, no matter how inaccessible the green patch may appear. It is no uncommon thing to see long wires stretched from the height to a farm in the valley. These wires, which are often hundreds of yards in length, are used for conducting to the farmstead the grass or wood which is cut high up on the mountain slopes.

The town of Molde, the Madeira of the north, as it is sometimes called, although in N. latitude 53° or thereabouts, has a wonderfully mild climate, owing to its sheltered position.

The Romsdal, or the valley of the Rauma, is one of the grandest mountain valleys in the whole of Norway.

The Romsdal Horn, which guards the pass, is 5,000 feet high—the ascent of this mountain, which was accomplished for the first time in 1827, is said to be more dangerous than that of the Matterhorn. At the foot of the mountain is seen a series of terraces, which are so wonderfully flat-topped and evenly sloping as to give one an idea at first that they are artificial. These terraces mark, in the same way as do those at Odde, the former level of the fjord in a by no means remote past.

The town of Throndhjem is the most northerly of all the larger towns of Europe, being in the latitude of the south coast of Iceland. It lies on a peninsula at the mouth of the Nid. Of the town and its interesting old Cathedral, I must, from lack of time, say nothing. Near the town there are two famous falls, where the whole of the river comes down in one magnificent leap of 100 feet.

At the mouth of the valley of the Nid, and in many places on the coast near Throndhjem, the old marine terraces are numerous, and very beautifully marked. Miller has recently mapped no fewer than forty-five of these terraces one above the other, and all marking short pauses in the upward movements of the land. They are chiefly in greenish clay, like brick-clays, and the smaller terraces remind one of "the incised lines and little planes engraved on the sandbanks bordering rivers in flood."

The first object of real interest which is to be seen in coasting from Throndhjem northwards, is the curious hill of Torghatten on the island of Torget, in N. latitude 65½°, therefore a little south of the Arctic Circle. It is a hill of granite about 800 feet high, and in shape somewhat resembles a sailor's waterproof hat. It is an excellent example of the rounded dome-shaped hills produced by the action of the glacial ice-sheet.

At a height of from 500 to 600 feet above sea-level, this hill of solid granite is pierced by a natural tunnel 520 feet long, and sloping gently from east to west. This wonderful tunnel increases in height from 66 feet at its eastern to 200 feet at its lower or western entrance. As the steamer passes the island, daylight can be clearly seen through this passage, and standing at its upper or eastern end, a view of the sea and islands is obtained, as through a gigantic telescope. We were fortunate enough to be able to land, and I spent a few hours in endeavouring to ascertain how the tunnel had been produced, as I have never seen, in the scanty notices of this remote island, any attempt to explain it.

The hill itself is, as I have said, of solid granite, but, like all such rock, it shows lines of weakness in certain definite directions, which are known as joint planes. It is along the line of one of these joints that the tunnel has been excavated. No doubt it originally commenced as a sea cave, at a time when the land was relatively lower than at present, and the rock *débris*, as it broke away by weathering along the line of least resistance, just as it is doing now, was removed by the action of the sea, the cave extending farther and farther, until the hill was completely pierced.

The commencement of this action is well shown in some of the joint planes near the tunnel, where excavations have been made to a depth of several feet from the face of the rock. If the sea now laved the cliffs at this level, and could remove weathered fragments, all the conditions would be present for the production of a series of caves, which might in time completely penetrate the hill as the present tunnel does.

The old Norse legends are, I regret to say, against this simple but natural explanation of the origin of the tunnel, and if we are to accept these legends as history, my matter-of-fact explanation must give place to the following. The giant, Hestmand, whilst pursuing a maiden whom he loved, was attacked by her brother, at whom the giant discharged an arrow which pierced the brother's hat. The hat, now turned into stone, is the island of Torghatten ; and in further proof of the correctness of the story, the flying figure of the woman is still to be seen, turned into stone, on the adjoining island of Lekö, whilst 100 miles further to the north is the Hestmand, or giant horseman, also turned into stone.

Northwards from Torghatten, after entering the province of Nordland, the coast maintains a character of surpassing interest for hundreds of miles, the well-rounded summits and flowing outlines of the hills, which are so characteristic of Southern Norway, giving place to bold and serrated outlines of great picturesqueness. It is very clear that these peaks have not been submitted to the abrading action of the great ice-sheet which flowed outwards from the central portions of Scandinavia, but that they stood well above the level of the ice in bold peaks and ridges, whilst their flanks and bases were assuming, under the influence of the moving ice, those smooth and rounded contours which contrast so greatly with the Alpine ruggedness of their summits.

The Seven Sisters is the name given to an indescribably beautiful and rugged chain of mountains in the island of Alstenö. They are about 3,000 feet high, and consist of mica schist. The contrast between the jagged summits and the chafed and undulating base upon which the mountains rest is very striking.

We have long ago left the realms of night behind us, but as we are not yet quite within the Arctic Circle, the sun still dips below the horizon about half-an-hour before midnight, becoming again visible half-an-hour after. The gorgeous and brilliant colouring of sea, mountain, and islands under this continuous evening light of the northern summer is perfectly indescribable; and so great is the beauty of the ever-changing scene as we steam along, that it becomes a difficult matter to take any rest. The inhabitants of this northern region never seem to take any sleep. It is no uncommon occurrence to see men working in their small farm-holdings long past midnight; and in the town of Tromsö the fashionable hour for paying calls appears to be between midnight and one o'clock in the morning. The people say there is plenty of time to sleep in the winter.

In the navigable roads between the highlands and the main-land we are continually meeting strange-looking, square-built vessels, propelled by one huge square sail attached by the yard to a single mast. These are the trading "yachts," and the heavy deck cargoes which they carry, and which look for all the world like huge stacks of fire-wood, consist of dried fish, which are being conveyed to southern ports from Hammerfest and the villages round. In build, these vessels are almost exactly similar to the ships in which the dreaded Vikings made their raids upon our coasts from these very fjords a thousand years ago. It is a curious case of survival, and of the survival of the fittest too, for, notwithstanding their apparent clumsiness, they are excellent sea boats, and wonderfully well adapted for the work they have to do.

Immediately in the Arctic Circle is the Hestmandö, the "isle of the horseman," so called from its resemblance, in certain views, to the figure of a cloaked horseman. This is the petrified giant who pierced Torghatten with his arrow. There is, perhaps, some excuse for his bad shot, in the fact that his adversary was some 105 miles distant.

We now pass the great Svartisen snow-field, from which a splendid glacier flows down to within a few feet of the sea level.

As the steamer passes up the stormy and treacherous Vestfjord, where, within the last few months such an overwhelming disaster overtook the fishing fleet, the magnificent panorama afforded by the Lofoden Islands opens out to the west. The summit of these islands has been very aptly compared with the jaw of a great shark, so many and so jagged are its points. They extend for a distance of fully 130 miles, and for the whole distance they are one mass of apparently inaccessible and partially snow-covered peaks.

The town of Tromsö is especially interesting, as we here for the first time come into contact with the Lapps, a nomad non-Aryan race, who, with the Finns, at one time constituted the sole population of this northern region of Europe. In the Tromsdal is a small colony of Lapps, who occupy several Gammer, which are dome-shaped huts made of turf and birch-bark, "with a round opening in the top for the exit of smoke and admission of light." These Lapps possess from four to five thousand reindeer.

From Tromsö we pass through magnificent coast scenery until we reach Hammerfest, a small town of from 2,000 to 3,000 inhabitants, in latitude 70° 40″ N., and which enjoys the privilege of being the northernmost town in the world. Hammerfest is the centre of the cod-liver oil manufacture, and for the great fish-curing and whaling industry of Northern Scandinavia. The curious old warehouses and shops on its wooden quays are full of polar bear skins, tusks and heads of the walrus, and many rarities of the Arctic regions, for it is from Hammerfest that the walrus hunters, who go yearly to Spitzbergen, and even farther north, commence their expeditions. Its harbour is crowded with curious, clumsy Russian vessels, which come every summer from Archangel for fish, which are cured on board; and the quays of the town are thronged with Russians, Lapps, and Finns, making a picturesque and polyglot crowd.

Here, in this remote spot, we are still within immediate touch with the more civilised portions of Europe by means of the telegraph, and the public spirit of this little town may be understood from the fact that when we were there rapid progress was being made in the installation of the electric light for illuminating the streets and houses during the long and dark winters, for from the middle of November to the end of January the sun never rises above the horizon.

How far the great fire, which occurred a very short time after we were there, has affected this work, I am unable to say. The dynamos were to be driven by a waterfall some little distance on the heights. The amount of power running to waste in the waterfalls of Norway is enormous, and, properly applied, a very small fraction of it would be sufficient to supply all the industries of the world with motive power. It is highly probable that, as our coal becomes exhausted, we shall invoke the aid of these natural sources of power, and that the energy derived from the stupendous waterfalls of Norway will one day be transmitted by cables under the North Sea to supply our factories of the future.

Such a scheme is by no means so Utopian as at first sight it may appear to you; but the day has not yet quite arrived for floating the Scandinavian United Waterfalls Company, Limited.

From Hammerfest to the North Cape is but a few hours' sail, and the scenery becomes extremely desolate and Arctic in character. We are now above the northern limits of trees, the few stunted birch trees a little south of Hammerfest being their last representatives. Vegetation of every kind is extremely scanty, "and the silence and solemnity of the scene is only broken by immense flocks of sea-fowl wheeling over shoals of fish or congregating around their island homes," and by the occasional noisy spouting of a whale.

We pass the Bird Rock, with its myriads of auks and gulls, which at the sound of a cannon shot rise in one dense cloud high in the air.

As our course is now very much to the east of north, we are reminded of the high latitudes we are in by the rapid and bewildering change in the ship's time. This, of course, is due to a comparatively short course resulting in a rapid change of longitude, the parallels of longitude lying so very close together as we approach the Pole.

The North Cape, the most northerly point of the Continent of Europe, is in latitude 71° 10″ N., and is a bold and forbidding headland rising precipitously out of the sea.

> "And then uprose before me
> Upon the water's edge
> The huge and haggard shape
> Of that unknown North Cape,
> Whose form is like a wedge."
>
> *Longfellow.*

So sang, according to Longfellow, Othere, the discoverer of the North Cape, to the incredulous King Alfred.

The arrival at this, the most northerly point of our journey, was timed so that we should have an opportunity of seeing the midnight sun from the Cape. Unfortunately, a rough sea did not permit us to land and ascend the cliff, but the clouds which had obscured the sun to within a few minutes of midnight fortunately cleared away, and we had a fine view of the sun.

Notwithstanding the bare desolation of all around, it is somewhat difficult to realize at the North Cape that one is within 400 to 500 miles of the everlasting ice of the Polar regions, and within 1,200 miles of the North Pole itself. Thanks to the strong north-eastward set of the Equatorial current of the Gulf Stream, the Norwegian seas are kept clear of ice even during the severest winters. Whilst this superficial current is freely admitted right into the land by the deeply-indented fjords, the deeper Arctic current of ice cold water never reaches the shores of Norway, owing to the existence of submarine ridges off the coast. Were it not for this, it is probable that the northern portions of Norway would be as inaccessible as Greenland is at the present day.

On Some Ancient Burton Manuscripts.*

(WITH TWO PLATES).

BY T. KNOWLES, M.A., of St. John's College, Cambridge.

(*Read before the Society, April* 10*th*, 1891).

THE ancient documents discovered in the chest of the Parish Church of this town are twelve in number. They are all of them written on parchment, and they vary in size from about 18 inches by 6 or 7 to 10 inches by 3 (about). They are in mediæval Latin, and the words are, as is usual in such documents, much contracted and abbreviated. This latter circumstance, coupled with that of the great dissimilarity between the shapes of the letters used in the middle ages and the letters used now, makes the deciphering of these documents a matter of some difficulty to anyone unused to the work. The documents are all of them deeds; that is to say, they are under seal. It is not, as many suppose, the fact of their being written on parchment that constitutes them deeds, but the fact of their being, as the phrase is, "under seal." It is probably known to most here that some law documents have merely to be signed, whilst to others you have not only to sign your name, but also to affix a seal. It is these latter documents, which are said to be "under

* I must acknowledge my indebtedness to Mr. W. H. St. John Hope, Secretary of the Society of Antiquaries, for his kind assistance in helping me to read these MSS.—T. K.

seal," that are called "deeds." All these old documents, with the exception of two, have parchment labels attached to them, and on eight of the labels the seals are still to be seen, in a more or less perfect state of preservation. On two of the labels there are no seals —time, or other means, having no doubt worn them off. On one document there is the incision in the parchment showing where the label was inserted, but the label has gone ; and on the remaining one document there is no external sign or trace of a label, but the contents of the document show that it originally had a seal attached to it.

When you come to inspect these deeds, you will, I daresay, remark that none of them are signed. That is so. None of these deeds are signed either by grantor or witnesses. The period to which the greater part of these documents belong was a time when, it may be said, it was the mark of a gentleman not to be able to sign his name, and so it was not then necessary that a deed should be signed by anyone. There were then two requisite formalities necessary to the execution of a deed—namely, sealing and delivery. In the days of which I am speaking, every person who owned property had a distinctive seal of his own. It was competent, I presume, for anyone to put whatever device he chose on his seal, provided, of course, it was a distinctive device. I do not suppose the luxury of a registration office for seals had been thought of in those days. No doubt the knowledge of the seals of private persons was gained by experience and going about in the world only. When a person executed a deed, then, in the middle ages, he affixed to it an impression in sealing wax of his own private seal, and delivered the deed to the grantee, relessee, or whatever the other party might be, but he did not sign the deed. Neither did the witnesses seal or sign it. It is still, I believe, the theory of the law that it is not necessary to sign a deed even now-a-days in order to complete its execution. But I should be very sorry to advise anyone not to sign a deed now. Since writing is a general accomplishment, and since it is found as a matter of experience that no two persons' handwriting is exactly similar the name of the maker of the deed signed by him is found to constitute a distinctive mark, testifying to the genuineness of the deed, in the same way that formerly the private seal of the maker of the deed testified to the same effect. And now, as you will be aware, distinctive private seals are not used.

Now, as to the dates of these documents. The oldest of them is dated Monday, the 2nd day of February, 1310, showing that it is now upwards of 581 years old. The next oldest is dated Thursday, the 20th day of July, 1340, nearly 541 years ago. But you must not think the dates of these documents appear in the deeds in the form in which I have just given them. If they had been given in that form I may venture to say I should have discovered their antiquity long before I actually did discover it. This is the form in which the date of these two documents is put:—"Datum apud Burton super Trentam die Lunæ in festo purificationis beatæ Mariæ, anno regni regis Edwardi filii regis Edwardi tertio." I say I am showing you the form in which the date is put in the deed, but the truth is I am giving you the words in full, not in the abbreviated form in which they appear on the parchment. Well, the translation of that Latin sentence, as you no doubt see, is—"Given at Burton-on-Trent on Monday, on the Feast of the Purification of the Blessed Mary, in the third year of the reign of King Edward, the son of King Edward." Now, that is not, of course, the way in which we should date a document nowadays. We should not, at least not as a rule, give the day of the week, but we should give the day of the month, the month, and the year anno domini. I think this would satisfy most of us better than to be told such and such a document was dated on some saint's day or another, in some year or another of a certain king. Now, this date can be modernised without much trouble. A reference to the calendar in the Prayer-book shows us that the Feast of the Purification of the Virgin falls on the 2nd of February. So the day of week and month is, "Monday, the 2nd of February." The question then is, in what year? But, before this, another question arises—namely, what king? The parchment says "King Edward, the son of King Edward." That might apply to Edward II. or Edward III., for each of these was the son of a King Edward.

But I think a little consideration will show us that Edward III. is not meant here, for he would be described as "King Edward, the son of King Edward II." Then in what year, anno domini, was this document dated? Now, Edward II. began to reign on the 8th July, 1307, so that the first 2nd February in his reign would be the 2nd February, 1308, and the third 2nd February the 2nd February, 1310. The date, therefore, of this deed is Monday the 2nd February, 1310.

I will now pass on to the date of the second deed. I have a reason for doing so, which, I think, you will see afterwards. The date is put thus:—"Datum apud Stretton die Jovis in festo sanctæ Margaretæ virginis anno regni regis Edwardi tertii post conquestum quarto decimo." That, when translated, is as follows:—"Given at Stretton on Thursday, on the Feast of St. Margaret the Virgin, in the 14th year of the reign of King Edward the III., after the conquest." Now, first of all, it cost me a little reflection to make out what the words "after the conquest" meant here. These words appear in the date of almost every one of the deeds, and may, therefore, be said to be what is called "common form." But a little reflection shows that the words are really relevant and necessary. Thus the king known as Edward III. *is* the third Edward after the Conquest; but he is by no means the third Edward if the kings of the name of Edward who reigned before the Norman Conquest are reckoned in.

On referring to the Prayer-book calendar we find St. Margaret's day is the 20th of July. Therefore, the day of week and month of this deed is Thursday the 20th of July. Now, Edward III. began to reign on the 25th January, 1327, therefore the 20th July, which fell in his fourteenth year, was the 20th July, 1340, and that is the date of this deed.

Though I entertained no doubt these were the correct dates of these two deeds, I thought it would be as well to check them as opportunity seemed to offer itself; and I calculated, supposing the 2nd of February, 1310, *was* a Monday, what day of the week would the 20th July, 1340, be? and my calculation showed that the 20th July would fall on a Thursday, the same as is stated in this second deed.

I come now to the subject matter of these deeds. What are they all about? They are all of them conveyances, of one kind or another. Nine are conveyances of the kind called "feoffments," two are "releases," and one is a conveyance of goods and chattels; so that eleven relate to real property, and one to personalty. Now I need scarcely say that these conveyances are worded very differently to the way in which a modern conveyance is worded.

I will now refer to Plate IX. for a facsimile of the first deed. I daresay it looks like Greek, and, perhaps, very bad Greek, to most of you. I confess it puzzled me at first, but a little study soon breaks down most of its difficulties. Below is the same deed in modern type, and without any of those awkward abbreviations and contractions:—

"Sciant præsentes et futuri quod ego Rogerus le Rous dedi concessi et hâe præsenti cartâ meâ confirmavi Mauricio filio Roberti de Swynesco quoddam tenementum cum edificatis supra-stantibus et omnibus aliis suis pertinentibus in villâ de Burton super Trentam et jacet in le Newe strete inter terram Hugonis de Swynesco ex unâ parte et terram Reginaldi de Lincoln ex parte alterâ et lanceat super regias vias ad utrumque caput* Habendum et tenendum de me et heredibus meis prædicto Mauricio et heredibus suis de corpore suo legitime procreatis seu procreandis et eorum heredibus faciendo inde capitalibus dominis illius feodi servicia debita et consueta quæ ad prædictum tenementum pertinent libere quiete bene et in pace cum omnibus libertatibus aysiamentis et pertinentibus ad præfatum tenementum ubique spectantibus in perpetuum. Præterea ego prædictus Rogerus et heredes mei præfatum tenementum cnm omnibus suis pertinentibus prædicto Mauricio et heredibus suis de corpore suis legitime procreatis et procreandis et eorum heredibus ut supradictum est contra omnes gentes warentizabimus et in perpetuum defendemus. In cujus rei testimonium huic præsenti

* The word in the original is written "capud": this is a mistake for "caput."

cartæ sigillum meum apposui, his testibus. John Proudfoot tunc ballivo de Burton Roberto de Chartel Waltero tintore Nicolao le Rider Johanne de Rolleston et multis aliis. Datum apud Burton super Trentam die lunæ in festo purificationis beatæ Mariæ Anno regni regis Edwardi filii regis Edwardi tertio."

Below is the same deed translated into modern English :

"Let existing and future persons know that I Roger le Rous have granted yielded up and by this my present writing have confirmed to Maurice son of Robert of Swynesco a certain tenement with the buildings standing thereon and all other its appurtenances in the town of Burton-on-Trent. And it lies in the "newe strete" between land of Hugh of Swynesco of the one part and land of Reginald of Lincoln of the other part and it extends over the king's highways at either end. To have and hold of me and my heirs to the aforesaid Maurice and his heirs of his body lawfully begotten and their heirs making therefor to the chief lords of that fee the services due and of right accustomed which appertain to the aforesaid tenement Freely quietly well and in peace With all liberties easements and appurtenances to the aforesaid tenement everywhere belonging for ever Moreover I the aforesaid Roger and my heirs will warrant the aforesaid tenement with all it appurtenances to the aforesaid Maurice and his heirs of his body lawfully begotten or to be begotten and their heirs as is aforesaid against all persons and will for ever defend. In witness whereof I have affixed my seal to this present writing these being witnesses John Proudfoot then bailiff of Burton Robert of Chartel Walter the dyer Nicholas the Rider John of Rolleston and many others. Given at Burton-on-Trent on Monday on the Feast of the Purification of the Blessed Mary, in the third year of the reign of King Edward the son of King Edward."

Now this deed is a feoffment, by which a person named "Rogerus le Rous," or, as I take it, "Roger the Red," grants, yields up, and confirms to a person named "Maurice," who is said to be the son of Robert of Swynesco, a piece of land with the buildings standing upon it, and all the appurtenances. This tenement is situate in the town of Burton-on-Trent, and lies in a street called "Newe Strete," and then the boundaries of the tenement are given.

You will observe that the rent payable, or renderable, in respect of the tenement conveyed is not, as is usual in these days, a money rent. The passage is "by rendering therefor" "to the chief lords of that fee the services due and accustomed, which appertain to the aforesaid tenement." I will not dwell on this now; I will only call your attention to it. I shall deal with it afterwards.

It was the practice in those days for a grantor of real estate to give a warranty, or a guaranty, to the grantee, in respect of his title. The warranty clause in this deed begins with the words "Præterea ego." The effect of that warranty was that if the grantor's title failed and the grantee was ejected, then the grantor had to give the grantee an estate of equal value somewhere else.

I will now refer to Plate X. for a fac-simile of the deed of 1369.

Below is a translation of this deed:

"Pateat universis per præsentes me Willelmum de Restoleston capellanum remisisse relaxavisse et omnino pro me et heredibus meis in perpetuum quietum clamavisse Roberto le Smyth de Burton super Trentam omnino dum jus et clameum quod habeo seu aliquo modo habere potero in quodam tenemento cum suis pertinentibus jacente in le Neuwe Strete de Burton super Trentam inter tenementum quondam Rogeri de Aldustree et tenementum quod Johannes de Oxenforde tenet ex alterâ parte. Ita vero quod nec ego prædictus Willelmus nec heredes mei nec aliquis alius Nomine* nostro aliquod jus vel clameum in prædicto tenemento de cetero exigere poterimus vel vendicare seu tenere præsentem firmiter sumus exclusi. In cujus rei testimonium huic præsenti scripto meo sigillum meum apposui, his testibus, Alano de Gatham tunc ballivo de Burton Willelmo Huwetsone Johanne de Oxenforde et aliis. Datum apud Burton super Trentum die lunæ

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* In the original the word "Nomine" is here written twice over.

proximo past festum Sancti Michaelis Archangeli. Anno regni regis Edwardi tertii past conquestum quadragesimo tertio."

I subjoin a translation of the same deed : 1st Oct., 1369.

"Let it be manifest to all by this present deed that I William of Restoleston Chaplain have given up released and entirely for myself and my heirs for ever have quit claim to Robert the Smyth of Burton-on-Trent the entire right and claim which I have or in any manner shall be able to have in a certain tenement with its appurtenances lying in the 'Neuwe strete' of Burton-on-Trent between a tenement formerly of Roger of Aldustree and a tenement which John of Oxford holds on the other part. Namely so that neither I the aforesaid William nor my heirs nor any one else in our name shall be able to set up any right or claim to the aforesaid tenement but from selling or holding the present tenement we are firmly precluded. In witness whereof I have placed my seal to this my present writing, these being witnesses, Alan of Gatham, then a bailiff of Burton, William Hewetsone, John of Oxford, and others. Given at Burton-on-Trent on the Monday next after the feast of St. Michael the Archangel, in the 43rd year of the reign of King Edward the 3rd after the Conquest."

This document is not a "feoffment" but a "release," another kind of conveyance.

Now by this deed William of "Restoleston," which I take to be the same place that is now called "Rosliston," releases to Robert the Smyth of Burton-on-Trent all William's interest in a certain tenement lying in the "le Neuwe strete" of Burton-on-Trent. Here again New Street is mentioned, but this time it is spelt Neuwe strete with a *u* and a *w*. The rest of the deed calls for no comment, except, perhaps, that I might call your attention to the fact that this deed does not contain any warranty of title, nor any reservation of rent. This I propose to explain later on. I might also ask you to notice that what are called the "operative words" are different in this deed from those used in the other. In the "feoffment" the words were, "dedi" "concessi et confirmavi": in this they are "remisisse relaxavisse et quietum clamavisse." One other thing might be noticed, and that is the occurrence of a word which seems to have been coined for the occasion. I mean "omninodum," an adjective agreeing with jus and clameum. The same word occurs in another deed in the accusative plural.

Having now put before you a specimen of each kind of conveyance, I propose to endeavour to explain to you the meaning of an ancient conveyance such as we have seen to-night. Tha which strikes anyone, I think, more than anything on reading one of these conveyances for the first time is the clause reserving the rent, which generally runs thus:—"To hold of the chief lords of that fee by the services therefor due and of right accustomed." That is very different to our modern notions of rent. "Paying, therefor, the yearly rent of £50 (say) by equal quarterly payments," and so on. Now, that clause points to a time when society was constituted in a radically different way to modern society as we know it. I must ask you to carry your minds back 581 years, to the year 1310. Now, that year is not quite 100 years subsequent to the granting of Magna Charta by King John, about the same distance of time that separates us from the great French Revolution, and this space had been bridged over by the reigns of Henry the Third and Edward the First; and a few more years were to see the Battle of Bannockburn. It is into that kind of atmosphere that we must try to carry ourselves for a few minutes. It was a time when, according to the well-known lines, people generally were guided by

> "The good old rule, the simple plan,
> That they shall take who have the power,
> And they shall keep who can."

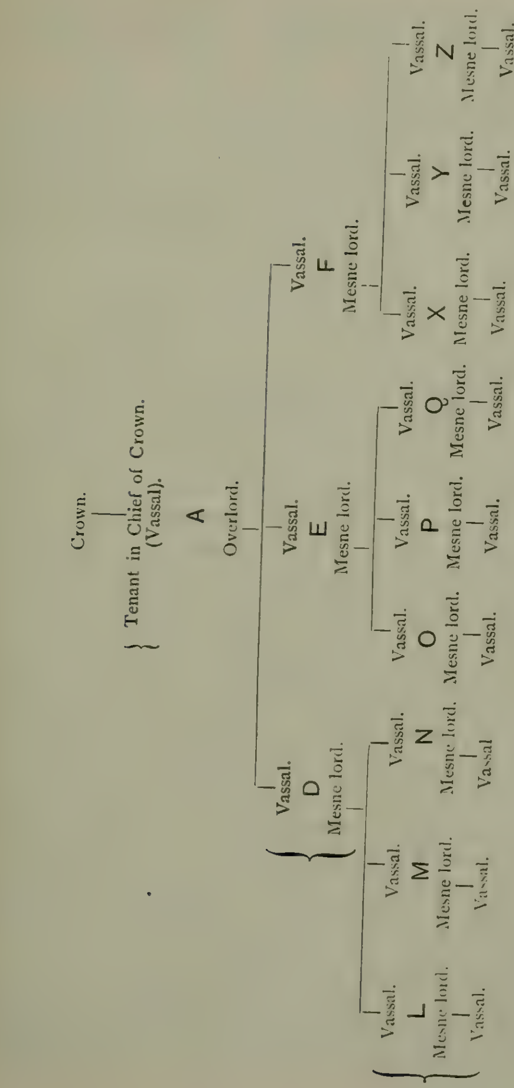
All the land in this country was then, as it is now, vested in the Crown. William the First was lord paramount of every inch of the soil, and so were, and, indeed, so are, his successors; and the Crown was the representative of the nation. It was then the business of the Crown to take the best measures it knew of in order to keep and retain its ownership of the soil for its subjects. What did the Crown do then? It divided the land up amongst those whom it judged would be strong and powerful enough to retain control of it, and who would remain loyal and faithful to itself, and these persons were styled "tenants-in-chief of the Crown." These were the two leading considerations—ability to retain and control, and loyalty. Of course the land was not divided by means of a surveyor and valuer, as we do such things now. Certain tracts or districts, with boundaries more or less defined, were handed over to certain persons, according to their supposed capacity for governing and keeping in order; some would have a large and difficult district, others smaller and easier ones, according to their ability. And what did they render to the Crown in return for this privilege? Not so much money a year, according to the acreage, as now-a-days. No; there was but little cash circulating in those days, and, as you will have understood, a money payment would not have met the circumstances. The tenant of a fief, fee, feu, or feud in those days, on being invested with his fief or fee, took an oath of fealty or fidelity to the Crown, or to whomsoever was his immediate overlord. He also made a declaration of homage—that is to say, he declared he was the man, the *homo* of his overlord. Having gone through these two ceremonies, which were by no means empty forms, the tenant or vassal became liable to assist the Crown, or whomsoever was his overlord, in war, both personally and also by bringing with him all his armed retainers. This was called "tenure by knight service," and the service to be rendered was called *rent-service*. The above formed what I may call the active part of the tenure as regards the tenant or vassal. But the tenure also carried with it certain incidents, as they were called; or, in our modern language, we should say, involved certain liabilities on the tenant's part. These liabilities or incidents may be enumerated as four. 1st.—*Aid*. The tenant was liable to render to his lord pecuniary aid, to ransom him if taken prisoner, to contribute to the expense of making his eldest son a knight, and to contribute to his eldest daughter's marriage portion. 2nd.—*Relief*. On the death of a tenant his heir had to pay a sum of money, called a relief, on taking possession of his ancestor's estate. This is somewhat analogous to our modern way of paying a premium on taking a lease. 3rd.—*Wardship.* If the heir on succeeding were under age, his lord had the custody of the body and lands of the heir until, in case of males, the age of twenty-one years was attained: in the case of females, the age of sixteen years, and the lord had to render no account of his stewardship. 4th.—*Marriage.* The lord had the right of nominating a husband or a wife, as the case might be, for his infant wards; and if a suitable match were declined, the ward had to forfeit to the lord a sum of money equal to the value of the match.

It will be seen that these "incidents" were very valuable to any chief lord of a fee.

There were other incidents to which tenants-in-chief of the Crown were liable, to which tenants of other lords were not liable, but time fails to go into these.

Now, a tenant-in-chief of the Crown, especially one who had a large fief or fee, naturally let off, as it were, all land that he could spare to his own tenants, and these became *his* vassals, took the oath of fealty, made declaration of homage, and became liable to rent-service and incidents to the chief lord, in much the same way as the chief lord was liable to the Crown. And this second lot of tenants, as I may call them, in turn became overlords to THEIR own tenants, and so on as far as the extent of the land and other circumstances would allow. I will show you a plan which I have made of the working of this style of tenancies, and which, I hope, will make the matter plain.

But you must not think that all the land of the country was let out on this particular kind of tenure. Besides the tenure of knight-service, land was let on what was called the tenure of "free and common socage." This tenure was not liable to knight-service. The "free and common socage" tenant does not appear to have taken the oath of fealty, but he made the declaration of homage, and, instead of joining in his lord's wars, he seems to have paid a yearly rent in money, and he was liable to most of the knight's incidents. These two tenancies, knight-service and free and common socage, were called the "free" tenures—that is, they


Crown.
Tenant in Chief of Crown.
(Vassal).
A
Overlord.
Vassal.
D
Mesne lord.
Vassal.
E
Mesne lord.
Vassal.
F
Mesne lord.
Vassal.
L
Mesne lord.
Vassal.
Vassal.
M
Mesne lord.
Vassal.
Vassal.
N
Mesne lord.
Vassal
Vassal.
O
Mesne lord.
Vassal.
Vassal.
P
Mesne lord.
Vassal.
Vassal.
Q
Mesne lord.
Vassal.
Vassal.
X
Mesne lord.
Vassal.
Vassal.
Y
Mesne lord.
Vassal.
Vassal.
Z
Mesne lord.
Vassal.

were only undertaken by "freemen." Other tenancies, such as those by which a tenant held land by the tenure of ploughing land for his lord, or finding him manure, were called "base" tenures.

But to return to our system of tenure by "knight-service."

When I speak of a system of tenures, I do not wish to be understood as meaning that anyone, as it were, invented an actual system, and it was brought into use by Act of Parliament, commencing on a certain day, so to speak. No; this was the system into which use, habit, and other circumstances gradually fashioned the tenure of land in those days.

This system seems to have worked well enough so far as the rendering of the rent service went. Suppose, for instance, the Crown engaged in a war; it would call on its vassal A, and A would call on D, E, and F, and they on their vassals, and so on. In this respect the plan seems to have worked well. But as time went on the class of "mesne lords" began to increase. It began to be seen that it was a good thing to be an overlord, and so vassals would let off their land to vassals of their own, and so became overlords, or, as they came between the chief lord and the lowest vassal, they were called "mesne lords," meaning "middle lords." For instance, as in the plan, D, who was vassal to A, would himself become an overlord, and would, consequently, become entitled, not only to the rent-service, which was nothing much, as it were, but also to those valuable incidents which I have spoken of, and would, as it were, intercept them from A, the chief lord of the fee. In fact we have here a phase of a question which troubles us occasionally now; I mean the question of the "middleman," the trader who comes between the wholesale dealer and the consumer, and intercepts part of the profits or raises prices. Of course the process of sub-infeudation went on gradually, and it was some time before the chief lords began to find out that their rights were being intercepted by the creation of "mesne lords." Now, naturally, the chief lords objected to this excessive sub-infeudation, or sub-letting of the land, and matters had reached such a pitch that about 200 years after the Conquest, in the year 1290, an Act of Parliament was passed, which forms a kind of landmark in the history of English conveyancing law. This Act is known as the Statute "Quia emptores." The statute enacts that in future the feoffee of lands should hold them of the chief lord of the fee by the same rent and services as his feoffor held them before. This statute, therefore, put an end to the practice of sub-infeudation. I have it here, and will read it to you. So that after the passing of the Act, D, for instance, would no longer be able to become overlord to L; but if he disposes of his land to L he must make A the overlord of L. Now, you will perhaps recollect that in the deed of 1310 Roger le Rous grants to Maurice of Swynesco, "habendum et tenendum de me et heredibus meis faciendo inde capitalibus dominis illius feodi servicia debita et consueta." That is, "to have and to hold of me and my heirs, making therefor to the chief lords of that fee the services due and accustomed." I can only suppose that the conveyancer here had not quite got used to the new state of things brought about by the statute known as "Quia emptores." But it should be noticed that, although he makes the land to be held of the feoffor and his heirs, nevertheless he reserves the rent to the chief lord. In all the other deeds the feoffee is made to hold from the "chief lords of the fee," to whom also the rent is reserved.

It may, perhaps, interest you to know that this process of sub-infeudation was the way in which "manors" were created. The owner of a manor, or lord of a manor, as he is called, is, of course, what used to be called a "mesne lord."

Lastly, it was not until the reign of Charles the Second, in the year 1660, that the tenure by knight-service was abolished. In that year was passed the statute which turned all tenancies of knight-service into tenancies of free and common socage, thus commuting what had then become an unnecessary and useless rent-service into an annual money payment.

I hope I have succeeded in making myself intelligible about these old tenures. I will now pass on to the subject of "feoffment," or the act of enfeoffing a person with an estate; in other words, granting him a freehold estate in land. You will most of you know that when a piece of freehold land is conveyed to a person on purchase now-a-days, what takes place is this: the purchaser pays down the purchase money, and then the seller delivers to the purchaser a deed signed and sealed by himself and all other persons interested in the land, and in consequence thereof the purchaser becomes the owner of this land. Nothing more is required to make this purchaser the owner of the land. But the new owner generally wishes to take possession of his newly acquired estate. Either he goes and farms or otherwise occupies it himself, or, if it is being occupied by tenants, he gives notice to them of his purchase, and demands payment to him of all rent becoming due in future. If he neglects these, as I may call them, precautions, we all should class him, and justly too, as a Simple Simon. But, observe, there is no formal or prescribed method of taking possession; and, observe further, there must be a deed executed by the seller to the purchaser. You cannot convey freehold land now-a-days by an agreement merely, or by word of mouth, there must be a document under seal. But in the days about which I am speaking, land could be conveyed without writing of any kind, the only necessary formality was that *possession* of the land must be delivered by the seller to the purchaser in a formal and prescribed manner. It was not till the year 1676, more than 150 years later than the date of any of these old deeds, that writing was made necessary to the possessing of a freehold estate. This was done by a well-known Act, called the "Statute of Frauds." This act of delivering possession was called "livery of seisin," *seisin* being the old name for *possession and receipt of rents and profits*; so that in those days in order to convey an estate of freehold upon a person, all that you had to do was to give him "livery of seisin" in the prescribed form. It was not until the year 1845, or only forty-six years ago, that this act of "livery of seisin" was actually done away with. Until that year, on a *direct* conveyance of freeholds, it was actually necessary to go through that antiquated and then useless, ceremony. It is true that for centuries it had been possible, by more or less circuitous modes of conveyancing, to dispense with this ceremony. Now "livery of seisin" was effected in this way. The feoffor and the feofee both went on to the land to be conveyed, and, in the presence of witnesses, the feoffor took up a clod of earth, or a stick, or twig, and handed it to the feofee, saying at the same time: "I deliver this to you in the name of seisin of the whole." By this simple act the feoffee became the owner, and entitled to receipt of rents and profits. I believe it was usual for a deed of feoffment to be signed and sealed and handed to the purchaser, but it was not necessary.

It is not difficult to conceive how, in those wild, turbulent, and uneducated days, the fact of an owner actually making over his land to a new owner, publicly in the presence of witnesses, should be deemed a prime necessity; and that a written instrument which few could read, and fewer understand, should be considered a thing of quite secondary importance. Our ancestors appear to have had an almost superstitious veneration for "seisin," or feudal possession, for if a person should have made "livery of seisin" when he was not really in a position to do so, nevertheless the person upon whom the seisin had been so conferred actually thereby acquired the estate which had been wrongfully conferred upon him. Thus, supposing a person to have had a life estate in property, and he was to have enfeoffed and made "livery of seisin" of the property for an estate of inheritance upon someone, then this latter person actually acquired an estate of inheritance in the property. The feoffment in this case was said to have a *tortious* operation, that is, a *wrongful* operation. The person who was entitled to be enfeoffed, if there were any one such person, was said to be "disseised," that is, he was, as it were, disestablished and disendowed; and the person tortiously enfeoffed was called a "disseisor," and he had to be got out by operation of law: a mere physical "kicking out," so to speak, would not be effective, for he might still enfeoff some third person, who might enfeoff number four, and so on. I cannot help thinking it was during the times when the notion of "seisin" prevailed that the saying originated, "Possession is nine points in the law;" and I have always thought the saying was taken from the analogy of the game of whist, of course *long* whist. The saying may be paraphrased thus—"In the game of the law, he who has the possession has only to gain one more trick in order to win the game."

I can only very incidentally touch upon the conveyance by "release." A "release" was the proper mode of conveyance of an ulterior interest. Thus, suppose a person entitled to an estate for life, of course he would be in possession of the property—*i.e.*, livery of seisin would have been made to him, and, of course, there must be someone entitled to the property after his death—technically called, entitled in remainder. Suppose the remainder man wished to convey his interest to tenant for life, he would, therefore "release" his interest to the life tenant by deed, and, of course, it follows that no livery of seisin would be necessary, nor any reservation of rent-service, nor any warranty of title.

The foregoing are what I consider the chief points connected with these ancient documents. But there are several points of importance, and many of interest, which I must leave untouched. Such are, the estate tail, such as is created by the deed of 1310 (this is the only one of these deeds which creates an estate tail), the livery of seisin in law, the livery by deed, the burgage tenure, and others. Nor can this paper be considered anything like a full or exhaustive account of the subjects of which it treats, for a full explanation of the different subjects would fill a small volume.

Besides the deeds of 1310 and 1369 already commented on, there are ten other deeds: one of 1340, one of 1342, two of 1351, and one of each of the following years:—1378, 1394, 1398, 1479, 1497, and 1512.

In conclusion, I propose now to put before you briefly the chief local points of interest connected with these documents.

Having gone through the deed of 1310, I will only now point out one fact that seems to be of local interest—namely, that one of the witnesses to the deed is John of Rolleston, thus showing that Rolleston can claim to be at least 600 years old.

The deed of 1340 is a feoffment by which Richard Groucocks of Stretton grants to Richard of Ilum some land near a place called

Twychell. One of the witnesses is John Gober of Horninglow, and another Henry del Bushcones of Brontceston, which, no doubt, is Branston.

The deed of 1342 is a deed of gift, by which John Ordurday gives to his son, Stephen Ordurday, all the goods and chattels of his in a certain tenement which he (John) has previously granted to Stephen.

The one deed of 1351 is a feoffment by which Matilda, daughter and heiress of Maurice of Swinesco, grants to Galfred of Ockbrook, who is described as "de Burton," all her lands and tenements in the counties of Stafford and Derby. This lady appears to be the daughter of the grantee named in the deed of 1310. Among the witnesses are Maurice of Wynsull—which, no doubt, is Winshill—and William of Stapenhull; also Robert of Amynton, no doubt Amington, near Tamworth.

The other deed of 1351 is a feoffment by which Millicent—spelt here Milisand—late the wife of John of Horninglow—I presume the widow of John is meant—grants to Stephen Orderday of Burton a messuage in the town of Burton. Among the witnesses are Reginald of Asscheburne, which is Ashbourne, and John of Caldwell.

The deed of 1378 is a feoffment by which Adam of Hopton, described as of Lichfield, grants to John Peynter of Burton-on-Trent, three acres of arable land, which appear to be situate "in campo de Whytinor." Among the witnesses are John Worthington and William of Linton.

The deed of 1394 is a feoffment by which John Walker of Burton-on-Trent grants to William Robeley of Burton all the arable lands situate in the fields of "Wychinere" (Wichnor), which were granted to him (William) by Robert Walker of Repyndon, which no doubt is Repton.

The deed of 1398 is very illegible. It is a form we have not had before, commencing "omnibus christi fidelibus." It is evidently a release made by one Richard Redynges to Roger Combreford of Burton.

The deed of 1479 is a feoffment by which William Blount of Burton-on-Trent, tanner, grants to Jacob Nones of Burton, and John Mylles and William Walker of the same place, the fourth part of a burgage tenement in Burton. It is noticeable that the tenement is said to be built and situated "below Newbygging, now called Horninglow Street," thus showing that Horninglow Street was a comparatively new name in the year 1479.

The Latin scholarship of the draughtsman of this deed is not very high, seeing that he writes "totum illud quartam partem," meaning, I presume, "all that fourth part."

The deed of 1497 is a feoffment by which John Porter, senior, of Bromley Abbotts, grants to John Barnes of Burton a half burgage tenement in the town of Burton. It is noteworthy that in this deed we have the date given in the modern form, namely, the 5th of May; and not so many days before or after a saint's day.

The deed of 1512 I venture to call a fine specimen of handwriting. It is written in the hand called "Court hand." This document is a release by which William Greysley, grandson of John Greysley, releases to Thomas Power, John Blount, and Henry Watson, their heirs and assigns, a certain messuage situate in High Street, Burton-on-Trent, with its appurtenances. William Greysley also ratifies and confirms a feoffment which had been made of the same property by his grandfather, John Greysley, to Robert Middleton, Thomas Browne, Thomas Power, Henry Watson, Richard Poppawe, John Mills, John Blount, junior, John Walker, and William Walker. One of the boundaries of the property released is the Hay Ditch, which all who have known Burton for the last thirty years will remember. This deed, though of more recent date than the one just referred to, is dated in the ancient way, by reference to a saint's day. There is also a warranty of title in this release, which, according to the recital part of it, seems to have been rendered necessary by some defect in the feoffment made by the relessor's grandfather, John Greysley.

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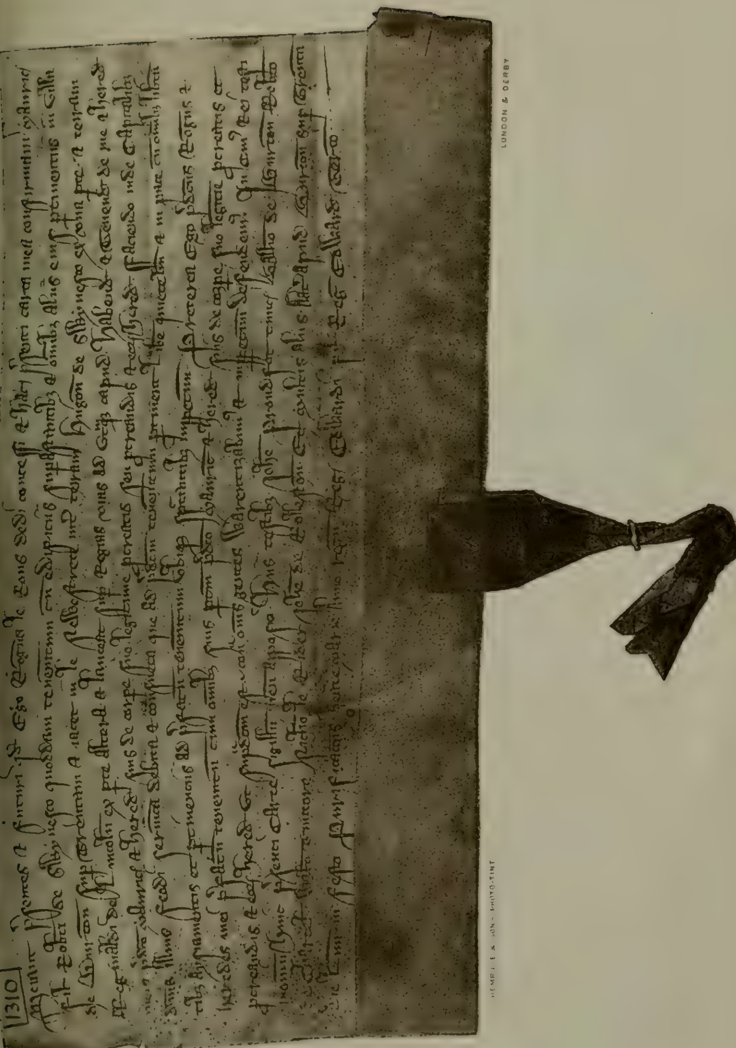
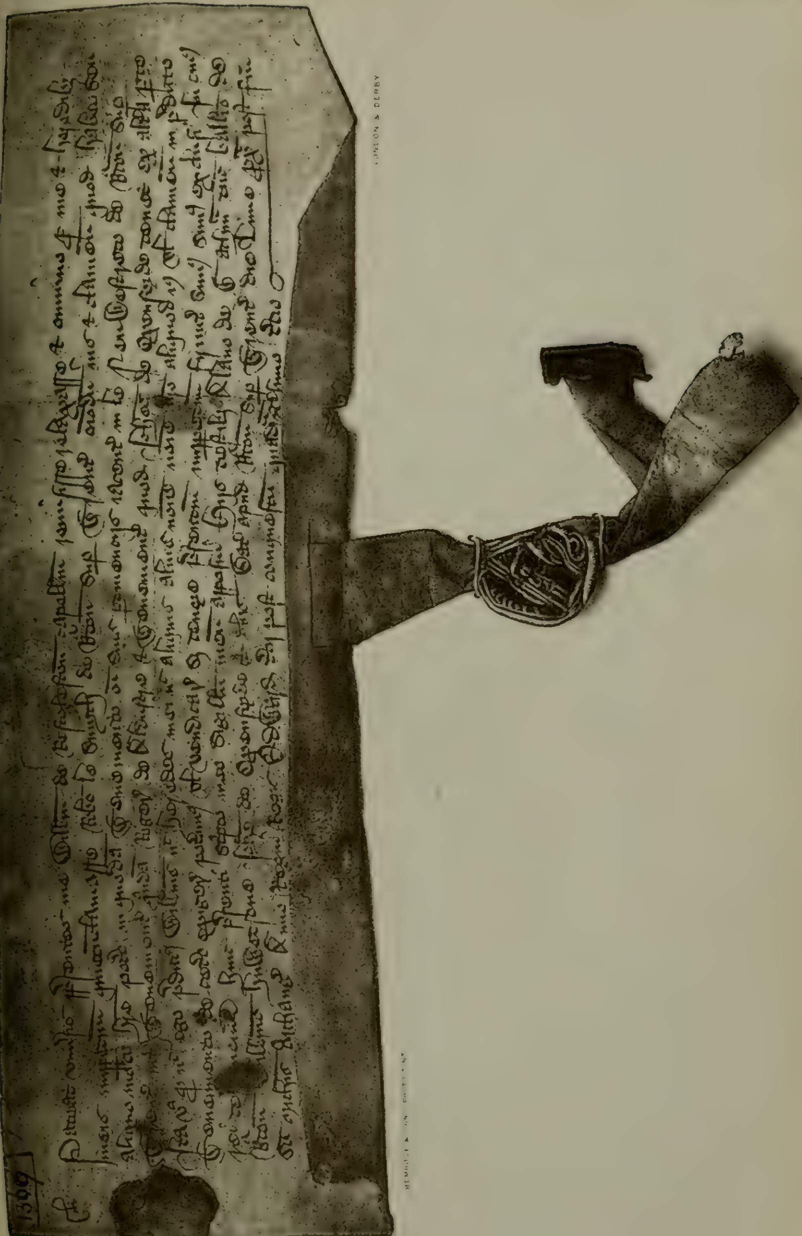

1310

Plate X.



VOL. III.—PART I.

Transactions

OF THE

Burton-on-Trent Natural History and Archaeological Society,

WITH

Annual Report, Balance Sheet, &c., &c.,

FOR SESSION 1892-93.

EDITED BY

JAMES G. WELLS,
Hon. Secretary.

LONDON:
Bemrose & Sons, Ltd., 23, Old Bailey; and Derby.

MDCCCXCIV.

BURTON-ON-TRENT

Natural History & Archæological Society,

30, HIGH STREET.

ANNUAL REPORT, BALANCE SHEET,

&C., &C.,

FOR THE

YEAR ENDING SEPTEMBER 30TH, 1893.

LONDON:
BEMROSE & SONS, LTD., PRINTERS, 23, OLD BAILEY;
AND DERBY.

1894.

PAST PRESIDENTS.

1876-77—S. EVERSHED, Esq., M.P.

1877-78— „ „ „

1878-79—Rev. C. F. THORNEWILL, M.A.

1879-80—H. G. TOMLINSON, Esq.

1880-81—W. MOLYNEUX, Esq.

1881-82—R. THORNEWILL, Esq.

1882-83—C. O'SULLIVAN, Esq., F.R.S.

1883-84—Rev. C. F. THORNEWILL, M.A.

1884-85—Hon. G. H. ALLSOPP, M.P.

1885-86—J. T. HARRIS, Esq

1886-87— „ „

1887-88—HORACE T. BROWN, Esq., F.R.S.

1888-89— „ „ „

1889-90—P. B. MASON, Esq., J.P., M.R.C.S., F.Z.S., F.L.S. &c.

1890-91— „ „ „

1891-92—T. KNOWLES, Esq., M.A.

1892-93— „ „

OFFICERS OF THE SOCIETY,

1893-1894.

President:

G. HARRIS MORRIS, Esq., Ph.D., F.I.C., F.C.S.

Vice-Presidents:

Horace T. Brown, Esq., F.R.S., F.G.S., &c.
T. Knowles, Esq., M.A.
Philip B. Mason, Esq., M.R.C.S., F.Z.S., F.L.S., &c.
The Right Rev. Bishop Mitchinson, D.C L., F.L.S., &c.
C. Perks, Esq., M.R.C.S., &c.
C. O'Sullivan, Esq., F.R.S., F.I.C., &c.
Rev. C. F. Thornewill, M.A., F.E.S.

Hon. Treasurer:

Mr. Edwin A. Brown.

Hon. Secretaries:

Mr. James G. Wells, Selwood House, Shobnall Street. (General.)
Mr. J. E. Nowers, Blackpool Street. (General.)
Mr. T. C. Martin, Trinity House, Horninglow Street. (Excursion.)

Committee:

Mr. Adrian J. Brown.	Mr. E. F. Daniel.	Mr. C. Hensman.
Rev. V. A. Boyle.	,, G. M. Day.	,, R. Moxon.
Mr. R. Churchill.	,, S. J. Fisher.	,, H. S. Skipton.

Hon. Auditor:

Mr. C. G. Matthews.

LIST OF SECTIONS & SECTIONAL OFFICERS.

BOTANICAL AND MICROSCOPICAL.

Chairman:

MR. P. B. MASON, M.R.C.S., F.L.S., &c.

Hon. Secretary:

MR. JAMES G. WELLS, Selwood House, Shobnall Street.

PHOTOGRAPHIC.

Chairman:

MR. R. CHURCHILL.

Hon Secretary:

MR. R. N. BLACKBURN, Blackpool Street.

*** *Members wishing to join either of the above Sections are requested to communicate with the respective Secretaries.*

ANNUAL GENERAL MEETING, 1893.

The Eighteenth Annual General Meeting was held in the Friars' Walk Schoolroom, on Friday, October 20th, 1893

The PRESIDENT (Mr. T. Knowles) was in the Chair, and a large number of members were present.

The HON. SECRETARY read the Report and Balance Sheet for the past year, as follows:—

REPORT OF THE COMMITTEE FOR YEAR ENDING SEPTEMBER 30TH, 1893.

Your Committee have much pleasure in presenting their Report of the Seventeenth Session, and are glad to be able to say that great interest in the Society is shewn by members, who have attended the evening meetings in large numbers.

The Conversazione, promoted by the Photographic Section of the Society, and held on the same day as the last Annual General Meeting, was a very great success, due in no small degree to the zeal of Mr. R. Churchill, the chairman of the section. The expenses connected with it cost the Society the sum of £7 1s. 5d.; but as no charge was made to members for admission, and refreshments were supplied free, this result was considered to be very satisfactory.

The monthly meetings were held as heretofore at the Masonic Hall, and were attended by the high average number of 59 members and friends at each meeting.

The titles of the papers read at these meetings, and their authors, were—

October 21.—Annual General Meeting and Photographic Conversazione, at St. Paul's Institute.

November 18.—President's Inaugural Address: "Notes on a Sojourn in the Levant."

December 16.—"Westminster Abbey and its Monuments." (Part II.) R. Moxon.

January 20.—"Leaf outlines—Why so varied." J. W. Carr, M.A.

February 17.—"A Recent Visit to the Dalmatian Coast," H. T. Brown, F.R.S.

March 17.—"The Chemical Action of Light." Dr. G. Harris Morris.

April 21.—"York; with a few Notes on Beverley and Whitby." R. Churchill.

The thanks of the Society are certainly due to the gentlemen who so kindly contributed these papers, which not only afforded instruction and pleasure to members, but also maintained the high reputation that the Society's proceedings have acquired during the last few years.

Three excursions were arranged for the summer months, but only two of them took place. The first was to Wingfield Manor, under the leadership of Mr. H. S. Skipton, and it is a matter for regret that it was only scantily patronized by members, as Wingfield Manor is a place of great historical interest, and the route selected for the walk passed through some very pretty country. The day was fine, and those who went had a very enjoyable trip. The second excursion was to Coventry, under the leadership of Mr. W. G. Fretton and Mr. Horace T. Brown. Mr. Fretton, who lives at Coventry, kindly undertook to draw up the programme for the use of members, and as the town teems with subjects of archæological and general interest, he provided one that gave great satisfaction to all who took part in the excursion. It is pleasant to record that the members turned up in considerable numbers, that the weather was extremely fine, and that the excursion was a great success from every point of view; and the committee sincerely hope that the success scored on this occasion will stimulate members to attend the excursions in larger numbers and with an increased zeal for archæological subjects.

The third excursion, arranged for Mancetter and Merevale, had to be omitted owing to the unfortunate indisposition of one of the leaders.

The election of President for the ensuing season took place at the April meeting, when Dr. G. Harris Morris, who has for so many years done such good work for the Society, was unanimously elected.

It is gratifying to note that the number of subscribing members is larger now than it has ever been before, the figures having risen from 211 to 215; a small but satisfactory increase, shewing that the Society not only holds its own, but continues to rise in favour. There are also eight honorary members and three associates.

Mr. G. Morland Day, who has acted as honorary secretary during the past year, finds that he is unable to continue the duties in connection with the post, and retires from his office with the hearty thanks of the Society for the able manner in which he has managed its affairs during the year and for the time and care he has devoted to them.

During the last summer Mr. Fleming found it necessary to give the Society notice to quit its premises at No. 46, High Street, as the site was required by Messrs. Worthington & Co. for building purposes. The Committee after careful consideration decided to take for a year another room at No. 30, High Street, the rent of which was £10, as against £6 that they had been paying for the old room. Messrs. Worthington & Co. announced that they would be glad if the Society would give up possession immediately, and if this were done, they would, in consideration of the trouble caused, pay all the expenses of removal, and also pay the first year's rent of the new room. It is needless to remark that this generous offer was immediately accepted, and the habitation of the Society is now No. 30, High Street. The Committee take this opportunity of drawing attention to the fact, that at this room there is a fair collection of archæological remains, and an excellent library; and they would be glad if it were better patronised by members.

The thanks of the Society are again due to Mr. J. G. Wells, for the careful and competent manner in which he has looked after the meteorological instruments, and for the able weather report he compiled for the year 1892. This report was issued to members early in the year, but will also be attached to the annual report, as has always been the custom.

It was found on several occasions last season that the accommodation at the Masonic Hall was not nearly commensurate with the needs of the members, and the Committee have therefore decided to hold the monthly meetings at the Friars' Walk Schools.

Financially, the Society is still in a flourishing condition, the balance in hand having risen from £21 0s. 7d. to £27 0s. 6d., and there is also the sum of £9 6s. 9d. to the credit of the Publication account.

The Photographic and Botanical Sections of the Society have done good work during the year, but the Entomological Section has ceased to exist. The Committee hope that this section will be started with renewed vigour during next year.

In accordance with Rule II., Messrs. Thrift, Wells, and Odling retire from the Committee, and are not eligible for re-election.

In conclusion, your Committee are glad to be able to congratulate the members on the very flourishing state of the Society, and tender their best thanks to all who have assisted in placing it in its present high position in the estimation of the public.

The Report and Balance Sheet were adopted on the motion of Mr. D. V. Anderson, seconded by Mr. J. E. Nowers.

The Officers, Committee, and some new members were then elected, a vote of thanks to the Chairman bringing the meeting to a close.

NATURAL HISTORY & ARCHÆOLOGICAL SOCIETY.

BALANCE SHEET FOR YEAR ENDING SEPTEMBER 30TH, 1893.

Dr.				£	s.	d.
To Balance in hand				21	0	7
,, Subscriptions—215 at 5s.				53	15	0
,, Do. Three Associates at 1s.				0	3	0
,, Sale of Transactions and Stamps				1	7	9
,, Hire of Lantern				1	0	0
,, Sale of Oxygen				0	1	0
				£77	7	4

Cr.				£	s.	d.
By Expenses in Connection with Conversazione	14	7	5			
,, Less Receipts for Tickets Sold	7	6	0			
				7	1	5
,, Rent of Room—46, High Street				6	0	0
,, Gas—46, High Street				0	4	5
,, Printing and Stationery—						
Bemrose	1	2	8			
Perfect	15	13	1			
				16	15	9
,, Purchase of Oxygen				0	9	4
,, Carriage of Cylinder				0	1	0
,, Postage				7	3	4
,, Addressing Circulars				1	14	6
,, Collector's Commission				2	14	0
,, Hire of Masonic Hall				2	8	0
,, Refreshments at General Meetings				1	2	2
,, Purchase of Books and Binding				2	9	3
,, Hire of Chairs				0	10	6
,, Fixtures at 30, High Street				0	6	0
,, Repairs to Boards and Desk				0	6	0
,, Tools				0	3	8
,, Lime Cylinders				0	3	6
,, Sundry Expenses				0	14	0
,, Balance in Treasurer's Hands				27	0	6
				£77	7	4

Audited and found correct,

CHAS. GEO. MATTHEWS.

PUBLICATION ACCOUNT.

		£	s.	d.
Oct. 1st, 1892.	To Balance in Hand on Deposit at Bank	9	0	0
Oct. 1st, 1893.	To Interest to Date	0	6	9
		£9	6	9

REPORT OF THE PHOTOGRAPHIC SECTION, 1892-93.

Chairman: R. CHURCHILL, ESQ.

This Section has been rather inactive during the past year. Only three meetings have been held, with an average attendance of four.

The principal event of the year was a very sûccessful Photographic Exhibition, held in St. Paul's Institute, at the annual general meeting of the Society, on October 21st, 1892.

The exhibits were numerous, including some very fine work by members and others.

JOHN E. NOWERS,
Hon. Sec. of Section.

REPORT OF THE BOTANICAL & MICROSCOPICAL SECTION, 1892-93.

Chairman: P. B. MASON, ESQ.

One meeting has been held during the past Session, at which a discussion took place on the pr̈oposed "Flora of the District," when it was decided, among other resolutions affecting its scope and plan, that the district be the country included within a circle of twenty miles radius from Burton, instead of the area originally decided upon, and also that all localities given should be referred to their respective counties. Mr. J. E. Nowers and the Hon. Sec. were appointed to obtain all possible references to existing lists, and, as the result of several meetings, they have completed their task up to the end of the *Cistineæ.*

The following finds have been placed on record during the Session :—

By Mr. Nowers :

Mentha gentilis, Linn. ; Thorpe.

By Messrs. Nowers and Gibbs :

Habenaria conopsea, Benth. ; Brassington Rocks.

By Messrs. Gibbs and Wells :

Helleborus fœtidus, Linn. ; Matlock.

Sedum Telephium, Linn. ; Via Gellia and Brassington Rocks.

By the Hon. Sec. :

Chrysosplenium alternifolium, Linn. ; Ellastone, Northwood, and Wootton.

James G. Wells,

Hon. Sec. of Section.

THE WEATHER OF 1892.

The past year was an abnormal one from both the aspect of its temperature and of its rainfall. It was colder than any year since 1879, and its rainfall was considerably below the average, making it the sixth dry year in succession. Its remarkable features were its severely cold March, June, and July, and its dry March and April.

MEAN SHADE TEMPERATURE.

	Means for 1892.	Averages of 1876-91.	Difference of 1892 from average.	
Jan.	35·4	36·4	—	1·0
Feb.	37·7	39·1	—	1·4
Mch.	36·4	39·7	—	3·3
Apl.	43·2	44·0	—	0·8
May	51·4	49·9	+	1·5
June	54·0	56·6	—	2·6
July	55·2	59·5	—	4·3
Aug.	57·6	58·7	—	1·1
Sept.	52·6	54·6	—	2·0
Oct.	43·7	47·0	—	3·3
Nov.	43·4	41·6	+	1·8
Dec.	34·4	37·0	—	2·6
Year	45·4	47·0	—	1·6

With the exception of two months, May and November, the mean shade temperature of every month was below the average, and in three cases exceptionally so. March was colder than any month of that name during the past 16 years, except in 1883, and June than any June save in 1882. July was unprecedently cold, the mean shade temperature being lower than in any July during the period of which I hold records. October was also a very cold month, while November was the reverse, having practically the same temperature as its predecessor.

RAINFALL.

	Totals for 1892.	Averages of 1876-91.	Difference of 1892 from average.	
Jan.	1·41	1·94	—	0·53
Feb.	1·19	1·82	—	0·63
Mch.	0·76	1·79	—	1·03
Apl.	0·96	2·02	—	1·06
May	2·07	2·34	—	0·27
June	2·63	2·43	+	0·20
July	1·89	2·63	—	0·74
Aug.	2·44	2·75	—	0·31
Sept.	2·74	2·36	+	0·38
Oct.	2·49	2·77	—	0·28
Nov.	1·61	2·50	—	0·89
Dec.	1·96	2·51	—	0·55
Year	22·15	27·86	—	5·71

With two exceptions—June and September, which were not greatly in excess—the rainfalls of the months were all below the average, and in two instances considerably so. March was over an inch deficient, being the driest month of that name during the past seventeen years. It was succeeded by an April, which was equally deficient, and which was the driest, save in 1881, in the same period.

The maximum temperature in the sun, 100·2°, was registered on June 10th, and the minimum on the grass, − 1·2°, on February 19th. The latter temperature is the lowest which has been registered during the past 17 years, the lowest previous record being −0·7° on December 22nd, 1890. The maximum temperature in the shade, 81·6°, was recorded on July 3rd, and the minimum, 7·8°, on February 17th. The last frost on the grass of the Winter of 1891—92 was not registered until June 18th, which is much later than in any year during the past sixteen. The first frost on the grass of the succeeding Winter was recorded on September 8th.

South-westerly winds were again the most prevalent during the year, blowing on 77 days.

DETAILED REMARKS ON THE MONTHS.

JANUARY was persistently cold from 1st—22nd, and frosty from 7th—17th, but no very low temperatures were registered. Snow fell on 10 days, but not to any great amount, and the rainfall was small. There was very little fog, 17 frosts in the air and 20 on the grass.

FEBRUARY.—The first fortnight was mild, but from 15th—20th the weather was severely cold, very sharp frosts occurring on 17th and 19th, 7·8° and 8·8° being registered in the shade, and − 0·3 and − 1·2° on the grass. From thence to the end of the month the temperature was low. The rainfall was small, and included 6 falls of snow. There were 8 frosts in the air, and 10 on the grass.

MARCH.—From 1st—15th the weather was very cold, bitterly cold winds with occasional snow showers prevailing. Then ensued a short spell of warm weather until 19th, but the rest of the month was cool, with the exception of the last day, which was the only really warm day of the month. The latter half of the month was almost without rain. Snow fell on 8 days, and there were 20 frosts in the air and 25 on the grass.

APRIL.—The weather from 1st—11th was fine and very warm, but with the 12th came a return of Winter, with snow and very sharp frosts, which continued almost without a break until the end of the month. With the 11th ended a period of 15 days absolutely without rain. There were 11 frosts in the air, 19 on the grass, and 4 falls of snow. The Aurora Borealis was observed on 25th.

MAY.—A warm and fairly dry month almost throughout. There was a thunder-storm on 25th, 2 frosts were registered in the air and 6 on the grass, the last frost of the winter in the air being on the 7th.

JUNE.—From 1st—5th the weather was cool, from 6th—10th hot, from 11th—20th very cold, the remainder of the month being about normal. A heavy fall of rain occurred on 28th, amounting to 1·24 inch. There were thunder-storms on two days, no frosts in the air, and two on the grass, the last one of the Winter being on 18th, the latest date yet recorded.

JULY was a very cloudy month. The first three days were hot, but the remainder of the month was cold, and from the 12th—20th extremely so, the shade temperature then scarcely reaching above 60°. The greater part of the rain fell on 16th (0·84 inch) and 19th (0·48 inch), the remainder of the month being very dry. From 20th—30th was a period of 11 days without rain.

AUGUST was somewhat cool throughout, and its rainfall was fairly evenly distributed. There were thunder-storms on two days, and the Aurora Borealis was observed on 12th and 28th.

SEPTEMBER was cool throughout. 1·44 inch of rain fell on 20th, and 0·43 on 27th, the remainder of the month being dry. There were no frosts in the air but 2 on the grass, the first one of the Winter being on 8th.

OCTOBER.—A bitterly cold month, the shade temperature not once reaching 60°. There were 7 frosts in the air, and no less than 16 on the grass.

NOVEMBER.—The first half of the month was very mild, the latter half being about normal. There were only 6 frosts in the air and 8 on the grass. The rainfall was low, and there were very few fogs.

DECEMBER was cold throughout, with sharp frosts during the last week, which resulted in skating been indulged in during that time, and towards the end of the month upon some parts of the Trent. There were 21 frosts in the air, and 25 on the grass. The first half of the month was very wet, with five heavy falls of snow, the first one of the Winter taking place on 3rd. Snow lay on the ground from 6th—10th. The latter half of the month was absolutely without rain.

BURTON-ON-TRENT METEOROLOGICAL SUMMARY FOR 1892.

MONTH.	Pressure of Air. Mean height of Barometer.	Pressure of Air. Maximum reading of Barometer.	Pressure of Air. Minimum reading of Barometer.	Shade Temperature. Extremes. Maximum.	Shade Temperature. Extremes. Minimum.	Shade Temperature. Means. Mean of Maximum readings.	Shade Temperature. Means. Mean of Minimum readings.	Shade Temperature. Means. Mean daily Range.	Shade Temperature. Means. Mean Temperature. (corrected).	Temperature in the open. Maximum in Sun.	Temperature in the open. Minimum on Grass.	Hygrometric Conditions. Mean of Dry Bulb Readings.	Hygrometric Conditions. Mean of Wet Bulb Readings.	Hygrometric Conditions. Mean Dew Point.	Hygrometric Conditions. Mean Relative Humidity.	Wind. Prevailing Direction.	Wind. No. of Days on which it blew from that quarter.	Cloud. Mean Amount. (0–10).	Rainfall. Total Amount. (inches.)	Rainfall. Number of Rainy Days.	Rainfall. Maximum fall in 24 hours.
JANUARY	29.83	30.41	29.24	53.1	18.6	40.56	30.58	9.98	35.37	59.5	11.6	35.32	34.02	32.00	87.6	W.	8	7.5	1.41	19	0.22
FEBRUARY	29.78	30.63	29.20	54.6	7.8	43.52	32.66	10.86	37.69	60.0	—1.2	37.41	35.82	33.63	86.3	N.E.	7	7.8	1.19	16	0.45
MARCH	30.05	30.66	29.23	64.8	17.9	44.83	30.06	14.77	36.44	78.4	12.6	36.85	34.26	30.55	78.4	N.E.	9	7.1	0.76	11	0.25
APRIL	30.03	30.49	29.61	70.0	20.6	55.70	33.84	21.86	43.25	85.3	14.6	45.30	40.99	36.05	70.4	N.E.	9	6.8	0.96	7	0.35
MAY	29.98	30.46	29.68	78.4	25.9	62.06	44.17	17.89	51.42	98.1	16.8	54.04	49.25	44.61	70.0	S.W.	7	6.8	2.07	16	0.42
JUNE	29.98	30.42	29.56	78.7	36.3	65.07	46.53	18.54	54.00	100.2	28.1	58.29	52.97	48.22	69.4	W.	8	6.4	2.63	17	1.24
JULY	30.03	30.39	29.50	81.6	41.5	64.73	49.43	15.30	55.18	98.1	34.8	57.59	53.80	50.35	76.9	NE&E.	6	8.3	1.89	12	0.84
AUGUST	29.90	30.27	29.45	76.8	37.5	67.86	50.73	17.13	57.59	96.6	32.6	60.22	55.80	51.94	73.9	S.W.	8	7.3	2.44	17	0.57
SEPTEMBER	29.94	30.34	29.41	68.0	35.1	61.15	46.73	14.42	52.64	79.0	30.1	55.64	52.11	48.74	78.5	S.W.	16	7.1	2.74	15	1.44
OCTOBER	29.70	30.31	29.17	59.2	22.5	51.95	37.53	14.42	43.74	70.9	(?)	44.05	42.16	39.90	85.0	S.	7	6.5	2.49	20	0.43
NOVEMBER	30.03	30.59	29.60	56.8	23.7	49.64	38.02	11.62	43.43	67.4	20.0	42.27	41.28	40.09	92.1	S.	9	8.0	1.61	16	0.33
DECEMBER	29.98	30.33	29.38	53.5	10.5	40.54	28.19	12.35	34.36	56.9	8.1	33.11	32.29	30.69	90.9	S.W.	9	7.3	1.96	13	0.37
Extremes for Year		30.66	29.17	81.6	7.8					100.2	—1.2					S.W.	77		22.15	179	1.44
Means for Year	29.94					53.97	39.04	14.93	45.43			46.67	43.73	40.42	79.7			7.2			

NOTES.—All the Readings are taken daily at 9 a.m. The Barometer Readings are corrected to sea-level and 32° F.; and to the Mean Temperatures in the Shade, Glaisher's Corrections have been applied. The Thermometers in the Shade are placed in a Stevenson's Screen, 4 feet from the grass, as are the Dry and Wet Bulb Thermometers. The Maximum Temperatures in the Sun are taken with a Black Bulb Thermometer, not in vacuo. The mouth of the Rain Gauge is 1 foot above the ground and 153 feet above sea-level. In calculating the Mean Relative Humidity, 100 is taken to represent a saturated atmosphere and 0 a perfectly dry one.

St. Paul's Street West.

JAMES G. WELLS.

THE WEATHER OF 1893.

The year 1893 continues the series of very dry years that commenced with the "Jubilee year," 1887. It is also remarkable as having been the warmest year, with the exception of 1884, in the eighteen years for which we have a continuous record.

MEAN SHADE TEMPERATURE.

	Mean for 1893.	Averages of 1876-1892.	Difference of 1893 from average.
Jan.	35·5	36·3	− 0·8
Feb.	39·8	39·0	+ 0·8
March	44·4	39·5	+ 4·9
April	48·6	44·0	+ 4·6
May	53·1	50·0	+ 3·1
June	57·9	56·5	+ 1·4
July	60·2	59·2	+ 1·0
Aug.	61·7	58·6	+ 3·1
Sept.	54·1	54·5	− 0·4
Oct.	48·6	46·8	+ 1·8
Nov.	41·0	41·7	− 0·7
Dec.	40·1	36·9	+ 3·2
	48·8	46·9	+ 1·9

January was, it will be seen, below the average in temperature, but after that, every month, with the exception of September and November, was above the average, March and April being the warmest months of those names during the last eighteen years. This excess of temperature was particularly marked throughout the spring and summer, giving a more than usually pleasant character to those seasons.

RAINFALL.

	Total for 1893.	Averages of 1876-1892.	Difference of 1893 from average.
Jan.	1·40	1·91	− 0·51
Feb.	2·39	1·78	+ 0·61
March	0·28	1·73	− 1·45
April	0·47	1·96	− 1·49
May	2·32	2·32	—
June	0·74	2·44	− 1·70
July	2·70	2·59	+ 0·11
Aug.	1·91	2·73	− 0·82
Sept.	2·26	2·38	− 0·12
Oct.	1·91	2·75	− 0·84
Nov.	1·12	2·45	− 1·33
Dec.	2·22	2·48	− 0·26
	19·72	27·52	− 7·78

With the exception of the year 1887, the past year is the driest during the period over which our record extends, the fall in 1887 being just one inch less; while a more recent year, namely 1891, comes very close with a fall of 19·80. The deficiency was fairly evenly distributed throughout the year, but was particularly marked in the months of March, April, June, and November, the first three of which were the driest of their names in our record, while the fourth was only exceeded by November, 1889. The only months with a fall above the average were February and July, and their aggregate excess only amounted to ·72 inch.

The maximum temperature in the sun, 145·2° was registered on July 12th, the minimum on the grass, 5·2°, on January 5th. The maximum temperature in the shade, 88·8°, was reached on August 18th, this being the highest shade reading since 1888; the minimum in the shade, 8·4°, was recorded on January 5th. The last frost on the grass of the "winter" 1892-3, occurred on June 26th, an unusually late date, and the first of the succeeding winter on August 28th.

As in the two previous years south-westerly winds have been the most prevalent, having blown on seventy-six days.

DETAILED REMARKS ON THE MONTHS.

JANUARY.—The first half of the month was very cold, frosts occurring on all save two nights, those on the fourth and fifth being very intense. Skating on parts of the Trent occurred on the 1st—15th. The remainder of the month was, on the whole, mild. The rainfall was small and included ten falls of snow.

FEBRUARY.—A mild and wet month almost throughout, only eight frosts in the air, and none of those severe. There were six falls of snow. A gale blew from the west from 9th to 11th. It was the wettest February since 1885, and contained only five days free from rain. The mean height of the barometer was unusually low.

MARCH.—The first week was mild and showery, the second fine with high day temperatures but slight frosts at night; then, after three stormy days, there set in a fortnight of splendid weather, hot sunny days with frosty nights. The month was the warmest and driest March in the past eighteen years. There were ten frosts in the air and nineteen on the grass. Snow fell on two days, the fall on the 17th being the last of the winter.

APRIL, like March, was the warmest and driest during the past eighteen years. There were two long periods, one from the 2nd to the 15th, of fourteen days, the other from the 21st to the 28th, of eight days, absolutely without rain. The shade temperature exceeded 70° on six days. There were three frosts in the air and eight on the grass.

MAY was another very warm month, its mean temperature being exceeded only twice (in 1878 and 1879) during the previous seventeen years. Nearly all the rain fell in the six days from the 15th to the 20th. There was one period of twelve days (3rd to 14th) absolutely without rain. The shade temperature exceeded 70° on five days. There were no frosts in the air and only two on the grass.

JUNE was the driest June in the last eighteen years, from the 5th to the 21st, a period of 17 days, absolutely no rain falling. There were two frosts on the grass, and the shade temperature exceeded 80° on three days.

JULY commenced warm and dry, but after the first week scarcely a day passed without a little rain. There were heavy thunderstorms on the 11th, when 1·30 inches of rain fell. The shade temperature exceeded 80° on four days.

AUGUST was the warmest month of that name in the past eighteen years, with the exceptions of August 1880 and 1884. The shade temperature exceeded 80° on seven days, and there was only one frost and that on the grass only. There was a slight earthquake shock on the 4th, and on the night of the 9th and 10th a remarkable thunderstorm, the thunder and lightning being incessant from 10 p.m. until 4 a.m., and at times very violent. A slight display of Aurora Borealis was observed on the 19th.

SEPTEMBER.—The first part was dry and bright on the whole, the latter part showery. On the 8th there was a heavy thunderstorm, during which 1·18 inch of rain fell. The mean temperature exceeded 70° on six days. There were no frosts in the shade, but four on the grass.

OCTOBER was a warm and rather dry month, there being only two frosts in the shade and seven on the grass.

NOVEMBER was the driest November, with the exception of 1889, in the last eighteen years. There were three falls of snow, the first fall of the Winter occurring on the 18th. Gales occurred on the 16th, 18th, and 19th. There were eleven frosts in the shade and sixteen on the grass.

DECEMBER.—The mean temperature was high, being 11° above that of the preceding month. There was only one fall of snow. Gales occurred on the 8th and 19th. There were ten frosts in the shade and seventeen on the grass.

BURTON-ON-TRENT METEOROLOGICAL SUMMARY FOR 1893.

MONTH.	Pressure of Air. Mean height of Barometer.	Pressure of Air. Maximum reading of Barometer.	Pressure of Air. Minimum reading of Barometer.	Shade Temperature. Extremes. Maximum.	Shade Temperature. Extremes. Minimum.	Shade Temperature. Means. Mean of Maximum readings.	Shade Temperature. Means. Mean of Minimum readings.	Shade Temperature. Means. Mean daily Range.	Shade Temperature. Means. Mean Temperature. (corrected).	Temperature in the open. Maximum in Sun.	Temperature in the open. Minimum on Grass.	Hygrometric Conditions. Mean of Dry Bulb Readings.	Hygrometric Conditions. Mean of Wet Bulb Readings.	Hygrometric Conditions. Mean Dew Point.	Hygrometric Conditions. Mean Relative Humidity.	Wind. Prevailing Direction.	Wind. No. of Days on which it blew from that quarter.	Cloud. Mean Amount.	Rainfall. Total Amount. (inches.)	Rainfall. Number of Rainy Days.	Rainfall. Maximum fall in 24 hours.
JANUARY	30·05	30·42	29·37	53·2	8·4	40·71	30·66	10·05	35·48	..	5·2	35·16	33·83	31·75	87	S.W.	7	7·5	1·40	21	0·43
FEBRUARY	29·64	30·39	28·79	57·0	27·1	45·34	35·14	10·20	39·84	..	20·7	39·71	38·12	36·05	87·3	W.	8	7·3	2·39	23	0·47
MARCH	30·11	30·46	29·47	65·8	21·8	56·14	34·76	21·38	44·45	119·8	17·2	43·02	40·16	36·73	78·8	S.W.	8	6·2	0·28	9	0·07
APRIL	30·20	30·58	29·94	77·6	24·7	61·96	38·33	23·63	48·64	134·4	19·3	49·00	45·35	41·43	75·1	N.E.	11	4·7	0·47	5	0·21
MAY	30·07	30·44	29·56	73·7	34·5	64·71	44·85	19·86	53·08	133·7	24·7	56·87	51·50	46·55	68·2	N.E.	5	6·2	2·32	11	1·30
JUNE	30·01	30·41	29·30	84·4	34·5	69·74	49·61	20·13	57·87	142·2	28·5	61·12	55·29	50·25	68	NE&W	6	6·4	0·74	6	0·42
JULY	29·90	30·26	29·51	84·8	45·8	70·17	54·03	16·14	60·20	137·5	41·0	63·14	57·04	51·88	66·6	N.W.	6	6·9	2·70	10	1·30
AUGUST	30·00	30·34	29·46	88·8	37·5	73·24	53·60	19·64	61·72	145·2	31·0	65·11	59·49	54·89	70	S.W.	6	6·4	1·91	15	0·47
SEPTEMBER	29·86	30·38	29·20	75·1	33·6	64·44	46·33	18·11	54·09	140·0	28·4	57·10	52·83	48·90	73·5	W&SW	8	6·3	2·26	14	1·18
OCTOBER	29·87	30·46	29·09	65·7	24·0	57·06	42·14	14·92	48·60	120·3	16·3	49·80	47·17	44·36	82·4	S.W.	11	5·5	1·91	15	0·57
NOVEMBER	30·00	30·43	29·00	56·1	20·1	47·65	35·15	12·50	41·00	108·3	14·5	41·48	39·40	36·80	84·3	N.E.	8	7·3	1·12	16	0·23
DECEMBER	29·93	30·75	28·82	54·3	18·7	46·20	34·02	12·18	40·11	92·7	13·1	39·58	38·10	36·18	88·2	S.W.	13	7·1	2·22	22	0·49
Extremes for Year		30·75	28·79	88·8	8·4					145·2	5·2					S.W.	76		19·72	177	1·30
Means for Year	29·97					58·11	41·55	16·56	48·76			50·09	46·52	42·75	76·7			6·5			

NOTES.—All the Readings are taken daily at 9 a.m. The Barometer Readings are corrected to sea-level and 32° F.; and to the Mean Temperatures in the Shade, Glaisher's Corrections have been applied. The Thermometers in the Shade are placed in a Stevenson's Screen, 4 feet from the grass, as are the Dry and Wet Bulb Thermometers. The Maximum Temperatures in the Sun are taken with a Black Bulb Thermometer, in vacuo. The mouth of the Rain Gauge is 1 foot above the ground and 153 feet above sea-level. In calculating the Mean Relative Humidity, 100 is taken to represent a saturated atmosphere and 0 a perfectly dry one.

St. Paul's Street, West.

JAMES G. WELLS.
T. GIBBS.

LIST OF MEMBERS.

MAY, 1894.

HONORARY MEMBERS.

BAKER, G., Wirksworth.
BLATCH, W. G., Temple Road, Knowle, Birmingham.
DAWKINS, W. BOYD, M.A., F.R.S., F.G.S., &c., Owen's College, Manchester.
HARRISON, W. J., F.G.S., 365, Lodge Road, Hockley, Birmingham.
HERON, J., B.E., F.C.S., F.I.C., 74, Northside, Clapham Common, London, S.W.
MELLO, Rev. J. M., F.G.S., &c., Mapperley Vicarage, near Derby.
THORNEWILL, Rev. C. F., M.A.
TRIPP, C. U., M.A., F.R.Met.Soc , The Grove, Addlestone, Surrey.

Abbotts, A.	Tutbury.
Adams, A.	Bearwood Hill Road.
Adams, Miss M.	11, Grange Street.
Allsopp, Hon. G. H., M.P., J.P.	Foston Hall.
Anderson, D. V.	Alexandra Road.
Auty, R. H.	Arthurlie House, Ashby Road.
Auty, Mrs. R. H.	,, ,, ,, ,,
Baggley, C.	13, Sydney Street.
Barnes, Rev. E. G.	Guild Street.
Batty, J.	128, Scalpcliff Road.
Baxter, T.	Lichfield Street.
Beardmore, T.	Messrs. Smith, Garrett, & Co., Bow, London.
Beaven, Rev. F. H.	St. Paul's Vicarage.
Beck, H.	Branston Road.
Beckett, Rev. T. W., M.A.	Lichfield Street
Beels, G.	104, Horninglow Street.
Bence, H., B.A.	Clay Street.
Benson, A. E.	Barton-under-Needwood.
Bernard, Mrs.	Rose Mount Road.
Blackburn, R. N.	Blackpool Street.
Boyle, Rev. Vicars A.	The Vicarage, Orchard Street.
Boyle, Miss	,, ,,
Bound, C. J.	Messrs. L. & G. Meakin.
Bradbury, H. K., M.R.C.S., L.R.C.P.	208, Ashby Road.
Bradbury, Mrs. H. K.	,, ,, ,,
Bramell, Rev. J.	Branston Vicarage.
Bridgman, H. E., M.R.C.S., L.R.C.P.	Bridge Street.
Briggs, S.	Branston Road.
Briggs, W. C.	Borough Road.
Brookes, H.	High Bank, Ashby Road.
Bromwich, F. A.	80, Uttoxeter New Road, Derby.
Brown, Adrian J., F.C.S., F.I.C.	6, Alexandra Road.
Brown, Mrs. A. J.	,, ,,
Brown, Edwin A.	Bank House, High Street.

Brown, Horace T., F.R.S., F.I.C., F.C.S., F.G.S.,	52, Nevern Square, Kensington, W.
Brown, Mrs. H. T.	,, ,, ,,
Brown, Miss A.	,, ,, ,,
Burton, Right Hon. Lord	Rangemore.
Burton, Lady	,,
Butt, H. G.	258, Branston Road.
Cartmell, A.	119, Alexandra Road.
Cartmell, Mrs. A.	,, ,,
Caney, E.	Messrs. Charrington & Co.
Chadfield, F. B.	2, Frederick Street, Stapenhill.
Charrington & Co.	Lichfield Street.
Churchill, R.	Rangemore Street.
Churchill, Mrs. R.	,, ,,
Churchill, R. A. T.	,, ,,
Churchill, H.	,, ,,
Churchill, L. A.	,, ,,
Clarke, R.	St. Paul's Square.
Clubb, J.	63, Guild Street.
Connett, W.	93, Derby Street.
Coxon, J. S.	Horninglow Road.
Coxon, Mrs. J. S.	,, ,,
Daltry, Rev. T. W., M.A., F.L.S.	Madeley Vicarage, Newcastle, Staffs.
Daniel, E. F.	Derby Street.
Dannell, J. O.	206, Ashby Road.
Day, Miss M. E.	Lichfield Street.
Day, G. Morland	8, Alexandra Road.
Day, Mrs. G. Morland	,, ,,
Dobell, Guy	Branston Road.
Drewry, W. J., J.P.	Drakelow.
Dunwell, F. S.	Stapenhill Road.
Eadie, J.	Barrow Hall, Derby.
Eadie, Miss	,, ,, ,,
Eadie, Miss Agnes	,, ,, ,,
Eadie, Miss Annie	,, ,, ,,
Evans, W.	71, Branston Road.
Evershed, S., M.P., J.P.	Albury House, Stapenhill.
Evershed, Mrs. S.	,, ,, ,,
Evershed, Percy	Clay Street, Stapenhill.
Evershed, S. H.	Ramura House, Stapenhill.
Fisher, S. J.	32, Derby Road.
Forster, F.	Ashby Road.
Fox, A.	Cumnor House, Branston Road.
Gaved, T. A.	99, High Street.
Gibbs, T.	7, St. Paul's Street, West.
Gibson, Thomas	87, High Street.
Goodger, Miss C.	Bridge Street.
Gorton, T.	62, Branston Road.
Gothard, F.	Bearwood Hill.

Graham, W. N. .. .. Branston Road.
Grinling, J. C., J.P. . .. . Barton-under-Needwood.

Hadfield, Miss M. .. .. 248, Branston Road.
Hallam, Mrs. F. . .. . High Street.
Hallam, Miss J. . .. . 25, Rangemore Street.
Hanson, C., Jun. .. .. 195, Ashby Road.
Harlow, Miss A. . .. . 27, Rangemore Street.
Harper, J. .. .. Derby Road.
Harris, W. T. .. .. 110, Scalpcliff Road.
Harrison, C., J.P. .. .. Branston House.
Harrison, C. R. . .. .. . 123, Alexandra Road.
Harrison, Rev. G. R. .. .. .. 60, Branston Road.
Harrison, R. .. . . Stapenhill.
Harrison, Mrs. R. .. .. ,,
Harrow, G. H., Ph. D., F.C.S., F.I. . .. . Station Street.
Hawkesbury, Lord .. .. Cockglode, Ollerton.
Healey, Miss . .. . 125, Alexandra Road.
Hearn, R. .. .. High Street.
Hensman, C. .. .. Cardiff.
Hensman, Mrs. C. .. . . ,,
Hodson, E. . .. . Newton Road.
Hodson, Mrs. E. .. .. ,, ,,
Hooper, A. .. .. Horninglow Street.
Hooper, F. J. .. . . Derby Road.
Hopkinson, W. .. . . 121, Alexandra Road.
Horsman, F. .. The Laboratory, Messrs. Allsopp & Sons.
Howarth, W. . . .. High Street.

Jackson, J. T. .. .. Alexandra Road.
Jackson, S. F. .. . .. Bourne Place, Bexley, Kent.
James, Miss A. J. . . .. Lichfield Street.
Jeffcott, W. T. .. . . .. Sutherland House, West Street.
Jenkins, T. . . .. .. 116, Malvern Street, Stapenhill.

Knowles, T., M.A. . . . . .. Ashby Road.
Knowles, Mrs. T. .. .. ,, ,,

Lathbury, G. .. .. Hunter's Lodge, Horninglow Road.
Lawson, H. .. .. Rangemore Street.
Lott, Frank E., Assoc. R.S.M., F.I.C. .. Glenthorne, Alexandra Road.
Lowe, C. .. .. 1, Alexandra Road.
Lowe, T. B., J.P. .. . . Alexandra Road.
Lowe, T. E. .. .. 1, Alexandra Road.
Lowe, S. .. .. Malvern Street, Stapenhill.
Lowe, W. G., M.D., M.R.C.S., L.R.C.P. .. . Horninglow Street.
Lowe, C. H. .. .. Clay Street, Stapenhill.
Lowe, Mrs. C. H. .. .. ,, ,, ,,
Lockyer, G. S. .. .. 79, Blackpool Street.

Madeley, F. .. .. 122, High Street.
Martin, T. C. .. .. Trinity House.
Mason, P. B., J.P., M.R.C.S., F.L.S., F.R.M.S., F.Z.S. Bridge Street.
Mason, Mrs. P. B. .. .. ,, ,,
Matthews, C. G., F.I.C., F.C.S. .. .. Alexandra Road.
McAldowie, Dr. A. M. .. .. .. Brook Street, Stoke-on-Trent.
Meakin, Lewis J. .. .. Tatenhill.

Meakin, George	Callingwood.
Meredith, J. H.	Sansome Street, Worcester.
Miers, Miss	27, Rangemore Street.
Miller, Rev. S. O., M.A.	Horninglow Vicarage.
Mitchinson, Right Rev. Bishop, D.C.L., F.L.S.	Sibstone Rectory, Atherstone.
Morris, G. Harris, Ph. D., F.I.C., F.C.S.,	18, Gwendwr Road, West Kensington, W.
Morris, Mrs. G. H.	,, ,, ,, ,,
Morris, J.	Primrose Hill, Newton Road.
Morris, Mrs. J.	,, ,, ,, ,,
Moxon, R.	209, Newton Road.
Moxon, Miss W. M.	,, ,,
Murray, J. A.	Borough Road.
Nash, A. A.	Alexandra Road.
Nowers, J. E.	282, Blackpool Street.
Odling, W., F.I.C., F.C.S.	132, High Street.
Oldershaw, J., M.R.C.S., L.R.C.P.	Horninglow Street.
O'Sullivan, C., F.R.S., F.I.C., F.C.S., &c.	High Street.
O'Sullivan, J., F.I.C., F.C.S.	Ashby Road.
Oswell, B. L.	70, Spring Terrace Road, Stapenhill
Perfect, J. C.	Stapenhill.
Perks, C., M.R.C.S., L.R.C.P.	High Street.
Peters, W. N.	Stapenhill Road.
Peters, Mrs. W. N.	,, ,,
Port, H. H...	5, Elms Road, Stapenhill.
Porter, H.	Donithorne, Horninglow.
Price, J., B.A.	Beacon Lodge, Trellech, Mon.
Pullin, T. J.	Ashby Road.
Ramsden, F. S.	Corporation Gas Works.
Randell, H.	Netherseal.
Ratcliff, Miss F.	Holly Bank, Scalpcliff Road.
Ratcliff, Robert	Newton Park.
Ratcliff, Richard, J.P.	Stanford Hall, Loughborough.
Ransford, Miss	The Infirmary.
Reeve, A.	Matlock Villa, Derby Road.
Reynolds, R.	Stapenhill Road.
Riddell, R. ...	86, Derby Street.
Robinson, G.	88, Horninglow Street.
Robinson, R. M.	Branston Road.
Robinson, T., M.R.C.S., L.R.C.P.	Horninglow Street.
Roseblade, J. T.	Ashby Road.
Rugg, H.	Guild Street.
Russell, G. H.	22, High Street.
Sadler, J. W.	11, Market Place.
Sadler, B.	,, ,,
Sadler, Mrs. M. T.	10, Lichfield Street.
Sadler, Miss M.	Elms Road, Stapenhill.
Salt, E. D...	Newton Solney.
Salt, Mrs. E. D.	,, ,,
Salt, W. C.	Willington Hall.
Scarisbrick, J.	Rose Mount.

Sharpe, B.	Messrs. Bass & Co.
Skipton, H. S., M.A.	Winsfield School, Clay Street.
Skipton, Mrs. H. S.	,, ,, ,,
Slator, Henry	Lichfield Street.
Smith, D.	High Street.
Smith, Mrs. D.	,, ,,
Smith, E.	1, Alma Terrace, Sandown Lane, Wavertree, Liverpool.
Starey, E.	Stapenhill Road.
Starey, Mrs. E.	,, ,,
Stern, A. L., D.Sc., F.C.S.	Ashby Road.
Stocker, C.	High Street.
Strachan, A.	Station Street.
Swindlehurst, J. E., Assoc. M. Inst. C. E.	Alexandra Road.
Swindlehurst, Mrs. J. E.	,, ,,
Swinnerton, W.	73, Branston Road.
Tabberer, Miss	10, Alexandra Road.
Talbot, J.	Lichfield.
Tarver, G.	Station Street.
Taverner, W.	15, Rosemount Road.
Thoday, A.	Ashby Road.
Thompson, Frank	Newton Road.
Thompson, Mrs. Frank	,, ,,
Thompson, Miss S.	Ivy Lodge, Stapenhill.
Thompson, Miss M.	,, ,,
Thornewill, R., J.P.	Tutbury.
Thudichum, Miss M.	52, Nevern Square, Kensington, W.
Tod, A. Maxwell	Newton Road.
Tomlinson, H. G.	The Woodlands.
Underhill, C. F.	New Street.
Van Laer, N.	Blackpool Street.
Walker, H. T., B.A.	83, Blackpool Street.
Walters, W.	Alexandra Road.
Wartnaby, G.	Newton Road.
Wartnaby, Mrs. G.	,, ,,
Wells, James G.	Selwood House, Shobnall Street.
West, C. R.	45, Derby Road.
West, W. R.	,, ,,
Whitehead, T. N.	Bridge House, Bridge Street.
Wilkinson, J.	Alexandra Road.
Wilkinson, Mrs. J.	,, ,,
Willcox, J. B.	86, Claremont Terrace, Branston Road.
Worthington, W. H., J.P.	Derwent Bank, Derby.
Wright, A. T.	Victoria Crescent.
Wright, Josh.	Branston Road.

Associates.

Brown, L. Clifford	52, Nevern Square, Kensington, W.
Brown, Miss B.	,, ,, ,,
Hatherley, S.	Winsfield School, Clay Street.
Hind, H. L.	Ash Villa, Ashby Road.
Morris, A.	18, Gwendwr Road, West Kensington, W.
Wells, E. L.	8, Derby Road.

RULES.

1.—That this Society be called the "Burton-on-Trent Natural History and Archæological Society," having for its object the promotion and encouragement of the practical study of Natural History, Archæology, and General Science.

2.—That the Officers of the Society consist of a President, two or more Vice-Presidents, Treasurer, General and Excursion Secretaries, Assistant Secretary, Curator, and Librarian; these officers to retire annually, but to be eligible for re-election.

That the Committee consist of nine Members, and that the three Members who have made the least attendances retire annually, and be not eligible for re-election. All Officers shall be *ex-officio* members of Committee. Three to form a quorum.

3.—That a General Meeting be held not later than the end of October in each year, for the purpose of electing Officers for the ensuing year, and transacting any other business which may be brought before it.

4.—That Candidates for Membership shall be proposed and seconded (in writing) at any meeting of the Committee, and may be elected at the next General Meeting by a majority of the Members present.

5.—That the Society commences its year with October 1st. That an annual subscription of five shillings be paid by each Member *in advance*, and that all Members whose subscriptions are six months in arrear be considered to have forfeited their privileges as members of the Society; that all Members who have not given notice to the Treasurer or Secretary of their intention to retire before the Annual General Meeting in October shall be held responsible for the current year's subscription.

6.—That the Committee may elect as Associates any persons under the age of eighteen, and that the subscription of such Associates be one shilling per annum, payable in advance; Associates to have no voice in the appointment of officers or the management of the Society, except in the election of their own Secretary, who shall be considered as a Member of the General Committee.

Note.—Associates must be elected Members in the ordinary way on exceeding eighteen years of age.

7.—That the Committee may recommend as Honorary Members any persons distinguished for scientific attainments, or who may have in any special manner advanced the interests of the Society.

8.—That Field Meetings or Excursions be held during the year, in suitable localities, and that timely notice of each be given to the Members by circular.

9.—That in addition, the Committee may organize a series of Field Meetings for Junior Members, under the leadership of one or more Members of the Society, to be invited for that purpose by the Committee; such Meetings to be devoted to practical explanation and the collecting of specimens.

10.—That Evening Meetings be held during the Winter months at such times and places as the Committee may appoint, for the exhibition of specimens, and the communication or discussion of any subjects connected with the objects of the Society: **that at Evening Meetings Members may introduce one friend, but no one resident in or within five miles of Burton may be present at more than two Evening Meetings in one Session**; that the notice of Meeting sent to each member be the entrance ticket, admitting bearer and one friend; that the Secretary be empowered, on application, to issue additional tickets when necessary; and that a book be kept at the door of the place of meeting in which Members must enter the names of any friends they introduce.

11.—That the Committee may select and recommend to be given annually a series of prizes for the best selection of specimens in any one of the branches of Natural History made by Associates individually during the preceding year, and that Members be invited to offer Prizes or Special Subscriptions for that purpose.

12.—That the Committee have power to make such arrangements as they may consider advisable for the establishment of a Museum in connection with the Society, for the preservation of specimens illustrating the Natural History and Antiquities of the district.

13.—That after providing for the payment of all incidental expenses, the funds of the Society shall be applied to the maintenance of a Museum, the purchase of Books, Journals, etc., or in any other way the Committee may think likely to advance the interests of the Society.

14.—That the Committee have power to make rules for the circulation amongst the Members generally of Books, Periodicals, etc., belonging to the Society.

15.—No rules of the Society shall be altered except at a General Meeting called for that purpose.

LIBRARY.

NUMBER.	TITLE.	AUTHOR.
1	School Botany	*Lindley.*
2	Manual of Botany	*Balfour.*
3	Elements of Botany	*Balfour.*
4	Handbook of the British Flora	*Bentham.*
5	Elementary Botany	*Grugeon.*
6	Useful Plants	*Johnson & Sowerby.*
7	Elements of Metallurgy	*Phillips.*
8	Elementary Course of Geology	*Ansted.*
9	Students' Elements of Geology	*Lyell.*
10	Introductory Text Book of Geology	*Page.*
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38	Vol. VII., Practical Chemistry.	
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75-76 Transactions do. do. do. Vols. I and II.
100-104 Year Book on Scientific and Learned Societies, 1887-1891.
110 Report of the British Association (Birmingham) 1886.
111 ,, ,, .. (Manchester) 1887.
112 ,, ,, ,, (Bath) 1888.
113 ,, ,, ,, (Newcastle) 1889.
114 ,, ,, ,, (Leeds) 1890.
115 ,, ,, ,, (Cardiff) 1891.
116 ,, ,, ,, (Edinburgh) 1892.
117 ,, ,, ,, (Nottingham) 1893.
120-129 Midland Naturalist, 1884-93.
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Dulwich College Science Society (1890-92).
Elisha Mitchell Society, North Carolina, U.S.A. (1889-93).
Holmesdale Natural History Club (1888-92).
Leicester Literary and Philosophical Society (1890-94).
Marlborough College Natural History Society (1889-93).
North Staffordshire Naturalists' Field Club and Archæological Society (1877-93.
Nottingham Naturalists' Society (1878-91).
Yorkshire Naturalists' Union (1877-1893).
Yorkshire Philosophical Society (1849, 1855, 1886-93).

LIBRARY REGULATIONS.

1. Books shall be issued to Members by the Librarian, General Secretary, or Assistant Secretary only.

2. No Member shall have more than two Books at any one time.

3. Any Book may be retained for one month from date of issue, provided no other Member has applied for it in the meantime, in which case it must be returned within 14 days of date of issue, or on demand, as the case may be.

4. On returning a Book, a member may renew it for a further period of one month should no other application be made for it.

5. All books required for Sectional Meetings must be applied for beforehand in the usual way by the Secretary of the Section, who will be held responsible for their safe custody and return.

6. All Books must be returned to the Library by September 1st in each year, and will not be re-issued until October 1st.

7. The Officer who issues or receives a book shall make an entry of the same in the book provided for that purpose, and initial it.

8. Members will be held responsible for Books issued to them, and will be required to replace all Books lost or damaged while in their custody.

TRANSACTIONS

OF THE

BURTON-ON-TRENT

Natural History & Archæological Society.

EDITED BY

JAMES G. WELLS,

Hon. Secretary.

VOLUME III., PART I.

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BURTON-ON-TRENT

NATURAL HISTORY & ARCHÆOLOGICAL SOCIETY.

Studies in English Spelling: its Methods and Delusions.

By T. KNOWLES, M.A.

(*Presidential Address delivered November 20th*, 1891.)

[CONDENSED.]

MY first study will be in the double vowels, as I call them. No careful reader of English can fail to observe the considerable number of double vowels, that is, two concurrent vowels which have only one sound. Here is a list of them :—

1. ae, ai, ao, au, aw, ay.
2. ea, ee, ei, eo, eu, ew, ey, eau.
3. ie.
4. oa, oe, oi, oo, ou, ow, oy.
5. ua, ue, ui, uy, uoy.

No cognate language contains so many of these double vowels. The reason of this is that the alphabet we use does not contain enough letters to express our vowel sounds. One of the results of the Norman Conquest was that the English discarded, gradually, their own alphabet, and adopted that used by the Romans.*

The Roman alphabet contained but six vowel letters, whereas the old English alphabet contained fourteen vowel letters in pairs, each pair containing an accented and an unaccented letter. I will shew you the sounds represented by these letters.

á	...	as in haul, brawn.
a	...	,, farm.
ǽ	...	,, brae, maid, gaol, say.
æ	...	,, mad.
é	...	,, meet, neither, belief, bead.
e	...	,, met.
í	...	,, aisle, eye, sleight, guile, buy.
i	...	,, sit.
ó	...	,, oak, foe, stow.
o	...	,, not.
ú	...	,, boot, fruit, soup, accrue, feud, new, due, beauty.
u	...	,, but.

The other pair, ý and y, is only a duplicate of í and i. As to the sound of á and ó, I follow Rask, the Danish grammarian. Now, these double vowels are used to express the old long or accented vowels which are not contained in the Roman alphabet, the ordinary vowel letters being used to express the old shallow or unaccented vowels.

English writers compelled to use the Roman alphabet found themselves with only six letters to express at least double that number of vowel sounds. They used these double vowels to supply the deficiency. The following table will show the matter pretty clearly :—

* See Transactions of this Society, Vol. I., p. 68.

Old English.		*Modern.*
a	=	a.
æ	=	a.
e	=	e.
i	=	i.
o	=	o.
u	=	u.
á	=	au, aw.
ǽ	=	ae, ai, ao, ay.
é	=	ee, ea, ei, eo, ie.
í	=	ai, ay, ei, ui, uy.
ó	=	oa, oe, ow.
ú	=	oo, ui, ou, ue, eu, ew, ue, eau.

Thus, during the period of transition from old to modern English, an English writer who had to express the sound formerly denoted by á, would write "au" or "aw," the second vowel giving notice, as it were, that the preceding "a" must be sounded as "á" was formerly, and he would deal in like manner with the other long or accented vowels. It must, however, be observed that some double vowels as "ea," "ei," "ou," and "ui" are also sometimes sounded in other ways, the words "head," "sleight," "eight," "house," "thought," "build" and "guile" furnishing examples. It is curious, too, that "oo" should be used to express "ú" instead of "uu."

The combinations "oi," "oy," "uoy" and "ow" (as in "cow"), do not express any sound used in old English.

It is impossible not to admire the ingenuity with which English writers surmounted the difficulty which confronted them, but the method was not consistent with itself, and being of the nature of a makeshift, Nemesis has followed its adoption by creating the delusion that these double vowels are really diphthongs, and another that they correctly spell the sounds they are used to express.

My next study is in what I will call the "duplicated consonant." I mean such combinations as we see in the words *hatter*, *stellar*, *bitter*, *sloppy*, *shutter*. In the usual method of pronouncing such words only one of these consonants is sounded. The question arises, "What is the use of the second letter?" Now, H-a-t spells "hat," and e-r is pronounced "er," and yet when you put the two together they do not spell "hatter" but "hater," and it is the same with the other words just mentioned. To express the sound "hatter" we have to duplicate the middle consonant. But why? It is another result of the change of alphabet resulting from the Norman Conquest.

Take for example the words

hăt	hāte
bĭt	bīte
shŭt	shūte

In those in the first column the vowel is short, but the addition of a final mute "e," as in the second column, has the effect of lengthening the vowel. It should be noticed that this only applies to syllables whose final consonant is single. The addition of a mute "e" to such a word as "fish" or "hand" would make no difference at all to the sound.

And a mute "e" is not the only addition which lengthens the vowel. Any one syllable commencing with any vowel has the same effect. Thus:—

hăt	hāted
bĭt	bīter
slŏp	slōpy
shŭt	shūting.

But how is this effect to be counteracted when we wish to add a syllable commencing with a vowel, and yet not lengthen the preceding vowel; when, for instance, we wish to say "hat-er," not "ha-ter?" To prevent the "er" being attached directly to the "hat," thus lengthening the vowel "a," we put another "t" between the "hat" and the "er," but this second "t" we do not pronounce.

In further proof, I would notice that we do not do it in such a word as "heat" where the vowel sound is long already, whereas we do do it in a dissyllable like "fulfil," where the second syllable is accented, because it contains a short vowel which would otherwise be lengthened. I think the same reason should lead us to continue the practice of duplicating the "p" in "worshipper" and the "l" in such words as "traveller," in spite of the example set by the late Thomas Carlyle and American writers generally; although in these words, where the syllable in question is not accented, there may be no actual necessity to duplicate the consonant.

The method of altering the sound of a vowel by adding a mute "e" to the syllable seems to have led to two delusions. First, it is a delusion to suppose that the vowel is really altered. Next, it is a delusion to suppose in the case of the duplicated consonant that both letters are pronounced. But I do not say that all duplicated consonants are formed in the way I have described.

In conclusion, a few words on what is usually known as the "phonetic" system may not be out of place. Even amongst the educated the modes in which the same word is pronounced are many and various, for which reason the phonetic spelling of different persons would vary very much. Moreover, the same person would spell the same word sometimes one way and sometimes another. This would produce complete confusion. But supposing some such system had been devised, and that everyone pronounced every word precisely in the same way, it would be found that the grammar of the language had been complicated, and that there was no real simplification of spelling.

At present, for instance, there is a very simple general rule for the formation of the plural of substantives, viz., you add an "s" to the singular. In the word "cats" this is pronounced "s," whereas in "dogs" it is pronounced "z." To enable us to spell phonetically we should have to learn when to put "s" and when to put "z," involving a rather intricate study of the distinction between "surd" and "sonant" consonants. And the same reasoning applies to other grammatical formations besides the plural substantives.

Again, the phonetic system is specially inapplicable to our language on account of our peculiar method of utterance. We emphasize one or perhaps two syllables in a word, and slur over the rest. The accented syllable, or syllables, is or are pronounced correctly, but for the other vowels we simply make a sort of grunt.

Take the word "photograph." The first and third vowels are sounded correctly, but the middle one is a grunt, and in our phonetic spelling would have to be represented by the symbol, whatever it might be, used to denote a grunt. Now add the syllable "er," making the word "photographer." The incidence of the accent is changed, now falling on the second syllable, which is accordingly pronounced correctly, but the third and fourth (if not the first also) are grunts, and would be represented by the proper symbol. Supposing this symbol to be "+," these two words would be represented—

phot+graph

ph+togr+ph+r.

Similarly the word "Canada," with its derivative "Canadian," would appear—

Can+d+

C+nadi+n.

When a person reads he uses his eyes, and with them he picks out the resemblances between the different words, and judges the meaning of derivative words by the character of the addition to the root. Now, in learning to read under the phonetic system, he would in the word "photograph" see the "o" in the first syllable, the grunt in the second, and the "a" in the third. When he came to "photographer" he would see a grunt in the first syllable in place of an "o," an "o" in the second syllable instead of a grunt, and a grunt in the third syllable in place of an "a," and another grunt in the fourth syllable. His eye would thus be prevented from recognising the original root in the derivative word, and he would be impeded and embarrassed. In order to explain this shifting about of the letters many new and complicated rules would have to be framed and taught, and it would take many years to teach a child, or anyone else, to read under such a system.

The Peasants' Revolt of 1381.

By H. Bence, B.A.

(*Read before the Society, January 15th, 1892.*)

[Condensed.]

THE social revolution that was working itself out in this country five hundred years ago was remarkable for the variety of causes and popular cries which combined to produce it; for the mysterious way in which it was organised; for the extraordinary rapidity with which intelligence and communication passed between the different parts of the country affected; for its indirect permanent results; and, when the crisis came, for its sudden collapse. Like other revolutions, that which came to a head in 1381 cannot be attributed solely to any one cause, or to any sudden outburst of popular fury and discontent; it had been in the air for generations. True, the immediate causes of the insurrection were the growing pressure of taxation—the new poll tax in particular—the provoking severity in the collection of taxes, added to a strong desire and determination of the peasants, still in a state of serfdom, to obtain such a measure of freedom as the inhabitants of the towns had for a long time enjoyed. In dealing with our subject, however, we must take into account not only these, but causes much more remote, but no less important.

The most prominent feeling pervading all sorts and conditions of men at the time with which we have more especially to deal was that of general discontent with the existing state of things. In the religious world we find the begging friar at enmity with the parish priest; the Lollard disliked and persecuted by both;

the monk drifting into a mere self-indulgent and grasping landlord, impoverishing the parish priest by incorporating at every opportunity the parish tithes into the already wealthy foundations and monasteries; and, lastly, Wycliffe's "poor priest" as an itinerant preacher endeavouring to make up for the shortcomings of many of the parochial clergy—for their worldliness and incompetence, for their neglect of preaching, which with many of them had become a lost art, and for the evil custom of non-residence in their parishes. Abroad, English arms had suffered defeat and disgrace, while at home the men who remembered Cressy and Poitiers saw towns destroyed, districts ravaged, and English ships carried off from English harbours by their hated foreign foes. Torn by the dissensions of the nobles and higher clergy, and with a king barely fifteen years of age, the country could then appreciate to the full the wisdom of Solomon when he said, "Woe to thee, O land, when thy king is a child!" for even within the royal family itself there was intrigue and plot, if not actual treason. With the religious and political affairs of the country, however, we shall have nothing to do except so far as they directly bore upon and influenced the social condition of the people. Our business is to endeavour to ascertain what were the aims and aspirations of the mass of the English people five centuries ago; how far these aims and aspirations were justified; by what means it was attempted to attain them; and to what extent such attempts were successful.

Let us consider briefly what was the social system existing in England from the Conquest to the middle of the fourteenth century. In theory, all the land belonged to the king. From him the barons held tracts or fiefs (often in several portions in different counties), and were expected as tenants to make some acknowledgment to the king in the shape of some service, and not, originally, by a money payment. In many cases the barons found it necessary, or more profitable, to place under sub-tenants those scattered portions of their estate which they could not personally look after. These sub-tenants rendered service to the lord of the fief, were the great men of the several parishes, and became lords of the manors. The lord of the manor kept from about one-fourth to one-half of the land in his own hands as his demesne or home-farm, and the remainder was held under him by free tenants, who were called franklins, freeholders or freemen, and by villeins or feudal serfs. The former, living in houses of their own and cultivating what was practically their own land, made an annual payment to the lord of the manor as an acknowledgment, and could not be turned out of their holdings so long as these annual payments, which corresponded to ground rents, were maintained. If the free tenant wanted to sell out of his holding, the lord of the manor exacted payment for the privilege. At the death of the free tenant the heir paid for admittance to the inheritance. If he died without heirs, the property went back to the lord of the manor, and then, but then only, could the ground rent be raised. This, however, was very rarely done. The villein was by no means in so good a case; he could not go away from the manor in which he was born, he could not marry without a license from the lord, for which he had to pay. However shrewd, enterprising, and thrifty he might be, he had no hope of changing his state except by the special grace of the lord of the manor. "Once a villein, always a villein." Ordination by a bishop would, however, remove him from the villein class, and this formed a strong inducement to young people to obtain an education that would fit them for entering the ranks of the clergy. It will also be remembered that a serf living a year and a day in a borough without challenge on the part of his lord became, *ipso facto*, a free man. The villein was bound to give so many days' service, and to pay certain small dues, generally in kind. This done, the villein was absolutely secure in his holding. When the lord wished for ready money to join in a campaign or to pay aids or reliefs, he would exchange services due for ready money, and this bargain would be entered in the court roll of the manor. A copy of this agreement became the title deed of the tenant, who was hence called a copyholder.

The earliest disturbance of the tenures which have been briefly described arose from the introduction of leases. For various reasons the lord of the manor in many cases found it inconvenient or unprofitable to cultivate his demesne through a bailiff, and so was induced to let it to a tenant at a given rent, payable either in money or in kind. Although this made little direct change in the manorial system, it had the indirect effect of breaking the tie on which the feudal organisation rested—that of personal dependence of the tenant on his lord. In this way, the wealthier tenants could rise to apparent equality with their former masters. This modification of the manorial system by the rise of a farmer class was soon followed by the appearance of the free labourer.

Early in the reign of Edward II. we find the practice of accepting money compensations in lieu of labour rents becoming general, and by the end of the reign it had become almost universal. This was to the interest of both parties, for it would be vexatious to the tenant to be called away from the work of his own holding to do the lord's labour, the bailiff would have no little trouble in getting a due quota of work from the tenant, and, if the lord could get fair money compensation for labour, he could save the expense of a bailiff's supervision over unwilling labourers. Nothing, perhaps, had a greater effect in freeing labour from local bondage than the great increase of population. Between the Conquest and the opening of the fourteenth century the population had probably tripled, and we shall see the effect of this on serfdom when we consider that under the law of gavel-kind, applicable to all estates not held by military tenure, the inheritances of the tenantry were divided equally among their sons, and the services due on account of the holdings were divided correspondingly. Services thus divided up would naturally be difficult to enforce. This and the luxury and pomp of the time, and the excessive cost of endless campaigns, made the lord anxious to accept money payment in lieu of personal service.

Naturally, the appearance of this new class—that of the Free Labourers—caused a modification in the whole social system of the country, and this change was accepted apparently with willingness by all until circumstances arose which rendered labour scarce and consequently dear. That which had most effect in making labour scarce was the dreadful scourge known as the Black Death, which carried off more than half the population of the country. This terrible plague, the most desolating ever known in Europe, is said to have originated in the far East. It seems to have made its first appearance in China in 1333, and after travelling along the northern shores of the Black Sea and Mediterranean, spread through France and Germany early in 1348, entered England in August of the same year, and three months afterwards reached London. The terrible havoc caused by this plague, and the effect it must have had in throwing the whole social fabric into confusion, can be imagined when we find that it is said to have claimed no less than 100,000 victims in London alone, and about half that number in Norwich, then the second city in the kingdom. These numbers appear the greater when we remember that the population of the whole country at the time was between three and four millions only. The immediate consequence of such a catastrophe as this was that, for some years after, there was a great dearth of labour and a consequent excessive enhancement of wages. There was serious difficulty in gathering in the harvests in the case of those landowners who depended upon hired labour. Crops were suffered to rot in the fields, cattle and sheep roamed over the country from lack of herdsmen, land went out of cultivation, and there was, eventually, a general impoverishment of the upper classes. To make matters worse, riot and disorder followed the plague, chiefly on the part of the "landless men," the labourer and artisan wandering in search of employment. And now arose for the first time in the history of this country a conflict between capital and labour. The progress of the emancipation of the serfs was suddenly checked, and all possible ingenuity on the part of the lawyers, who were also the stewards of the manors, was exercised, without any thought of the consequences, to find plausible excuses for cancelling manumissions and exemptions, which had been unquestioned for years, on the ground of informality. Peasants were forced again into a bondage to which they had grown unaccustomed. The discontent of the poor was naturally increased by the fact that all causes were pleaded in the manor-court itself, and judgment was given by the very officer whose interest it was to decide in favour of the lord. There is no doubt that the landowners were in great difficulties at the time, for on the one hand there were fewer farmers wanting farms, hence rents fell, and on the other hand, wages and the price of everything which depended on labour rose enormously. The difficulties of the situation drove the governing classes to adopt a most unwise policy, one which was calculated to cause the utmost friction, and which from its very nature was doomed to fail. In the panic caused by the Plague it was considered necessary to dissolve Parliament, and the date of its re-assembling was postponed from time to time. The king, meanwhile, issued a proclamation that no higher than the customary wages should be paid, and when Parliament at last met this Proclamation was embodied in a statute known as the Statute of Labourers. Its chief enactments were:—

1. No person under sixty, whether serf or free, should decline to undertake farm labour at the wages which had been customary in the twentieth year of the king's reign (that is, the year before the appearance of the Black Death) unless he lived by merchandise, was regularly employed in some mechanical craft, was possessed of private means, or was an occupier of land.
2. All persons quitting their employment before the time fixed in the agreement should be liable to imprisonment.
3. No other than the old wages should be given, and remedy against those seeking more was to be sought in the lord's court.
4. Lords of manors paying more than the customary amount were to be liable to treble damages.

This statute was no doubt often, if not generally, evaded.

We will turn now to trace another cause of the rising of the Commons under Richard II., a rising which we must remember was partly a religious one. There were no more grasping and oppressive landlords in England in the middle of the fourteenth century than the monks, who are said to have held no less than one-third of the soil, and who were constantly encroaching on the rights of the common people and taking from them their common rights in meadow, wood, and pond. Nor was the internal condition of some of the monasteries more satisfactory or more calculated to inspire respect for their occupiers. Under different abbots the monks were subjected to great austerity of life, or were allowed an unlimited and unhealthy licence. In the reign of Edward III. the rules of the monasteries are said to have been a dead letter—the monks came and went at their pleasure. Many of the parish priests were like the one described by Chaucer, learned and faithful, not seeking wealth, but of their poverty giving to the poor. With large parishes and houses far apart, the weather however bad, would not keep them from walking long distances to visit the sick and those needing their help and counsel. This, however, was not universally the case. The friars, also, had much degenerated in Chaucer's time. Coming first to this country in the early part of the thirteenth century, and setting then, and for many years after, an example of extreme self-denial, they devoted themselves to supplement the work of the parochial clergy, especially of those labouring in the towns. When, however, time wore on, and the first enthusiasm caused by the movement had exhausted itself, we find the friars still, it is true, professing poverty, but demanding and satisfied with nothing less than the best of fare and entertainment. In the first stages of the movement their ranks were recruited by men of extraordinary sanctity. Monks, ambitious of devoting themselves to a life of hardship for the welfare of their fellow men, were allowed by special licence from Rome to transfer themselves into a mendicant order. Later, a transfer was sought by brethren simply weary of restraint. With such examples as these, we do not wonder at Chaucer's parish priest remarking:

> "If gold rust, what should iron do?
> For if a priest be foul, on whom we trust,
> No wonder is, a ruder man should rust."

Under such circumstances men of intellect came to look upon religion as an imposture, and Wycliffe's movement began in indignation at the falsehood, corruption, and oppression of the age. Inquiries began to be made into the principles on which the goods of this world were distributed, and it is little matter for surprise that men's thoughts took a socialistic turn, however impossible the carrying out of such ideas may seem to us.

We have now to seek the more immediate causes of the peasants' revolt. In 1379 the country was found to have sunk so deeply into debt, owing to the expensive foreign wars, that both clergy and laity agreed to a graduated poll tax, which ranged from £6 13s. 4d., payable by John of Gaunt, to 4d., payable by the poorest man. This tax did not by any means produce as much as was expected, the total sum obtained not exceeding £22,000; and in November of the following year it was found that no less a sum than £160,000 was still required. To meet this, in addition to the ordinary taxes, Parliament once more fell back upon the expedient of a poll tax of a shilling upon everybody over fifteen. The unfairness of demanding from rich and poor alike the same amount was keenly felt by people of the peasant class. We must remember, too, that as each member of a family over fifteen years of age would have to contribute one shilling (a sum which would represent from twelve to fifteen shillings of our present money, and which would mean several days' pay in the case of most of those from whom it was due), such an amount would be a serious drain on the resources of the poor. Frequent disputes arose in respect of those who were apparently about the minimum age. Parents and collectors could not agree, and the latter, by their brutality in attempting to prove their case, added the spark that alone was needed to turn the smouldering embers of discontent into an outburst of revolt. The peasants of the east, south, and a portion of the centre of England, arose almost simultaneously, as though by some pre-concerted signal, and those of Lancashire, Yorkshire, and Durham would have made common cause with them, but for the sudden collapse of the whole movement. Though the rising may fairly be described as general, the cries which gave life to the movement were local. In Essex and Suffolk the labourer was exasperated by the tyranny of serfdom.

In Kent, where villenage was unknown, the cry was for a more equal division of property. In London and the centre of England John of Gaunt was singled out as the cause of the woes of the poor, while in the north of England he was held up as the great emancipator of the serf. In some districts itinerant preachers had stirred up the people against the clergy, while in others the clergy infused into the people their own feeling of impatience at the oppression from which, they held, the Church suffered. There was general discontent, but no common cause. The movement, universally of a mixed democratic and socialistic character, owed the possibility of its organisation to three causes :—

1.—The existence of associations called into existence by the general determination to defeat the aims of the Statute of Labourers.

2.—The preaching of Lollard emissaries, who travelled about the country as the friars had done before them, and, in some cases, drawing into their ranks many of Wycliffe's itinerant preachers, spread through the country perverted social views in the guise of religion.

3.—The existence of a large number of discharged soldiers in all parts of the country, and possibly of mechanics thrown out of employment by war.

The outbreak was simultaneous north and south of the Thames. In Essex, a baker at Fobbing boldly resisted a collector, while at Dartford in Kent, a tiler murdered a tax-officer who had exasperated him by outrageous conduct towards his daughter. The weakness of the effort made by the authorities to put a stop to such deeds of violence only led to further outrages.

The revolt spread with startling rapidity, and paralysed the authorities with fear. From Kent alone, 100,000 men are said to have marched towards London, the immediate neighbourhood of which they reached on June 13th, 1381. The Hertfordshire men made their headquarters at Highbury, the men of Essex at Mile End, while the Kentish men occupied Tower Hill. The same day the poorer London artisans insisted that the gates should not be closed against the insurgents, who proceeded to show their dislike of John of Gaunt by burning his noble residence, the Savoy Palace. The new Inn of the lawyers at the Temple and the houses of the foreign merchants were also in a blaze. The insurgents, anxious that the true cause of their revolt should not be misunderstood, sternly repressed any attempt at pillage. The next day, Friday, June 14th, after some rough horse-play on Tower Hill, the tower was entered, and the Archbishop of Canterbury, Simon Sudbury, who was also Chancellor of the Kingdom, together with several other high state officials, was seized and condemned to be beheaded. Deeds of reckless and unpardonable violence such as these seem to have been more the result of accident than of intention. During the time these deeds were in progress the neighbouring counties were overrun, and numerous houses of the nobles, and many rich foundations, including St. Albans, destroyed. The king met the body of peasants waiting without the city at Mile End for a conference, and showed a boldness, a tact, and a presence of mind which probably saved the country from a scene of frightful slaughter and a desolating civil war. At the meeting, Wat Tyler's manner was so threatening that Walworth, then Lord Mayor, slew him with his dagger. The death of the boldest and most determined of the leaders inspired the gentry with fresh courage, and correspondingly disheartened the insurgents. Everywhere active measures were taken to suppress the revolt. On July 2nd, the charters of manumission and pardons, issued only a fortnight previously, were annulled, and on the 18th of the same month local courts were forbidden to release prisoners charged with taking part in the revolt. During the autumn, the judges on their circuits hanged without mercy all who had taken a prominent part in the rising. The severe measures adopted to inspire terror were inexcusable, and can only be accounted for by the alarm the revolt had occasioned. No less than seven thousand persons, including victims on both sides, are said to have perished during and after the rising. Parliament met early in November, and being composed of members of the dominant class, naturally looked upon the demands of the peasants as a direct attack upon the rights of property, forgetting the superior rights of their fellow-men to personal liberty and equal justice. As early as possible in the session, the treasurer, Sir Hugh Seagrave, explained the course taken by the king, admitted that the granting of the manumissions was contrary to good faith and the law of the land, stated that the policy had been justified by its success, and that the charters had been revoked as soon as it was safe to do so. The king, however, he said, was willing that the bondsmen should be enfranchised in a proper and legal manner if the three estates of the realm desired that it should be so. In the reply there was no appearance of a desire to smooth matters by a compromise, but the king was informed that Parliament viewed with satisfaction the revoking of the manumissions, that the serfs were their goods, and the king could not take their goods from them without their own consent. "This consent we have never given," they added, "and never will give." This uncompromising attitude was only possible, because the common danger had caused the propertied classes, both lay and clerical, to place on one side their differences, and to combine for their common safety. In spite of the declaration of the propertied classes in Parliament to stand on their rights, the cause of the peasants was really won. No one desired to see a second revolt, and it became evident that service unwillingly rendered was too expensive to be maintained. Eventually, though gradually, all was granted; money rent was accepted universally in lieu of labour rent, and no further attempt was made to degrade the free labourer to the position of a slave.

Here I must bring my paper to a close. The picture I have had to draw has been a gloomy one, the tale I have told has been one of gross oppression on the part of the privileged classes, leading eventually, as all tyranny unredressed naturally does lead, to an ungovernable outbreak of popular fury. No lesson would appear to have been sufficient to teach the governing classes in the latter half of the fourteenth century that the poor had rights as well as duties. Had they been less selfish they might have learnt the terrible consequences of driving men to extremities by the frightful enormities perpetrated by the Jacquerie in France not thirty years before, and to which their attention must have been forcibly directed, as they occurred while the French king, John, was a prisoner in England. They had reason to be thankful that the sound common sense, self-control, fairness, and order-loving nature of Englishmen prevented like excesses, almost too horrible to contemplate, from being perpetrated in this country. The lessons of history have, however, in times later than the fourteenth century been ignored; had it been otherwise, we should have been spared many a dark page in the history of the world during the last five hundred years.

Westminster Abbey and its Monuments.

By R. Moxon.

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[Condensed.]

THE origins of the City of Westminster and of our own town, Burton, are exactly parallel. Just as the township of Burton was formerly nothing but a village or hamlet occupied by persons attracted by and wholly dependent on the Abbey of Burton, so the township of Westminster only grew up as a consequence of the foundation of the Abbey of Westminster. The reason why Westminster became so much more famous and important than Burton was that amongst the inhabitants of the former was usually numbered the King of England. It was the Abbey that attracted the kings to the neighbourhood, there to be crowned and anointed, there to fix the seat of government, there to summon their great councils and parliaments, and there to be buried. Thus Westminster, in this respect unlike Burton, owes not only its origin, but its subsequent growth and present importance directly to the Abbey.

It is of course doubtful when first a religious establishment arose on this spot. The legends on the subject are many and various. Most of them may be found related in Dugdale's "Monasticon." Some writers attribute the foundation to Sebert, King of the East Saxons, nephew of Ethelbert, King of Kent, whose Queen, Bertha, was the patroness of St. Augustine. Others give the credit to Mellitus, Bishop of London, one of Augustine's companions. Bede, however, makes no mention of Westminster in his "Ecclesiastical History."

A wonderful story is told that the church was miraculously "dedicated" by the Apostle St. Peter himself. It is to be noticed that the writer of the "Monasticon" evidently knew nothing of the subtle distinction between the terms "consecration" and "dedication," which lately exercised the minds of the members of the Burton Town Council. This story of the miraculous dedication was implicitly believed in the Middle Ages, and the belief had great practical effect. In the time of Richard II. there was a controversy and lawsuit about the right of sanctuary at Westminster, and in the arguments on both sides the fact of the consecration by St. Peter is taken for granted.

Whatever may have been the real origin of the Abbey, there is little reason to doubt that it existed in the time of King Offa, who died A.D. 794, and that it suffered a great deal at the hands of the Danes. Under Archbishop Dunstan it was restored, but only on a small scale. Edward the Confessor may be regarded as the true founder of the Abbey as a really important ecclesiastical and national institution. It is said that during the usurpation of the Danes he made a vow that if it should please God to restore him to the throne of his fathers he would go in pilgrimage to Rome, but that Pope Leo. IX. subsequently absolved him from the vow, on condition that he should expend the money intended for the journey in the foundation or repair of some religious house dedicated to St. Peter. The benefaction was accordingly bestowed upon Westminster Abbey. The church was finished in a few years, in the style of architecture which we now know as "Norman." It is also stated that it was the first cruciform church built in England. In the Bayeux tapestry is a rude and, no doubt, somewhat conventional representation of this church. There is still one fragment of it remaining, viz., the base of one single three-quarter column which lies under the sanctuary floor. In the surrounding buildings which were part of the monastery, though not of the church, there remain many chambers and fragments of chambers of Norman work, most of them, however, later in date than the Confessor's time. The most important of these is known as the Chapel of the Pyx, which was probably originally the treasury of the Abbey.

I cannot within the limits at my disposal give the history of the Abbey in any detail. My chief object is to direct attention to the question of burials and memorials of the dead. Sebert and his wife are said to have been buried in the original church, and Edward the Confessor erected a monument over their remains before the high altar of his new minster. He also made elaborate arrangements for his own interment in a chapel to the east of the altar. William the Conqueror chose the Abbey as his place of coronation, and everyone of his successors who has been crowned has in this respect followed his example. The Norman and Angevin sovereigns, however, for various reasons, were not buried here. In A.D. 1163, Pope Alexander canonized Edward the Confessor, and, at the instigation of St. Thomas, Archbishop of Canterbury, King Henry II. had a new shrine made, worthy of the regal saint. In doing this he displayed the same spirit which actuated nearly all the kings of England down to the time of Henry VIII. They were all anxious to establish their claim to be considered Englishmen, and to identify themselves with English thoughts and feelings, and in no way could they do this better than by showing respect to the memory of one who was always regarded as specially representing the family of Egbert and Alfred. And they could devise no more obvious way of showing that respect than by gifts to that monastery of which Edward was now regarded as the founder and patron. These feelings were very strongly developed in the mind of Henry III., who conceived the idea of making the Confessor's shrine the centre of the burial place of his race. He added to the church a "lady chapel," and later the still existing octagonal chapter house; but, not content with these additions, he pulled down the Confessor's church, and in its place erected a large portion of that which exists to this day. The shrine of the Confessor was still to be the nucleus of the building, but that which Henry II. had erected gave way to one yet more splendid. Of this enough remains to show what it was originally like. It stands in the centre of a chapel commonly called the chapel of Edward the Confessor, surrounded by the tombs of most of the Plantagenet kings. Outside the chapel is an ambulatory, which is surrounded by a wreath of chapels. The style and ground plan of this portion of the building are French rather than English, but the nave, choir, and transept present a splendid example of Early English. Although the nave was not completed till well into the sixteenth century, the same style was continued, contrary to the almost universal custom of mediæval builders.

Henry VII., whose hereditary claim to the throne was of the most shadowy nature, strove to emphasize that claim by extravagant devotion to the memory of his predecessors; and the chief medium of this devotion consisted, as usual, of benefactions and additions to what might fairly be called the Royal Monastery. And just as the Confessor had pulled down the earlier Church, and Henry III. in turn had pulled down the Confessor's, so did Henry VII. pull down, not indeed the whole church, but a very important part of it, viz., the lady chapel, and erected in its place that which we still know as Henry VII.'s chapel, a fine specimen of the Later Perpendicular style. In the centre of the nave of this chapel stands the splendid shrine of Henry VII., beneath which he and his queen are buried; quite unaccountably the coffin of James I. has also been discovered here. Dean Stanley, who made this discovery, has given a most interesting account of it in his "Memorials." This shrine, in the Renaissance style, the forerunner of many similar but less splendid ones, has always been attributed, in the main no doubt correctly, to the famous Italian artist Torregiano; but I was assured by Mr. St. John Hope that the form of the heraldic devices on the large shields at either end shows that they are of English design.

Westward of this shrine, under an altar, also the work of Torregiano, Edward VI. was buried. No monument was erected to his memory, but the altar over his grave was looked upon as his memorial. Curiously enough this, though thus associated with the name of England's first "Protestant" sovereign, was the only one that was destroyed by the Puritans during the Great Rebellion.

In the time of Richard II. was built the Jerusalem chamber, which has been the scene of many famous historical events. Originally, it was the Abbot's withdrawing room, and was connected with his house through a smaller apartment known as the Jericho parlour. Here it was that Caxton is said to have set up his printing press, which was both the figure and the instrument of that great revival of learning which led the way to so many changes, and amongst others to that Reformation of religion which we must allow one another to call "blessed" or "accursed," according to our individual notions. The incident of that Reformation which concerns us chiefly now was the suppression of the monasteries. The last abbot of Westminster was one Boston or Benson, who, according to Dugdale, had previously been abbot of Burton-on-Trent. He made no resistance to the Act of Suppression in 1540, but quietly became dean under the new *régime*.

Henry VIII. made Westminster the seat of a bishopric, the Abbey Church being, of course, the Cathedral; but after ten years the diocese was again merged in the see of London, and from the second year of Queen Elizabeth the legal designation of what is commonly called "Westminster Abbey" has been "the Collegiate Church of St. Peter at Westminster." After the Dissolution, most of the monastic buildings were destroyed, and others given over for the use of a school, still known as "Westminster School." It is not improbable that the church might have shared the fate of so many other Benedictine Abbeys, and fallen into ruins like St. Mary's at York, or wholly disappeared like Burton Abbey, but the existence there of the tombs of so many kings saved it.

With the exception of the Western Towers, no addition has been made to the structure of the Abbey since the time of Henry VII. This is decidedly matter for congratulation, for no doubt if anything in that line had been done the style of architecture chosen would have been utterly incongruous with the ancient building. Considering the total disrepute into which

Gothic architecture fell all over Europe for more than three centuries, we may be thankful that our many beautiful English minsters, and especially the one with which we are now concerned, were not all swept away, and replaced by "classic" buildings similar to St. Paul's Cathedral. The late great architect, Mr. Street, speaks of Westminster Abbey as "the most lovely and loveable thing in Christendom." Alas! in this case, as in so many others, we are now face to face with the melancholy fact that architects and builders, even of the highest class, can construct only for time, not for eternity. Many parts of the fine church are to-day in such a condition that they must either be rebuilt or suffered to fall into decay and ruin. And this question of rebuilding is a very difficult one. However reverently the restoration may be carried out, the feeling of the spectator will assuredly be "No man who has seen the old, straightway desires the new, for he says the old was better."

After the Reformation the Abbey still remained the customary royal burial place. With the exceptions of Charles I. and James II., every English monarch, from Edward VI. to George II. inclusive, lies under the floor of Henry VII.'s Chapel. Oliver Cromwell, too, was buried here; but, to the eternal disgrace of Charles II., his remains, with those of the other regicides, were disinterred after the Restoration and ejected from the Abbey. But to none of the post-Reformation sovereigns was any monument erected, with the exception of one to the sister queens, Mary and Elizabeth. This was put up by James I., who also erected a somewhat similar one to the memory of his mother, Mary Queen of Scots.

So far, I have spoken only of the burials and memorials of sovereigns. Many other persons, however, even in early times, were interred in the Abbey. To a nineteenth century mind, the words "Westminster Abbey" suggest the idea of interments and monuments intended to recognize the distinguished merit of their subjects either as warriors, patriots, statesmen, or men of letters or science. But this idea is a comparatively modern one. It was certainly no part of the design of the founders of the Abbey;

its origin was almost accidental, and its growth has been both slow and gradual. Such a notion would have been quite inconsistent with mediæval ideas on the subject of burial. The leading motive which would induce Edward the Confessor, or Henry III., or Henry VII., or any of their contemporaries, to build a chapel in which their remains and shrines should be placed after their death, was to secure a place for an altar at which masses might continue to be said for the repose of their souls. They never thought of making the edifices they founded receptacles for the bodies or memorials of others than themselves and their own immediate relatives. Only by very slow degrees did others than those of the royal house, and the abbots, obtain interment in the church. Up to the time of the Reformation, sepulture in the Abbey was confined to members of the royal family, distinguished courtiers and royal favourites, and abbots. The immediate effect of the Reformation appears to have been a reduction in the number of burials in the Abbey, though in 1551 a monument was erected to the memory of Geoffrey Chaucer. It should, however, be remarked that he owed the honour of his burial here, one hundred and fifty years previously, not to his merits as a poet, but to the posts which he held at the court of Richard II., and to his connexion through his wife with the royal house of Lancaster. But in the reign of Queen Elizabeth the number of burials was enormously increased, and the chapels at the east end, no longer used as places of worship, became simply receptacles of tombs and monuments. On the sites of the ancient altars, vast monuments—I am inclined to say "monstrous" monuments, using the word "monstrous" in more than one sense—were erected to the memory of persons who had little claim to the honour. For some generations after this, burial in the chapels was mainly confined to great statesmen, lawyers, soldiers, and their families, but in 1599 Spenser was buried in the south transept near the grave and monument of Chaucer, expressly as a tribute to his fame as a poet, and during the succeeding forty years many other poets and men of letters were similarly honoured. To George Villiers, Duke of Buckingham, Charles I. assigned a small chapel to the north-east of that of Henry VII., this being the earliest instance of the burial of anyone not of the seed royal in that part of the Abbey. The sixteenth and seventeenth century monuments are of course quite out of keeping with the architecture of the church itself, and apart from this we cannot help marking a distinct loss of the religious feeling which seems inherent in the pre-Reformation monuments. The old form of altar tomb with recumbent effigy gradually disappeared, the whole character and style of the monument was changed, effigies of the dead were placed in every conceivable attitude and mural tablets appeared, the delicate arcading and ornamentation of the walls being often sadly mutilated to make way for them.

It was during the great Civil War that the Abbey was first recognized as the regular burial place for national heroes, as distinguished from court favourites or men of letters, and the same principle prevailed during the reigns of the later Stuarts; and burial in the Abbey has from that time been recognized as conferring the highest honour on various kinds of merit. And not only has burial been thus looked upon. In many cases cenotaphs have been put up in memory of those buried elsewhere. Down to the early part of this century the privilege was granted with a freedom that we now cannot help thinking excessive. Not only were the monuments set up unduly numerous, but many of them take up an enormous space. It must also be remarked of the monuments of the last two centuries that only in very few instances can they be taken as any guide to the place of sepulture, even when that is also in the Abbey. But during the last forty or fifty years the authorities have been more careful in these matters, and the interments and monuments have been confined to the cases of those who have occupied a large space in public estimation. Moreover, a few of the more objectionable or obstructive of the monuments have during the last few years been somewhat reduced in size. Nevertheless, the condition of the Abbey is now such that, in the words of the late Sir Gilbert Scott, "there is in fact no more room for monuments, unless the interior is to be entirely crowded up with them, and both the church and the monuments themselves rendered objects of public ridicule instead of veneration and interest." Since 1848, only two monuments at all worthy of the Abbey have been erected. The others are all erect statues, busts, or mere tablets. And it is now impossible to increase the number of such paltry memorials as these, even if it were thought desirable. When the late Dean Stanley found a place for the statue of Lord Beaconsfield in 1881, he said it left only one such site remaining, which he designated for another statesman of great eminence still living, after which there would practically be no space whatever.

Accordingly, in 1890, a Royal Commission was issued to enquire into the present state of Westminster Abbey "as regards the facilities which it offers for providing for the interment, and otherwise preserving the memories of the most illustrious of the Queen's subjects, and to consider plans for providing, at the Abbey or elsewhere, an additional place for memorials, should such provision appear necessary." The Commissioners duly met and examined a large number of witnesses. I have their reports and minutes of the evidence given before them, and shall be happy to lend them to any member who may desire to study the subject more closely. The reports do little more than echo Dean Stanley's plaintive cry of "No room for more monuments," and the question how to provide more room presents grave difficulties on all sides. As far as burial is concerned, there appears no difficulty. For several years past the deans have only permitted burial in the cases of persons of undoubted eminence, or where irresistible pressure was put upon them by public opinion. The present dean has held his office for nearly twelve years, and in that time there have only been six burials in the Abbey. And it seems that there yet remains room for from eighty to one hundred graves, which is sufficient for any demand likely to arise for at least a hundred years. Should cremation come into general use there will practically be no limit to the possible number of burials. But, on the other hand, it must be taken as an undoubted fact that henceforth to no national hero, however great—not even to Tennyson for instance—can a memorial worthy both of the place and the man be set up in Westminster Abbey as it now stands.

To meet this difficulty there are many suggestions. One is that we should not have any more monuments; and there is a great deal to be said in support of this view. Those whose life and work have really earned the regard and gratitude of their fellow-countrymen need no stained pane or sculptured stone to keep their names alive. But, on the other hand, we cannot forget that many of the ancient monuments are full of interest, and it seems unreasonable to say we will retain and care for them, but make no provision for the due commemoration of the heroes of our own day, or of those who may arise hereafter.

Another proposal is that there should be a great weeding out and re-arrangement of the present monuments.

> "O could we do with this world of ours
> As men do with their garden bowers;
> Reject the weeds and keep the flowers,
> What a heaven on earth we'd make it!"

But the difficulty always arises, Who is to decide between the weeds and the flowers? And there is great objection to the removal of any monuments, as is well stated by the Archbishop of Canterbury and by Dr. John Evans, the President of the Society of Antiquaries, in their evidence before the Royal Commission. We are thus brought face to face with a demand for some enlargement of the available space, and architects on all sides are ready with a variety of plans to meet this demand. Alas! to each and all of them objections arise as quickly as the plans are propounded.

The most ambitious is one of the present architect of the Abbey, Mr. Pearson, to build a new aisle on the north side of the existing nave. But as this would completely hide the only part of the Abbey in which Henry III.'s design can be seen externally, I am glad to find that this proposal finds no favour in any quarter.

Several architects have made plans for an extension to the south-east. Close to the Abbey there are a number of eighteenth century houses of no interest whatever, which everyone agrees ought to be removed at once. By this means, if the ground were left unoccupied, a fine view of the chapter house and of Henry VII.'s chapel would be opened out, for which reason I should be very sorry to see any new buildings placed there. But taking for granted that some extension must be made, it is felt by many that this would be the best place for it. It has been objected by some that the ground we are now speaking of is not and never has been a part of the Abbey precincts. But Mr. Micklethwaite, the well-known antiquary, has, I think, conclusively shown that it was the ancient monastic burial ground. As far, therefore, as I can judge, there is, from an archæological point of view, less objection to one of these schemes than to any other that has been made for the enlargement of the Abbey. Three of the Royal Commissioners, Sir Austin Layard, Sir Frederick Leighton, and the Dean of Westminster, advise that preference should be given to this scheme, but the other three, Mr. Plunket, Mr. Jennings, and Mr. Waterhouse, prefer the erection of a monumental chapel on a piece of ground practically vacant, the site of the old refectory, south of the great cloister, and parallel to the nave of the Abbey. This was much favoured by the late Dean Stanley, and has the great recommendation that, its site being surrounded by other buildings, it could scarcely be seen from the outside, and so could not disfigure the Abbey. But the wall between the south walk of the cloisters and this refectory site is said to date back to the eleventh century, traces of the ancient arcading still remaining, and I need not say that archæologists strongly object to these remains being interfered with, or to fragments of an old building being worked up into a new one. Still weightier is the objection that the new chapel would be absolutely separated from the present church by the whole width of the cloisters.

Amongst all these various schemes I confess that I am puzzled, and I do not feel ashamed to say so, seeing how many wise and learned men seem to be in the same puzzle. Possibly the only solution will be to fall back on the first suggestion I considered, viz.: to have no more monuments in the Abbey, or, at any rate, only such as public opinion may insist upon, and to make room for such by removing some that may be considered unworthy of their position. For the due commemoration of others another place must be found, and I am not at all sure that for the majority of them it is necessary that the place should be a consecrated church. Certainly of some of those to whom memorials have been put up of late years—the late Matthew Arnold for example—it cannot be said that churchmanship was their distinguishing characteristic. And though, doubtless, a monument in Westminster Abbey is a great honour, it does not follow that the absence of such a monument must be counted a dishonour. You will search in vain there for memorials of Simon de Montfort, the Black Prince, Oliver Cromwell, John Pym, Sir Robert Walpole, Edmund Burke, Robert Clive, Lord Brougham, John Bright, John Stuart Mill, Drake, Blake, Nelson, and Wellington, Caxton, More, Wren, Hogarth, Reynolds, Dr. Johnson, Pope, Byron, Scott, Dickens, Tennyson, and Bishop Wilberforce. The last strikes me as a very singular omission, inasmuch as at one time he was Dean of the Abbey. Of course, some of these are buried here, but without monuments. Others have monuments at St. Paul's; but, be that as it may, I fancy the list will justify me in saying that no man's friends can feel that his memory is dishonoured because he has no monument in Westminster Abbey, seeing what distinguished society he can keep amongst the outcasts.

To conclude, I have explained to you the difficulty, and confessed my inability to point the way out of it. Let me try my hand at consolation. Things might be worse. We complain that there are no empty niches in our temple for monuments to our heroes. Let us be thankful that we cannot say we have niches that must be left empty because we have no heroes worthy of monuments. In Westminster Abbey "we are encompassed about with a great cloud of witnesses" to the prudence, the pluck, and the patriotism of our forefathers. We can be thankful that our own age has produced many a hero worthy to be laid and remembered in the same solemn abode. We trust that the day will never come when it will be possible to say of our country that she no longer produces sons worthy of commemoration even in so august a temple as the Collegiate Church of St. Peter at Westminster.

In preparing these papers I have been under great obligations to several gentlemen, especially to Mr. Robert Thornewill, a past president of this society, for the loan of the volume of Dugdale's "Monasticon" containing the account of Westminster Abbey, to Dr Harris Morris for preparing several special lantern slides, and to Mr. Micklethwaite, F.S.A., and Mr. W. St. John Hope, who both spent a great deal of valuable time in conducting me to parts of the Abbey to which access is not easily gained, and in drawing my attention to many facts and points of interest of which I was previously ignorant.

Notes on a Sojourn in the Levant.

By T. Knowles, M.A.

(*Presidential Address delivered November 18th*, 1892.)

[Condensed.]

ONE morning towards the close of November, 1873, the Russian steamship *Alexander II.* cast anchor in the Bay of Beyrout, having left Alexandria the day but one before. I was one of her passengers. Every passenger, including myself, was soon on deck examining the country and town lying just opposite the vessel. Beyrout is situated on the coast of Syria, twenty-seven miles north of the old Phœnician town of Sidon, near a head of land that is formed by the coast-line, as it were, suddenly receding ten miles or more to the east, thus leaving what may be described as a ledge in the coast. The town is not situated on the point or end of the ledge, but in the westerly one of the two bays which have been scooped into this ledge. The point or head of land is called Ras Beyrout, the word "Ras" being the Arabic for "head." The two bays which have been formed in the ledge are called "the Bay of Beyrout," and "St. George's Bay": the former, the westerly bay, being opposite the town of Beyrout. The shore of the inner, or easterly bay, is the traditional spot where took place the battle between St. George and the Dragon. A few miles to the north the Nahr el Kelb, or Dog River, flows into the Levant. This river is apparently only a few miles long, but it has a subterranean course under the curiously convoluted rocks from which it issues. It was through the pass lying between these rocks and the sea, that almost all the invaders of Syria made their descent upon that country, and there are tablets cut in the rocks close to the Dog River, on which are engraved in cuneiform character, inscriptions relating to these invasions, more especially I believe to that by Sennacherib in the days of King Hezekiah.

But to return to Beyrout, the shore on which the town stands slopes gradually up from the sands, and the houses rise picturesquely one above the other. One's eye is caught by the European roofs of the hotels, the places of business and the larger dwelling-houses; but the very great majority of the buildings have the Oriental flat roofs. Another thing strikes one wherein Oriental towns as a rule differ from European ones, and that is the large number of trees that are dotted about the town among the houses. These do not grow in the streets, but in the court-yards of the houses, and are useful for the shade which they give, and also for their fruit, for it is usually the olive, the banana, or the kharub tree that is thus planted, the olive tree being especially valuable.

Standing on the ship's deck, the Lebanon mountains seem to rise up out of the sea on the left, peak rising over peak in tiers, until at the back of all rises Jebel Sunnin, whose height is close upon 10,000 feet. The top of this mountain was at the time of which I am speaking covered with snow. The prevailing colour of the Lebanon mountains is that of French grey; wherever the eye looked, whether along the shore out to Ras Beyrout on the right, or towards St. George's Bay on the left, or on those celebrated Lebanon hills, not a patch of green turf was to be seen. The country seemed to be quite bare of trees, except for an occasional olive grove or small copse of pine trees, which, however, were not sufficient to relieve the prevailing monotonous general tint of the country.

Beyrout has been for some time the most considerable commercial centre in Syria. No doubt its name is Semitic in origin, probably Phœnician. The Hebrew word "beer" means a well, or spring, as we should say now, and the plural is "beeroth." There are springs now in the old town, but they are very deep and difficult to work. By far the larger part of the town is supplied by the Beyrout Waterworks Co., which brings the water of the Dog River into the town. Beyrout is said by some to be mentioned in the Bible in two places: namely, 2 Samuel viii. 8, where it is called "Berothai"; and Ezekiel xlvii. 16, where it is called "Berothah"; but it is doubtful if it is Beyrout that is referred to in either place. The Roman name of the town was Berytus. It was destroyed by Tryphan, the usurper of the Syrian throne, in B.C. 140. Afterwards the elder Agrippa built there a theatre and amphitheatre, baths and porticoes. The Emperor Titus here celebrated the birthday of his father, Vespasian, by shows and gladiatorial contests. After this, during the troublous times that followed the disruption of the Roman empire, Berytus became celebrated as a school of Greek learning, especially of law. It was a great object of contention in the Crusades, and was captured by Baldwin the First, and afterwards by Saladin.

The present population of the town is estimated at from 45,000 to 60,000, but it is always difficult to estimate the population of an Oriental town. The chief industry is silk growing and weaving, and this is a considerable one. The mulberry leaves for feeding the silkworms are grown for the most part on the lower slopes of the Lebanon hills, not many miles from Beyrout. It is no uncommon thing in riding about the slo pes to come across, every now and then, a mulberry garden laid out in terraces which rise in tiers one above the other, and are planted with nothing but mulberry trees, which, when I saw them, looked like rather tall standard rose trees with the leaves growing in a bunch on the top.

But it is also to its position as the port of the ancient and important town of Damascus, and as the general port of supply for the whole of Syria, that Beyrout owes its size and importance. Three first class lines of steamers call there, the French "Messageries Maritimes," the "Austrian Lloyd steamers," and a line of Russian steamships, and besides the weekly calls from these vessels several other less known lines of steamships call at irregular intervals.

Let us turn now to the inhabitants of the country. The great bulk of the present inhabitants of Syria are Arabs—Syrian Arabs.

Like other Arabs they claim descent from that very important person in the history of Western Asia, Abraham, or, as the Arabs call him, Ibrahim. Abraham, as is well known, had two sons, Ishmael and Isaac. The descendants of Ishmael appear to have settled in the north of the country which we call Arabia. Here or hereabouts they remained in comparative obscurity until there arose the greatest of Ishmael's descendants, Mahommed, who was born about the year 568 A.D., and whose followers and their descendants conquered and impressed their religion upon an empire in Western Asia and Northern Africa larger than that conquered by the Romans.

Syria, more than any of the countries conquered by the followers of Mahommed, was settled by the Arabs, one reason for this being probably that Syria previously to the Arab conquest was inhabited by a Semitic people, and therefore the Arabs, being themselves Semitic, would mingle and unite with them without great difficulty, except as regards Jews, whom the Arabs regard as fraudulent interlopers.

The Syrian Arab is of an olive complexion with dark hair—as a rule he is not as dark as the Spaniard. When dressed in European costume you would not easily tell him from a European, until he began to speak: then you would soon tell something of his nationality by his deep gutturals. In character he is subtle, and treacherous in his dealings, and generally the reverse of honest towards those who employ him. In temperament he is, as contrasted with his conqueror the Turk, impulsive and enthusiastic, but in a very far less degree than the native Arab, or even the Egyptian Arab. In intellect he is receptive and imaginative, and what is usually understood by the word "clever."

To continue the history—the Arabs conquered and governed Syria until they in turn were conquered and governed by the Turks. The date of the Arab conquest over Syria is 634 A.D.

Just when the countries of the Mediterranean basin had become settled by their Arab conquerors, consolidated into one empire, and called by one name, Arabistan, then down upon them came the Turks, who conquered and subdued the Arabs, adopted their religion and extended their empire, just as the Teutonic tribes did the Roman empire. But the greatest feat of all accomplished by the Turks was that they got their Sultan named Khaleef, or Successor of Mohammed. The present Sultan of the Turks wields great influence no doubt as Sultan, but he exercises an incomparably wider and stronger power through his being Khaleef.

The manner of the Turkish irruption and conquests was as follows. About the beginning of the fourteenth century from some cause or another the Turks of Turkestan began to leave their country in tribes to seek for new homes in other countries. Some of these tribes went to the north of the Caspian Sea, and some of them effected a settlement in Europe. The Tartar races were given to making irruptions out of their own country to settle in that of some other nation, whom they would turn out and dispossess.

On these occasions the Turks seem to have gone their way in tribes, leisurely and deliberately, roaming through foreign countries, sometimes being pushed on by the inhabitants of one of these victimised countries until they came to a country which, for their own reasons, they conquered, subdued, and settled. Other tribes took a course south of the Caspian—included in these were the Ottoman and the Seljuk tribes—who gradually forced their way into Asia Minor, which seems to have been settled by the Seljuk tribe. The Ottomans went further—they crossed the Bosphorus, and eventually, in 1453, took Constantinople. Part of the Ottoman tribe turned southward as they came to Asia Minor, and they over-ran and conquered Syria in the early part of the sixteenth century. The Arab government of that country, therefore, lasted about nine hundred years.

The Turkish empire is a military empire only. The Turks appear to have little or no genius for colonising a country after conquering it. The countries of the Turkish empire are governed by Pashas, civil and military, and their subordinates; the whole of the empire being divided into provinces called pashaliks. The great majority of the Arabs in the Turkish empire profess the Mohammedan religion.

The climate of Syria is very varied. Round about Beyrout the thermometer begins to rise about the middle of April from 78 degrees or thereabouts in the shade, till in July and August it reaches 95 and 100 degrees. From the beginning of March to the middle of October it is very seldom that you see a cloud in the sky. Then the autumnal rains begin, and last for fourteen days or three weeks. During December, January, and February the rains are heavy, and are accompanied by much lightning and thunder.

Let us now leave Beyrout and go to Damascus. The way is by the French road, and the distance about seventy miles. There is a good service of six-horse coaches between the two towns, one by day and one by night each way. The road is carried over the Lebanons, reaching at one point a height of about 6,000 feet, after which it descends into and crosses the low-lying and generally fertile plain called Cœle-Syria—Cœle meaning hollow—that lies between the Lebanon mountains and those of Anti-Lebanon. After crossing this valley the road is taken through a pass of Anti-Lebanon, and then by the side of the river Basada for some distance right into the city.

The southernmost part of Anti-Lebanon is Mount Hermon, under whose shadow lies Damascus, a town of about 140,000 inhabitants. The situation of the town is remarkable—it lies at an elevation of 1,400 feet above sea level, and is surrounded by thick groves of fruit trees, chiefly apricot (standard), plum, apple, and damson. Damascus is generally considered to be one of the most ancient cities in the world. It is mentioned in the fourteenth chapter of Genesis, and appears to have been a town of importance even in the time of Abraham. The water supply of Damascus is unrivalled. It is obtained from a comparatively small stream, the Phege, which flows through the same valley as the Basada. The water of the Phege is taken in a conduit which taps the stream some way up in the Anti-Lebanon hills, and is then brought down by gravitation to Damascus, every house of any importance in which has a fountain playing in its courtyard. The sound of the splashing water is grateful to the senses in the parched up months of the Damascus summer.

The other river which runs through Damascus is the Abana, familiar to us in connection with the name of Naaman the Syrian.

The mosque of Damascus is believed to have been built on the site of the temple of Rimmon, where Naaman is said to have sacrificed (see 2 Kings v. 17 and 18). This temple was destroyed, and afterwards a Christian church was built on the site; and now on the same site stands a Mohammedan mosque.

The celebrated Saladin was born in the suburb called Saleikeeyah.

Next to Mecca, Damascus is the most fanatical place in the Turkish empire. Here Europeans are frequently called "Christian Dogs" and "Giaours" in the streets by the natives, and the tone of voice in which these names are uttered betray the deep scorn and hatred of the faithful Mussulman for the renegade and idolatrous Christian. It is a fact that the very street dogs of Damascus bark at Christians. This statement may seem hardly to be founded on fact, nevertheless it is as nearly true as any general statement is; for since Orientals invariably wear the tarboosh on their heads, and Europeans do *not* wear it, the dogs let pass anyone who wears a tarboosh, but the luckless European, who is usually some kind of Christian, is saluted in the way I have stated.

Let us now leave Damascus and go to Baalbec. In order to get there from Damascus you go back by the French road to a point about midway between the Anti-Lebanon and the Lebanon, called Shtaena. Here you leave the road and travel on horseback, first of all to Zahleh, a town of about 14,000 people. Not far from this town, near a village called Kerak, is the traditional tomb of Noah. Noah is one of the chief Mohammedan prophets, the word "prophet" being used in its primary sense of "preacher." The tomb consists of a long low narrow building of one storey, containing one room. In this incense is kept burning night and day. Down the middle of this room, from end to end, nearly, runs a brick thrall about two feet in height, and on the top of this thrall is a plaster or mortar sarcophagus, running the whole length of the thrall. In this the prophet is said to be lying.

They say he lies on his back, with his legs below the knees hanging down, so that you only see his length from his head to his knees. I stepped the length of this thrall, and, adding on a quarter of his apparent height to cover the length of his tibia and feet, I made his height just one hundred and twenty feet. And yet he would seem to have been no broader or stouter than any ordinary man.

The traditional tomb of Seth lies farther along the valley. This, however, I did not visit.

From Zahleh to Baalbec the distance is about twenty-five miles, and the road lies mostly by the side of the river Leontes, or Litâny, as it is now called. Baalbec is generally considered to be the same place as Baalgad, mentioned in Joshua xi. 17, thus—" Baalgad in the valley under Mount Hermon." And again in Joshua xiii. 5, "Baalgad under Mount Hermon by the entering into Hamath." Baalbec, or as it is also called, Heliopolis, was once a large and flourishing town. This was in the time when the Phœnicians were the great commercial nation in the Levant. In those days Tyre was the port to which were carried the goods brought by the Persian caravan, and from this port they were distributed to all parts of the then known world. Baalbec was on the direct route of this caravan, and was one of the intermediate centres of distribution. Now, nothing is left of this once flourishing town but the vast ruins which all the world has heard of, and some mud hovels in which live the regular inhabitants of the place.

Little is known as to who built these temples; history is silent on the matter. Tradition assigns the building of them to Solomon, but the style of architecture of the greater part, if not of the whole of the buildings, is debased Corinthian, so it is not easy to see how Solomon could have built them. I think the best opinion is that the buildings that originally stood where these temples now stand were of considerable antiquity—perhaps Solomon may have built them—that they fell into ruin, and their foundations were used in building the temples whose ruins we now see there, and which *must*, by the style of their architecture, have been built between 400 and 250 B.C. I believe authorities generally consider that the remains consist of the ruins of two temples, called the great and the small temple, dedicated to the Sun.

Out of all the great number of columns which once adorned the Baalbec temples, only six remain standing. The enormous size of the stones used in these buildings causes the greatest wonder to all who see or know of them. There are three stones in one of the walls of the Great Temple lying side by side of one another, one is sixty-four feet long, another sixty-three feet eight inches, and the third sixty-three feet, and in a quarry just a mile outside Baalbec is one whose length is seventy feet, and which is seventeen feet high and fourteen feet thick.

But we must now leave Baalbec, as we have to get on to Constantinople. Going back to Beyrout, we can take one of the steamers of the "Messageries Maritimes" line and voyage along the coast of Syria northwards Skirting along the coast of Asia Minor, under the shadow of the Taurus mountains, you pass the island of Rhodes, and then at once you are among the islands of the Ægean archipelago. And here begins the most delightful part of a most interesting and enjoyable voyage. The sea is studded with innumerable small islands, many of them too small to be marked in a map, some appearing to be inhabited solely by sea birds, which rise in large flocks from the white cliffs as the vessel passes by. The larger ones contain a town, or a village or two, built picturesquely on the steep surface of the island, and shining with dazzling whiteness in the brilliant sunshine.

In this way you sail along for a whole day and night, when you begin to leave the small islands behind as you near the Bay of Smyrna. And now you are actually in the region that may be said to be almost sacred to a large part of mankind, in that it is the scene of the deeds and achievements of that truly wonderful nation, that of the ancient Greeks, and most travellers, I believe, find it difficult to withstand the influence of the "*genius loci.*" In these waters, and in the countries whose shores are washed by them, lived those learned and mighty men and heroes of old, of whom it is not too much to say that they have helped more than any other people to make modern Europe what it is, and to whom we are indebted, if not for our religion, yet for our learning, our arts, and sciences.

When you have passed through the Dardanelles, and are getting across the Sea of Marmora, your thoughts naturally begin to turn to the great city of Constantinople, which you are rapidly nearing.

The Sea of Marmora ends towards the north in a small bay which leads into the narrow channel of water called the Bosphorus. Ships which have to discharge at Constantinople do not enter the Bosphorus, but turn to the left and enter an arm of water a few miles long called the "Golden Horn." The Golden Horn separates the old town on the south from the new on the north, and serves as the harbour of the port.

It only needs a glance to see the importance and strength of the situation of this city for on the land side a line of fortifications of only a few miles in length is needed for its protection, while seaward there is room in the waters of the Bosphorus and the Sea of Marmora for the largest fleet which any nation could wish to possess. The only sea approach from the south is through the Dardanelles, a narrow channel, at one place only a quarter of a mile wide, while the sea approach from the north is the channel leading out of the Black Sea into the Bosphorus, which is not more than a mile wide. In the hands of a powerful maritime nation Constantinople would be practically impregnable.

As a commercial centre, Constantinople, if properly taken in hand and provided with docks, wharves, and railways, might be the port for distributing the produce and goods of Asia among the nations of Europe.

The principal building in the city is the mosque of Santa Sophia in the old town. This was originally a Christian Church, and was built by the Emperor Justinian in the sixth century.

It is generally supposed that at one time the Bosphorus was a succession of lakes united by a stream, and that in course of time the stream became widened, and the lakes somewhat contracted, thus producing the present condition of things. The European shore of the Bosphorus from Constantinople to Biyukdere, which is about four miles from the Black Sea, or twelve from Constantinople, is studded with villages, which are in reality suburbs of the great city, the most pleasant one being Therapia, which is just one and a half miles below Biyukdere. Here the chief merchants of Constantinople have their residences, and all the embassies, but that of Russia, their summer palaces.

The Bosphorus is a most delightful spot, except during the winter, which is, I understand, however, a very short one. There are no tides, and therefore no mud banks, but you can stand on the shore and look sheer down into fifteen or twenty feet of blue water.

On a recent visit to the Dalmatian Coast: with some remarks on the physical history of the Mediterranean.

By Horace T. Brown, F.R.S.

Read before the Society, February 17th, 1893.

[Condensed.]

WHEN we have clearly before our minds the important fact that the recent history of the Mediterranean is in reality the history of civilization itself, it cannot certainly be without interest to reflect upon the remote physical causes which have given rise to this great inland sea.

The Mediterranean fills part of a great depression in the earth's surface which runs almost in an east and west direction through sixty-five degrees of longitude, or nearly one-sixth of a great circle. This depression extends with varying width from some distance to the west of the Straits of Gibraltar nearly to the Mongolian frontier, a distance of over four thousand miles. A portion only of this depression is filled by the waters of the Mediterranean, its eastward prolongation including in its deepest parts the Caspian Sea, the Sea of Aral, and Lake Balkhash. This great natural depression does not, it is almost needless to say, owe its origin to erosion, as do most of the smaller depressions or valleys on the earth's surface, but is an expression of great earth movements which originated in very remote geological times. It is the trough or synclinal hollow of a gigantic fold in the earth's surface, and owes its origin, in part at least, to that constant attempt of the consolidated earth-crust to accommodate and adapt itself to the gradually cooling and shrinking interior portions. This trough has one of its complementary crests or anticlines to the northwards in the parallel ridge of high land which runs through central Europe and western Asia, a ridge which, although it has undergone many and great changes of level, has in the main always retained an elevation high in comparison with its corresponding trough to the south. Farther to the south another crest belonging to this same system of folding is visible in the Atlas range.

This primary system of folding or rucking up of the earth's surface, which is still recognizable when the phenomena are studied on a large scale, must have originated in remote Palæozoic times, but its pristine simplicity, as might be expected, has been much modified and altered by subsequent earth movements. These subsequent movements can be resolved into two systems, acting in directions almost at right angles to each other; that system of movements running in the original east and west direction resulting in the elevation of the present Alps, and the Pyrenees and the Cantabrian Mountains, with the parallel ranges of Spain to the south; whilst the movements acting at right angles or in a meridional direction have resulted in the elevation of the Apennines and Dinaric Alps, and the mountains of Albania and Greece.

These cross movements, acting in a direction approximately north and south, were also due to tangential thrusts resulting in folding, the sea for the most part occupying the hollows between two successive crests or anticlines of the fold. This is nowhere seen better than in the Adriatic, which lies in a great sag or syncline, two anticlinal phases of the fold being represented by the Apennines on the west, and the mountains of Dalmatia and Albania on the east.

Another effect of this later folding in a meridional direction, which only took place in Tertiary times, is very evident when we come to examine a hydrographical map of the Mediterranean shewing the various depths of the sea. Instead of one trough or basin of uniform depth, there are recognizable four distinct areas of deep water separated by ridges running approximately north and south, and upon which the water is comparatively shallow. The most westerly of the deep basins lies between the Balearic Islands and a north and south ridge, which is in part visible above the sea level in the islands of Corsica and Sardinia, and the deep area is continued towards the west to a point within one hundred and fifty miles of the Straits of Gibraltar. The depth of this basin is from eight thousand to ten thousand feet. In the Straits of Gibraltar itself the water is shallow.

In the Tyrrhenian Sea, between the Corsican ridge and the shores of Italy, there is another deep but smaller depression reaching depths of over twelve thousand feet. Between the western extremity of Sicily and the African Coast the water is very shallow, as it also is between Cape Passero, the south-eastern point of Sicily, and the opposite point of the African Coast. Between these two ridges lies a small deep basin of an area approximately that of Sicily.

From the eastern shores of Sicily another deep area sets in, the largest of all the Mediterranean depressions. This extends northwards into part of the Ionian Sea, and eastward as far as the island of Cyprus.

It is evident, therefore, that the Mediterranean includes four deep depressions separated by comparatively shallow water, and that an elevation of the sea bottom of only about two hundred fathoms, or a drying up of the water to the same extent, would convert this now continuous sea into a chain of four lakes, whose physical connection with the further chain of lakes formed by the Black Sea, the Caspian, and the Sea of Aral, would be even more apparent than it is at present.

That the Mediterranean has consisted, at perhaps more than one period of its history, of such a chain of lakes there is strong geological evidence to show, but it would occupy too much space to give you the evidence upon which that opinion is based. It must suffice to say that strong proof can be adduced that during Pleistocene times, there was a ridge of land connecting Cape Passero in Sicily with the African Coast through Malta, whilst at the same time Spain and Africa were also united, so that the earth-movements which finally disunited Europe from Africa must have taken place at a period which is, geologically speaking, but yesterday. Thus we see that the making of one continuous Mediterranean and the final preparation of this great inland sea for the part it had to play in the civilization of the world, was not completed until after the appearance of palæolithic man.

There are many other points connected with the physical history of the Mediterranean which are of very great interest, but I must now give you some more detailed account of a portion of our journey.

In steaming from Corfu to Venice we had already obtained something more than a glimpse of the Dalmatian Coast, as we had kept pretty close to the eastern shores of the Adriatic, threading our way through some of the outlying islands. It was, however, only after leaving behind us all the glories of Venice that we shaped our course almost south-east with the intention of making Spalato our first place of call on the opposite coast. The gradual change in the colour and appearance of the water claims our attention as we sail farther to the south and east. The muddy yellowness which characterises the water on the Italian side gradually gives place successively to yellowish green, green, and blue as the Dalmatian Coast is reached. This is due to the gradual subsidence of the mud carried out into deeper water from the mouths of the Po and Adige, the water-borne detritus of the streams and glaciers which flow down the sides of the far distant Alps.

On the eastern shores of the Adriatic the rivers are small, and run for the most part through hard rock, so that the amount of sediment on this side does not sully the purity of the water to the same extent. Blue, however, as the water is in this part of the Adriatic, it is altogether surpassed by the azure hue of the Mediterranean itself. I had always imagined that the deep blue of the Mediterranean was largely due to the reflected glories of the southern sky above it. This, however, is not the case. The sky seen in the late spring and summer is seldom of that depth of colour which we generally associate with the idea of an Italian or an Alpine sky; I have often seen our English skies of deeper azure than we saw on any occasion in the Mediterranean in the month of May. The colour of the sea is quite independent of that of the sky above, and is of a deep liquid blue which transcends all powers of description.

How are we to account for this marvellous colour? It doubtless has an origin similar to that of the azure of the sky, *i.e.*, it is not due to any inherent colour of the medium itself, but to the particular state of division of minute solid particles in suspension. When the dimensions of the particles are reduced to such a state of minuteness as to bear a sensible relation to the dimensions of the light waves, the light which is reflected from the medium, whether it be air or water, is no longer composed of the waves of various refrangibilities mixed in the proportions constituting ordinary white light, but the rays of smaller wave length, that is, those of the blue or more refrangible end of the spectrum, are reflected in greater proportion by the minute particles, and the emergent light consequently has a more or less blue tinge. The greater the amount of subsidence of the grosser particles, the greater is the residual proportion of the more minute, and the bluer is the reflected light.

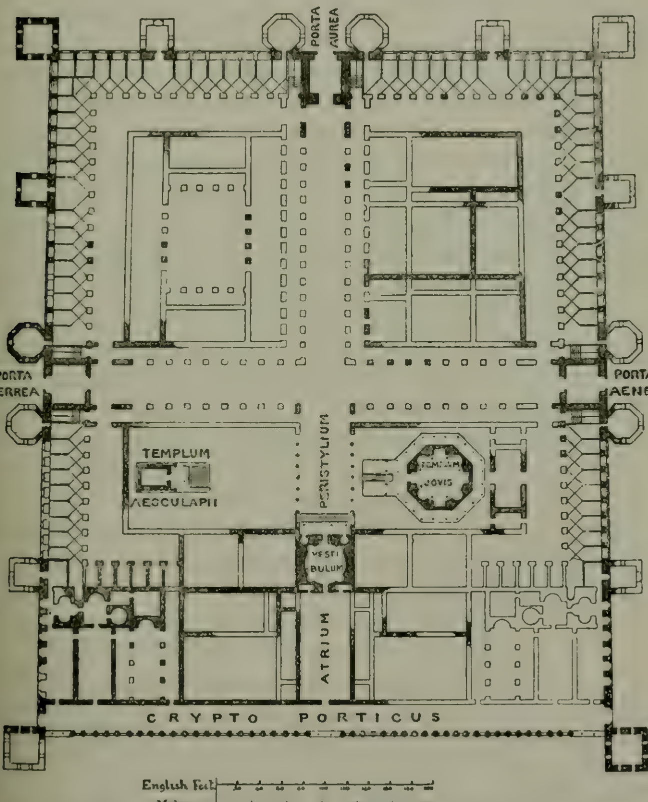
Now, owing to the great depth of the Mediterranean, and to the comparative absence of currents in these deep basins, the conditions are favourable for the complete subsidence of all but the most minute particles, hence the purity and depth of the blue of the Mediterranean water as compared with that of the open oceans.

As we approach the Dalmatian Coast, or sail along it within the belt of islands, which, like the Norwegian Skjaergaard, extends as a natural breakwater for several hundreds of miles, we see, lying between the far distant mountains and the sea, a narrow tract of undulating country of bare and desolate aspect. This impression is to a great extent produced by the prevailing sombre greyness of the hills, and their comparative freedom from vegetation of any kind; but as we become more closely acquainted with the country, we find that it is by no means of the barren nature our early impressions have led us to believe, but that it possesses fertile plains, and valleys rich in corn and oil and wine. This narrow strip of land bordering the sea, in its people and language, still bears the impress of its early Roman colonization, and since that time, during all the stormy vicissitudes of its history, it has never ceased to be the bulwark of civilization as opposed to the barbarism, which, even to this day, is divided from it by but a few miles breadth of mountains. As we travel further south these mountains approach nearer and nearer to the sea, until at Cattaro, they almost touch the coast.

The mountains and the lower-lying hills in front consist for the most part of a very hard grey limestone, which is so light in colour as occasionally to give the appearance of snow-clad heights. This limestone is of about the age of our chalk, from which, however, it differs greatly in hardness, as it is almost as compact a rock as our mountain limestone, and makes a most excellent building stone. Owing to the comparative ease with which this rock, like all limestones, is acted upon by rain charged with the carbonic acid derived from the air and other sources, the prevailing outlines of the hills and mountains are flowing ones. There is, however, in these flowing lines of the foot-hills and rounded rocks of the shore and islands an entire absence of any of those indications of ice action which are so evident to the trained eye where they occur. This part of Europe, in fact, owes nothing of its sculpturing to the ice-sheets which have left such a strong impress upon the scenery of Northern Europe.

As one sails along the channel of Spalato with the low-lying island of Bua to the left, the town of Spalato itself gradually comes into view, built on a narrow promontory running westward. The sections in the sea cliffs here indicate an enormous amount of folding and contortion, giving one some idea of the force of those great lateral earth-thrusts, which, increasing in magnitude as we travel eastward, have resulted in the elevation of the Dinaric Alps.

As the town is neared, all such thoughts are for a time banished by the expectation of the architectural wonders of the place we are approaching, for it is here that Diocletian, one of the greatest of Rome's emperors, built for his retreat a mighty palace, now become a city, a palace which, even to this day, mutilated and ruined as it is, is one of the most wonderful buildings in the world.



PLAN OF DIOCLETIAN'S PALACE, SPALATO (from ADAM)

Fig. 1.

The unparalleled importance of this building does not however lie in the fact that it is the finest example of Roman domestic architecture in existence, but that it bridges over a gap in the architectural record, and supplies a necessary link in the evolutionary history of architecture which would otherwise have been missing. Without it we should have had no means but that of pure conjecture to connect the architecture of ancient Greece and Rome with that of later times. It marks, in fact, as the late Professor Freeman has well said, "The greatest step ever taken, the beginning of all later forms of consistent arched architecture, Romanesque, Gothic, or any other."

The general plan of the palace (fig. 1) is after the restoration of Robert Adam, who was the first to draw the attention of the world to the wonders of Spalato. In the year 1757, Adam visited Spalato, and in the course of five weeks of incessant labour, carried on under considerable difficulty, completed a survey of the palace, which he subsequently gave to the world in 1764 in a large folio volume, the "Ruins of the Palace of the Emperor Diocletian at Spalato in Dalmatia." During the progress of this work Adam was enabled for the first time to form an idea of the plan and disposition of the building when in a perfect state, and although many other careful observers, notably Sir Gardner Wilkinson, Professor Freeman, and Mr. T. G. Jackson, have followed him with the fuller knowledge of the nineteenth century, yet this description of Adam's stands to this day the best account of Spalato we have, and the general accuracy of his statements has been abundantly confirmed.

The whole building was quadrangular, the dimensions of the alternate sides of the quadrangle being 698 feet and 592 feet. The enclosing walls, which exist almost intact to this day, are extremely massive in structure, and have a height of 50 feet at the lowest part, rising to 70 feet in height towards the sea, owing to the natural fall of the ground in that direction. There were sixteen towers in these walls, one at each angle, and four on three of its sides. These towers were not much more lofty than the walls of which they formed part, and seem to have been intended for ornament rather than for defence. The total area covered by the building is about nine and a half acres. It, of course, contained, besides the apartments of the Emperor, accommodation for the numerous retinue of officers who attended his court, and was capable of lodging a whole pretorian cohort.

The building was divided by two large streets, crossing each other at right angles, and leading to the three principal gates of the palace. Adam has noted that in the arrangement of these streets, and of the apertures of the villa, the architect has managed to avoid any inconvenience which might arise from the prevailing winds of the country.

Passing through the Porta Aurea, the visitor to the palace would have found himself in a broad street with spacious arcades on either side running directly south. Of this arcaded street, as also of the one at right angles to it, but little or nothing remains, but beyond the crossing of the other main street the remains of the old palace are still so perfect that it requires very little imagination to re-construct it in all its magnificence. On either side is the Peristyle, a name given to the area or court of the Roman Villa. In front of us is the porch of the vestibule, which is of the Corinthian order, but possesses several novel and important features, to which I shall presently call your attention. The vestibule itself is circular in form, as is usual. It was originally domed, but the dome has now fallen in. Next to the vestibule is the atrium, and from the atrium we pass to the Crypto Porticus, which is on the sea front of this vast building. It is an open cloistered gallery, 517 feet in length, and whilst primarily intended for walking and other exercises, served also most probably as a gallery adorned with statues, pictures, and *bas reliefs*.

Adjoining the atrium, and on the west side of it, was the basilica, a large room used for dramatic performances, and such like entertainments, whilst on the opposite side of the atrium was another large hall corresponding in size.

The small square temple on the west of the peristyle was dedicated to Æsculapius, and is now the baptistery of the Cathedral. It is one of the most perfect ancient buildings in the world, the lapse of fifteen centuries having left it almost untouched. On the opposite side of the peristyle is the octagonal temple which is generally believed to have been dedicated to Jupiter, who was especially venerated by Diocletian, and in whose honour he assumed the surname of Jovius. This temple is surrounded by a peristyle of its own, and has its original dome almost intact. It is now the Cathedral of Spalato.

A great part of the old palace has now disappeared and given place to an irregularly built town with narrow streets. The houses are in fact built on the foundations of the rooms and offices of the palace, and in many parts modern work is so intermingled with the ancient as to become scarcely distinguishable from it.

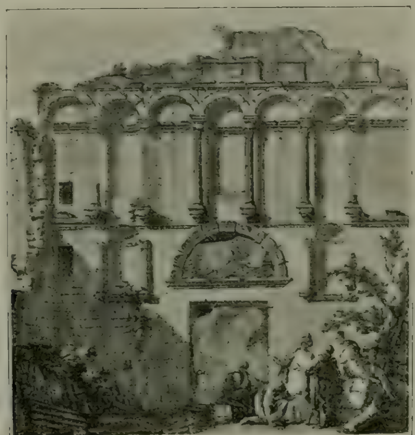


Fig. 2.

This transformation of a house into a city commenced immediately after the destruction of the neighbouring city of Salona by the Avars in 639 A.D. Such of the unfortunate inhabitants as escaped destruction at the hands of the barbarians took refuge within the walls of this palace, then long-deserted, and after the lapse of nearly three hundred and fifty years already beginning to fall into decay. This was the commencement of the modern city of Spalato, which for many centuries afterwards found sufficient room for its requirements within the walls of the imperial palace—at what a cost as regards the priceless treasures of antiquity can well be imagined.

The Golden Gate itself has suffered very much from the ravages of time, even during the last hundred years or so, as is very evident on comparing recent photographs with the engraving made by Adam in 1763 (fig. 2). One of the most important features of the adornment of this gate is the use which has been made of small columns resting on carved corbels, and supporting arches above, thus forming a miniature arcading, an architectural ornament of which this is the first known instance, and which was destined to be used so very largely in Romanesque and Gothic work.

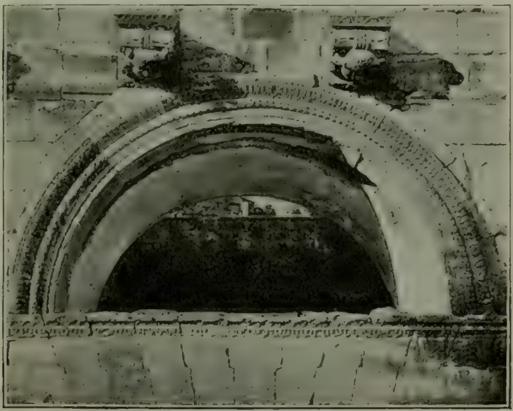


Fig. 3.

The entrance of the Gate is divided from the semi-circular opening above it by a straight piece (fig. 3) of lintel-like masonry, which, nevertheless, from its construction we must call an *arch*. The voussoirs of this perfectly flat arch are cut in a curious zig-zag form, and are thus made to fulfil all the mechanical requirements of the components of an ordinary arch.

Fig. 4 is a photograph of the portico of the vestibule, which, as far as the exterior is concerned, is almost untouched. The dome which originally formed the roof of the vestibule has, however, fallen in; but you will readily notice by a comparison with Adam's engraving (fig. 5) how very little imagination was required in this case to restore the building to its original state.

The entablature of the portico, which is of statuary marble supported by Corinthian columns of granite, is divided, as is usual in classical architecture, into architrave, frieze, and cornice, but between the two central columns the whole entablature with its three members springs boldly into an arch. This is all very

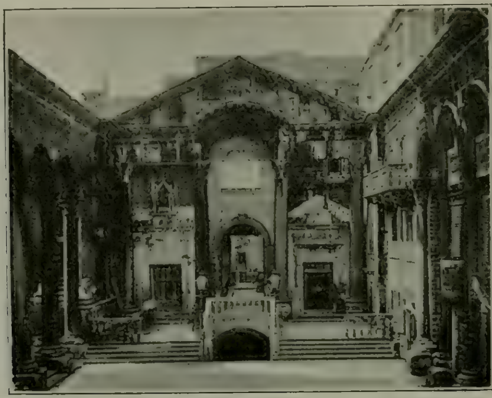


Fig. 4.

terrible from a purely classical point of view, and has given occasion for Adam and others to object to this deviation from the pure simplicity of the ancients. It is only since Adam's time that the full significance of this apparent barbarism has been properly interpreted. It marks almost the first step towards the final abandonment of trabeated construction, which had long survived its principals, and the complete emancipation of the arch. A few words of explanation may perhaps be desirable.

There can be little doubt that the entablature, *i.e.*, that part of the architectural design which surmounts the columns, owed its origin in classic architecture to the unconscious imitations of forms of construction of the oldest temples, which were of *wood*. The various members of the entablature, architrave, frieze, and cornice, had their respective origin in the square beams laid from post to post, in the ends of the cross beams, and in the projecting boarding which covered the rafters and ties of the roof. The entablature was the one persistent element in all Greek and Roman art, and continued for a long time after the trabeated or beamed construction had lost its real structural meaning ; it was in fact what a naturalist would term a *vestigial* phenomenon. In this portico of the vestibule we see quite clearly that the architect

Fig. 5.

had abandoned the idea of the entablature being a beam, whilst at the same time it retained all its traditional elements. The next step, the omission of the frieze and cornice, and the complete emancipation of the arch from its traditional style, was a comparatively short one. The record of this further evolution is beautifully shown in the arcading of the peristyle (fig. 6). Here the frieze and cornice of the quondam entablature are omitted, and the arches spring directly from the capitals of the columns right and left.

The columns of the peristyle from which these beautiful arches spring are of *cipollino* and rose-coloured granite. A flight of steps on the eastern side leads to the Temple of Jupiter, now the Duomo. On these steps, without any other foundation, is built the mediæval campanile, pierced in its basement by a large archway leading to the Duomo.

The campanile belongs to the best period of Romanesque

Fig. 6.

work, having been begun about the middle of the thirteenth century, and completed about the commencement of the fifteenth. It is a fitting sequence to the classical work around it, and a standing witness to the influence of Diocletian's building upon the fancy of mediæval architects.

The Temple of Jupiter is the most important and perfect of the existing portions of the palace, the lapse of sixteen centuries having left it almost untouched. Its exterior form is octagonal, each side being about thirteen feet long, and it is built of large oblong blocks of marble very accurately squared and fitted to each other without mortar. Around the outside of the building runs a peristyle of its own, made up of twenty-four beautiful columns with Corinthian capitals. The columns are in part of Oriental granite and part of marble. Surmounting the entablature of this peristyle statues were placed immediately over each column, as

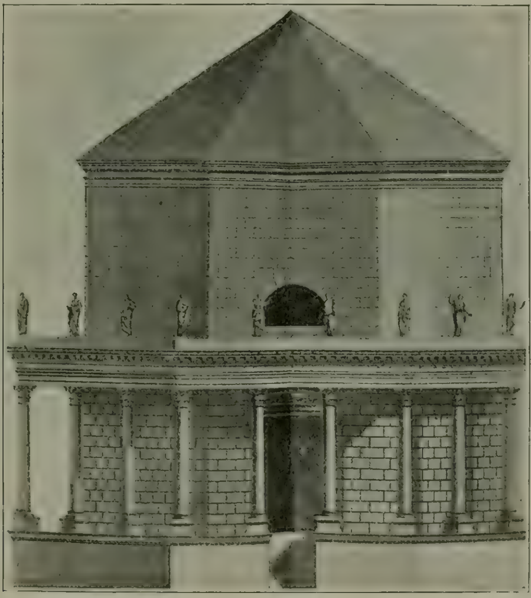


Fig. 7.

indicated in Adam's restoration (fig. 7) but of these none now remain.

The interior of the temple is circular (fig. 8), the immensely thick wall being divided into eight bays by detached columns two orders in height. These columns have really no work to perform in supporting any part of the building, but are purely ornamental. The roof is a dome of a very peculiar construction, the brickwork being for a considerable distance arranged in a scale-like form, giving place higher up to ordinary concentric courses. Externally this dome is covered with a pyramidal tiled roof which, notwithstanding doubts expressed to the contrary, has been clearly shown to be the original roof.

This ancient Temple of Jupiter is now the Duomo, the cathedral of Spalato. Two of the original semicircular niches are fitted

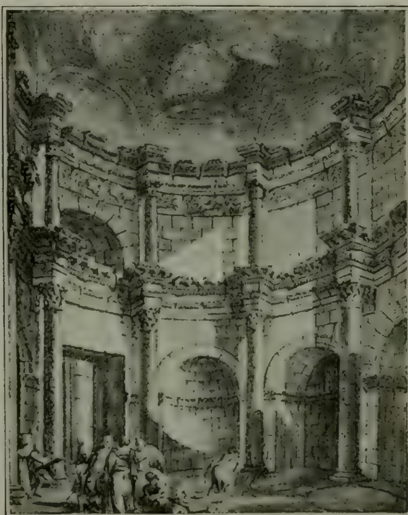


Fig. 8.

with two Gothic canopied shrines or chapels; they are very elaborate and handsome, and date from the middle of the fifteenth century. There is also a very fine mediæval pulpit of marble of various colours.

On the west side of the great peristyle court, that is on the side opposite to the Temple of Jupiter, is another smaller temple, now the baptistery, which has generally been considered by antiquaries as having been dedicated to Æsculapius, although some have looked upon it as the mausoleum of Diocletian. "It is a small rectangular temple, raised on a lofty podium, and originally preceded by a tetrastyle portico which is now gone. The interior measures no more than 16 feet by 27 feet $7\frac{1}{2}$ inches, and is covered by a fine wagon vault of stone sunk into coffers. But for the font, the interior of the little shrine has remained unaltered since the time when Diocletian sacrificed within its walls, so completely has it withstood the wear of time, and escaped the wanton injury of man."—*T. G. Jackson.*

I must now conclude this brief description of the house which has become a city by calling your attention to the sea-front (fig. 9),

Fig. 9.

with its crypto-porticus or cloistered gallery. The most noteworthy features from an architectural point of view are that the entablature of this crypto-porticus has no frieze and no distinct architrave, but only a cornice with two facias below it. Over two openings we also see, as in the portico of the vestibule, the whole entablature springing into an arch. This is doubtless the origin of the Venetian window.

In taking our leave of a building which has played such an important part in the history of architecture, and in which, as Freeman has well expressed it, "the germ was planted which grew into Pisa and Durham, into Westminster and St. Ouen's," it will not be out of place to dwell a little upon the life, the work, and influence of that great man at whose bidding this palace arose.

"As the reign of Diocletian was more illustrious than that of any of his predecessors, so was his birth more abject and obscure." His parents had been slaves in the house of Annulinus, a Roman senator, and obtaining the freedom of his family his father had acquired the humble office of scribe. Conscious of his own superior merit, and as fully imbued with the certainty of his future greatness as was the young Napoleon fifteen centuries later, he threw himself into the profession of arms. Rising rapidly in military command he was promoted to the government of Mœsia and the honours of consulship; he distinguished himself in the Persian war, and at Chalcedon. After the mysterious death of the Emperor Numerian, the choice of the army fell upon him as successor and avenger. This was in the year of our era 284. Scarcely had he attained to the purple before he commenced the completion of that great change for which the time was ripe, by which the chief magistrate of the commonwealth was transformed into the sovereign of the empire. His life was one of ceaseless activity in the field and in the cabinet, and having crushed the remaining power of the Senate he soon left it a mere "venerable but useless monument of antiquity on the Capitoline hill" (Gibbon, chap. xiii.). Surrounding himself with all the pomp and majesty of an Oriental despot, he commenced that constructive portion of his policy which stamps him as a great ruler, and which delayed for many years the dissolution of that Empire which was still mistress of the world.

Convinced that the abilities of no single man were adequate to the public defence, he associated with himself three others to share in the government. The Empire was divided between these four rulers, but the various parts were still to some extent federated The work of rescuing the Empire from the inroads of barbarians occupied Diocletian and his colleagues for twenty years, and it was after vanquishing all his enemies and after the complete fulfilment of all his ambitious designs that, deeming his work accomplished, he "cast away both the form and substance of power," and retired to Spalato, where he had built a house worthy of his name and fame, and where he spent the last years of his life, following the peaceful occupation of horticulture, and cultivating those cabbages which he refers to in his letter to his old colleague, Maximian, as affording him greater pleasure than all the sweets of despotic rule.

On the gentle slopes which border the lake-like sea-inlet a little north of Spalato lie the remains of the city of Salona, once the capital of the ancient Roman province of Illyria. In passing amid the huge lines of stones which now cover the ancient site of the town, so complete has been the destruction that we found it difficult to realize that we were actually on the spot occupied 1,200 years ago by a thriving and prosperous town at least half the size of ancient Constantinople. Here and there, however, are still the ruins of the old walls, and under local guidance we soon found remains of great interest. On the right of the road as we come from Spalato, is the aqueduct which was built by Diocletian to supply his palace with water from the sources of the Giadro. This aqueduct has of late years been repaired, and now supplies the modern town of Spalato with water.

At the extreme west of the city, commanding a fine view over the sea-inlet, is the amphitheatre, and, beyond the limits of the city, towards Trau, the remains of a long line of wall apparently connecting Salona with a port further down the coast. But amongst the ruins of this ancient city by far the most important and interesting are those of the basilica. Here we have the remains of a Christian church apparently untouched since the early part of the seventh century. The site, as was usual in the early churches, was outside the walls of the town, and recent excavations have shown that the building was founded upon a smaller and still earlier church, whose foundation walls are in part visible. It is evident that the ground occupied by these churches was at one time a Roman cemetery, for pagan sarcophagi have been found in great numbers, and can still be seen underlying its foundations.

As we have already dealt at Spalato with some of the evolutionary problems of architecture, it may not perhaps be out of place here to call attention to another important linking of the past and present afforded by the structural peculiarities of the classical basilicas, and the very marked influence which these have had upon the form and arrangement of Christian churches.

The earliest known basilicas of Rome do not date back to a later period than 150 to 200 years B.C. They were buildings which were originally used for very much the same purposes as our Merchants' Exchanges, and as the convenience of their form became more recognised they were used also, with some modifications, as courts of law. In plan they generally consisted of large rectangular halls, with one, or in some cases, two rows of columns on each side of the central area. These columns were returned at either end, thus cutting off at one extremity a vestibule or narthex, and at the other a tribunal forming a kind of transept. Above the aisles so formed was often a second row of columns supporting the roof, and forming at the same time a gallery for the general public. The building was lighted with windows in the side walls and at the back of the galleries, by a clerestory in fact. The end wall was generally in the form of an apse, and in the centre of the curve of the apse stood the prætor's curule chair, whilst in the centre of the chord of the apse stood an altar upon which the judges took an oath to administer true justice.

These halls furnished to the early Christian communities exactly what was wanted for their religious assemblies, and we consequently find their churches built on this pattern, and it will be evident to all of you that the classical basilica has determined the general form of the Christian church in all ages. "The capacious nave accommodated the ordinary congregation, the galleries or aisles the females, and the more dignified worshippers; while the raised tribunal formed the *bema* or sanctuary, separated by lattice-work from the less sacred portion below, the bishop and his clergy occupying the semi-circular apsis. The prætor's curule chair became the episcopal throne, the curved bench of his assessors the seat for the presbyters of the church. The inferior clergy, readers and singers took the place of the advocates below the tribunal; while on the site of the heathen altar rose the holy table of the Eucharistic Feast."—*Canon Venables.*

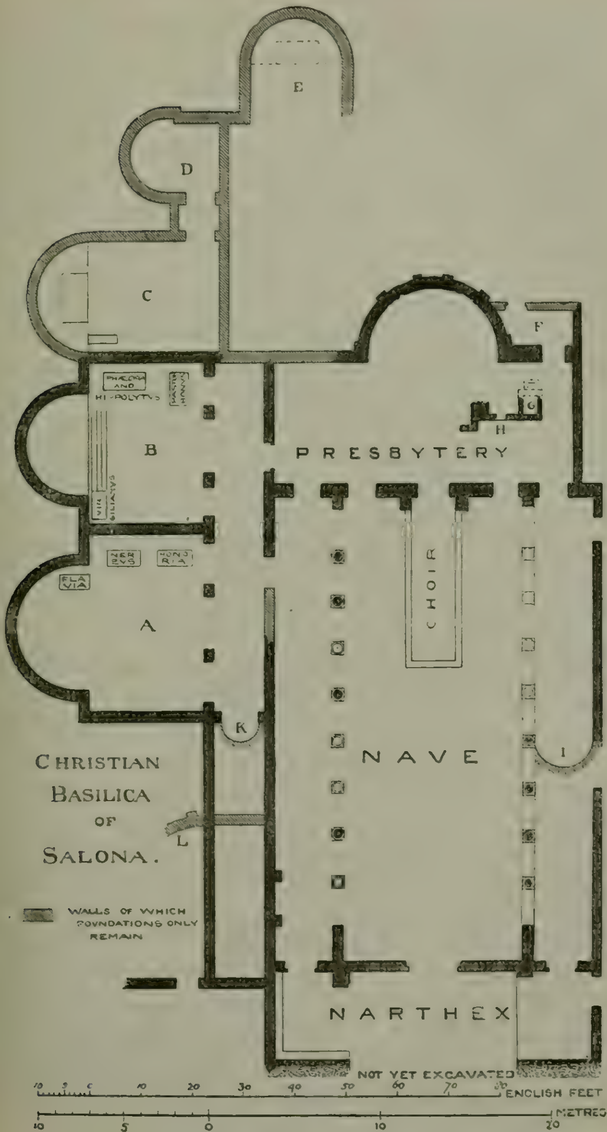


Fig. 10.

This Plan is reproduced from Mr. T. G. Jackson's Work on Dalmatia by the kind permission of the Clarendon Press.

The Christian basilica at Salona, of which Fig. 10 is a plan, "consisted of a nave with side aisles divided by a colonnade of nine arches on each side, and preceded by a narthex. . . . at the east end of the nave is the choir, enclosed once by a dwarf wall or screen, of which the foundations remain."—*Jackson.*

A great peculiarity in this basilica is the thick wall beyond the choir forming a solid partition pierced only by five doorways. Antiquarians are unable to offer any explanation of this curious wall. Northward of the church is an additional aisle running the whole length of the building, with two apsidal chapels opening out from it. The choir wall itself bears an inscription of the year 431. Some highly interesting sarcophagi were discovered in the chapels, one of which represents the legend of Phædra and Hippolytus. This is one of many Pagan sarcophagi which have been put to Christian use.

Although, as I have said, the choir dates back to the fifth century, there are vestiges of a building even more ancient still; the main body of the church is supposed to have been built very early in the seventh century. The masonry constituting the walls is rude, and was most likely plastered outside, the internal decoration being marble and mosaic.

Those portions of the walls of Salona which are still standing bear witness in their battered and patched state to the many attacks to which the city had been subjected before its final destruction. It was taken and re-taken many times by Goths, Huns, and other barbarians, and was finally swept away by a terrible irruption of the Avars in 639, when, ruined and pillaged, it fell to the state in which we now know it.

As we turn from the ruins of Salona towards the mountains of the north east, we see the celebrated fortress of Clissa perched on its rocky eminence, and guarding the valley. This fortress has always been looked upon as the key to this part of Dalmatia by every army which has invaded the country. It has been held by Hungarians, besieged by Tartars, and has changed hands over and over again between Turks and Venetians. It is still kept in a state of defence, and is garrisoned by Austrian troops.

Our next stopping place on the Dalmatian coast was Ragusa, a city which was an independent Republic of considerable importance during the middle ages, and which in fact survived down to the beginning of this century, when it only ceased to exist at the tyrannical and capricious bidding of Napoleon.

It is the one spot on these coasts which boasts that it has never come under the dominion of either Venetian or Turk, although I believe there are historical grounds for believing that at various times it was in more or less tributary relation to both these powers. It certainly, however, never lost its autonomy, always retaining during all its vicissitudes its old form of government. This was an aristocratic Republic, resembling much in its constitution that of Venice. The head of the Republic was the Rector, who was the chief magistrate, and resided in the palace, to which I shall presently draw your attention. As Sir Gardner Wilkinson has said, "The whole career of the Ragusan Republic was a struggle for self-preservation, and the maintenance of independence in the midst of constant danger." In this particular also she resembled her powerful neighbour Venice.

The geographical limits of the old Ragusan Republic are still indicated in our modern maps in a very curious way. Before I visited these border lands of the Adriatic, and had occasion to study a map on a fairly large scale, I had imagined that the Austrian territory of Dalmatia extended in a continuous but ever narrowing strip as far south as a little beyond Cattaro. As a matter of fact, however, there are two very small breaks in this strip, one at the Gulf of Klek, on the narrow inlet formed by the peninsula of Sabioncello, the other at Sutorina on the Bocche di Cattaro. At both these points Herzegovina, a country which until lately was nominally Turkish, comes down to the Adriatic, this small piece of territory so severed from Dalmatia being exactly co-terminous with the ancient Republic of Ragusa, and these severances owe their origin, as pointed out by Freeman, to the mediæval Ragusans being willing to allow the territory of the Turk to touch her own sea coast rather than have a common frontier with her hated rival Venice.

We have still another reminder of the vanished greatness of this little Republic in the word *argosy*, which owes its origin to the town of Ragusa, and carries us back to a time when it shared with Venice the carrying trade of the Adriatic, and sent out its argosies to all parts of the world.

The town lies at the foot of the mountains, which here approach very near to the coast, "A ledge of Christendom with a background of barbarism." It is built on the neck of a rocky isthmus, and with its bastions, towers, and all the various adjuncts of an ancient fortress, affords a magnificent example of a mediæval fortified town, whilst every islet near it is also strongly fortified.

Ragusa has from time to time suffered immense damage from earthquakes, which are of frequent occurrence, but are curiously local in their effects. The records of the sixteenth century contain abundance of evidence of the alarming nature of these earthquakes, and in the year 1667 nearly the whole town was destroyed. It might consequently be expected that Ragusan architecture would present but few points of interest. Such, however, is by no means the case, as there are several buildings which in part, at least, date back to the fourteenth and fifteenth centuries. The Rector's Palace, which is on the site of an older building devoted to the same use, was built about 1464 by two very celebrated architects, Michelozzo Michelozzi and Giorgio Orsini. It consists of a loggia of six round arches between two solid structures which originally carried towers, the windows above being Italian-Gothic. This building has aroused the enthusiasm of Professor Freeman, who looks upon it as "One of the fairest triumphs of human skill within the range of the builder's art," and from a study of this palace, of the *dogana* or custom-house, and of the house of Count Caboga, near Gravosa, he concludes that early forms of architecture were in use in Ragusa until a very late date, that in fact architecture did not pass through the same stages of development here as in most other places, and that there is no line of demarcation in point of time between the true Romanesque and the Renaissance. In the chief arcades of the principal buildings the round arch of the Romanesque style passed into the Renaissance without any intermediate Gothic stage, whilst on the other hand, in windows and doorways, the forms of Italian-Gothic came in and continued to exist up to a very late date.

The cathedral of Ragusa dates back only to the year 1671, the older building having been completely destroyed in the great earthquake. The old cathedral was built about the beginning of the thirteenth century, and is said to have been founded by our Richard of the Lion Heart. It was for some time a matter of doubt amongst historians as to where Richard landed at the commencement of that eventful and romantic journey which placed him in the power of the Archduke of Austria. There are, however, documents in existence in Ragusa which prove that after leaving Corfu Richard was driven by stress of weather to the island of La Croma, lying just off Ragusa, and that as a thanksgiving for his preservation he destined 100,000 marks for the rebuilding of the Benedictine Convent there. The Ragusans, however, persuaded him to alter his vow and found the church in Ragusa. This was the origin of the old cathedral, so completely destroyed by the earthquake of 1667.

From Ragusa to Cattaro is a beautiful sail of about six hours. That great fringe of islands, with its long canal-like reaches of perfectly calm water, ceases to form a distinct physical feature of the coast south of Ragusa, and we are once more in the open Adriatic.

Passing Ragusa, Vecchia, the ancient Epidaurus, we are at the entrance of one of the most remarkable natural inlets in the world, the celebrated Bocche di Cattaro, the Rhizonic Gulf of antiquity. It is a salt water loch, or fjord, consisting of three triangular shaped sheets of water connected by as many narrow deep channels, which are the "Bocche," or mouths of the inlet. Within the first "mouth" lies Castel Nuovo, built on a beautiful and well-wooded hill, and surrounded by ancient Turkish fortifications, which, in their dismantled state, testify to the numerous sieges and earthquakes through which they have passed. There can be little doubt that the earthquakes of this region, to which I have already had occasion to refer when speaking of Ragusa, are due to a continued manifestation of those mountain-building forces which, farther to the east, have culminated in the upheaval of the Dinaric Alps. The scenery which opens out as we penetrate further into this land-locked inlet is beautiful in the extreme, and has been so well described by Sir Gardner Wilkinson that I cannot do better than give you his own words.

At Castel Nuovo "begins that grand scenery which has made the Gulf of Cattaro so celebrated. The forms of the mountains are bold and rugged; the sides are clothed with trees, studded with houses; and here and there are a church steeple perched on a height, and a village below seeming to rise from the edge of the water in which it is reflected. As you proceed onwards, a succession of different views present themselves; and the mountains, rising on either side with a majestic sweep from the water, sometimes scarcely leaving room for a village on the shore, give this winding gulf the appearance of an inland lake. At one time you are in a bay half a mile across, which expands to a breadth of three miles; you then pass through narrow channels to a succession of land-locked bays, and so great is the area of water that the fleets of all Europe would occupy but a small portion of this splendid harbour, whose depth would allow them to anchor close to the shore."

The last mouth of the gulf is the Catene, so called from its having been closed by chains drawn across when King Lewis of Hungary defended Cattaro against the Venetians in 1380. As one approaches the Catene it is difficult to believe that there is any passage through the mountain, which seems completely to block the way, but gradually the narrow strait opens out until it appears again to be terminated by the little town of Perasto. At this point, instead of turning sharply to the east and heading for Cattaro, we turned westward for a short time, past two rocky little islets opposite Perasto, into the Gulf of Risano, a *cul de sac* terminating in a steep valley which leads to the district of Krivoscie. Where the land valley comes down to the water lies the little town of Risano, the ancient Rhizon, which gave its name to the whole gulf, *Rhizonicus sinus*. Our yacht now doubled back into the Gulf of Cattaro, the town of Cattaro soon coming into sight at the end of the gulf. The town is built upon a very narrow alluvial plain at the base of lofty mountains, which rise like a steep wall behind it. These are the mountains of Montenegro, and although along the eastern shore of the gulf the boundary between that principality and the Austrian territory of Dalmatia is only distant in a horizontal direction something like half a mile, yet, in order to reach the frontier, it requires three or four hours' stiff walking from Cattaro up the wonderful zig-zag road which traces its sinuous course up the mountain side. This is the main road to Cetinje, the capital of Montenegro. As far as the frontier it has been constructed by the Austrian Government, and is now met by the Montenegrin portion of the road which is continued beyond Cetinje. There can be no doubt that the portion of the road on the Dalmatian side has been constructed with a view to the possibilities of its being required for military purposes, for it can be raked by the guns of the citadel of Cattaro, and also by those of a fort higher up.

The Bocche di Cattaro and the channels and inlets further to the north have often been compared with the Norwegian fjords. The resemblance, however, is only very slight in reality. It is true that both owe their origin to the submergence of land valleys, but here the parallel ceases. In the Dalmatian fjords there is of course no sign of ice action having played any part in their sculpture. This, coupled with the fact that the rocks of the two countries are of such an entirely different nature and appearance, will readily prepare one for the strongly marked differences of contour in the hills and the low-lying rocks on the margins of the inlets.

It seemed to me a matter of considerable interest to determine if these Dalmatian inlets exhibit any instances of that peculiarity of the northern fjords and sea lochs in having much deeper water within than at their mouths. During our voyage I had a very good opportunity of examining the Admiralty Chart of the coast, but I could not discover a single instance of this peculiarity. All the channels and inlets of the Dalmatian coast gradually become shallower from their mouths inwards, and the soundings of the submarine valleys appear in all cases to deepen westward towards the Adriatic.*

At Cattaro, and in fact upon any part of the shores of the Bocche, we realise that we are at last truly in Eastern Europe. At this point the narrow fringe of half Italian population bordering the eastern shores of the Adriatic dies away, allowing the Slavonic nationalities to come down to the seaboard. The Bocchesi, although under Austrian rule, are essentially Slavonic, and closely allied by kinship and sympathies with the indomitable Montenegrins of the neighbouring mountains. With this change of nationality comes also a change of religion, and we find in the town of Cattaro itself the Eastern Church almost in a majority, whilst without the walls the Orthodox really outnumber the Catholics.

Until 1878 Montenegro had no port of its own, but it was then accorded by the Treaty of Berlin, in a very half-hearted manner, a share in the port of Antivari. Still more recently, mainly by the exertions of Mr. Gladstone, who has always championed this chivalric little nation in its endeavours to maintain its independence, the port of Dulcigno was also accorded to it, free from all Austrian control. Notwithstanding this, Cattaro still continues, I believe, to be the main port of Montenegro, for which it is well fitted by its natural position.

It is here at Cattaro, especially on days when the peaceful occupation of marketing has brought down the Montenegrins with their flocks and herds from their mountain fastnesses, that one has the best opportunity of studying the appearance and manners of this wonderful nation, in which every man is a born soldier, prepared at any moment to do battle for his country—a country of bleak mountains and waterless ravines, so desolate and barren that one cannot but wonder why it should arouse the earth-hunger of any of the adjoining nations. Yet the whole history of

* The soundings at the mouth of the Bocche di Cattaro are from twenty-six to twenty-eight fathoms, and those of the Spalato Channel twenty-nine to thirty fathoms.

Montenegro for centuries has been one of ceaseless conflict with their natural and relentless enemy the Turk. "Over and over again have the Turkish forces, eighty thousand strong, burning and ravaging everything in their way, emerged at the other side of the country with the loss of more than half their number, although the Montenegrins can bring at most only twenty thousand men into the field, and even that represents a larger proportion of fighting men to the population than is calculated upon in other countries."—*T. G. Jackson.*

The Chemical Action of Light.

By G. Harris Morris, Ph.D., F.C.S., F.I.C.

(*Read before the Society, March 17th*, 1893.)

[Condensed.]

SOME few months since the two leading professors of chemistry in Germany were engaged in a vigorous controversy concerning the derivatives of two little-known acids, namely, tiglic acid and angelic acid. The point in dispute was an important one, as affecting the constitution of these acids, and was purely experimental: the one worker maintaining that certain compounds could be obtained from the acids, whilst the other asserted his inability to prepare these compounds. Eventually the solution was found in the fact that the former worked in comparative darkness and the latter in full daylight, and that under the influence of light the derivatives in question were decomposed as fast as they were formed. Hence the difference in the results obtained.

This incident serves as a fitting introduction to the subject which I wish to bring before you to-night. In it we have an instance of the all-pervading influence of the chemical action of light, which is as essential to the well-being of the world as is air or water. The green foliage of the trees, the bright hues of the flowers, the strength and health of mankind, are all due to its beneficent influence. The stimulating action of light not being of such obvious universal necessity to vital action as that of heat; nor its effects and influence so prominently marked, its full power as an excitant upon animal and vegetable life was not so quickly and readily recognised; but now it is universally admitted that just as the deprivation of light produces blanching or etiolation in plant life, so the absence or diminution of light exerts an injurious influence on animal life and development, whilst free exposure to sunlight helps to produce animal life in its highest form: the remarkable absence of deformity among savage races being attributed to the constant exposure of the body to strong light.

Before proceeding, I must remind you that light, as we know it, is not homogeneous. When ordinary white light—be it sunlight, candle-light, or gas-light—is passed through a prism we find that it is split up into its component parts, and in place of white light we get a bright band of many colours. This is due to the phenomenon of refraction, the component parts of white light being bent aside, each to a different extent, during passage through the prism, the result being that the band of seven colours, called the spectrum, is produced. The colours are, beginning with the least refrangible, red, orange, yellow, green, blue, indigo-blue, and violet.

But in addition to the visible rays of the spectrum, there are also invisible rays at either end which are known respectively as the ultra-red and the ultra-violet.

Different parts of the spectrum have very different effects; thus, in addition to the rays which give the impression of light, there are others which produce heating effects, and others, again, the special function of which is to promote chemical combinations and decompositions. Experiments show that the maximum heating effect is found beyond the red end of the visible spectrum, whilst, on the contrary, the maximum chemical action is produced by the rays of the violet end, the action extending into the ultra-violet on the one side, and into the green on the other; all perceptible action, except in the case of plants, ceasing in the yellow or most luminous portion of the visible spectrum.

Turning now to the action of light upon the vegetable kingdom, we find that the entire life of a plant depends on this action on the cells which contain the green colouring matter, chlorophyll; for here are constructed the organic substances, which go to build up the plant, from the materials of its food. Carbonic acid is absorbed by the green parts from the air, and is decomposed by the chlorophyll under the influence of light, setting free oxygen. The chlorophyll is almost universally associated with starch-granules, and it has been found that the presence of the latter is dependent upon exposure to light. The formation of starch, in fact, depends upon the same conditions as does the decomposition of carbonic acid, and is intimately connected with it, as is shown by the fact that if leaves exposed to light are not supplied with carbonic acid no starch-granules are formed in the chlorophyll corpuscles. We see, therefore, that the formation of starch-granules is the visible product of the absorption of carbonic acid by plants.

But if green leaves under the influence of light absorb carbonic acid and give off oxygen, in darkness they do the very reverse—oxygen being absorbed and carbonic acid given off. Owing to this well-marked difference, it was formerly thought that during the day green plants absorbed carbonic acid and gave off oxygen, whilst at night the contrary was the case. We now know, however, that this view was not correct. In plants exposed to the light the two processes are always going on side by side. On the one hand, oxygen is absorbed and carbonic acid exhaled; on the other hand, carbonic acid is inhaled and oxygen is given off. When the light is intense, as for instance when leaves are exposed to bright sunlight, the relative activity of the latter of these processes is so much greater than that of the former that it alone appears to be in operation.

I have stated that a green plant is incapable of constructing organic substance from the materials of its food unless it is exposed to light, and that under these conditions it increases in weight; but when in darkness, the plant not only does not increase in weight, but it even loses weight in consequence of the exhalation of carbonic acid and the loss of aqueous vapour in respiration. Prolonged exposure to darkness must therefore eventually prove fatal to the plant, the length of time required being determined by the amount of reserve material which the plant possesses. On the other hand, adequate exposure to light enables the green plant to assimilate its food, and thus not only to make good the loss due to respiration, but to increase in weight.

This is well illustrated by some experiments of Sachs, the results of which are shown in the following table. Four seeds of *Tropæolum majus* were sown in each of ten pots. When the seedlings appeared they were treated as follows :—

1. Two pots were placed in a dark cupboard.

2. Two pots were so placed in a room that they received only diffused daylight.

3. Two pots were so placed in a window that they received diffuse daylight for seven hours daily.

4. Two pots were so placed in a window that they received diffuse daylight and often direct sunlight for about six hours daily.

5. Two pots were so placed in a window that they received as much light, both diffuse daylight and direct sunlight, as possible.

After twenty-five days the weights of the plants in the different pots were determined, with the following results :—

	1. Gram.	2. Gram.	3. Gram.	4. Gram.	5. Gram.
Weight of seeds....	0·394	0·394	0·394	0·394	0·394
,, ,, seedings	0·238	0·264	0·301	0·480	1·292
Loss	0·156	0·130	0·093	—	—
Gain	—	—	—	0·086	0·898
Percentage loss	39·6	33·0	23·6	—	—
,, gain....	—	—	—	21·8	227·9

It has already been said that it is by means of the chlorophyll that green plants are able to avail themselves of the energy of the sun's rays. Now, there are two opinions as to which rays of the spectrum are the most efficacious in promoting the decomposition of carbon dioxide by the chlorophyll, but the balance of evidence is in favour of the view that the rays which correspond to the most conspicuous absorption-band of the chlorophyll spectrum are the most active. This is the more intelligible since it may be inferred that the rays are converted into chemical work after absorption. The view that it is the rays absorbed by chlorophyll which promote the decomposition received important confirmation by the very ingenious experiments of Engelmann on the action of light on bacteria.

Naturally, there must also be a relation between the intensity of the light and the decomposition of carbonic acid. There must be a minimum intensity below which this process does not take place, and, as Sachs points out, there probably is an optimum intensity above which the activity of the process decreases; but it is questionable whether this optimum is ever reached in sunlight, at all events in this country.

As might be expected, rays of light of different degrees of refrangibility have a different influence on the increase of weight of the organic substance of plants. And as light exercises so great an influence upon the building up of green plants, it may be inferred that it must indirectly affect the absorption of mineral food-materials by the roots; this actually is the case, and this process is also dependent upon the refrangibility of the rays of light. The following table shows the extent to which the different parts of the spectrum affect this absorption. The experiments were made by growing peas covered with glasses of different colours, but as the light which passed through was in no case monochromatic, the results are only relative.

Plants grown in	Increase in organic substance.	Increase in ash-constituents.
Sunlight........................	100	100
Red light	35·5	41·4
Yellow ,, ...	82·6	62·0
Blue ,, ...	22·4	33·3
Violet ,, ...	14·5	5·3

In the foregoing sketch of the action of light upon plants, reference has been made solely to sunlight. But it is found, from experiments made with various kinds of lamps, that provided the light is sufficiently intense, carbon dioxide is decomposed and oxygen evolved under the influence of artificial light. In this connection, the striking experiments of Siemens with the electric light will be remembered.

I have already mentioned the fact that the presence or absence of light has a great influence on the health of man, and that light is as necessary for his well-being as fresh air or pure water. Apart from the great stimulating action of light on the tissues of the animal body, it has quite recently been shown that light plays a most important part in the prevention of disease. Some years ago, Dr. Richardson said, "I once found by experiment that certain organic poisons, analogous to the poisons which propagate contagious diseases, are rendered innocuous by exposure to light." This statement has quite recently received confirmation in the remarkable results which Buchner in Germany, and Marshall Ward in England, have obtained in experiments on the action of light on micro-organisms producing infectious diseases. It has been known for some time that sunlight exerts some retarding influence on the growth of micro-organisms, and some experiments leading Marshall Ward to suspect that ordinary daylight exercised similar effects, he examined this question with striking results, which leave little doubt that the most potent factor in the purification of the air and rivers of bacteria is sunlight. The fact that direct sunlight is efficacious as a bactericide had been long suspected, but it had never before been experimentally proved.

Starting from the observation that a test-tube or small flask containing a little Thames water, with many hundreds of thousands of anthrax spores in it, may be entirely rid of living spores by continued exposure daily for a few days to the light of the sun, and that even a few weeks of bright summer daylight—not direct insolation—reduces the number of spores capable of development on gelatine, Marshall Ward tried the effect of direct insolation on plate cultures in order to see if the results could be obtained more quickly and definitely. Many difficulties had to be overcome before a completely successful result was obtained, but in the end the experiments were absolutely successful, and proved the complete bactericidal action of light.

Experiments with spores were also made to determine the relative power of the different rays of the spectrum. Screens of coloured glass were interposed between the source of light and the plate culture, with the result that it was found that the bactericidal action of the sun's rays is due to those in the blue-violet half of the spectrum.

But in addition to the part which light plays in physiological chemistry, it also exerts a powerful influence in purely chemical actions, as, for instance, in the combination of hydrogen and chlorine, which takes place with violence in the presence of light, or in the conversion of red into white phosphorus, also in the presence of light.

But of all the actions brought about by the influence of light, those concerned in the production of photographs are, perhaps, the most widely known and appreciated. The action here is a purely chemical one: certain salts of silver are so altered when exposed to light that they themselves change colour, or whilst themselves undergoing no physical change, can subsequently be decomposed by other substances, which have no action upon them in the unaltered state. In addition to the ordinary photographic processes in which silver salts are concerned, there are many others which depend upon the action of light on other substances; thus, for instance, there is the platinotype process, depending upon the changes brought about in the salts of platinum and iron; the autotype process, which depends upon the action of light upon prepared pigmented gelatine, and many others.

An extremely interesting and novel process has lately been introduced which depends upon the action of light upon an entirely different class of compounds to those just mentioned. This is the diazotype process, in which organic compounds are alone concerned. The basis of the process is primuline, one of the multifarious derivatives of coal tar. The material on which it is desired to produce a photographic image is coated or dyed with this substance, and then converted into the diazo-derivative by means of a suitable bath. The material so prepared is exposed in the usual way under a negative, with the result that in the high lights the diazo-compound is decomposed by the action of light. The picture is then developed by immersion in a bath of a suitable phenol or amine, a wide range of colours from blue to red being obtained by varying the developer. In this process we have a method of photographic printing which is entirely dependent upon organic compounds.

Time will not allow me to enter into the many applications of the action of light in the arts and sciences, but enough has been said to indicate the important part which it plays with regard to our health and well-being, as well as in relation to the comforts and luxuries of life.

York: with a few notes on Beverley.

By R. Churchill.

(*Read before the Society, April* 21*st*, 1893.)

[Condensed.]

ONE of the first things, I should imagine, that would strike a visitor upon setting foot in the quaint and ancient city of York, is, that he has arrived at a town with a history. The instant you leave the nineteenth century railway station you are brought face to face with the city walls of the twelfth century.

It is quite unknown when these walls were first built. There is evidence that they were in existence before the time of Henry III. (1216), and there are large portions that are attributable to the Romans. The Multiangular tower (as it is called) especially, which is in good preservation, is no doubt a Roman work, Roman legionary inscriptions having been discovered in the lower courses of the interior. This tower has ten sides and therefore contains nine obtuse angles. It is built with stone bonded in with five courses of red bricks alternately. The upper part is of later date, and is of the Decorated period.

These Roman walls, a portion of which may be seen on the right hand side of the tower, formed part of the town of Eboracum, which title is still in evidence when the Archbishop signs his name in the contracted form of "Ebor." But this name of Eboracum is only the Latinized or Roman version of the name of a town of considerable importance that existed long before Julius Agricola lived in the North of England, A.D. 78. Its earliest name was probably Eoforwic, and Eurewic or Euerwic, signifying a street or town on the Ure or Yore, as the Ouse at this place was anciently denominated. It is mentioned in the writings of Ptolemy, and Richard of Cirencester says that it was called Sexta from its being the station of the victorious sixth legion (Legio Sexta Victrix). The Emperor Hadrian lived here about the year 120, and for three hundred years the Roman legions made it their head quarters. The Emperor Severus died here, and to this day there are three sand hills called Severus' hills, at a place on the west side of the city.

It is believed that Constantine the Great was born here, at any rate he certainly lived a portion of his life at this place, and was here when his father, the Emperor Constantius Chloris died. The Emperor Hadrian bestowed the dignity of a civitas upon the town, and a temple to Bellona was erected.

The first Christian churches were erected during the age of Constantine, and the first bishop of York is mentioned in 314.

The Romans left Britain to her fate in 450, and then the Saxons besieged York and turned out the Picts and Scots, but in 524 Arthur defeated the Saxons, turned *them* out, and celebrated the first Christmas ever held in Britain.

It would take up too much time, I am afraid, if I were to enter more fully into details of the fierce struggles that afterwards took place. It will be sufficient for our present purposes if I just note that Saxons and Danes fought for possession of the city, and the Normans in 1068 cleared them both out, not for any certainty of possession however, for the next year the Saxons and Danes together retook the city and massacred the Norman garrison. The Normans, who held the Castle, set fire to the suburbs so that the enemy should not hold them. This unfortunately spread to the city, and the Minster suffered in the general devastation.

Among the other items of history for which York is celebrated, there is the fact that the first Parliament was held here in 1160, and it was there that five hundred years afterwards the Scottish army surrendered Charles I. to the English Parliament on payment of £200,000, and a room in the old Guildhall is shown where the ransom was confirmed, and also the chair in which the king sat at the time.

In the siege of 1644, during Charles's last struggle, the walls suffered badly. The damage done was repaired about twenty-five years later, but afterwards they fell into great decay.

The walls are pierced in several places to allow passage for the various main streets leading out of the city, and at the several Bars where the ancient entrances were not wide enough to admit the traffic of the present day, additional Gothic arches have been thrown across the full width of the roads, so as not to destroy the continuity of the walls themselves.

All these entrances through the outer walls are called "bars," nearly all the streets being called "gates."

The entrance from the north is called Bootham Bar. This Bar had a barbican in 1831, but it was then taken down when the general restoration was carried out. It is said that this barbican was the most perfect in York, but as the street is very narrow here, so that no extra width could be obtained on the inside for an extraneous arch, it had to come down to make way for the increased traffic.

From this Bar to Monk Bar, so named after General Monk, there is an uninterrupted length of wall. Monk Bar is considered to be the most perfect specimen of this description of architecture in the kingdom. Upon arriving at this Bar, you pass, on your way to the steps, through a chamber in which is drawn up the old portcullis. This Bar is higher than the others, and contains two stories of vaulted chambers, in which the freemen of the city were imprisoned when occasion demanded. The Bartizans are embellished, as in some of the other bars, with statues of figures throwing down stones.

The next portion of the wall extends from Foss Island to the Castle, and crosses the Watling Street of the Romans. The Bar at this point is called Walmgate Bar, the name being supposed to be a corruption of Watling Gate. This Bar retains its barbican, and is a very interesting specimen of antiquity. The old door wickets and portcullis still remain, and it bears upon its front the arms of Henry V. (about 1420). The interior side of the Bar has been extended by a pseudo-classic porch across the front, with a parapet enclosed by a wooden balustrade of Jacobean style, altogether out of place and incongruous.

We now come to Micklegate Bar. This is a very fine gate, and will compare very favourably with the Monk Bar. It is in good preservation and is particularly picturesque. Drake and other historians state that it is of great antiquity, and that it is of Roman foundation. However, it is now considered to be a Norman work. This gate also had a barbican, and when this was in existence it must have been a very imposing work of defence. Above the gateway are shields bearing the royal arms of England and France between those of the city of York, and also the arms of Sir John Lister Kaye, Lord Mayor of York 1737, and an inscription "Renovata A.D. 1727." On this gate the powers that were exposed the heads of persons they considered traitors to the Government, and here, amongst others, were placed the heads of Richard Plantagenet, Duke of York, and the Earls of Devonshire and Wiltshire, but since 1746, after the Jacobite rebellion, this delightful method of ornamentation has been abandoned.

The old Abbey of St. Mary's, a wonderful specimen of beautiful Early English architecture, is within the walls of York, and at present is enclosed for preservation in the Museum grounds. Although the monastery was founded in 1078, the present Abbey was not commenced till 1270, and took twenty-two years to build. Considerable portions of the Abbey remain, which is rather wonderful seeing that after the dissolution in 1540 a licence was granted to the authorities to dismantle the place and use the stone for the building of a palace for the President of the Council of the North, to repair York Castle, to restore one of the city churches, and for the repairs of Beverley Minster. However, some good archæologists stepped in in time, and obtained from Government a grant of the Abbey and a great portion of the site, which was laid out as public gardens, and the further demolition of the ruins stopped.

We are informed by the Venerable Bede that the first building on the site of the cathedral was erected by Edwin, the first Christian King of Northumbria, and used at his baptism on Easter day, 627. This was simply a little wooden oratory, but he replaced it by a stone edifice which he dedicated to St. Peter. In 633 Christianity was suppressed, but again introduced by King Oswald and subsequently when England was divided into two ecclesiastical provinces, York was made the seat of an archbishopric.

One of the characteristics of this cathedral is its peculiar liability to destruction by fire. It suffered much in 1068; was rebuilt in 1080; partly destroyed by fire in 1137; restored in 1171. At this time Archbishop Roger commenced the re-building of the choir in the Norman style. The present structure, however, dates from 1227. At this time the south transept was built by Walter de Grey. In 1260 the north transept was built by John de Romayne, father of the archbishop, and the central tower was also built about this time.

The Choir was not completed till about 1400, and in 1405 the central Tower was recased, heightened, and changed into a lantern tower in the Perpendicular style to agree with the rest of the building.

The Nave was commenced in 1291 by Archbishop Romayne; this is all Decorated work, and was completed about 1345, including the two western towers as well as the Chapter House. My authorities do not quite agree as to the date of the western towers, there being only about 140 years difference in the two opinions, one making them of the Decorated period, and the other of the Perpendicular.

The proprietors of the *Builder* have had the Minster specially surveyed and measured, and in doing this some curious irregularities have been discovered, which have not perhaps appeared in any other plan. These irregularities may be attributed to the piecemeal alterations that have been made at various times, and the curious way in which they have been carried out. One would imagine, for instance, that in the alteration of the Choir I have alluded to, the work would have been commenced at the tower or western end, and gradually carried through, instead of which they left at least half of the Norman Choir interspersed between the tower and the extreme east, the result being, as anyone who knows anything at all about such matters would expect, when they decided to pull down this intermediate portion, they found (to express the difficulty in simple language) that it would not fit. Now, let me show you the result. The western arch of the tower is not at right angles with the others, and it will be found upon measurement that the north side of the tower is a foot narrower than the south (but this is put right before it pierces the roof, by corbelling over). Then the axis of the Chapter House is not parallel with anything else. This was because the House was built before the Vestibule, and you will also note that the centre line of the Choir and Presbytery is not lineable with the centre line of the Nave. As a matter of fact it is two feet six inches further northwards. This has caused the organ (or rood) screen to be built with the central arch out of the centre, and with a larger number of panels on the right hand, or south side, than on the other. Again, the eastern portion, that is, the Choir, Presbytery, and Lady Chapel, gradually swell out, so to speak, towards the East end, which is at least two feet six inches wider than at the West end. These are some of the peculiarities of the plan that do not come in an everyday description, but it is wonderful how the difficulties have been bridged over and hidden from the casual observer.

The filling in between the arch piers in the North and South Transepts was done to resist the thrust caused by the heightening of the tower, which pushed the transept arcades out of the perpendicular.

The extreme dimensions of the Minster are, in length 518 feet, and the internal width across the transepts 223 feet.

The extreme West end, so far as the Nave is concerned, is of the Decorated period. I am bound to say, that in spite of its size, the cathedral is somewhat disappointing in general effect as compared with other cathedrals. Our cathedral of Lichfield is much more striking, and Beverley Minster is far before it. This is probably due to the fact that, as Mr. Fergusson (a great authority on architecture) observes, "the open spacing of its wide arches prevents any sense of mystery, as one sees through the building in every direction," and in this I agree. The nave of the stately Norman cathedral at Peterborough, which is only four-fifths of the width of York, is much more impressive by reason of its immense piers and narrow arches.

But the interior effect of the Minster is much enhanced by the quantity of stained glass it can boast of.

In the North Transept are the far famed "Five Sisters." These are the finest and largest group of English lancet windows in the kingdom, and are not surpassed in effect by any Decorated or Perpendicular window. They are each five feet seven inches wide, and are about sixty feet high. These windows are filled with grisaille glass, and the effect on entering the Minster by the South door is wonderfully attractive.

The South Transept is a fine specimen of the Early English style, and has been lately restored. The Rose, or Wheel window in the gable of this Transept is thirty feet in diameter, and is a very noble example of this kind of window (perhaps the finest in England).

There are two or three tombs in the East Aisle, of which perhaps the most beautiful is that erected to Dean Duncombe. It contains some exquisite sculpture.

We must now consider the Tower. This is 188 feet clear in height inside, and is supported on four arches 109 feet in height. It is 213 feet high outside and is 65 feet square, and is said to be the most massive tower in England. It has a most magnificent appearance from the Nave looking upwards, the upper part above the arches being very rich in detail, and the great Perpendicular windows on each side adding much to the effect.

Between the east piers of the Tower is placed the Rood Screen supporting the Organ. In consequence of the Choir not being central with the Nave, the entrance under the screen is not in the centre, there being more divisions on one side than the other.

This Screen is in the richest form of Perpendicular work, and is considered to be the finest specimen in the world. The niches contain statues of the kings of England from William I. to Henry VI.

The West Window of the Nave, thirty feet wide by fifty-four feet high, is one of the finest examples of the Decorated period in the country. Mr. Britton says that, "it is an unrivalled specimen of the leafy tracery of the fourteenth century."

We now enter the Choir. The first thing that strikes an observer is the great height of the altar table above the Choir. The Presbytery rises in tiers or divisions of three steps each above the other, and the benches for the congregation are placed north and south on each of the landings, there are therefore fourteen steps up to the altar table. This certainly gives a very fine effect.

The distinctive feature of the Lady Chapel is the great east window, which Drake calls the "wonder of the world, both for masonry and glazing," but other architectural critics are not disposed to allow it such an exalted position. One says "the tracery of the upper part is extremely beautiful," another says "it is effective from its size but not from its design." There are about two hundred panels in the window, each about three feet square, and they contain subjects taken from the whole range of Scripture, those from the Apocalypse being interesting as showing how such subjects were interpreted at that time (viz. 1400). Most of the figures are about two feet in height, and I think, without doubt, it may be considered to be a marvellous piece of work. This window is seventy-five feet high and thirty-two feet broad.

But the thing that mostly interested me in this window (as well as in the Choir Transept windows) was the means adopted by the architect builder to overcome the difficulty of building such lengthy and thin mullions without risk of what we call "buckling." You will note that these mullions are about forty-five feet high, and are on an average only seven to eight inches thick. Now, let anyone try the experiment of erecting a column of stones in these proportions, and see what would happen. But the York window is practically as strong as if it were cut out of a wall four feet thick. The window consists of two sets of mullions, one behind the other. These are tied together by cross transomes at various points, the whole being finally attached to the outer tracery. At this point there is a platform at least two feet wide (at any rate, wide enough) for persons to walk across; and, as a matter of fact, there are staircases provided in the angles of the Lady Chapel giving access to this passage across this window. Now, with reference to the mechanical principle of this arrangement; it will be, of course, patent to anyone that the double mullion, by giving such an extended base, and being tied in at various levels, and connected longitudinally by the tracery to the outer stonework, acts in the same way as a table with four or more legs and spindle bars; for, whereas a table leg by itself would have no possibility of standing, yet, when connected with the other legs by transome framing, it becomes at once stable and strong, and it would be difficult to push it over; so with the tracery of this window, and yet it is so beautifully designed and arranged that the interior mullion in no way interferes with the stained glass, and a casual observer would never know that what I have attempted to describe was an actual fact until he got within a few feet of the window.

The Chapter House itself is sixty-three feet in diameter, and is nearly sixty-eight feet high.

This Chapter House has no central pillar as in most chapter houses, and this is considered to add to its beauty, but at any rate it does not add to its usefulness; for the immense space, without anything to break up the sound waves, is conducive to an echo that entirely prevents anything being heard even half across the diameter of the place; and although there are forty-four stone stalls for the chapter dignitaries arranged around the walls, they can be of no use whatever for business purposes. These stalls are ornamented with splendid projecting canopies, enriched with wonderful carving, no two of which are alike. The windows, with the exception of one, are all filled with magnificent old stained glass. This Chapter House is considered to be an architectural gem.

The west front is an elaborate combination of niches and buttresses. Of course the window is very beautiful, as I have already pointed out, but the towers, I think, are not at all sufficiently dignified to harmonise with the rest of the building, and the cornices and pinnacles are deplorably bad.

To the South Transept a vast amount of dignity is added by the broad flight of steps leading up to the south doorway. The door itself is very beautiful in detail, being carved in delicate tracery, but, with the exception of the great rose window, this transept is not considered to be a very admirable specimen of medieval architecture.

The exterior of the Choir shows the minor Eastern Transept. These transepts are really means for breaking up the long length of the eastern portion of the fabric, and do not form actual transepts in the interior. They are, nevertheless, a happy architectural feature.

The general effect of the window tracery throughout the Minster is disappointing. It is not of any extraordinary design, or, if so, it is of a negative rather than of a positive value, and although there are so many windows, the repetition of the same design is so great that little or no interest is excited in this portion of the details. But in the windows of the Choir, etc., a very novel feature is introduced externally. There is a mullioned screen placed in front of these windows of quite a different design, and which is entirely separate therefrom, and this causes a considerable amount of shadow, which is very effective.

* * * * * * *

Beverley Minster, which is dedicated to St. John, ranks next to York Minster so far as the ecclesiastical structures of the county are concerned. The greater portion has been erected in the best style of English Gothic. The west front in the Perpendicular style is far before York in the Decorated style. It is noticeable how much these two Minsters agree in general composition, but Beverley, although two hundred feet shorter than York, is perhaps more striking to the eye by reason of its isolated position. The chief features of the west door are the statues and symbols of the Four

Evangelists, which are remarkable, and very boldly carved in relief.

St. Mary's Church, Beverley, is quite sufficient in itself to detain the traveller in this town. It is very rare to find a town boasting two such magnificent fabrics. As is generally the case, you may find here all kinds of Gothic architecture, from Norman to Perpendicular, but it is all in such beautiful taste and symmetry that admiration hardly expresses one's feelings. The arcading of the Nave is most refined, and the bases of the columns being raised well above the benches does away with that appearance of having "dropped in" so prevalent in most churches.

I must here call your attention to a peculiarity in the groining of the eastern portion of the north aisle. The mouldings of the ribs on the north side of this aisle continue unbroken down the pier without capital or base, and diverge equally towards the roof, but on the opposite side they all enter into rings without appearing below them, and moreover cross each other, forming an arrangement that is not only extremely curious, but unusual and beautiful.

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VOL. III.—PART II.

TRANSACTIONS

OF THE

BURTON-ON-TRENT

Natural History

AND

ARCHÆOLOGICAL SOCIETY,

WITH

Annual Reports, Balance Sheets, &c.,

FOR SESSIONS 1893-94, & 1894-95.

EDITED BY

THOMAS GIBBS,

Hon. Secretary.

BURTON-ON-TRENT:
JOHN C. PERFECT, PRINTER, 204 & 205, STATION STREET.

MDCCCXCVI.

BURTON-ON-TRENT

NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY,

30, High Street.

Annual Reports, Balance Sheets,

&c., &c.,

FOR THE

YEARS ENDING SEPTEMBER 30TH, 1894,

AND SEPTEMBER 30TH, 1895.

BURTON-ON-TRENT:
John C. Perfect, Printer, Station Steeet.

1896.

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Mr. R. N. Blackburn
Rev. V. A. Boyle
Mr. R. Churchill
,, E. F. Daniel
Mr. G. M. Day
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BOTANICAL AND MICROSCOPICAL.

Chairman :

Mr. P. B. Mason, M.R.C.S., F.L.S., &c.

Hon. Secretary :

Mr. James G. Wells, Selwood House, Shobnall Street.

PHOTOGRAPHIC.

Chairman :

Mr. R. Churchill.

Hon. Secretary :

Mr. R. N. Blackburn, Blackpool Street.

Members wishing to join either of the above Sections are requested to communicate with the respective Secretaries.

ANNUAL GENERAL MEETING, 1894.

The Nineteenth Annual General Meeting was held in the Friars' Walk Schoolroom, on Friday, October 26th, 1894.

The PRESIDENT (Dr. G. Harris Morris) was in the Chair, and there was a fair attendance of members.

Mr. J. G. Wells read the Report and Balance Sheet for the past year, as follows : —

REPORT OF THE COMMITTEE FOR YEAR ENDING SEPTEMBER 30th, 1894.

The past Session of the Society, which is the eighteenth of its existence, has been a most successful one, following well in the wake of the Sessions of the last few years.

The Monthly General Meetings have been well attended, for, although the average attendance, 53·3, does not quite reach that of the previous year, this is easily accounted for by the absence of a lecture during the past Winter, which was always well attended.

The titles of the papers read at these meetings, and their authors were—

Oct. 20.—Annual General Meeting and Exhibition of Lantern Slides.
Nov. 10.—President's Inaugural Address: "Micro-organisms in Relation to Man."
Dec. 8.—"Herbert Spencer, our Great Philosopher." W. R. Hughes, F.L.S.
Jan. 12.—"The Characters of Shakespeare's King Lear." H. S. Skipton, M.A
Feb. 9.—" Some Fishes of the District." G. Morland Day.
Mar. 9.—"The Catacombs of Rome." W. Odling, F.I.C., F.C.S.
Apl. 10.—"The History of our Parish Register." Rev. V. A. Boyle.

Of the excursions arranged for the Summer months, three were carried out successfully, the fourth to Cannock Chase, under the leadership of Mr. J. E. Nowers, falling through on account, no doubt, of the unfavourable character of the weather at the time. The first to Rolleston, on May 19th, was in conjunction with the North Staffordshire Naturalists' Field Club, under the leadership of Messrs. Wells-Bladen, and J. G. Wells. It attracted a large number of members both of the North Stafford and our own Society, and passed off very satisfactorily. On the occasion of this excursion, Dr. Mason threw open to the members of both Societies who were present, his magnificent private museum, and the opportunity thus kindly given was greatly appreciated. The second was to Croxden Abbey, on June 23rd, under Mr. R. Moxon, and attracted a fair attendance, though not nearly so large as its attractions deserved, increased as they were by the paper read by Mr. Moxon, on the history of the abbey. The third to Kenilworth and Guy's Cliff, under the leadership of Mr. W. G. Fretton, F.S.A., was also a success, and the thanks of the Society are deservedly due to Mr. Fretton for the time and trouble he took over this, the third excursion of this Society that he has been connected with.

The Botanical Section has had a very prosperous session, having increased its membership and carried out a successful programme during the Winter. The Photographic Section has also been active, as its report will shew.

Owing to unavoidable causes, the publication of the Report and Transactions for 1892-3 has not yet been completed, but your Committee hope that copies will be despatched to members in a few days.

Your Committee ventured again on the experiment of a Popular Lecture last Winter, and this was a splendid success in every way. Mr. E. Whymper, F.R.G.S., was secured to deliver his lecture on "20,000 feet above the Sea," on March 1st, and it attracted a large audience of 376, and resulted in a gain to the Society's funds of £9 3s. 0d.

We have great pleasure in reporting that a substantial increase has been made in the roll of the Society, which shews that its vitality is in no way diminished.

The roll of members is as follows:

Subscribing Members—October 1st, 1893 ...		215
Resigned	13	
Left Burton	9	
	—	22
		193
New members elected		35
		228
Hon. Members		8
Associates		6

The last number is a gain of three.

The election of President for the ensuing session took place at the April meeting, when Mr. P. B. Mason was unanimously elected, the removal of Dr. Morris from Burton preventing his much wished-for re-appointment.

The Society has sustained three serious losses during the past year, viz.: in the removal of Mr. Horace T. Brown and Dr. G. H. Morris from Burton, and in the death of Mr. T. Knowles.

Mr. Horace T. Brown was President for 1887-9, and his valuable services during that period aided materially in raising the Society to its present status. The important papers, too, that he has contributed for some years past to the proceedings of the Society have considerably helped on its progress. Prior to leaving Burton, he presented the Society with a valuable collection of local geological specimens, for which we have accorded him the hearty thanks of the members.

As Hon. Sec. for six years, as President for last year, and as the contributor of several papers, Dr. G. H. Morris has rendered the Society invaluable services, and the loss the Society sustains by his removal is a very serious one.

The Committee feel that such services as have been given to the Society by Mr. Horace Brown and Dr. Morris should not remain without official recognition, and they will submit their names to you to-night for election as Hon. Members.

In the early death of Mr. T. Knowles, the Society has lost one who was its President from 1891-3, and who has by his papers and his many other services contributed materially to the welfare of the Society.

Messrs. J. G. Wells and J. E. Nowers, the joint Honorary Secretaries during the past year, find themselves obliged, through pressure of other work, to retire from the office, and deserve the hearty thanks of the members for the time and trouble they have bestowed upon the Society's affairs, and the efficient way in which they have managed them.

The financial position of the Society is very satisfactory, the balance in hand being £30 9s. 2d., whilst there is standing to the credit of the investment account the sum of £40. Part of the cost of printing last year's Transactions has still however to be paid.

In accordance with Rule II, the Rev. V. A. Boyle and Messrs. Hensman and A. J. Brown retire from the Committee, and are not eligible for re-election.

The Report and Balance Sheet were adopted on the motion of Mr. Gibbs, seconded by Mr. Caney.

The Officers, Committee, and some new members were then elected, a vote of thanks to the Chairman bringing the meeting to a close.

NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

Balance Sheet for year ending September 30th, 1894.

Dr.

				£	s.	d.
To Balance in hand, 30th September, 1893				27	0	6
,, Members' Subscriptions—223 at 5/-				55	15	0
,, Associates ,, 5 at 1/-				0	5	0
,, Sale of Transactions				0	14	0
,, Hire of Lantern				0	10	0
,, Messrs. Worthington & Co.—Compensation for Disturbance				10	0	0
,, Proceeds of Popular Lecture	28	2	3			
,, Less Expenses	18	19	3			
				9	3	0
,, Sale of old Cases				0	2	6
				£103	10	0

Audited and found correct.

THOS. GIBBS.

Cr.

				£	s.	d.
By Rent of Room—30, High Street				10	0	0
,, Hire of Friars' Walk Room				1	15	0
,, Gas—30, High Street				0	5	6
,, Printing and Stationery— Perfect				6	2	7
,, Publication of Report and Transactions—						
Meisenbach	4	4	0			
Bemrose	0	12	0			
				4	16	0
,, Purchase of Oxygen, and carriage of same				0	10	3
,, Postages				5	2	1½
,, Collectors' Commission				2	14	3
,, Refreshments at General Meetings				2	17	9
,, Cheque Stamps				0	2	6
,, Geological Cabinet				3	15	6
,, Blackboard and Carriage				0	19	5
,, Reading Lamp				0	10	0
,, Secretaries' Sundries				1	10	8½
,, Addressing Circulars				1	15	6
,, Transfers to Investment Account				30	3	9
,, Balance in hand				30	9	2
				£103	10	0

INVESTMENT ACCOUNT.

To Balance on 30th September, 1893	9	6	9
,, Transfers from General Account	30	3	9
,, Bank Interest	0	9	6
	£40	0	0

REPORT OF THE PHOTOGRAPHIC SECTION, 1893-94.

Chairman: R. Churchill, Esq.

The Session was inaugurated by a lantern-slide competition; a prize being awarded for the best set of six slides made by a member of the Section. Some very fine slides were sent in for competition, and were exhibited at the Annual General Meeting of the Society, the slides sent in by Mr. J. G. Wells being judged the best.

Four meetings have been held during the Session, with an average attendance of seven members.

A practical demonstration of re-touching was given before the Section by Mr. Wells, and a demonstration of reduction of negatives and removal of silver stains was given by Mr. Russell.

R. N. Blackburn,

Hon. Sec. of Section.

REPORT OF THE BOTANICAL AND MICROSCOPICAL SECTION, 1893-94.

Chairman: P. B. Mason, Esq.

Four meetings were held during the Session, all of which were fairly well attended. The November meeting was devoted to the exhibition of specimens recently collected, and the December meeting to the inspection of a large and splendid collection of plants from the shores of the Mediterranean made by Mr. and Mrs. Horace T. Brown. In February, Mr. J. G. Wells read "Some notes on the *Uredineæ*," and exhibited several specimens of the order collected in the neighbourhood. At the April meeting, Mr. J. E. Nowers read a paper on "The British *Characeæ*," which was illustrated by several specimens and lantern slides.

From various causes, but little progress has been made with the Flora of the District.

James G. Wells,

Hon. Sec. of Section.

ANNUAL GENERAL MEETING, 1895.

The Twentieth Annual General Meeting was held in the Masonic Hall, on Thursday, October 24th, 1895.

The PRESIDENT (Mr. P. B. Mason) was in the Chair, and there was a fair attendance of members.

The Honorary Secretary read the Report and Balance Sheet for the past year as follows :—

REPORT OF THE COMMITTEE FOR YEAR ENDING SEPTEMBER 30TH, 1895.

In presenting the Report of the Society's Nineteenth Session, your Committee have pleasure in testifying to the continued interest shewn by the members in its proceedings.

The monthly meetings have been well attended, the average attendance being about 53.

The following is a list of the papers read, and other business transacted at these meetings.

1894.

Oct. 26. Annual General Meeting and Exhibition of Lantern Slides.

Nov. 30. President's Inaugural Address: "The Struggle for Life in the Individual and the Community."

Dec. 21. "India prior to European Invasion." A. Maxwell Tod.

1895.

Jan. 24. "Picturesque Warwickshire." J. H. Pickard.

Feb. 15. "Lundy Island and its Bird Life." R. W. Chase.

Mar. 22. Photographic Competition.
"Notes on the Life History of the Eel." T. Gibbs.
"An old Burton Natural History Society." P. B. Mason, F.L.S

Apl. 19. "Egypt and its Monuments." H. T. Brown, F.R.S.

Three excursions were arranged during the Summer, and of these two were successfully carried through. The first, to Tamworth and Hopwas Wood on May 18th, was a joint excursion with the Birmingham Natural History and Philosophical Society. The Burton party, under the leadership of Mr. T. Gibbs, turned out in fair force; but the Birmingham Society, led by Mr. T. V. Hodgson, was very scantily represented. Although the weather was unseasonably cold, a very pleasant afternoon was spent. The second excursion was on the 22nd June, when a good party of members, under the leadership of Mr. J. G. Wells, visited Castleton, and spent a most enjoyable day among the Caves and Dales. The third excursion which had been arranged was to Ratby and the Roman Encampment, Mr. R. Harrison having promised to be the leader—but this, which promised to be an interesting and popular excursion, unfortunately fell through, in consequence of unsettled weather.

In connection with the Summer season, mention must also be made of the President's generous action in throwing open his private museum to the members of the Society on two Saturday afternoons in August. A considerable number availed themselves of the opportunity thus afforded of viewing what is, doubless, one of the best private collections of natural history objects in the country, afterwards partaking of the refreshments which Mrs. Mason had hospitably provided.

Encouraged by the striking success of Mr. Whymper's lecture last season, your Committee secured Captain C. H. W. Donovan, Author of "With Wilson in Matabeleland," to deliver his lecture on experiences in the Matabele War. The lecture, which was given in St. George's Hall, on March 12th, attracted a good audience, and resulted in a substantial addition to the Society's funds.

Since our last Annual Meeting, a further part of the Society's Transactions has been published and despatched to members. Another part, completing the Society's proceedings down to the end of the past Session is now in hand, and will, it is hoped, be published during the Winter. With the Volume lately published a new departure was made : the practice for several years past has been to publish annually a bare report, balance sheet, list of members, &c., for gratuitous distribution among members, and at intervals a volume of Transactions, comprising the more valuable papers read before, and other work done by members of the Society, for which Volume a small charge was made. It was felt that the financial position of the Society allowed of a return to the original and more convenient practice of including each year's Report and Transactions in one volume, and distributing this gratis among members.

The election of President for the ensuing year took place at the April Meeting, when Mr. F. E. Lott was unanimously elected, Mr. P. B. Mason, to the general regret, declining re-election.

Mr. T. C. Martin, one of the earliest members of the Society, and for many years the manager of its excursion programme, having left the town, your Committee recommend that, in recognition of his long-continued and valuable services, he be elected an Honorary Member.

Your Committee regret that the activity of the Sections has not been so great as it has been in recent years. The Botanical Section has only held one meeting, while the meetings of the Photographic Section have been few and far between. In the former Section, however, good work has been done by individual members, notably by Mr. J. E. Nowers, among the Mosses and *Characeæ*, and the Photographic Section has given some excellent displays of Lantern Slides.

The membership of the Society shews somewhat of a decline from the very high number which it had lately attained ; this decrease is chiefly owing to an unusually large number of members having left the neighbourhood, and there is no reason to fear that the loss will be more than temporary. The present number of subscribing members is 202, honorary members 10, associates 2—total 214.

The financial condition of the Society continues very satisfactory, the balance in hand being £24 4s. 6d., against a balance in hand of £30 9s. 2d. at the commencement of the year, the difference being more than accounted for by the heavy expenditure on the publication of Transactions. There is also a sum of £40 14s. 9d. standing to the credit of the Society's Investment Account.

The School-room in Friars' Walk, in which the Society's meetings have been held for the past two seasons, not having proved altogether suitable for the purpose, it has been decided to again hold them at the Masonic Hall, Union Street.

Your Committee recommend that that part of Rule ii, which provides that the three members of the Committee who have made the smallest number of attendances at Committee Meetings shall retire and not be eligible for re-election, shall be amended by the substitution of "two members" for "three members," as your Committee find by experience that the latter number is too large a proportion.

The three members who have this year made the smallest number of attendances are (in order)—Messrs. Skipton, Fisher, and Day, and if the rule be amended as suggested, the two former will retire and not be eligible for re-election.

The Report and Balance Sheet were adopted on the motion of Mr. Harper, seconded by Mr. Hanson.

The proposed amendment of Rule ii was carried.

The Officers, Committee, and some new Members were then elected, a vote of thanks to the Chairman bringing the meeting to a close.

NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY.

BALANCE SHEET FOR YEAR ENDING SEPTEMBER 30TH, 1895.

Dr.

	£	s.	d.	£	s.	d.
To Balance in hand, 30th September, 1894				30	9	2
Members' Subscriptions—						
201 Members' Subscriptions at 5/- ...	50	5	0			
3 ,, Arrears	0	15	0			
2 Associates' Subscriptions ...	0	2	0			
				51	2	0
Balance from Popular Lecture—						
Receipts	17	6	0			
Payments	13	5	10			
				4	0	2
To Price of Case sold				1	10	0
,, ,, Transactions sold				0	16	6
				£87	17	10

Examined with Vouchers and found correct.
G. MORLAND DAY.

Cr.

	£	s.	d.
By Rent of Room—30, High Street	10	0	0
,, Gas—30, High Street...	0	3	2
,, Insurance of Furniture and Collections ..	0	4	3
,, Hire of Friars' Walk School	1	15	0
,, Printing and Stationery—			
J. C. Perfect, Notices of Meetings, &c. ...	6	12	0
,, Publication of Report and Transactions, 1892-3—			
Bemrose & Sons	26	10	10
,, Postages	5	5	11½
,, Collector's Commission	2	9	0
,, Addressing Notices and addressing and distributing Transactions	2	1	2
,, Refreshments at General Meetings (including attendance)	4	7	4
,, Birmingham Oxygen Co. for New Cylinder and Fittings	1	16	11
,, Do., Hemp Cover for same	0	7	6
,, Do., Oxygen and carriage	0	18	5
,, Secretary's Sundries	0	19	3½
,, Cheque Stamps	0	2	6
,, Balance in hand	24	4	6
	£87	17	10

INVESTMENT ACCOUNT.

	£	s.	d.
Balance on 30th September, 1894	40	0	0
Bank Interest	0	14	9
	£40	14	9

REPORT OF THE PHOTOGRAPHIC SECTION, 1894-95.

Chairman: R. CHURCHILL, ESQ.

Two meetings have been held during the past Session.

The principal feature of the year was the lantern-slide competition, held in January, 1895, the competing slides being exhibited at the January General Meeting of the Society. The slides sent in were of a high standard of excellence, and proved that this branch of Photography receives considerable attention from the members of the section. The set exhibited by Mr. T. A. Gaved was adjudged the best, and was much admired by the members present.

R. N. BLACKBURN,

Hon. Sec. of Section.

REPORT OF THE BOTANICAL AND MICROSCOPICAL SECTION, 1894-95.

Chairman: P. B. MASON, ESQ.

Owing to the loss of several of its members, the past Session has been one of inactivity as far as this Section is concerned. One meeting only was held, at which it was decided to curtail the Flora District to one of a radius of ten miles from Burton. Some slight progress has been made with the Flora.

Field work has not, however, been at a standstill, among the records made being the following:—

By Mr. J. E. Nowers:

Stellaria umbrosa, Opiz.: Willington.
Geranium pusillum, Burm.; Dovedale.
Trifolium filiforme, Linn.; Dovedale.

By Mr. T. Gibbs:

Papaver Argemone, Linn.; Alrewas.
Hypericum dubium, Leers.; Tatenhill.
Geranium pusillum, Burm.; Alrewas; Milton.
Silaus pratensis, Bess.; near Mickleover.
Senecio erucifolius, Linn.; Boylestone; Tatenhill; Rangemore.
Picris hieracioides, Linn.; Tatenhill.
Hieracium umbellatum, Linn.; near Rangemore.
Specularia hybrida, D.C.; near Cauldwell.
Zannichellia pedunculata, Reichb.; near Dunstall.
Scirpus pauciflorus, Lightf.; Repton Rocks.

James G. Wells,
Hon. Sec. of Section.

EXCURSIONS, 1895.

Tamworth and Hopwas Wood, May 18th.

Leader: T. Gibbs.

A party of 14 members left Burton by the 1-56 train for Tamworth. Here they were met by Mr. T. V. Hodgson and a small contingent, representing the Birmingham Natural History and Philosophical Society. The joint party immediately proceeded to the Church, the largest Parish Church in the County, as well as one of the oldest, and a considerable time was spent in observing its architectural features and fine stained glass windows, one of these being by Sir E. Burne-Jones.

Several members of the party ascended the tower, which is remarkable for having a double-spiral staircase. From the tower there is, in clear weather, a very fine view of the surrounding country, but unfortunately, on this occasion, the weather was dull and hazy, and there was little to be seen beyond the town and its immediate surroundings.

After leaving the Church, the party walked round the grounds of the ancient Castle, associated by Sir Walter Scott with his legendary hero "Marmion." Here a fine example of herring-bone masonry was noticed. Carriages, obtained at the Peel's Arms, took the party to Hopwas, where they were joined by some cyclist members of the Birmingham Society. Just before reaching the wood, a fine section through the Drift was noticed and inspected. Leaving the carriages, a very pleasant hour was spent in walking through the wood, then in the full beauty of its bright green spring foliage, and carpeted with Blue Bells

(*Scilla nutans*), Violets (*Viola sylvatica*), Wild Strawberries (*Fragaria vesca*), and Bilberry (*Vaccinium myrtillus.*) Another drive took the party back to Tamworth, where Miss Jasper. of the Peel Arms, provided an excellent repast; and, after the usual votes of thanks, the Burton contingent took the train homeward, reaching Burton about 7-30.

Castleton, June 22nd.

Leader: J. G. Wells.

The party, numbering 16, arrived at Hope Station (on the Dore and Chinley line) shortly after mid-day, and drove thence to the "Blue John" mine, staying at Castleton for lunch on the way. After inspecting the slopes of Mam Tor, the descent was made of the mine, the principal features of which are the curious natural caverns which were encountered during the mining operations. The occurrence *in situ* of the mineral "Blue John," as well as many other geological points of interest, was pointed out by the guide, to whom the party are indebted for his courtesy. Leaving the mine, the party walked to the Windy Knoll Quarry, where the Leader pointed out the occurrence of Bitumen, in both its elastic and hard forms, Fluor Spar, "Blue John," and other minerals. Passing down the narrow pass of the Winnats, the Speedwell Mine was reached and descended, the party proceeding by boat through the old workings of the mine, and inspecting the "Grand Cavern," an enormous natural cavern discovered during the unsuccessful mining operations for lead. After tea, which was served at the "Nag's Head," the party visited the entrance of the Peak Cavern, with its fine natural archway, beneath which a colony of rope spinners has established itself; and also Peak or Peveril Castle, a well-nigh impregnable stronghold made famous by Sir Walter Scott in his "Peveril of the Peak." From Castleton the party drove to Hope Station for the return journey.

LIST OF MEMBERS.

SESSION 1894-95.

HONORARY MEMBERS.

BAKER, G., Rozel Road, St. Jacques, Guernsey.
BLATCH, W. G., Temple Road, Knowle, Birmingham.
BROWN, HORACE T., F.R.S., F.G.S., &c., 52, Nevern Square Kensington, W.
DAWKINS, W. BOYD, M.A., F.R.S., F.G.S., &c., Owen's College Manchester.
HARRISON, W. J., F.G.S.
HERON, J., B.E., F.C.S., F.I.C., 343, Clapham Road, London, S.W.
MELLO, Rev. J. M., F.G.S., &c., Mapperley Vicarage, near Derby.
MORRIS, G. HARRIS, Ph.D., F.I.C., F.C.S., 18, Gwendwr Road, West Kensington, W.
THORNEWILL, Rev. C. F., M.A., F.E.S., Calverhall Vicarage, Salop.
TRIPP, C. U., M.A., F.R.Met.Soc., The Grove, Addlestone, Surrey.

Allsopp, Hon. G. H., M.P., J.P.	Foston Hall.
Anderson, D. V.	Alexandra Road.
Auty, R. H.	Arthurlie House, Ashby Road.
Auty, Mrs. R. H.	,, ,, ,, ,,
Baggley, C.	13, Sydney Street.
Barnes, Rev. E. G.	Guild Street.
Batty, J.	128, Scalpcliff Road.
Baxter, T.	Lichfield Street.
Beardmore, T.	Messrs. Smith, Garrett, & Co., Bow, London.
Beaven, Rev. F. H.	St. Paul's Vicarage.
Beck, H.	Branston Road.
Beckett, Rev. T. W., M.A.	Lichfield Street.
Beels, G.	104, Horninglow Street.
Bence, H., B.A.	Clay Street.
Bernard, Mrs.	Holly Bank, Scalpcliff Road
Blackburn, R. N.	Blackpool Street.
Blackhall, Mrs.	The Abbey.
Boyle, Rev. Vicars A., B.C.L.	The Vicarage, Orchard Street.
Boyle, Miss	,, ,, ,, ,,
Bound, C. J.	Messrs. L. & G. Meakin.
Bradbury, H. K., M.R.C.S., L.R.C.P.	208, Ashby Road.
Bradbury, Mrs. H. K.	,, ,, ,,
Bramell, Rev. J.	Branston Vicarage.
Bridgman, H. E., M.R.C.S., L.R.C.P.	Bridge Street.
Briggs, S.	Branston Road
Briggs, W. C.	Borough Road.

Brookes, H. ...	High Bank, Ashby Road.
Brown, Adrian J., F.C.S., F.I.C.	6, Alexandra Road.
Brown, Mrs. A. J.	,, ,,
Brown, Edwin A.	Bank House, High Street.
Brown, Mrs. E. A. ...	,, ,, ,, ,,
Burton, Right Hon. Lord	Rangemore.
Burton, Lady	,,
Butt, H. G.	258, Branston Road.
Bing, Mrs.	Scalpcliff Road.
Cartmell, A.	119, Alexandra Road.
Cartmell, Mrs. A.	,, ,,
Caney, E.	Messrs. Charrington & Co.
Chadfield, F. B.	2, Frederick Street, Stapenhill.
Charrington & Co.	Lichfield Street.
Churchill, R.	Rangemore Street.
Churchill, Mrs. R.	,, ,,
Churchill, R. A. T. ...	,, ,,
Churchill, H.	,, ,,
Churchill, L. A.	,, ,,
Clarke, R.	St. Paul's Square.
Clubb, J.	63, Guild Street.
Connett, W.	93, Derby Street.
Daltry, Rev. T. W., M.A., F.L.S.	Madeley Vicarage, Newcastle, Staffs.
Daniel, E. F.	Derby Street.
Dannell, J. O.	206, Ashby Road.
Day, Miss M. E.	Lichfield Street.
Day, G. Morland	8, Alexandra Road.
Day, Mrs. G. Morland...	,, ,,
Drewry, W. J., J. P.	Drakelow.
Dunwell, F. S. ...	Stapenhill Road.
Eadie, J. ...	Barrow Hall, Derby.
Evans, W.	71, Branston Road.
Evershed, S., M.P., J.P. ...	Albury House, Stapenhill.
Evershed, Mrs. S.	,, ,, ,,
Evershed, Percy ...	Clay Street, Stapenhill.
Evershed, S. H.	Ramura House, Stapenhill.
Fisher, S. J.	32, Derby Road.
Fletcher, Mrs. ...	Routhven, Ashby Road.
Fletcher, Miss	,, ,, ,,
Forster, F.	Ashby Road.
Fox, A.	Cumnor House, Branstone Road.
Gaved, T. A.	99, High Street.
Gibbs, T. ...	45, Grange Street.
Gibson, Thomas	87, High Street.
Goodger, Miss C. ...	Bridge Street.
Gorton, T.	62, Branston Road.
Graham, W. N. ...	Branston Road.
Grinling, J. C., J.P. ...	Barton-under-Needwood.

Hallam, Mrs. F.	High Street.
Hallam, Miss	St. Paul's Street West.
Hanson, C., Jun.	195, Ashby Road.
Hardy, J. A.	29, Moor Street.
Harlow, Miss A.	27, Rangemore Street.
Harper, J.	Richmond House, Wyggeston Street.
Harris, W. P.	32, Ashby Road.
Harrison, C., J.P.	Branston House.
Harrison, C. R.	123, Alexandra Road.
Harrison, Rev. G. R.	60, Branston Road.
Harrison, R.	Beech House, Stapenhill.
Harrison, Mrs. R.	,, ,, ,,
Harrow, G. H., Ph. D., F.C.S., F.I.C.,	Station Street.
Healey, Miss	125, Alexandra Road.
Hearn, R.	High Street.
Hincks, H. S.	Shortlands, Linton.
Hodson, E.	Newton Road.
Hodson, Mrs. E.	,, ,,
Hooper, A.	Horninglow Street.
Hopkins, T.	The Oaks, Newton Road.
Horsman, F.	The Laboratory, Messrs. Allsopp, & Sons.
Howarth, W.	High Street.

Jackson, J. T.	Alexandra Road.
Jackson, S. F.	Bourne Place, Bexley, Kent.
James, Miss A. J.	Lichfield Street.
Jeffcott, W. T., B.A.	Sutherland House, Branstone Road.
Jenkins, T.	116, Malvern Street, Stapenhill.

Lathbury, G.	Hunter's Lodge, Horninglow Road.
Lawson, H.	111, Alexandra Road.
Lott, Frank E., Assoc. R.S.M., F.I.C.	Glenthorne, Alexandra Road.
Lowe, C.	1, Alexandra Road.
Lowe, T. B., J.P.	1, Alexandra Road.
Lowe, S.	Malvern Street, Stapenhill.
Lowe, W. G., M.D.	Horninglow Street.
Lowe, C. H.	Clay Street, Stapenhill.
Lowe, Mrs. C. H.	,, ,, ,,

Madeley, F.	122, High Street.
Mason, P. B., J.P., M.R.C.S., F.L.S., F.Z.S.	Bridge Street.
Mason, Mrs. P. B.	,, ,,
Mathews, C. G., F.I.C., F.C.S.	58, Charing Cross, S.W.
McAldowie, A. M., M.D., F.R.S., Edin.	Brook Street, Stoke-on-Trent.
Meakin, Lewis J.	Tatenhill.
Meakin, George	Callingwood.
Meredith, J. H.	Sansome Street, Worcester.
Miers, Miss	27, Rangemore Street.
Miller, Rev. S. O., M.A.	Horninglow Vicarage.
Morris, J.	Primrose Hill, Newton Road.
Morris, Mrs. J.	,, ,, ,, ,,
Moxon, R.	206, Newton Road.
Moxon, Miss W. M.	,, ,, ,,

Nash, A. A. ... ... Alexandra Road.
Nowers, J. E. ... ... 282, Blackpool Street.

Odling, W., F.I.C., F.C.S. .. .. 132, High Street.
O'Sullivan, C., F.R.S., F.I.C., F.C.S. ... ... High Street.
O'Sullivan, J., F.I.C., F.C.S., ... Ashby Road.
Oswell, B. L. ... ... 70, Spring Terrace Road, Stapenhill.

Pearson, W. P. ... . 26, Bridge Street.
Perfect, J. C. .. .. Stapenhill.
Perks, C., M.R.C.S., L.R.C.P.... ... ... High Street.
Peters, W. N. ... ... Stapenhill Road.
Peters, Mrs. W. N. ... ... ,, ,,
Port, H. H. ... . 5, Elms Road, Stapenhill.
Porter, H. ... . Donithorne, Horninglow.
Pullin, T. J. ... ... Ashby Road.

Ramsden, F. L. ... ... Corporation Gas Works.
Randell, H. ... ... Derby Road.
Ratcliff, Miss F. ... ... Holly Bank, Scalpcliff Road.
Ratcliff, Robert ... ... Newton Park.
Ratcliff, Richard, J. P. ... ... Stanford Hall, Loughborough.
Ransford, Miss ... ... The Infirmary.
Ranshaw, George ... ... 276, Blackpool Street.
Reeve, A. ... ... Matlock Villa, Derby Road.
Reynolds, R. ... ... Stapenhill Road.
Riddell, R. ... ... 87, Horninglow Street.
Robinson, F. ... ... Stapenhill Road.
Robinson, G. ... ... 88, Horninglow Street.
Robinson, R. M. ... ... Branston Road
Robinson, T., M.R.C.S., L.R.C.P. ... ... Horninglow Street.
Roseblade, J. T. .. ... Hamilton Drive, The Park, Nottingham.
Rugg, H., M.R.C.S., L.R.C.P, ... Guild Street.

Sadler, J. W. ... ... 11, Market Place.
Sadler, L. .. .. ,, ,,
Sadler, Mrs. M. T. ... ... 10, Lichfield Street.
Salt, E. D. ... ... Newton Solney.
Salt, Mrs. E. D. ... ... ,, ,,
Salt, W. C. ... ... Willington Hall.
Sharp, B. ... ... Stanton Road.
Slator, Henry ... ... Lichfield Street.
Smith, D. ... . High Street.
Smith, Mrs. D. ... ... ,, ,,
Smith, E. ... 1, Alma Terrace, Sandown Lane, Wavertree, Liverpool.
Smith, W. ... ... Sydney Street.
Soar, W. ... ... Alexandra Road.
Starey, E. ... ... Stapenhill Road.
Starey, Mrs. E. ... . ,, ,,
Stern, A. L., D.Sc., F.C.S., ... Ashby Road.
Stocker, C. ... ... High Street.
Swindlehurst, J. E., Assoc. M. Inst. C.E. ... . Alexandra Road.
Swindlehurst, Mrs. J. E. ... ... ,, ,,
Swinnerton, W. ... ... 73, Branston Road.

Tabberer, Miss	10, Alexandra Road.
Talbot, J.	Lichfield.
Tarver, G.	Station Street.
Taverner, W.	Stapenhill Road.
Thoday, A.	Ashby Road.
Thompson, Frank	Newton Road.
Thompson, Mrs. Frank	" "
Thompson, Miss M.	Ivy Lodge Stapenhill.
Thompson, Miss S.	" "
Thornewill, F.	98, Blackpool Street.
Thornewill, R., J.P.	Craythorne.
Tod, A. Maxwell	Newton Road.
Tomlinson, H. G.	The Woodlands.
Underhill, C. F.	New Street.
Van Laer, N.	195, Derby Street.
Walker, A. J., B.Sc.	276, Blackpool Street.
Walters, W.	Alexandra Road.
Wartnaby, G.	Newton Road.
Wartnaby, Mrs. G.	" "
Wells, James G.	Selwood House, Shobnall Street.
West, W. R.	45, Derby Road.
Whitehead, T. N.	Bridge House, Bridge Street.
Wilkinson, J.	Alexandra Road.
Wilkinson, Mrs. J.	" "
Willcox, J. B.	86, Claremont Terrace, Branston Road.
Wright, A. T.	Victoria Cresent
Wright, Josh.	Branston Road.
Wyllie, Miss	Stapenhill Road.

ASSOCIATES.

Hind, H. L.	Ash Villa, Ashby Road.
Wells, E. L.	8, Derby Road.

RULES.

1.—That this Society be called the "BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY," having for its object the promotion and encouragement of the practical study of Natural History Archæology, and General Science.

2.—That the Officers of the Society consist of a President, two or more Vice-Presidents, Treasurer, General and Excursion Secretaries, Assistant Secretary, Curator, and Librarian; these officers to retire annually, but to be eligible for re-election.

That the Committee consist of nine Members, and that the two Members who have made the least attendances retire annually, and be not eligible for re-election for the ensuing year. All Officers shall be *ex-officio* Members of Committee. Three to form a quorum.

3.—That a General Meeting be held not later than the end of October in each year, for the purpose of electing Officers for the ensuing year, and transacting any other business which may be brought before it.

4.—That Candidates for Membership shall be proposed and seconded (in writing) at any meeting of the Committee, and may be elected at the next General Meeting by a majority of the Members present.

5.—That the Society commences its year with October 1st. That an annual subscription of five shillings be paid by each Member *in advance*, and that all Members whose subscriptions are six months in arrear be considered to have forfeited their privileges as Members of the Society; that all Members who have not given notice to the Treasurer or Secretary of their intention to retire before the Annual General Meeting in October shall be held responsible for the current year's subscription.

6.—That the Committee may elect as Associates any persons under the age of eighteen, and that the subscription of such Associates be one shilling per annum, payable in advance; Associates to have no voice in the appointment of officers or the management of the Society, except in the election of their own Secretary, who shall be considered as a Member of the General Committee.

Note.—Associates must be elected Members in the ordinary way on exceeding eighteen years of age.

7.—That the Committee may recommend as Honorary Members any persons distinguished for scientific attainments, or who may have in any special manner advanced the interests of the Society.

8.—That Field Meetings or Excursions be held during the year, in suitable localities, and that timely notice of each be given to the Members by circular.

9.—That in addition, the committee may organize a series of Field Meetings for Junior Members, under the leadership of one or more Members of the Society, to be invited for that purpose by the Committee; such Meetings to be devoted to practical explanation and the collecting of specimens.

10.—That Evening Meetings be held during the Winter months at such times and places as the Committee may appoint, for the exhibition of specimens, and the communication or discussion of any subjects connected with the objects of the Society: **that at Evening Meetings Members may introduce one friend, but no one resident in or within five miles of Burton may be present at more than two Evening Meetings in one Session**; that the notice of Meeting sent to each member be the entrance ticket, admitting bearer and one friend; that the secretary be empowered, on application, to issue additional tickets when necessary; and that a book be kept at the door of the place of Meeting in which Members must enter the mames of any friends they introduce.

11.—That the Committee may select and recommend to be given annually a series of prizes for the best selection of specimens in any one of the branches of Natural History made by Associates individually during the preceding year, and that Members be invited to offer Prizes or Special Subscriptions for that purpose.

12.—That the Committee have power to make such arrangements as they may consider advisable for the establishment of a Museum in connection with the Society, for the preservation of specimens illustrating the Natural History and Antiquities of the district.

13.—That after providing for the payment of all incidental expenses, the funds of the Society shall be applied to the maintenance of a Museum, the purchase of Books, Journals, etc., or in any other way the Committee may think likely to advance the interests of the Society.

14.—That the committee have power to make rules for the circulation amongst the Members generally, of Books, Periodicals, etc., belonging to the Society.

15.—No rules of the Society shall be altered except at a General Meeting called for that purpose.

LIBRARY.

NUMBER.	TITLE.	AUTHOR.
1	School Botany	*Lindley.*
2	Manual of Botany	*Balfour.*
3	Elements of Botany	*Balfour.*
4	Handbook of the British Flora	*Bentham.*
5	Elementary Botany	*Grugeon.*
6	Useful Plants	*Johnson and Sowerby.*
7	Elements of Metallurgy	*Phillips.*
8	Elementary Course of Geology	*Ansted.*
9	Students' Elements of Geology	*Lyell.*
10	Introductory Text Book of Geology	*Page.*
11	Advanced Text Book of Geology	*Page.*
12	School Manual of Geology	*Jukes.*
13	Laws of Winds prevailing in Europe	*Ley.*
14	Elementary Geology	*Skertchley.*
15	Geology and Mineralogy	*Buckland.*
16	Manual of Geology	*Harrison.*
17	Popular History of the Aquarium	*Sowerby.*
18	The Aquarium	*Taylor.*
19	The Fresh Water Aquarium	*Hibberd.*
20	Mineralogy	*Ramsay.*
21	British Butterflies and Moths	*Newman.*
22, 23	Manual of Butterflies and Moths—Vols. I. & II ..	*Stainton.*
24	Notes on Collecting and Preserving Natural History Objects	*Taylor.*
25	British Coleoptera	*Spry & Shuckard.*
26	Modern Meteorology	*Ley.*
27, 28, 29	Nests and Eggs—Vols. I., II., III	*Morris.*
30	Lepidopterist's Guide	*Knaggs.*
31	British Shells	*Turton.*
	Circles of the Sciences	*Orr.*
32	Vol. I., Organic Nature.	
33	Vol. II., ,, ,,	
34	Vol. III., ,, ,,	
35	Vol. IV., Geology and Mineralogy.	
36	Vol. V. ,, ,,	
37	Vol. VI., Elementary Chemistry.	
38	Vol. VII., Practical Chemistry.	
39	Vol. VIII., Mathematical Sciences.	
40	Vol. IX., Mechanical Philosophy.	
41	Popular History of British Ferns	*Moore.*
42, 43	British Mosses—Vols. I and II	*Tripp.*
44	Popular History of British Mosses	*Stark.*
45	Synopsis of British Mosses	*Hobkirk.*
46	Natural History of Selborne	*White.*
47	Dale and its Abbey	*J. Ward.*
48	History of Uttoxeter	*Redfern.*
49	British Mollusks	*Tate.*

50 The Bone Caves of Cresswell Craggs .. *Mello & Dawkins.*
51 Old English Churches .. .. *Markland.*
52 Moab's Patriarchial Stone ... . *King.*
53 A List of Diurnal Birds of Prey .. .. .. *H. Gurney.*
54 History of British Butterflies .. .. *Rev. F. O. Morris.*
55 Lepidopterist's Calendar .. .. *J. Merrin.*
56 Larva Collecting and Breeding .. .. *Rev. J. S. St. John.*
57 British Beetles .. .. *Rye and Fowler.*
58 British Pyralides .. .. *J. H. Leech.*
59 British Tortrices .. .. *S. J. Wilkinson.*
60 Insect Hunter's Companion .. .. *Rev. J. Green.*
61 Flora of Derbyshire .. .. .. *Rev. W. H. Painter.*
62 Flora of West Yorkshire .. .. *Yorkshire Naturalists' Union.*
63 Flora of Repton .. .. *Garneys and others.*
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TRANSACTIONS

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EDITED BY

THOMAS GIBBS,

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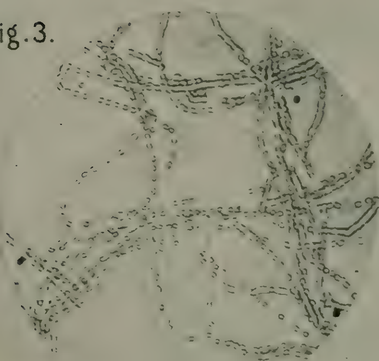

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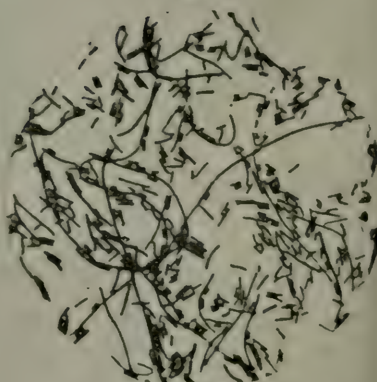

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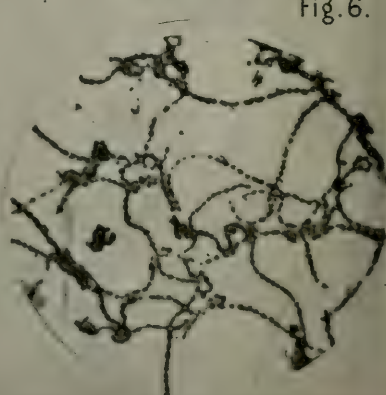

BURTON-ON-TRENT

Natural History and Archæological Society.

Micro-organisms in Relation to Man.

(Part I.)

By G. Harris Morris, Ph.D., F.I.C., &c.

Presidential Address, delivered November 10th, 1893.

WHAT are Micro-organisms? To give a complete answer to this question would occupy far more space than I have at my disposal; I must therefore content myself with answering it in a very brief manner, referring those of our members who desire a fuller knowledge to the very excellent paper on "Micro-organisms," which Mr. C. G. Matthews read before the Microscopical Section of the Society in March, 1886, and which appeared in Vol. I of the Society's Transactions.

Briefly then, micro-organisms are extremely minute members of the vegetable kingdom, visible only by means of the microscope, and, in some instances, even requiring the use of very strong powers for their detection. This being the case, it is not surprising that the study of these organisms

DESCRIPTION OF PLATE.

Fig. 1. A common mould—*Penicillium glaucum.*

Fig. 2. (a) Beer-yeast (*Saccharomyces cerevisiæ*) after de Bary; (b) Wine-yeast (*Saccharomyces ellipsoideus*) after Matthews and Lott.

Fig. 3. Bacilli, shewing rods full of spores (*Bacillus anthracis.*)

Fig. 4. Bacilli, shewing rods and filaments (*Bacillus typhosus.*)

Fig. 5. Comma bacillus, associated with Cholera.

Fig. 6. Chains of micrococci (*Streptococcus erysipilus.*)

(Figs. 3 to 6 are from Photo-micrographs of the actual organisms.)

did not make any great progress until recent years, when improvements in the manufacture of glass have enabled lenses of far greater magnification and definition to be constructed.

Like all the other groups of Nature's children, micro-organisms vary much among themselves with regard to size, shape, and even colour. In size we know them from small spherical granules less than one twenty-five-thousandth of an inch in diameter, and which require a magnification of 1,000 diameters before they can be microscopically recognized with certainty, to organisms like the moulds, which throw out processes visible to the naked eye. It is almost impossible to form any definite conception of the size of the average micro-organism, which closely approximates to one twenty-thousandth of an inch in length; and the mere statement that such or such a number will, for instance, reach from end to end of Burton Bridge, conveys but an indefinite impression to the mind. The best attempt to enable us to realise the extreme minuteness of organisms of the size just mentioned is, I think, that recently given by Prof. Percy Frankland, who tells us that no less than four hundred millions could be spread in a single layer over one square inch. We should thus have a population one hundred times as great as that of London settled on an area of a single square inch, without any over-crowding, and giving to each individual organism one four-hundred-millionth of a square inch, which space would be quite sufficient for each member of the population to thrive and multiply in.

The shape or form of micro-organisms is equally diverse, ranging from extremely small unicellular spherules to the comparatively large multicellular moulds.

Micro-organisms are divided into three principal groups or families, namely, the Moulds, or Hyphomycetes; the Yeasts, or Saccharomycetes; and, what are commonly called Bacteria, or Schizomycetes.

With some of the members of the first of these groups we are all of us familiar. We see them growing upon the walls of damp cellars, upon articles of food which have been left too long exposed to air and moisture, and the housewife finds them flourishing upon her preserves which have been imperfectly secured from the access of air. They form masses of various colours—white, grey, black, green, yellow, or brown—which throw up filaments, in many cases visible to the naked eye, carrying clusters of coloured spores. The ground mass consists of a ramification of threads, called mycelia, from which the perpendicular filaments are thrown up. The members of this group have little or no importance industrially or otherwise. Figure 1 shows the common green mould.

The Yeasts, the results of whose action is so well known to us, are small unicellullar plants, which vary much in size and shape. The ordinary beer-yeast has a spherical form (Fig. 2, a), with a diameter of about one four-thousandth of an inch; the yeast of wine (Fig. 2, b), is elliptical and smaller. Other species have other forms, some being pear or sausage shaped, and one species, which always occurs in the spontaneous fermentation of fruit juices, has a very curious and characteristic citron-shaped cell.

But it is to the members of the third group that I chiefly wish to direct your attention. These constitute by far the largest portion of the micro-organisms at present known, and, with but a few exceptions, it is to their action, injurious or the reverse, that we can now trace so many of the phenomena in Nature. The members of this group are usually somewhat loosely referred to by the name "Bacteria," which term should, speaking correctly, be employed for one class only of the group.

Bacteria, to use the word in its more general sense, vary greatly in size and form, and from these features, combined with other characteristics, are divided into various classes. Thus, some are simply more or less spherical granules, to which are given the name *Micrococci* (Fig. 6); others again with longer and shorter rod-like form, are known as *Bacilli* (Fig. 4); whilst others, having a corkscrew or spiral form, receive the name of *Spirilla*. The members of the last mentioned class sometimes appear in a shorter and disjointed form, and then resemble a "comma" (Fig. 5.) Sometimes the individual cells terminate in long, highly attenuated, hair-like processes, which are generally seen in a state of great agitation and serve as a means of propelling the bacterium through the liquid in which it exists.

Bacteria multiply in two ways. The more usual way is by the simple process of cell-division—a transverse partition forms in the centre of the adult organism, which then divides into two portions. Under favourable conditions this process takes place with extreme rapidity, and it has been estimated that in 72 hours there would be produced from one cell the enormous number of 4,772 billion organisms. This mode of splitting up transversely to their length has led to the term "fission-fungi" being given to the micro-organisms of this group. The second mode of multiplication is not nearly so frequent, but is in many respects more important. When certain species of bacteria are placed under conditions unfavourable to their free development, there is formed in the interior of the cells one or more round or oval bodies, having a very bright and refractive appearance. These bodies are known as *spores* (Fig. 3) and from their powers of resistance to outside influences, they play a most important part in the propagation of many organisms. In many cases they will survive the application of the most intense cold it is possible to produce; the spores of many species will also develop after the liquid containing them has been boiled for some time; they will also withstand the action of antiseptics—both as regards strength and duration of action—for a much longer time than will the ordinary vegetative cells from which they arise.

It is now generally admitted that all infectious and contagious diseases, and probably many others, are due to the activity of micro-organisms, although it is only in a comparatively few instances that any particular micro-organism has been conclusively proved to be the causal agent of a particular disease.

As long ago as 1671, Lange expressed the opinion that measles and other fevers were the result of putrefaction caused by worms or animalculæ growing in the body, and in 1683, Leuwenhoek, a native of Holland, described and figured, in material taken from the teeth and in various infusions, minute organisms which can now be recognised as bacteria. A little later, another physician, named Audry, replaced the worms mentioned by Lange, but really discovered by Kircher, by the newly described germs of Leuwenhoek, and, pushing the theory to its legitimate and logical conclusion, evolved a germ theory of putrefaction and fermentation. He maintained that air, water, vinegar, fermenting wine, old beer and sour milk were all full of germs; and that small-pox and other diseases, very rife about this period, were the result of the activity of these organisms. And, it is said, so much headway did he make that the mercurial treatment much in vogue at this time was actually based upon the supposition that these organisms were killed by the action of mercury and mercurial salts. About this time, too, it was first suggested that the dangerous character of marsh or swamp air was due to the action of invisible animalculæ. In the early part of the eighteenth century, however, great ridicule was thrown upon this theory and it became discredited. It is however, noteworthy that Linnæus firmly believed in this germ theory of disease.

Much continued to be written during the next hundred years, a large mass of facts were accumulated, and the question as to whence these minute forms came, was debated with great vigour. Even at the end of the seventeenth century there were those who considered that bacteria were the progeny of minute organisms which were present in myriads in the air, from which they were deposited on putrescible substances. This theory, however, met with much opposition, notably by an Englishman, Dr. Medham, who wrote in 1749, and who was really the first to bring forward the theory of abiogenesis or "spontaneous generation," a theory which attracted much attention, and which was only finally routed within our own times—to a large extent by the masterly and beautiful experiments of our countryman, Tyndall.

Medham's theory was, in brief, that the bacteria or "plant animals" as he called them, were developed from dead organic matter by some special vegetative power, and that from these plant-animals, by a process of evolution, other organisms again arose.

The experiments on which he based his theory were that when liquids like beef-infusions are boiled and then set aside in well-stoppered bottles, a vigorous growth of micro-organisms always takes place.

The objection taken to these experiments was two-fold: firstly, that air containing germs found entrance to the vessels after boiling; and secondly, that possibly the germs were so far resistant to increase of temperature that they might survive a short period of boiling. Both these objections were shewn to be well founded: when putrescible substances were heated under certain conditions, and air was rigorously excluded no putrefaction took place, and on this fact the methods of preservation of food-stuffs in vogue at the present time are founded; and on the other hand it was shown that when a growth of organisms did take place after boiling, even when the air-borne germs were excluded, it was due to the fact that the spores of some organisms are able to survive a boiling temperature for some time, although the ordinary vegetative cells are at once killed. On this observation was founded the intermittent system of sterilization, which consists in heating the liquid to be sterilized up to the boiling point ou several successive days, by which means the organisms developed from the spores during the preceding 24 hours are killed on each day, until finally no more spores remain to develop.

The controversy over spontaneous generation, which had lasted for about one hundred and twenty-five years, was thus brought to a conclusion, and it is now an accepted fact that bacteria or microbes may be destroyed by heat and certain chemical reagents, and that once destroyed in any medium, the medium remains free from any putrefactive changes until fresh germs are introduced from without. The recognition of this fact led, amongst other things, to the system of antiseptic surgery, with which the name of Lister will always be associated.

Whilst the final engagements in the great war of abiogenesis were being fought, Pasteur, who may be regarded as the father of modern bacteriology, was busily engaged in studying certain diseases of wine. These he proved to be due to micro-organisms, and by adopting remedies based upon the facts I have mentioned, he put into the hands of wine-growers a means of preventing these diseases. Immediately following this, Pasteur was called upon to investigate a mysterious disease which was causing the greatest distress in the silk-growing districts of the Continent. The disease, which attacked the silk-worms and their eggs, spread with alarming rapidity, until in one year in France alone, the loss is said to have been £4,000,000 sterling. For five years, from 1865 to 1870, Pasteur investigated this epidemic, and success crowned his efforts; he proved that the tissues of the affected worms contained an organism, in the form of small, glistening oval corpuscles, which caused the disease. He was able to demonstrate their presence not only in the moths which developed from the caterpillars, but also in the eggs they laid, and he found that when any one of these three forms was affected, the organisms were passed on to the next stage. He was able to show that they increased in the body, that they were the cause of the disease, and that by careful examination and destruction of the affected eggs, and the preservation of the healthy ones, the disease could gradually be eliminated. Pasteur thus succeeded in showing for the first time, the causal relationship between a certain specific micro-organism, endowed with definite morphological and physiological characters, and a specific and characteristic disease. It is, of course, almost superfluous to add that Pasteur's conclusions were not received without considerable opposition by his contemporaries, and one objection which was vigorously urged was, in effect, that he had not employed pure cultures of any single micro-organism.

I must here make a short digression to explain what bacteriologists mean by the term "pure-culture."

Although, as previously stated, bacteria vary much in size and shape, yet the simple examination under the microscope of the form of the cells composing any growth has been shewn by experience to be insufficient for the determination of the purity, or otherwise, of the growth. It thus became necessary to devise a method by means of which absolute certainty could be obtained that any particular growth consisted of one species or variety only. This was first of all done by diluting the liquid containing the organism under examination to an enormous extent with sterilized water, and then adding a small definite volume of the diluted liquid to each of a series of flasks containing a suitable nutritive liquid. The volume of liquid to be added to each flask was so arranged that it should only contain on an average one single cell; and therefore any growth in the flasks was supposed to proceed from the one cell. A comparison of the physiological and chemical properties of the different growths then enabled an opinion to be formed as to the number of species in the original liquid. There are objections, however, to this method, and it is now almost entirely superseded by that known as gelatine-plate culture. This consists in mixing the diluted liquid with nutritive material which has been rendered solid by the addition of five or six per cent. of gelatine. When being used, slight heat is applied to render the mixture fluid, and it is then spread out on glass plates, or round the walls of some convenient vessel, and allowed to set. In this way, the cells it is desired to cultivate are distributed throughout the gelatine, and when this sets, each cell is fixed at the spot where it happens to be, and develops there. By means of suitable apparatus, the cells in the solid gelatine can be observed from the commencement, and their growth followed throughout—in this way absolute certainty can be obtained that each growth proceeds from one cell, and that it is, therefore, a pure culture.

In addition to this use of "plate-cultures," there is another which I will mention here, as I shall have occasion to refer to it again later. You will readily understand from what has been said, that different species of bacteria show great differences with regard to the food and the medium which they prefer. Thus, some species flourish best in an acid, others in an alkaline medium. Then again different species show variations in the shape or colour of the colonies or growths they produce in the same medium; thus, some growths are white or yellow, whilst others, like the so-called bleeding bread, concerning which there was so much superstition in the past, are blood-red. Another distinctive feature is the power, or the reverse, to liquefy the gelatine in which they grow. Again, some bacteria require the presence of air before they can grow, others will not grow in the presence of air. All these, and many other characteristics, are carefully studied and noted with regard to various known species of bacteria; and then by cultivation under definite conditions, and observation of the results, any unknown species can readily be identified.

We are indebted to Dr. Koch, the eminent German physician, for the introduction of this method of plate-culture, and he was able by its means to show the connection between a micro-organism and splenic fever or anthrax. This organism, *Bacillus anthracis*, in its relation to the cause of a specific infective disease in the higher animals and man, has been more thoroughly studied than perhaps any other bacterium. Its power of adaptability to various conditions, and its characteristic appearance, have favoured a careful and systematic study of its properties. In 1850, Davaine and Rayer observed microscopic rods in the blood of animals which had died of anthrax, but they did not appreciate the full significance of their discovery. Some thirteen years later, the former worker, stirred by the researches of Pasteur, came to the conclusion that the organisms were the cause of the fever. This met with much opposition, which was not set at rest until Koch applied the method of plate-culture to the disease, It was to the experiments of Koch on the great difference in sensitiveness between the ordinary vegetative forms of the bacillus and its spores, and the rapid conversion of the latter into the former, that the method of intermittent sterilization, introduced by Tyndall, was due.

Pasteur also examined the cause of anthrax or splenic fever, and he employed the method he had used with great success in his previous experiments. He isolated the organism from infected blood, cultivated it in a state of purity in artificial liquids, and then examined the action of these cultures on animals. When thus purified, it was found that a small quantity of the culture, injected under the skin of a rabbit or a sheep, proved fatal in two or three days, the animal dying with all the symptons of splenic fever.

Both Pasteur and Koch experienced no difficulty in producing the disease in animals subject to it, by means of the artificial cultures; but under no circumstances could it be communicated to birds. Pasteur, by a most ingenious experiment showed the reason of this immunity; and if any more evidence were needed, the results of this experiment proved, without doubt, the causal relationship of the micro-organisms to the disease. It was proved by a series of experiments that the development of the organisms of splenic fever is checked by a temperature of 111° F., and may it not be, said Pasteur, that birds are protected from the disease because their blood is too warm—not far removed from the temperature at which the splenic fever organisms will no longer grow? Might not the vital resistance encountered in the living bird suffice to bridge over the small gap between 107° and 111° F. A certain resistance in all living creatures to disease and death must be allowed; and there can also be no doubt the body of an animal would not be so favourable to the development of a micro-organism as would a suitable nutritive liquid contained in a glass vessel. If, too, the organism is aërobic, that is, if it requires a supply of oxygen for its life and growth, as does the anthrax bacillus, it can only develop in blood by withdrawing the oxygen from the blood-globules, which themselves retain it with a certain force for their own requirements. Nothing was more legitimate, said Pasteur, than to suppose that the corpuscles of the blood of the fowl had such an avidity for oxygen that the cells of the splenic bacillus were deprived of it, and that their multiplication was thus rendered impossible. These considerations led Pasteur to ask the question—"If the blood of fowls were cooled, could not the splenic fever organism live in this blood?"

The experiment was made. A hen was taken, and after inoculating it with splenic fever blood, it was placed with its feet in water at 77° F. The temperature of the blood of the hen went down to 98° or 100° F. At the end of 24 hours the fowl was dead, and its blood was filled with the cells of the bacillus.

A further experiment was made to ascertain if it was possible to restore to health a fowl so inoculated by again increasing the temperature. A hen was inoculated, and subjected, like the first, to the cold water treatment; and when it became evident that the fever was at its height it was taken out of the water, carefully wrapped in cotton wool, and placed in a chamber at a temperature of 95° F. Little by little its strength returned; it shook itself, settled itself again, and in a few hours was fully restored to health. The organism was conquered, and fowls killed after having been thus treated, showed not the slightest trace of splenic organisms.

This experiment has been given at some length because it illustrates a point which I wish to emphasise in connection with the relationship between micro-organisms and disease. This is, the absolute necessity that before any organism is credited with the production of any particular disease, not only must the organism in question be isolated from the tissues or fluids of the animal affected, but it must also be possible to produce in healthy animals of the same species, the same disease by means of pure cultures of the organism, grown outside the body.

During the past summer, we constantly read in the daily papers statements to the effect that suspicious cases of cholera had occurred in various parts of England, and that the dejecta had been submitted to experts to pronounce upon the correctness or otherwise of the diagnosis. On this account and by reason of its general interest I have considered that no more appropriate example could be taken of the relations between a special bacillus and a special disease, and the manner in which this relationship is established, than that afforded by Koch's discovery of the comma bacillus in cases of Asiatic cholera, and its relationship to that disease. Since cholera appeared in this country in the great epidemic of 1832, great attention has been paid to the phenomena connected with it. One of the results of this has been to establish the fact that cholera spreads from its home in Lower Bengal to surrounding districts and distant countries. At first such spread was thought to be most erratic and inexplicable; now, however, there can be little doubt that it follows a very definite line of advance in the various epidemics, and travels along the ordinary lines of commerce by railways, caravans, and ships, from the regions in which it is endemic to those centres of trade and religion, which, by their imperfect sanitary arrangements, by the want of cleanliness of their inhabitants, by meteorological conditions, and by reason of their bad water supplies, are ready for its reception and propagation.

As you will readily believe, the possibility of micro-organisms playing a part in the propagation of cholera had not been neglected, but it was not until Dr. Koch—being sent by the German Government to Egypt and India to study the disease in its home—was able to demonstrate a peculiar species of bacterium as the causal agent, that any definite proof of the micro-organismal nature of the contagium of the disease could be obtained. Koch's conclusions met with much opposition, and Dr. Klein, one of our leading bacteriologists, took a very active part in that opposition in England; judging, however, from the reports from his laboratory which appeared during the recent epidemic, he has now adopted Koch's views, and the latter's "comma" bacillus must be regarded as the *causa causans* of the disease.

The comma bacillus usually occurs as a slightly curved rod, measuring from one to two twenty-five-thousandths of an inch in length, the average length being one seventeenth-thousandth of an inch; it is about one fifty-thousandth of an inch in thickness, the average thickness being about one-third to one-fourth of the length. Instead of occurring as single rods, these organisms may be grouped in pairs, or even in larger numbers, in which case the curve may be continuous or reversed, thus giving rise to the formation either of half-circles or of S-shaped curves. In cultivations in meat-broth the bacilli may be so grouped that they form long wavy or spiral threads, each of which may be made up of 10, 20, or even 30 short turns.

If plate-cultures of this bacillus, made according to Koch's method, be kept in a chamber in which the temperature is maintained at a little over 68° F., small greyish or white points are first seen; examined with a low-power lens, each of these is seen to have a slight yellow tinge and a somewhat wavy margin; as the colony increases in size its colour becomes slightly deeper, the margin becomes more and more crenated and the surface somewhat granular. Slow liquefaction of the gelatine is now found to take place, and small funnel-shaped depressions are seen in the gelatine. The liquefaction increases with the age of the culture, and towards the sixth day the colony has sometimes a delicate pink tinge—a most characteristic feature when present.

Another distinctive feature of the cholera bacillus is the puncture culture in gelatine. This consists in dipping a sterilised needle in a culture of the bacillus and then plunging it into sterilised gelatine contained in a test-tube. Cells of the organism are left along the track of the needle, and the growth under these circumstances is very characteristic. It takes place along the whole track of the needle, first as a delicate white cloud, then, gradually becoming more and more marked, it forms a delicate streak, around which there is usually a clear space, due to the liquefaction of the gelatine along the track of the needle. Near the surface, the liquefaction goes on more rapidly than deeper down, and at the end of forty-eight hours there is a distinct funnel-shaped area. About the fourth day of growth, this funnel is still more marked, but the upper portion has become quite clear, the central thread having fallen to the lower and narrower part of the funnel, where it may be seen as a comparatively short spiral, the thread as it sinks being arranged in regular bights, like those of a cable.

The cholera-bacillus is very greedy of oxygen, and methods for its separation are based upon this fact; in milk it grows with great readiness and gives rise to no noticeable alteration. Acids are deadly poison to it, and the organism cannot grow in acid media—hence it is killed by the gastric juice of the healthy stomach.

The cholera bacillus does not, so far as is at present known, form spores, but the ordinary vegetative cells are somewhat retentive of life under favourable conditions of moisture and temperature. Thus the organism was found alive eighty-one days after it had been placed in the water of the harbour of Marseilles, and Koch found that it lived for between five and six months in laboratory cultures.

In cases of suspected death from cholera, the dejecta are examined for the bacillus and pure cultures made of the organisms found. These cultures are then examined by the methods outlined above, and according to their behaviour in the nutritive media, and the production or otherwise of the appearances described, the case is pronounced to be one of cholera or the reverse. The test mentioned as being absolutely necessary before any micro-organism can with certainty be associated with any specific disease as cause and effect, has been satisfactorily carried out with the cholera-bacillus. Animals, guinea pigs chiefly, have been successfully inoculated with the cholera bacillus, and the disease thereby produced; and several cases are on record in which workers with the organism have accidentally ingested some of the bacilli, with the consequent production of cholera, terminating in some instances fatally.

Hitherto I have treated of micro-organisms as the enemy of man—secret foes who strike before we are aware of their presence; but this is not the only character in which they are known. There are species of a friendly and beneficent nature, so beneficent in fact that it is absolutely correct to say that we could not live without their aid.

It is unnecessary to mention the part they play in the manufacture of beer, wine, and other fermented liquids, but it is worth stating in passing that recent experiments prove that the distinctive character of a wine depends not so much on the grape from which the wine is prepared, as on the variety of wine-yeast used in the fermentation. Thus, yeast cultivated from that used in the district of the Garonne, and transferred to the juice of the grape in the Burgundy district, produces wines of the former class; and yeast from the latter district carried to the former takes with it its distinctive flavour.

All putrefaction and decay take place entirely through the agency of micro-organisms, and but for them the surface of the earth would be covered with the remains of defunct plants and animals, undergoing but little more change than the inorganic materials of the earth's crust. Under these circumstances, life as we know it, would soon come to an end, for it is by the decomposition of refuse animal and vegetable matter in the ground that the fertility of the soil is maintained, and in the absence of this decomposition the most fertile land would become a barren waste, incapable of supporting plant-life; and, with the extinction of the latter, animal life would also disappear.

One of the most important plant-foods in the soil is nitric acid in the form of salts; indeed, a soil destitute of this substance, is incapable of growing a crop of corn, roots or grass, however well-drained, cultivated, and supplied with other plant-foods it may be. But in spite of the importance of this substance, it is only found in very small quantities in any soil at any one time; in fact, the soil under ordinary circumstances, continuously generates this nitric acid from the various nitrogenous manures applied to it. It was some time ago shown that this power of soils to convert the nitrogen of nitrogenous substances into nitric acid was due to micro-organisms; but the particular organism responsible for this action has only recently been discovered. And it is remarkable that the conversion of the ammonia of the manure and soil into nitric acid requires the agency of two distinct organisms—the one to convert the ammonia into nitrous acid, and the second to convert the nitrous acid into nitric acid. Neither can do the work of the other, but the co-operation of the two is necessary to bring about the desired result. The enormous nitrate deposits of the rainless districts of Chili and Peru are doubtless due to the past action of these organisms; and it is said, I know not with what truth, that some of the difficulties experienced at the local sewage farm are due to the absence of these micro-organisms from the soil.

Another most important part which micro-organisms play in connection with vegetable life has recently been brought to light. It has long been a moot point whether the free nitrogen of the atmosphere can be assimilated as food by plants. The verdict was decidedly against the supposition, but it was noticed by Lawes and Gilbert that in the case of particular leguminous crops, such as peas, beans, vetches, etc., there is an excess of nitrogen absorbed which cannot be accounted for as being derived from manures or rain-water. It has been shown that this excess of nitrogen in leguminous crops is obtained from the atmosphere, and also that this assimilation of free nitrogen is dependent upon the presence of certain bacteria, flourishing in and round the roots of these plants, for when these same plants are cultivated in sterilized soil the fixation of atmospheric nitrogen does not take place. Moreover, the presence of these organisms in the soil occasions the formation of peculiar swellings or nodules on the roots of the plants, and these nodules, which are not formed in sterile soil, are found to be remarkably rich in nitrogen and swarming with bacteria.

Extremely important and instructive results have been obtained from experiments made to investigate the particular bacterium which brings about these important changes, and it has been shewn that in many cases each particular leguminous plant is provided with its own particular micro-organism. Thus, it was found that if pure cultivations of the bacteria obtained from a pea-nodule or tubercle were applied to seedlings of the pea there was a more abundant fixation of atmospheric nitrogen by the seedlings, than if they were supplied with pure cultures of the organisms from the nodules of a lupin or a robinia; whilst similarily the robinia was more beneficially affected by the application of pure cultures from the nodules of robinia, than by those from the nodules of either the pea or the lupin.

These are but one or two instances of the necessity of micro-organismal life for the continuance of the well-being of the world; and they show us, that dire as are the effects of certain members of the world of the "infinitely little," yet we owe our very existence to the friendly members of the class.

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Time will not allow me to dwell upon the distribution of micro-organisms. They are, as you know, present in myriads in the air we breathe, and in the water we drink. They accumulate upon all articles in daily use—the coin of the realm and bank notes are not free from them. Milk, butter, and other articles of daily consumption contain them, and it is scarcely too much to say that there is nothing in Nature from which micro-organisms of some kind cannot be obtained. As previously stated, the march of epidemics follows certain definite routes of travel, the infection being carried from place to place and disseminated through the air. We cannot congratulate ourselves too greatly upon the comparative isolation we enjoy by reason of the sea which surrounds our country, and which wards off the attacks of these insidious foes. The cholera epidemics of the past two summers have shown the value of this isolation from the rest of Europe.

But it was not left for us to discover the value, in this respect, of England's sea frontier. Shakespear, in his play of Richard II, says :—

> "This fortress, built by nature for herself,
> Against *infection* and the hand of war;
> This realm, this England,"

showing that the effect, if not the cause, was recognised even in pre-sanitation days.

We owe to a celebrated French writer, Dumas the elder, the cynical expression, "*Cherchez la femme*," but I think you will agree with me that now, on the eve of the twentieth century, we may add to this the expression "*Cherchez le microbe*," for every day shows us, more and more, how omnipotent are these organisms, whose very existence was questioned five-and-twenty years ago.

I had intended to have referred to the question of preventive inoculation and immunity, questions which are daily assuming greater importance, but time will not allow me to even touch upon the fringe of this most interesting branch of the subject. Perhaps on some future occasion I may have an opportunity to do so. I do not want you, however, to think that the work of the bacteriologist simply consists in finding out what organism is associated with any particular disease. That is the first step. The second is to devise some means by which its ravages can be held in check, or even prevented. The foregoing results constitute but the first stage; hundreds of patient workers are following these up into the domain of prevention. This branch of work requires the very greatest care and the utmost attention to minute details, both in order to ensure accuracy in the results, and also the safety of the worker.

As I intimated earlier in the evening, cases are on record in which the worker has fallen a victim to the micro-organism he was investigating. Only a few weeks ago, a physician, investigating the organism of diphtheria, contracted this deadliest of all diseases, and fell a victim to the cause of Science.

It is impossible to avoid the conviction that those who, for the good of mankind, undertake the investigation of these malignant foes, display a quiet heroism, which is equal to that of the sailor who prefers to perish with his ship, or the soldier who leads a forlorn hope.

Some Fishes of the District.

By G. Morland Day.

Read before the Society, February 9th, 1894.

[CONDENSED.]

FISHES form a large and interesting class among the vertebrate animals, and there are to be found in the rivers and ponds in this neighbourhood no less than twenty-three different kinds, and the following table shews at a glance not only their names, but also the different families, orders, and sub-classes, under which they are grouped.

CLASS—PISCES—FISHES.

SUB-CLASS—TELEOSTEI. Perfect boned.

CYCLOSTOMATA. Round-mouthed.

ORDER—PHYSOSTSMI. With opening from air bladder to œsophagus.

ACANTHOPTERYGII. Spiny finned.

ANACANTHINI. Spineless.

FAMILY—	SALMONIDÆ.	ESOCIDÆ.	MURÆNDIÆ.	CYPRINDÆ.	PERCIDÆ.	GASTEROSTEIDÆ.	COTTIDÆ.	GADIDÆ.	PETROMYZONTIDÆ.
Species:	Salmon.	Pike.	Eel.	Barbel.	Perch.	Stickleb'ks.	Bullh'd.	Burbolt.	Lamprey.
	Trout.			Bleak.	Ruff.				
	Grayling.			Bream.					
				Carp.					
				Chub.					
				Dace.					
				Goldfish.					
				Gudgeon.					
				Loaches..					
				Minnow.					
				Roach					
				Tench.					

It would be quite impossible in a short paper to enter upon a history of so many fishes, and I am therefore obliged to confine my remarks to a short life-history of the Salmon, and a few facts about the pike, the eel, and one or two others. It is a curious thing that, although no fish has had more attention paid to its study, or had more books and articles written about it than the salmon, there are great gaps remaining to be filled up in its life-history. Nobody knows where it goes to in the sea, and very little indeed is known about what it feeds on; and although it must be a voracious feeder in salt water, it seems probable that it eats little or nothing in fresh water to which it pays an annual visit for the purpose of laying its eggs. To do this it always goes up stream until it arrives at a shallow part, with a gravelly bottom, and clear sparkling water running rapidly over it. Here the female fish proceeds to make a considerable trench in the gravel by lying on her side and working strongly with her tail. During this time, the male fish, who is in close attendance, immediately gives fight to any other fish that happens to come near, and as during the breeding season it develops a very strong hook on its lower jaw, terrible wounds, sufficient in some cases to cause death, are often inflicted. As soon as the eggs are laid in the trench and fertilized by the male fish, they both set to work to cover them thickly over with gravel, forming a large heap at the bottom of the river, known as a redd. A favourite spawning ground in this locality is the shallow just above the bridge at Tutbury, and here, during the season, salmon may often be seen depositing their eggs. The time taken for the eggs to hatch depends on the temperature of the water, but, roughly speaking, it is from seven to twelve weeks. When first hatched, the baby fish is called an "alevin," and has a large yolk sac attached to its throat, which provides it with nourishment for about six weeks, at the end of which time it is absorbed, and the little fish is then known as a "par."

It is of a bright silvery brown tinge with brilliant red spots, and peculiar marks on its sides like finger marks. These marks are characteristic of the "par" stage of all the British salmonidæ, and are known as "par bands." It remains a "par" for about twelve months, and, during this time, feeds on flies and other small insects. At the end of its first year, another change takes place: the "par bands" disappear, it puts on a bright silvery coat, and becomes what is known as a "smolt," and is ready for its first journey down to the sea. As soon as the "smolts" are ready to start, they collect together into shoals, and set off on their journey. Wherever the water runs fast, they go down stream tail first, which seems a curious mode of progression; but really they allow the stream to carry them down, remaining suspended in the water, and travelling somewhat slower than the stream. It is, perhaps, the middle of May when the sea is reached, and now for a period our little friend is lost sight of. Where it goes to, nobody knows, and what it feeds on is merely a matter of conjecture; but it must feed somewhere, on something, and in a most voracious manner, for although in May it entered the sea a little chap of about a couple of ounces, it comes back to the river in August a respectable young salmon of four or five pounds weight, having in the short space of three months increased about twenty-five times in bulk, and is now known as a "grilse." At the end of the spawning season it again goes down into the sea, and on its return to the river next year, the four or five pound grilse has become a salmon of ten or twelve pounds, another remarkable increase in weight. Many efforts have been made to clear up the mystery of its food when in the sea, but the great difficulty that stands in the way is the strange fact that it is an exceedingly rare occurrence for any food to be found in its stomach, but occasionally, one or two herrings have been found, and it is probable that it feeds largely on these and kindred fishes.

It seems a great pity that so splendid a river as the Trent is, to a great extent, useless as a salmon river, but there are so many obstructions in the shape of weirs on the way up from the sea, and so much sewage from towns, that, although large numbers of fish do find their way up to the Dove and other tributaries to spawn, it takes them so long to get up that they are rarely in good condition when caught. A specimen of the obstructions they encounter may be seen at the weir at Dove Cliff, and here, when the river is in flood in the Autumn, hundreds of salmon may be seen leaping into the air and on to the weir, only to be swept back by the water time after time. A few occasionally surmount the obstacle, and some get up by a salmon ladder that is there, but the fish do not seem to find it easily.

Next to the salmon in size, and far in front of him in ferocity comes the Pike, a fish that is frequently spoken of as the freshwater shark: and if you look at its immense mouth, with rows of large sharp teeth, and note its cruel looking eyes, and then remember that it lives almost entirely upon other fishes, the name seems to be a well deserved one. Its appetite is enormous, and a short time ago a gentleman, fishing in Pembrokeshire, caught a pike about six pounds in weight, and noticing that it seemed a good deal distended with food, he cut it open and found inside it fifty-five small dace and a quantity of digested food. It is also recorded by Mr. Cholmondeley Pennell that, on a certain occasion, a trimmer was set for pike, and when it was taken up next morning there was a large fish on it. The hook was well inside the fish's stomach, and on opening it another pike was found inside it that had also swallowed the hook. The second pike was then opened, and inside it was a third small pike that had swallowed the original bait. There are many well authenticated records of pike having attacked and bitten men and boys when in the water, and it is not at all particular what it eats when hungry: rats, frogs, young ducks—in fact, almost anything that gets into the water falls a prey to its appetite. Its teeth are admirably adapted for its mode of life, and on each side of the lower jaw will be found a row of long and very sharp teeth firmly fixed in the jaw. The edges of the upper jaw have none, except a few small ones just in front: but on looking into its mouth three nearly parallel bands of teeth will be found on the palate, one in the centre, and the others on each side. On the central band the largest teeth are in front, and on the lateral bands the largest are on the inside. The remarkable point about these teeth is, that each one is furnished with a hinge at its base, and they are capable of being bent down in the direction of the throat until they lie in a nearly horizontal position. The object of this arrangement is obvious. When a pike seizes another fish it is nearly always caught crosswise, and is at once impaled on the long teeth of the lower jaw. The mouth being closed, the prey is held up against the roof of its mouth by the tongue, and it becomes impossible for it to move except in the direction of the pike's throat. Assisted by this remarkable arrangement of teeth, the pike is enabled to turn its capture lengthwise in its mouth before commencing to swallow it, and the struggles of the fish attempting to escape probably help on the operation.

Pike are to be found in nearly every pond and stream in the country, and it is often a matter of much difficulty to account for their appearance in ponds apparently cut off from communication with other waters. Izaak Walton says, "It is not" "to be doubted but that they are bred, some by generation" "and some not, as namely, of a weed called pickerel weed," "unless the learned Gesner be much mistaken, for he says" "this weed and other glutinous matter, with the help of the" "sun's heat in some particular months, and some ponds" "apted to it by nature, do become pikes." There is no doubt that "the learned Gesner" was much mistaken, and the probable explanation is that eggs are conveyed in some way by water birds, and eventually hatch out. The pike is a long lived fish, and under favourable circumstances will survive seventy or eighty years, and its usual breeding season is during the months of March, April, and May. The ova are very small, and the number of them varies from fifty-thousand up to half-a-million.

The Eel is the most numerous of all the British fresh water fishes, but it is only within quite recent years that it has been ascertained with any certainty where and when they breed. Recent research and observation have established the fact that they go down to the sea to lay their eggs, but whether they are deposited in the shallow waters at the mouths of rivers or in the deep sea, has not yet being found out. The downward migration commences in September and October, or even earlier in some rivers, and they then "run," as it is called, in enormous quantities, so much so, that at the great eel fishery at Toome, on the lower Bann, in Ireland, as many as seventy-thousand have been taken in one night. There is an eel trap at Peel's old mill, at Drakelowe weir just above Burton, and here six large sacks have been filled in a day. It is a curious thing that, after they have spawned, they do not seem to return to fresh water, or if any do, the number is so small that they are hardly ever seen. In the early months of the year, the young eels that have been hatched in the salt water begin to go up stream in countless thousands, and some rivers are said to be positively black with the multitude of them. There are two sorts of eel, generally described as the broad-nosed, and the sharp-nosed, and they have for many years been looked on as distinct species, but Dr. Francis Day now says that the broad-nosed eel is the male, and the sharpnosed the female, of the same species. Eels grow to a large size, and one was recorded in the *Daily Telegraph* of October 10th, 1893, that was taken from the river Nene near Wisbech, that weighed 37-lbs. and was nearly six feet in length.

Among the rarer of the British fishes that have been found in this locality, the ten-spined Stickleback is worthy of mention, which the late Sir Oswald Mosley, in his first inaugural address as the President of the Burton Natural History Society in 1847, recorded as having been found in a small stream close to the Station, the site of which is now covered with buildings. About a year ago I saw one of these fishes, that had a remarkable history. Messrs. Bass & Co. had made a bore-hole for water at Sleaford, in Lincolnshire, and at the depth of 120 feet had found a large supply, which rose some feet above the ground. One day on taking sample of the water, a small fish was found in the can, and it was sent to Burton, where I had the pleasure of examining it while it was alive, and found it to be a ten-spined stickleback. Nobody could tell where it started from before coming up the bore-hole, but it must have had a remarkable underground journey from somewhere.

Space forbids me to say more, or to describe the pleasures that await those who wish to make a study of the lives and habits of fishes; but they are well summed up by an old fisherman of long ago named Davors, who says:

"The lofty woods, the forests wide and long,
Adorned with leaves and branches, fresh and green,
In whose cool bowers the birds, with many a song,
Do welcome with their choir the Summer's queen;
The meadows fair, where Flora's gifts among,
Are intermixed with verdant grass between;
The silver-scaled fish that softly swim
Within the sweet brook's crystal watery stream:
All these, and many more of His creation
That made the Heavens, the angler oft doth see:
Taking therein no little delectation,
To think how strange, how wonderful they be."

The Roman Catacombs.

By W. Odling, F.I.C., F.C.S.

(Read before the Society, March 9th, 1894.)

[condensed.]

THE most important of the Catacombs is that now called S. Callixtus: it is situated on the Via Appia. We can descend by a succession of staircases to five different levels. This gives some idea of the vastness of the work done underground.

There is no doubt but that at first the Christians were allowed to bury their dead as they liked, and they never would have been interfered with if they had confined their operations to burials only, but it was their use of the catacombs as places for assembly and religious worship that led to their being suppressed. The first certain record is in the middle of the third century, when Valerian published a decree whereby he sought to close against the Christians even this subterranean retreat. He forbade them "either to hold assemblies or to enter those places which they call their cemeteries." This order was, of course, disobeyed, and Pope Sixtus II with some of his deacons was surprised and martyred in the catacomb of Prætextatus.

The persecution of Diocletian ended in 306, but it was not until 311 that the catacombs were restored to their natural owners—the Bishops of Rome.

In that year Pope Melchiades sent letters from the Emperor Maxentius to the Prefect of the City that he might recover legal possession of all "ecclesiastical places" of which the Christians had been deprived, and amongst these places the cemeteries were the most precious. Cemeteries now began to be made above ground, and for the next 100 years both places of burial were in use; but towards the end of the fourth century burials in the catacombs became more rare, and by the year 410 they had ceased altogether. About this time grand basilicas began to be built over the tombs of the more celebrated saints—S. Peter, S. Paul, S. Agnes, S. Sebastian, and others. This naturally caused a great destruction of subterranean graves. This went on until the time of Pope Damasus (364) who devoted himself with singular zeal and prudence to the preservation of the catacombs. He made new staircases, strengthened the walls, made regulations for the guidance of the pilgrims, and finally, made short sets of verses in honour of some of the martyrs, which have been of the greatest service in fixing the geography of the cemeteries and re-constructing their history. These inscriptions are beautifully engraved on marble, invariably by the same artist—Furius Dionysius Filocalus. In 557 much mischief was done by the Goths, and again by the Lombards in 756. Towards the end of the ninth century the catacombs ceased to be frequented for purposes of devotion, and, until the sixteenth century, they were quite neglected and practically unknown.

In 1578 the catacombs were re-discovered by some labourers who were digging for puzzolana; but it is a great pity that the ecclesiastical authorities at Rome did not forbid the removal of relics by private individuals as Pius IX did in 1851. However, fortunately for our knowledge, there arose about forty years ago a great scholar, who has worked with the greatest patience, most scrupulous caution, and in a thoroughly scientific spirit—Giovanni Battista de Rossi. The result has been a re-construction of the history of the catacombs, and there is probably now no group of ancient monuments which can be classified more exactly, and with greater certainty.

Tbe Roman catacombs are a vast gallery of Christian art. At first the Christians decorated their tombs in much the same manner as did their Pagan neighbours. The roof was divided into geometrical figures by means of lines and garlands of flowers, with figures filling up the spaces. Of one thing there there can be no doubt, and that is, the superiority of the paintings of the first two centuries over those of the third and fourth. One of the chief subjects of early decorators is that of the Good Shepherd. It is found on tombstones, cups, rings, &c. Then we have Jonas and Lazarus as types of the Resurrection, and the Anchor as an emblem of Hope. Another emblem is that of the Fish, which is used to represent not only the Christian but Christ himself. The Greek for fish is IXΘYC (Ichthus.)

I	Iησους	=	Jesus.
X	Xριστος	=	Christ.
θ	θεου	=	of God.
Y	Yιος	=	Son.
C	Cωτηρ	=	Saviour.

Then we have Noah and Daniel—the Ark being typical of the Church, and Daniel of the Resurrection.

The most beautiful painting of the Blessed Virgin is of the early part of the second century.

In the cemetery of S. Domitilla there is one of the third century, on either side of her two of the Magi are bringing offerings. The one of the fourth century, in the cemetery of S. Agnes, is much more stiff, and of the Byzantine type. Then several gilded glasses have been discovered with Peter as Moses striking the Rock—these are of the fourth century. It is only, of course, of late years that the inscriptions have been treated in a scientific manner.

The earliest Christian tombstones only record the bare name, with the addition, perhaps, of an anchor or *Pax tecum or tibi*. Towards the latter end of the 2nd century, the epitaphs become longer and more frequent. They ask for the departed soul peace and light, and refreshment and rest in God and Christ. Sometimes, also, they invoke the help of the prayers of the departed for the surviving relatives, whose time of trial is not yet ended.

The Registers of the Parish Church (St. Modwen's) Burton-on-Trent.

ON Friday, April 13th, 1893, the Vicar of Burton (The Rev. Vicars A. Boyle, M.A., B.C.L.) read a Paper before the Natural History and Archæological Society, on "Parish Registers," illustrated by references to the Burton Parish Registers. This paper it was proposed to publish in the Society's Transactions; but, yielding to the Vicar's representations that the publication of original documents was more in accordance with the aim of the Society, the Publication Committee consented to publish a portion of the Register itself. The portion chosen is the Marriage Register from 1538 to 1686. This is included in the first volume of the Parish Registers, a small quarto, bound in calf, and consisting of some four hundred leaves of paper. The volume contains the Register of Baptisms, Marriages, and Burials from 1538 to 1686, each separate, and in the order named. The book is perfect, with the exception of the title and the first leaves of the Baptismal Register. The last six leaves of the volume contain a list of Briefs and persons ex-communicate. The entries (except during the three years 1578 to 1581, where they are in English) are throughout the book in Latin. There are few entries of events other than Baptisms, Marriages, and Burials, and such are, for the most part, notices of the Bishop's Visitations, and of the appointment of Ministers of the Parish Church. In transcribing the entries, the Vicar has departed from the original in these particulars:

1. Latin has been translated into English.
2. Superfluous words are omitted, *i.e.*, such formal repetitions as "were married."
3. Contractions are extended.
4. Dates are reduced to the margin.

The names of those whose Marriages were celebrated and solemnized in the Parish Church of Burton-upon-Trent from November the First 1538, the 30th year of the Reign of Our Most Excellent Prince and Lord, Henry VIII, King of England and France, Lord of Ireland, and on earth, under Christ, Supreme Head of the English Church.

1538. Nov. 9. William Goodaye, of Horninglow, to Ellen Plant, of the same.
,, ,, 9. Robert Turner, of Horninglow, to Margaret Orgell of Bronston.
1539. Jan. 21. John Colburne of Burton, to Alice Thetyll.
,, ,, 25. Edward Percyfale to Margery Walton.
,, ,, 28. Richard Elkyns to Isabell Baker.
,, Feb. 1. Richard Edys to Joan Quolmon.
,, Apl. 29. William Hollynworth to Joan Gayland.
,, June 14. John Matthew to Clemens Wylkins.
,, ,, 25. Richard Smyth to Agnes Abbot.
,, July 5. Richard Burrowe to Joan Breerly.
,, ,, 20. John Chetylton to Cycily Jonson.
,, Sep. 10. Roger Hoorobyn to Joan Morley.
,, ,, 21. Robert Stables to Joan Budworth.
,, Oct. 11. Thomas Duffeld to Alice Baker.
,, ,, 26. Robert ssmyth to Joan Aterley.
,, ,, 26. Henry Jurdyn to Margaret Laurons.
,, ,, 26. Hugh Phyllypp to Elizabeth Blunte.
,, ,, 30. John Morlay to Ellen Hychekoc.
1540. Jan. 19. Ralph Knight to Margery Kynnerday (?)
,, ,, 23. William Lowe to Isabell Martyne.
,, ,, 23. William Dee to Joan Roland.
,, Apl. 25. Thomas Ewcraft to Joan Knosall.
,, July 13. Richard Morekott to Joan Wetton.
,, ,, 11. Edmund Percyfall to Margery Mooer.
,, Aug. 30. William Bybbi to Joan Martyn.
,, ,, 30. John ffletcher to Joan Wylkynson.
,, ,, 30. William Storer to Agnes Passand.
,, Sep. 26. John Watson to Izabell Beeles.
,, ,, 26. John Ade to Margery Chaplyn.
,, ,, 26. Edmund Dawkyn to Alice Harrysson.
,, Oct. 30. William Morekott to Anne Palewalle.
,, ,, 30. William Harnolde to Joan Pykforke.
,, ,, 23. Richard Hatherton and Alice Baker.
,, ,, 23. John More to Margaret Stablesse.
,, ,, 23. William Hampe to Margaret Brown.
,, ,, 29. John Mylner to Lucy Gilbert.
,, Nov. 14. Henry Harryssby to Margaret Bolland.
,, ,, 20. Wyllam Turner to Margaret Staley.
,, ,, 18. Richard Sharad to Joan Huet.
1541. Jan. 19. John Stone to Ellen Poppoo. (?)
,, ,, 19. John Bracley to Joan Wylson.
,, Feb. 7. John Baker to Margaret Whytell.

1541. Feb. 7. John Peymerton to Margery Myddylton.
" " 7. William Fysshewyk to Elizabeth Walker.
" " 12. William Jepson to Margaret Aneld.
" June 26. Thomas Brodbent to Elizabeth Ballynton.
" Aug. 18. John Carlesse to Elizabeth Blounte.
" Sept. 10. John Goodcolle to Agnes Cartleyge.
" " 26. John Brigen (?) to Alice Ros.
" Oct. 13. Thomas Hurde to Margery Byry.
" " 26. Edmund Fanage to Margaret Wilkynson.
" Nov 6. John Mydylton to Katherine Laveroke.
" " 6. Thomas Henson to Maud Appulbe.
" " 6. John Sargent to Emot Shakulton.
" " 6. John Warde to Agnes Wurthynton.
" " 20. Henry Boghton to Alice Smyth.
1542. Jan. 20. Richard Pyek (?) to Agnes Wylkynson.
" " 21. John Smyth to Elizabeth Yelde.
" " 21. John Hollme to Alice Cartwright (*written over* Shepperd.)
" " 28. William Jonson to Joan Bryde.
" Feb. 4. Thomas Malton and Joan Tomson.
" June 18. Thomas Poolley to Margaret Budworth.
" " 19. William Greneleffe to Joan Hollyngworth.
" Sept. 4. Edward Arnalte to Elesabeth Beche.
" " 24 John Batkyn to Alice Myddylton.
" Oct. 15. Hugh Wright to Margery Hanwyn.
" Nov. 5. James Bownde to Agnes Martyn.
" " 19. Thomas Langley to Joan Probyt.
" " 19. Thomas Barton to Margaret Cartwryght.
1543. Jan. 14. Henry Dane to Joan Teyt.
" " 14. John Yelde to Emot Weldon.
" " 14. John Henson to Elizabeth Harryson.
" " 15. William Bagshaw to Cecily Heyes.
" Apl. 17. Thomas Teylyer to Margaret Bere *alias* Hatmaker.
" June 24. William Foxlow to Edith Follwode.
" July 8. Robert Hod to Joan Baylys.
" Aug. 5. Richard Watson to Margaret Orgyll.
" Sept. 23. John Ade to Agnes Morley.
" " 30. William Cowper to Isabell Barstow.
" " 30. Thomas Cartwryght to Alice Chambres.
" Oct. 14. Richard Nowrthe to Joan Philipe.
" " 21. Richard Spenser to Alice Baker.
" " 24. Thomas Bladon to Emot Breley.
" Nov. 11. Henry Mylner to Agnes Gylbert.
" " 16. Robert Stoffeld to Margery Jewen.
" " 19. Roger Hynkerfall to Isabell Webster.
" " 20. Christopher Yssherwod to Joan Carter, *alias* Shepperd.
" " 25. William Halt to Agnes Allcraft.
1544. Jan. 20. Nicolas Mogge to Margaret Parker.
" " 27. John More to Margaret Potter.

1544. Jan. 28. James Sutton to Joan Wittill.
,, Feb. 24. James Bande to Joan Bysshope.
,, ,, 25. Robert Colman to Helinore Grene.
,, June 10. Robert Baker to Canthea (?) Byshope.
,, Oct. 12. William Massye to Joan Busshope.
,, ,, 12. Henry Sheparde to Jeys Gulfud.
,, ,, 26. William Sharpe to Alice Bande.
,, Nov. 2. John Prymyngam to Emot Tesdale.
,, ,, 17. Robert Mylward to Elizabeth Burrows.
,, ,, 25. John Ley to Ellen Stanley.
,, ,, 25. John Turner to Marjory Hallam.
1545. Jan. 26. George Bouthe to Marjory Grene.
,, ,, 27. Thomas Mylner to Joan Warde.
,, ,, 27. John Fytchett to Ellen Foxlowe.
,, ,, 31. John Aston to Joan Adye.
,, July 6. Thomas Bredon to Joan Laverock.
,, ,, 13. Michael Smyth to Agnes Lowe.
,, Sept. 1. John Syke to Isabell Wunwell.
,, ,, 14. Willam Egghe to Agnes Dobbys..
,, Nov. 22. Richard Hethe to Agnes Ynkerfall.
,, ,, 22. Richard Dakin to Agnes Tonlynson.
1546. Jan. 17. Richard Bennytt to Margaret Baker.
,, ,, 25. Thomas Hurde to Ellen Freer.
,, Sep. 19. John Halom to Joan Clerke.
,, ,, 21. George Kynnerdrett (?) to Isabell Teyte.
,, Oct. 21. Nicolas Wylkenson to Margeret More.
,, ,, 17. John Baker to Wereburg Worthenton.
,, Nov. 7. Thomas Baker to Joan Vernam.
,, ,, 22. Richard Haryson to Alice Haster.
,, ,, 23. William Sharpe to Elizabeth Wyntley.
1547. Jan. 16. Richard Bladon to Alice Shaarpe.
,, ,, 23. John Whynny to Joan Stanerne. (?)
,, ,, 29. Robert Shenton to Agnes Storar.
,, ,, 29. William Bladon to Margery Sharpe.
,, Feb. 3. Ralph Harby to Anne Hurlebut.
,, Apl. 30. Thomas Hyde to Agnes Smyth.
,, June 12. Henry Heyward to Alice Watson.
,, July 19. John Gylbert to Agnes Baker.
,, Oct. 2. Thomas Wandell to Elizabeth Holand
,, Nov. 13. Hugh Salford to Anne Fletcher.
,, ,, 20. Robert Mower to Isabell Woodcocke.
1548. Jan. 19. Nicolas Grundye to Isabell Browne.
,, ,, 22. Nicolas Ylseley to Alice Frythe.
,, ,, 23. Robert Bolocard to Isot Fletcher.
,, Apl. 16. Ralph Tofte to Agnes Watson.
,, July 8. John Peyte to Agnes Sowtham.
,, June 18. Thomas Irelond to Isabell Browne.
,, July 22. John Bladon to Elizabeth Stafford.

1548. Sept. 2. John Webster to Agnes Rolston.
,, Nov. 30. Richard Portar to Margery Myddylton.
1549. Jan. 21. John Bostocke to Margaret Meycocke.
,, ,, 27. William Alsoppe to Agnes Shaarpe.
,, Feb. 8. John Bolocard to Mary Hethe.
,, ,, 12. Thomas Caldewall to Margaret Bysshyppe.
,, May 12. Ralph Tofte to Joan Pyckforke.
,, June 17. Richard Turner to Eleonore Whytell.
,, ,, 19. Richard Sargent to Emmot Mylgate.
,, ,, 22. Richard Henson to Alice Whynny.
,, ,, 29. William Abell to Katharine Borose.
,, Aug. 11. William Fysshewycke to Elizabeth Bucley.
,, Oct. 6. Robert Browne to Agnes Sharpe.
,, ,, 13. Henry Mylner to Alice Cloose.
,, ,, 13. John Townsend to Margery Rychardson.
,, ,, 27. Richard Holoway to Joan Hyll.
,, Oct. 3. Thomas Heyward to Joan Halom.
,, Nov. 12. Robert Peeke to Emmot Waegestaff.
,, ,, 22. Thomas Haryson to Joan Haryson.
,, ,, 25. Nicholas Norton to Joan Fydcocke.
1550. Jan. 28. William Swynerton to Joan Ensoore.
,, May 6. Richard Fenton to Isabell Jackson.
,, ,, 10. Thomas Grundy to Ellen Bowde.
,, June 16. John Morecott to Agnes Halle.
,, ,, 16. Thomas Browne to Isabell Cowper.
,, Aug. 5. William Damporte to Joan Holoway.
,, Sept. 7. William Watson to Joan Sharpe.
,, ,, 2. Richard Blurton to Ellen Barlow.
,, Oct. 19. William Orgaell to Isabell Browne.
,, ,, 26. John Sharpe to Joan Greneleafe.
,, ,, 26. John Stretton to Margaret Watson.
,, ,, 28. Edmund Gylbert to Mary Stockewell.
,, Nov. 2. Richard Stathum to Margaret Fychett.
,, ,, 2. William Teyte to Emmott Fletcher.
,, ,, 3. Nicholas Goodcolle to Joan Maryat.
,, ,, 9. John Crockett to Ellen Dalman.
,, ,, 16. Robert Marten to Alice Orgaell.
,, Dec. 2. Nicholas Dawken to Isabell Dawken.
,, ,, 7. Henry Fychet to Joan Bostock.
,, ,, 9. Thomas Trubshaw to Joyce Wylton.
1551. Jan. 12. Edward Smythe to Joan Bolocard.
,, ,, 17. William Orgaell to Joyce Browne.
,, ,, 22. Robert Smyth *alias* Bolocard to Joan Smyth.
,, ,, 25. Robert Cartwryght *alias* Shepard to Alice Jackson.
,, Feb. 1. William Clyfton to Margery Crockett.
,, June 1. John Fryth to Agnes Norton.
,, ,, 7. Richard Abell to Margery Baker.
,, ,, 22. Ralph Wylkenson to Agnes Beche.

1551. July 5. Hugh Turner to Margery Caldewall.
,, ,, 5. John Elken to Alice Woodcocke.
,, Aug. 2. Richard Smyth to Elizabeth Bladon.
,, Oct. 20. Robert Rychardson to Margery Holand.
,, ,, 25. William Wryght to Clemens Matthew.
,, Nov. 10. Robert Gamag to Agnes Smyth.
,, ,, 8. Thomas Batman to Emott Blownt.
,, ,, 15. Hugh Watson to Margaret Rycroafte.
,, ,, 17. John Brereley to Sybil Twycrosse.
,, ,, 22. Oliver Bratte to Elizabeth Sharpe.
,, ,, 29. Robert Sharpe to Agnes Orgaell.
,, ,, 29. John Byrchell to Margaret Barton.
,, Dec. 5. James Campyon to Agnes Mylnehowse.
1552. Jan. 22. William Cowper to Agnes Ylseley.
,, ,, 25. William Soulle to Agnes Smyth.
,, Feb. 12. Thomas Walbank to Joan Byrchill.
,, Apl. 21. Edward Bokeley to Margaret Fletcher
,, ,, 29. Simon Underwood to Agnes Wetnall.
,, May 7. John Horowbyn to Margaret Burges.
,, June 13. Edmund Malton to Agnes Smyth.
,, ,, 17. William Campyon to Alice Elde.
,, ,, 19. Nicholas Kynnerdyne to Eleonore Ylseley.
,, ,, 25. John Carter to Dorothea Artchord.
,, July 22. John Smyth to Agnes Gylbert.
,, ,, 31. Robert Hyll to Elizabeth Banks.
,, Aug. 21. Ralph Bolendon to Margaret Marten.
,, Oct. 23. Richard Bande to Agnes Browne.
,, Nov. 6. Walter Belcher to Agnes Hyroner.
,, ,, 28. Richard Wryght to Margaret Jackson.
,, Dec. 9. John Saunder to Isabell Dawken.
,, ,, 12. William Haryson to Joan Dampord
1553. Feb. 9. Edmund Roe to Elizabeth Abell.
,, ,, 5. Robert Jackson to Margery Bodcocke.
,, ,, 6. John Sutton to Modwen Morley.
,, Apl. 11. William Morley to Joan Ledbeter.
,, ,, 29. Robert Leydebeter to Joan Fowler.
,, ,, 29. John West to Elenore Coke.
,, May 9. Ralph Samson to Alice Poole.
,, Sep. 12. John Hurde to Margaret Haryson.
,, ,, 29. John Smyth to Margery Walker.
,, Nov. 6. John Wyghtman to Modwen Caldwall
,, ,, 19. Thomas Ownysbye to Isabell Gylbert.
1554. Jan. 15. John Holoway to Agnes Moculson.
,, ,, 20. Richard Smyth *alias* Bolocard to Agnes Browne
,, Apl. 9. John Ade to Joan Morley.
,, May 21. William Wryght to Isabell Watson.
,, ,, 28. Nicholas Baker to Alice Matthew.
,, Jun. 11. Bodwen (?) Fyssher to Joan Hall.

1554. June 20. Robert Bladon to Agnes Carter.
,, July 21. Robert Bakewell to Elizabeth Hyll.
,, Oct. 18. John Lee to Margery Lane.
,, ,, 21. Thomas Bate to Margaret Henworth.
,, Nov. 3. Roger Marche to Joan Appulby.
,, ,, 12. William Holforth to Isabell Bentlye.
,, ,, 19. Thomas Orpe to Margaret Wace.
,, ,, 29. William Hyll to Agnes Long.
,, ,, 29. John Chamberlen to Isabell Cartwyght.
1555. Feb. 3. Richard Budworth to Alice Dalman.
,, ,, 8. Henry Tone to Joan Caldwall.
,, May 12. John Perkall to Elizabeth Dunne.
,, June 10. Richard Bulfeld to Alice Horne.
,, ,, 15. John Hurde to Margaret Cossale.
,, ,, 23. Thomas Newbold to Ellen Gybens.
,, July 1. William Woodcocke to Margery Cowper.
,, ,, 6. Robert Cloys to Agnes Fyssher.
,, Oct. 6. Humphrey Melburne to Margery Lowe.
,, ,, 27. John Mechrifte to Joan Wylson.
,, Nov. 17. John Clerke to Isabell Turner.
,, ,, 29. William Beerdmere to Agnes Heyse.
1556. Jan. 26. Hugh Bladon to Isabell Gylbert.
,, May 20. Ralph Hatchet to Alice Browne.
,, ,, 21. Richard Bladon to Joyce Astil.
,, Sep. 5. Richard Beerdmore to Agnes Woodfeld.
,, ,, 5. William Checkley *alias* Mason to Margery Watson
,, ,, 21. Richard Bradeley to Agnes Lowe.
,, Oct. 12. Richard Perlebie to Alice Smyth.
,, ,, 2. William Hatchett to Katherine Browne.
,, Dec. 21. Thomas Alcocke to Margaret Malton.
,, Oct. 27. Robert Heyse to Margaret Beeche.
*1557 May. 8. Richard Francis to Elizabeth Watson.
*Altered by later hand to 1558.
,, June 12. Richard Knyghth to Joan Bracley.
,, ,, 15. William Stone to his Wife.
,, ,, 20. John Swynnerton to his Wife.
,, Oct. 12. John Stokdale to his Wife.
,, ,, 23. John Brackley to his Wife.
*1559 Apl. 22. Henry Watsun to Agnes Wodcoke.
*Altered to 1558.
[No date] Henry Smyth to Senche Smyt.
,, Apl. 28. Yedmund Gilbert to Elesabeth Jacsune.
,, Feb. 16. Robert Bronfelt to Ellen Burley.
,, ,, 22. Wylliam Arnolde to his Wife.
,, ,, 26. Richard Watsune to his Wife.
,, ,, 28. Thomas Wystens to his Wife.
,, ,, 19. John Harrisune to Joanne Robynsune.
,, Apl. 16. John Browne to Isabell Wrygth.
,, ,, 28. Robert Gilbert to Agnes Prat.

[No date, probably the Marriages of 1557] John Swynnertun to Joan Alyn.
Christopher Hussharwod to Agnes Oxforth.
Robert Stapuls to Joan Ratlyffe.
,, Thomas Cloys to Margery Martyn.
,, John Yepe to Margery Hese.
,, Robert Gammo to Agnes Smyth.
,, William Plommer to Dorithy Percar.
,, Hugh Wrygth to Joan Stapuls.
,, Wylliam Tayt to Joan Hyatt.
,, Thomas Atkyns to Margery Smyth.
,, Thomas Dasune to Joan Hyll.
,, Robert Brat to Margery Holland.
,, Robert Sawfort to Eleonore Mylner.
,, John Robynsune to Ellen Pawmer.
,, Robert Smyth to Margery Smyth.
,, Wylliam Anyley to Modwen Dobbys.
,, John Loggyn to Anne Morecoke.
,, Edward Manyfeld to Alice Pawmer.
,, John Wrygth to Ellen Hurde.
,, Yedward Scalysbery to Alice Suttun.
,, Henry Cope to Margery Mylner.
,, Richard Eth to Yesabell Heys.
,, Thomas Atkyns to Joan Bladun.
,, Wylliam Sawfort to Ellen Bacar.
,, John Wyllsune to Margaret Bacar.
,, Thomas Wryght to Ellen Boman.
1560. Dec. 3. Wylliam Bryge to Joan Mylnys.
,, ,, 7. Henry Syre to Ellen Ratlyffe.
,, ,, 7. Thomas Graytwyge to Yesabell Wryhgt.
1561. Jan. 5. Thomas Warde to Agnes Porter.
,, ,, 7. John Grenleffe to Agnes Enworth.
,, ,, 9. John Jacsune to Margery Clarke.
,, ,, 12. Wylliam Wettun to Elezabeth Nycolsune.
,, ,, 15. Henry Heton to Yesabell Seckyntun.
,, ,, 18. John Boytl to Margery Mecoke.
,, Apl. 13. John Thurpe to Joan Dobbys.
,, ,, 20. Thomas Baxter to Alice Balyntun.
,, Jun. 23. Wylliam Mecocke to Elesabeth Wynny.
,, July 17. Wylliam Appulbe to Margery Browne.
,, ,, 14. John Morlee to Joan Browne.
,, Aug. 9. Nycholas Wylkynsone to Margery Mathowe.
,, ,, 25. Robert Gammo to Agnes Wylkynsune.
,, Sep. 16. John Bladun to Issabell Uwas. (?)
,, ,, 21. Thomas Percar to Ellen Spere.
,, ,, 22. Wylliam Porter to Margery Heth.
,, ,, 27. Wylliam Sparke to Margaret Horobyn.
,, Oct. 4. Wylliam Baddele to Alice Dicar.
,, ,, 7. George Starkye to Agnes Horne.

1561. Oct. 12. Richard Lowe to Agnes Bradshaw.
,, ,, 13. John Plommer to Alice Chaplen.
,, ,, 26. Stephen Hensune to Elenore Aster.
,, ,, 26. Wylliam Bysshop to Agnes Carter.
,, Nov. 2. Wylliam Clarke to Margaret Pawmer.
,, ,, 6. Robert Spenser to Joan Jamys.
,, ,, 17. John Egilsfelt to Elesabeth Wylkynsune.
,, ,, 17. Wylliam Tayt to Margery Pyrlby.
,, ,, 17. Wylliam Sucar to
,, ,, 20. John Howys to Joan Tunsune.
,, ,, 25. Thomas Byrdet to Joan Watsune
,, Dec. 1. Richard Smyth to Maud Walcar.
,, ,, 1. John Wrygth to Agnes Astyll.
,, ,, 7. Humphrey Lowton to Agnes Hunter.
1562* Jan. 20. William Wryghth to Margarit Stretton.
*In margin, and by later hand.
,, ,, 20. John Bull to Joan Heward.
,, ,, 21. Richard Smyth to Agnes Sharpe.
,, Apl. 4. Robert Carter to Margery Sansune.
,, ,, 29. Hugh Budworth to Modwen Greg.
,, May 2. Robert Smyth to Margery Smyth.
,, ,, 4. Wylliam Eton to Ellen Clarke.
,, ,, 31. Robert Atkyns to Catherine Barton.
,, July 4. Michael Mery to Catherine Bird.
,, Sep. 29. Richard Hely to Agnes Smyth.
,, Oct. 5. Ralph Rychardson to Alice Mylward.
,, ,, 25. Richard to Joan Bacar.
,, Nov. 8. Thomas Henworth to Joan Browne.
,, ,, 9. John Gydbyns to Elizabeth Goddard
,, ,, 14. Thomas Fytchyt to Elesabeth Coke.
,, ,, 22. Robert Watsune to Agnes Ylsley.
,, ,, 12. Nicholas Bacar to Elesabeth Hyll.
*1564 Jan. 17. Thomas Selvester to Emmot Cowper.
*In margin, and by later hand.
,, ,, 17. Thomas Baxtar to Emmot Orgyll.
,, ,, 18. Thomas Budworth to Margaret Smyt.
,, ,, 28. Richard Hurlebut to Margaret Bely.
,, Feb. 4. John Moysley to Agnes Balynton.
,, ,, 13. Richard Watsune to Margaret Furley.
,, ,, 15. Henry Mylner to Joan Browne.
,, ,, 8. John Ball to Joan Medley.
,, ,, 22. Roger Wakfelt to Joan Budworth.
,, June 7. Thomas Hygge to Agnes Wakefelt.
,, ,, 11. Thomas Bartram to Alice Harrysune.
,, June 13. Henry Burrusse to Margery Cartwright.
,, Aug. 18. Robert Budworth to Agnes Coke.
,, Sep. 11. Robert Hamsune to Elizabeth Okeley
,, ,, 27. Wylliam Lowe to Ellen Plommer.

1564. Oct. 3. John Watsune to Bennet Becke.
,, ,, 20. William Cryspe to Margaret Browne.
,, Nov. 19. Henry Clarke to Alice Hensune.
,, ,, 27. George Salt to Alice
*1565 Jan. 15 Richard Addams to Agnes Smyth.

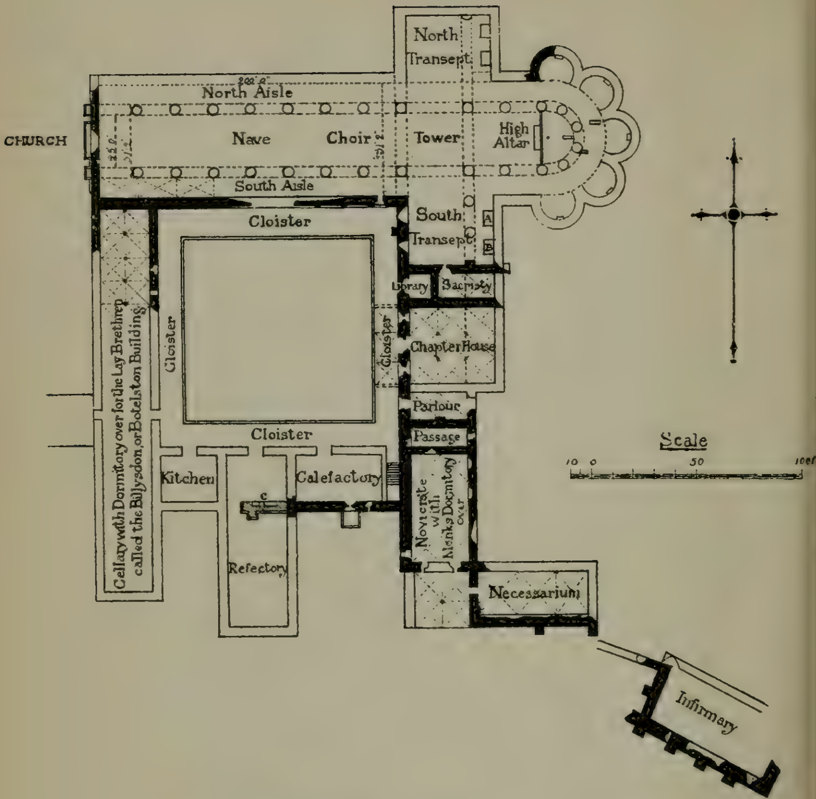
*In margin, and by later hand.

,, ,, 23. Jarrat Teyt to Margaret Hand.
,, Feb. 3. Thomas Gylbert to Elezabeth Bladun.
,, Apl. 22. Rafe Seuell to Margery Smyt.
,, ,, 23. John Blout to Agnes Mussegreffe.
,, May 28. John Bladun to Alice Pegg.
,, June 4. Henry Smyth to Susan Malaber.
,, Aug. 4. John Jacsune to Joan Fleccher.
,, ,, 4. Henry Mecocke to Margery Atkyns.
,, Sep. 10. Henry Horseley to Joan Kyndersley.
,, Oct. 28. Robert Jacsune to Margaryt Jacsune.
,, Sep. 5. Richard Bely to Agnes Warde.
,, Nov. 7. Richard Porter to Margritt Hulbut.
,, ,, 25. Thomas Thurlson to Catherine Cocker.
,, ,, 25. Robert Rolleston to Ellen Lee.
,, ,, 26. Thomas Haster to Sarah Percar.
,, ,, 27. Robert Gregg to Agnes Wygnoll (?)
,, Dec. 2. Yedward to Agnes Whetley
*1566 Jan. 21. John Smyth to Ysset Tayyt.

*In margin, and by later hand.

,, Feb. 5. Rychard Fransys to Jeis Gylbert.
,, ,, 5. Rychard Addams to Margarit Bladun.
,, ,, 6. Rychard Watsune to Agnes Hurlbut.
,, ,, 12. Wylliam Vinsune to Alice Sydwen.
,, Mar. 5. Robert Bladune to Joan Warde.
,, June 18. Henry Awcocke to Ellen Hensune.
,, July 2. James Foster to Yssett Storer.
,, ,, 16. John Jacsune to Elesabett Joll. (?)
,, ,, 15. Richard Pennyfather to Elesabeth Bosse
,, ,, 22. James to Alice Enworth.
,, ,, 29. Robert Browne to Joan Enssdale.
,, ,, 30. Thomas Reding to Alice Mery.
,, Sep. 15. Thomas Marsune to Elizabeth Bayward.
,, Oct. 14. John Knygth to Dorithy Maryatt.
,, Nov. 11. John Symsune to Margarit Fycchyt
,, Dec. 13. Richard Wrygth to Mawd Bratt.

[*To be continued.*]



CROXDEN ABBEY

References

A Altar of the Holy Trinity

B Altar of S^T Benedict

C Wall constructed in modern times out of old materials

Note. The black shews the existing ancient walls

Croxden Abbey.

By R. Moxon.

Read before the Society, at an Excursion to Croxden, June 23rd, 1894.

CROXDEN was one of the later Cistercian Abbeys founded in England. The Cistercians or "White" Monks were a fraternity which was an offshoot of the Benedictines. The famous St. Bernard of Clairvaux, though not the founder of the order, was its most influential promoter. The rules of the order were more severe than those of the Benedictines. In many cases, as for instance those of Fountains and Kirkstall, the Cistercian abbeys in England were actually founded by seceders from Benedictine abbeys; but this was not the case with Croxden. Its founder was a pious knight, Bertram de Verdun, Lord of the Manor of Alveton, or Alton, who on the occasion of a visit to the lately founded abbey of Alnet, or Aulnoy, near Bayeux in Normandy, was so impressed with the fervid piety and asceticism of the "white monks" that he importuned the Abbot to send over a foundation to Staffordshire. This was done in the year 1176 when Bertram gave the land of "Chotes" for the purpose. "Chotes" has been identified with "Cawton" or "Cotton," in the more immediate neighbourhood of Alton. All the first monks were foreigners with the exception of one, Thomas, who was elected Abbot.

Nearly all that is known of the history of the Abbey is gained from the Chronicle, which is mainly the work of William de Schepished, one of the monks at the end of the fourteenth century.* According to this Chronicle, it was, during Advent in 1178, "ordained that the monks should praise the name of the Lord in another place." I do not know by what means the said monks were led to this conclusion, but however it was they removed to Croxden. Little or nothing can have been done towards building at that time, for as far as I know, there are no remains in the style of architecture then prevalent. The actual plan of the building was, however, probably then arranged, because the first Abbot, Thomas, who died in 1229, was buried in the Chapter House, and about the same time Nicholas de Verdun, the son of the founder, was buried before the high altar. Under the fifth Abbot, Walter de London, who was elected in 1242, the greater part of the building was erected, and in what still exists of the church we see the work which was dedicated in 1253. The architecture is, without doubt, of the 13th century. During the abbacy of Walter de London there were built the gates, half the church, the chapter house, the refectory, the kitchen, the infirmary with the cloister there, and a wing—probably occupied by the novices, over which was the monks' dormitory. The sites of all these places are still to be distinguished—(*see Ground Plan.*) Probably these buildings were erected mainly at the expense of the De Verdun family, who continued to be the great patrons of the Abbey. In the time of John de Billysdon, who was elected abbot in 1286, the west wing was added. This consisted of a cellarium, or store

*In the "Month," the well known Roman Catholic Magazine, a series of articles on Croxden Abbey, by W. H. Grattan Flood, was published—the first in the number for June, 1894. The writer gives many interesting extracts from the Chronicle or "Annals" above referred to, which he says is in the British Museum among the Cottonian M.S.S., marked *Faustina* B. VI.

room, and an upper story, which was the dormitory of the lay brethren. These became known as the Billysdon buildings; and, in later times, the name appears to have been corrupted to Botelston.

In 1319, the patronage passed, by the marriage of the heiress, from the family of De Verdun to that of Furnivall. In 1329, Richard de Schepisched was elected abbot, and the following year the buildings suffered great damage from a violent storm of wind, which necessitated the re-covering of the refectory and belfry with shingles of oak. In 1334, the dormitories, the treasury, and other parts were also re-covered. This appears to have been done at the expense of Johanna de Furnivall, who, in the same year, was buried before the high altar. In 1335, a new chamber for the Abbot was constructed between the infirmary kitchen and the dormitory. I would remark that it has been customary, both here and at the ruins of other Cistercian Abbeys, to describe the remains of an important detached building, generally, as here, to the South East, as the "abbot's house"; but the fact is that the Cistercian rule required the Abbot to live absolutely in common with the other monks, and even the chamber or set of rooms which was by degrees set apart for the abbot involved some evasion of the rule. The detached building I have just spoken of was, no doubt, in reality the infirmary, and contained a large hall and probably a chapel. In 1367, the affairs of the Abbey had fallen into great confusion, probably the result of the terrible pestilence known as the Black Death, which was so fatal throughout the whole population, and especially amongst the clergy and the inmates of monasteries, a few years before. Accordingly in this year there was a visitation from the parent Abbey of Aulnoy, this being the only occasion recorded of any interference on the part of the parent Abbey.

In 1369, the "House called Botelston," presumably the West wing, fell from the church, except three couples, and in the following year it was re-built in timber. The annals for the succeeding five years mention various other disasters from storm and pestilence, and some of the entries seem to show that the Abbey, like many others at the same period, was, to use a modern expression, in rather low water.

The Chronicle of William de Schepished ends in 1374, the venerable annalist having died in Advent of that year, at the age, it is said, of one hundred and three. According to "the Month" of September, 1894, his concluding words are as follows:

"To be, to have been, to be about to be, are three vain periods of existence. For everything perishes which has been, which is, and which shall be. That which has been, which is, and which shall be, perishes in the space of a short hour. Therefore of little profit is it to be, to have been, and to be about to be."

The poor old monk seems to have become pessimistic in his old age. For my part I feel sure, speaking of such institutions as the Abbeys of which Croxden was a sample, that work was done there which was of great profit to mankind at the time, and to subsequent ages even down to our own.

From the date of the death of William de Schepisched, the details regarding the Abbey are comparatively meagre. The last Abbot was Thomas Chawner. The name of Chawner is, to this day, that of several families in the neighbourhood. The house was not suppressed with the other smaller abbeys in 1536 and 1537, and it is stated that this was the result of good report, and also of interest through the patrons with the Earl of Essex and the King. It was, however, surrendered to the King in 1539, and the property was in 1545 granted to Jeffrey Foljambe, and it is now owned by the Earl of Macclesfield.

The general plan follows the usual Cistercian arrangement. The chief architectural peculiarity is the extreme simplicity of the windows and detail. In the elaborations there is much of foreign aspect, doubtless the result of the influence of the parent house. Unfortunately a public road has at some time been made right across the middle of the church, and for this the remains of the North aisle and North transept, and the South side of the choir have been entirely sacrificed. The old mill is still in use, though, of course, much altered since mediæval times. The old Gate House Chapel, which was converted into a parish church after the dissolution, was pulled down about ten years ago, and a new church of good design was built close by.

The following are a few of the points to be especially observed in the existing ruins. In the West front of the church the descent of the side lights is somewhat unusual. The height of these windows is no less than thirty-five feet. The greensward is about the ancient floor level in the nave. In the wall of the South aisle of the nave the vaulting shafts and ribs show that the aisles had groined vaults. The South end and West sides of the South transept are almost entire. The lancet windows at the end of this transept were half blocked by the roof of the dormitory, as may be seen from the marks on the outside wall. On the East side of this transept were two chapels, with clustered pillars and vaulted. Each contained an altar—that to the North dedicated to the Holy Trinity, and that to the South to S. Benedict. The whole length of the church was 240 feet and the width 57 feet. The East end terminated in five small apses, but only the remains of half of one of them still exist. This is eastward of the public road that I have spoken of. This arrangement of the East end, though frequent in France, was unusual in England, the only other example being at Beaulieu, in Hampshire. In the central one of these five apses, no doubt, stood the Altar of the Blessed Virgin.

Three stone coffins, without lids, are to be seen sunk in the greensward before the site of the high altar. These are probably those of Nicholas de Verdun, the son of the founder, John de Verdun, who died in 1274, and Johanna de Furnivall, who died in 1334,

High up in the wall, at the end of the South transept, may be seen the door which led to the flight of stairs to the monks' dormitory. A round-headed door opens from this transept to the sacristy, and the adjoining chamber to the West of this was the library. South of these two chambers was the chapter house, which was groined and vaulted, with four detached supporting pillars near the centre. Beyond this to the South was the parlour, and beyond that a vaulted passage with an entrance door at the East end, and another door opening southwards into a large chamber, which was probably the novitiate. Above this was the monks' dormitory. The cloister court was to the South of the nave of the church. Some beautiful arches still remain on the East side, through which the chapter house is entered. South of the cloisters were the calefactory or monks' common room and the kitchen, and beyond these the refectory, but the extent of this is quite conjectural.

Although these ruins cannot either for beauty or extent be compared with those at Fountains, Furness, Tintern, or Rievaulx, they are of considerable interest and well repay the trouble of a visit.

The Struggle for Life in the Individual and Community.

By Philip B. Mason, M.R.C.S., F.L.S., F.Z.S., &c.

(Presidential Address delivered November 30th, 1894.)

AT the foundation of all modern ideas as to organized beings, not only in their structural peculiarities and mutual interdependence, but also in their faculties and social relations, since mind is inseparable in this world from the existence of the body, lies the work of Charles Darwin. Either consciously or unconsciously; for his theories have so permeated not only all minds, but also the phrases of scientific and philosophical expression, that all writings on these subjects necessarily show the impress of his genius, even when the object of the argument is actually to oppose his deductions.

His first publication on these subjects was made in the year 1859, and was contained in a modest octavo volume of less than 600 pages. Its Title page was as follows: "On the Origin of Species by means of Natural Selection; or, the Preservation of Favoured Races in the Struggle for Life."

I propose in this paper to shortly consider some of the results on individuals of the same species of the Struggle for Life, but before doing so, I must define what I mean by this phrase, show how the necessity for the struggle arises at all, and finally explain how the favoured races are preserved by means of Natural Selection.

In the first place, Nature ordains a definite term of existence for everything that hath life. The machinery, so to speak, gets worn out and requires renewal, and the in-organic materials of which the organism is built up, have to be set free to enter into new combinations.

Every individual accomplishing its full term, passes through four stages, viz.—birth, growth, old age, and death. But under ordinary circumstances it does not all die, but has, while in its highest stage of development, given off parts of its own substance to produce offspring. This reduced to its simplest form is seen in the lowest plants, where, under the microscope, the individual may actually be seen dividing bodily into two equal halves; these absorb nourishment, and repeat the process an indefinite number of times. In some animals, as the Butterfly, as soon as provision is made for offspring by the deposit of eggs, the parent's work is done, and it soon perishes itself. In this sense, by means of reproduction, and the destruction of used up material by death, the body of the species is immortal.

The scheme of Nature is a cruel one. On the one hand, every species being the natural food for one or many others, each individual has a double set of duties to perform—the one being to secure sufficient prey for itself, and the other to preserve its body from its enemies which continually seek its life for their own sustenance. On the other hand this cruelty has its beneficient side, and the net result is advantageous to the race, if destructive to the individual.

The struggle for life is therefore primarily a struggle for food on the one hand, and for escape from destruction on the other, because practically, except from accidental causes, the sum of life, animal and vegetable, possible at a given spot at a given time is limited, and any increase of one element is compensated by the diminution of others. The inevitable waste thus necessitated is provided for by prodigality of reproduction, and ordinarily the more the dangers to which the germs are exposed in their growth to maturity, the more numerously are they produced. This statement applies to both kingdoms of Nature—the Animal and the Vegetable. For instance, it is calculated that the roe of a single cod fish may contain more than 9,000,000 eggs at the same time; and again, the progeny of a single female Aphis, such as the rose-blight, would, in the course of her life of about six weeks, if all could be preserved and provided with sufficient food, amount to many billions. Again, the number originating from a single Bacterium might in a day exceed 16½ millions.

If from any cause a species multiplies unduly, its natural enemies also begin to increase in number, since abundance of food allows more young to be reared, and so nature begins to readjust itself. Many of you will remember reading of the plague of Voles, which devastated the lowland pastures of Scotland a few years ago. It was soon evident that unusual numbers of their natural enemy, the Short-eared Owl, were to be found there, and these bred far more freely than usual. Now that the number of voles has been reduced, the owls are dying of starvation. The increase of the Canadian rabbit, which takes place periodically to such an alarming extent that it threatens destruction to all the crops, is always accompanied by a great increase in the numbers of the lynx and other carnivorous animals which prey upon it; yet after a time this does not suffice to abate the nuisance, and then they commence to die in myriads, and their carcases are found in all directions, so that it becomes difficult to meet with a single living specimen. This destruction, when the country is overstocked, is probably due to the ravages of a Bacterium, as Dr. Löftler has successfully treated a similar visitation of voles in the plains of Thessaly, by poisoning a number of individuals with the Bacterium of the Typhus of the mouse, their neighbours, having cannibal propensities, ate their dead friends, and so spread the plague among themselves. So far, I have only spoken of cases where the forces of nature have had fair play among themselves, and so kept the balance true; introduce some new factor and everything is deranged—destroy the insectivorous birds, and the crops are at once ravaged by insects. In this country, for quite two hundred years, the law compelled the overseers to pay for the destruction of rooks and similar birds and of their eggs. The farmer grudged the toll taken of his grain, and did not understand that it was but a small price to pay for ridding his fields of the destructive wireworm.

Time will only allow me to quote one instance of the results of the interference of man when he introduces a species into a country without Nature's checks. It is that of the introduction of the rabbit into Australia ; the climate there suits them perfectly, and they are practically exempt from the attacks of foxes, dogs, stoats, weasels, and the like. The results have been that they have in thousands and thousands of square miles, in fertile pasture land, destroyed the sheep. To show the extreme rapidity with which they can multiply I may quote one case. About the year 1867, a Mr. Robinson turned thirteen wild rabbits out on his run, and by 1870, he had spent £7,000 in the vain endeavour to get rid of them. Both Government and private individuals have to face a heavy annual expense in order to keep them under in any way.

It is clearly impossible that all the individual members of a given generation can, under ordinary circumstances, reach maturity. Now what determines the success of any individual germ? Darwin has proved to demonstration that it is no matter of blind chance, but that certain individuals of the generation start with the dice loaded in their favour. Time will not permit me even to glance at the different lines of investigation which, when followed, will lead to the same result; but I think that a very few words will be sufficient to show that in this respect, as in all others, the Universe is under the "Reign of Law."

It is a matter of common experience that no two individuals are born exactly alike in every respect. The resemblance of two Dromios makes a capital foundation for "A Comedy of Errors," but the impression of their dirty thumbs on a piece of white paper would in itself suffice to show their non-identity. Moreover, every individual, from the law of its organization in other words, from heredity, tends to vary in certain definite directions.

No one would expect that the variations of the cat, would tend to produce the horn of a rhinoceros, or the whale to develop legs like those of a horse. In Nature, we find that the variations seen at any given time are small in themselves, but that some of them confer advantage, while others handicap their possessors, in their struggle for life. For instance, a small difference in the length of the leg in a beast of prey will affect its ability to procure food, and a small advantage will greatly increase the probability of the favoured individual reaching maturity and leaving offspring behind it.

There is also another well known law of Nature, which is this, that the offspring are likely to resemble the parents, therefore those individuals, either naturally or artificially selected to continue the race by the possession of any peculiarity, will leave offspring more or less resembling themselves; the same cause will act in the next generation, and so on, until in process of time, the originally small advantage is increased by the accumulation of individually very small variations, until a descendant is produced strikingly superior to its ancestor in its ability either to procure its food, or to avoid its enemies.

This is proved by the facts of what is called "artificial selection." It is in the power of man to influence the characters of his domestic animals, and by selecting the parents to procure breeds varying in any desired direction. I may illustrate this by reference to the case of the domestic pigeon, in which it is well known that races may be developed which will breed almost true among themselves even to the colour and size of any particular feather. The only limitation to this power is, that the selection must necessarily be carried out in one definite direction, so that it would hardly be possible to produce a bird with the powers of flight of a Homing Pigeon combined with the crop of a pouter. For the sum of the vital forces in any individual is strictly limited by the amount of food it can consume and assimilate, and therefore excessive growth or superiority in any part is always accompanied by dwarfing and inferiority in others.

I will now take one instance only to illustrate the methods by which Natural Selection can modify a species, and for this purpose use an animal, now, unfortunately for the picturesqueness of the world, rapidly becoming extinct—I mean the giraffe. The ancestor of the giraffe, must have been an animal browsing on the leaves of shrubs, and with no disproportionately long neck. Some, however, would be born with longer, and others with shorter necks, just as men are born different in the length of their limbs. As they wandered in search of food some would reach places where the leaves of the shrubs were less easily reached. Those born with rather longer necks would then have a slight advantage in procuring food, and would be more likely to thrive and leave offspring, and this process would be repeated in the next generation, and so on, until the giraffe as we see it now was produced. But why should the process ever stop? and why do we not see giraffes with necks long enough to reach the loftiest trees of the forest? Natural Selection also determines this. Individuals continue to be born with longer or shorter necks, but now increased length of neck is a positive disadvantage, because the greater weight of bone and muscle which must be carried would be an impediment to locomotion and the necessary change of feeding ground, while more food is necessary to maintain the nutrition of the greater bulk of tissue.

I only give two examples, those of the pigeon and giraffe, to illustrate my meaning, but the study of any other two species would lead to the same result, viz: that the fittest survive in the struggle for life. It is also a fair inference to draw, that as races and improved strains are produced in the same species, so different species themselves are evolved by the operation of the same laws of Nature. The only thinkable alternative is to believe that each species is the result of a special act of creative power. To take one instance, that the Almighty first designed a beetle to bore galleries in the substance of, and destroy, the tree which He Himself had made, and then created an Ichneumon fly with a sufficiently long ovipositor to lay eggs in the larva feeding in its gallery, the fly itself, with its own body fulfilling the purpose of providing food for other animal life, and so on. Of course, this *may* have been the fact, and it *may* also be a fact that no drop of rain can fall to the ground without a special and individual Divine order. But is it not much more in accordance with all we have been taught, and all which we can observe with our faculties, finite though they may be, that the Phenomena both of the inorganic and living worlds are the result of laws impressed at the beginning, upon matter and life, by the Creator, and that the occasions of supernatural or miraculous interposition have been, and will be, few and far between.

I think that I can now justify the proposition that "Nature red in tooth and claw with ravine," is cruel, and that this cruelty has also its beneficient side. Although suffering and death may be the lot of countless myriads of individuals, literally improved out of existence, the net result is the improvement of the race or type, giving it a better chance to exist as a whole, since it has become more in harmony with the surroundings. But change the surroundings, and the acquired adaptations become, not only useless, but an actual source of weakness, and the more highly specialised the type, the less plastic it has become, and the more certain is it to disappear in the struggle. Where are now the gigantic flying reptiles and other "Dragons of the Prime?" Where the

Tasmanian and Maori aborigine? Either extinct or disappearing like the Dodo and the wingless birds of New Zealand.

Now, man—Homo Sapiens—is the highest member of the Animal Kingdom, and is distinguished from all the so-called brutes by one anatomical peculiarity, viz.—the possession of a great toe. This enables him to sustain the more dignified attitude of the erect position, and to direct his gaze to the sky above instead of to the earth beneath him. No two species are alike in the size and proportions of the various organs, and it is found that the interior of man's body, in addition to the general identity of the plan, any unusual shape of bone, vessel or muscle, recalls the normal arrangement in some other animal. The process of development from the embryo, and the stages through which it passes before birth, also proclaim that man is a true member of the animal kingdom. He can hardly claim the monopoly of articulate speech, since other animals can communicate with each other, although by sounds and means which our ears and our senses cannot perceive or interpret. Again the dividing line between reason and instinct is at best but a shadowy one, while as for passions and affections, we cannot deny their existence among the inferior animals, while we commonly use such expressions as—brave as a lion, surly as a bear, cunning as a fox, and faithful as a dog. External influences such as heat, cold, electricity and the force of gravity, the abundance or scarcity of food, have precisely the same effect on the tissues of man, as on those of brutes, and he is quite as susceptible to the influence of his environment, physical and mental, as they are. All history and all experience prove that in his case, this "struggle for life" is just as real, and that his races are modified, improved, or deteriorated by their surroundings. Owing, however, to his longer life, the action, good or bad, of his neighbours, and to some extent, to his own power of will, the effects are not so evident on the surface and require the effluxion of longer periods of time to prove their reality.

We cannot doubt that in pre-historic times, there was a real struggle for mere existence, and that it must have affected the race. Exposed to the fury of the elements, or, merely sheltered by rude huts or caves, and precariously and irregularly fed, the weaker offspring were destroyed, and only the more robust and finer specimens left to reproduce the species and perpetuate their own qualities. Surprise has often been expressed at the fine and perfect teeth of savages, when compared with our own deficiences in this respect; but I fancy that the reason is easy to understand. Imperfect teeth would prevent sufficient mastication of the uncooked or roughly cooked food to enable their possessor to properly digest and extract the full amount of nutriment from it: and this would put him at a disadvantage at a time when the race was emphatically to the strong, and the weakest were bound to perish. Members of this Society will remember the admiration expressed at the beautiful sets of teeth, still remaining in the skulls of our Saxon ancestors, disinterred at Stapenhill in the exploration made there some years ago.

If we turn to the Scandinavian Mythology and examine their deities, we find that they, like all pagan gods, were anthropomorphous, that is deifications of the qualities held most in esteem by their worshippers; they were believed to be possessors of superhuman strength, devourers of huge beeves and quaffers of unlimited draughts of mead. Their earthly heroes also were admired in proportion to their prowess and appetites. Similar conclusions may be drawn from the study of the savages of the present day. I think that I may assume that under such conditions, the chief causes of death were as follows—Exposure to the elements, insufficiency of food alternating with over-repletion, and violence. We know many tribes at the present time who deliberately destroy all the weakly, and an undue number of female children, and who prevent people from dying of old age by the simple process of knocking them on the head, in order that there may be no useless mouths to fill. As civilization advances food becomes more plentiful, and is procured more easily by craft than by violence. As people live in closer association one with another, the proportions of the causes of mortality alter, since more weakly children reach maturity, for Nature selects, not the possessors of physical strength and great powers of digestion, but those who best resist epidemic and contagious disease. That such a selection is a reality and not a mere hypothesis is proved by numerous facts of which I will cite only two, one complementary to the other. In this country measles is looked upon as a comparatively mild disorder, and it has rather been the fashion for mothers to put children in the way of taking it, in order to get it over and done with. But measles when introduced accidentally into a country such as one of the Islands of the South Pacific, in which it has been before unknown, assumes the proportions of a veritable plague, men, women and children dying indiscriminately and wholesale. The complementary case is, that the European, who goes to the marshy districts of tropical Africa will almost certainly be attacked severely by malarious diseases which are comparatively harmless to the native inhabitants. In both cases, natural selection acting through long periods of time has in these particulars altered the type of the race and produced a relative immunity.

Another stage is reached when the introduction of a high pressure water supply renders possible the density of population now found in our own great cities. By this means a prime necessity of life is furnished to lofty buildings, and a means of removal of refuse provided, refuse which, if it could not be taken away by automatic means, would quickly poison the whole city. But, with the construction of sewers, new diseases such as typhoid fever and diphtheria appeared on the scene, for there is a true evolution of diseases or at least of those due to parasitic action. The germs of zymotic diseases themselves are subject to the same laws of change of type, as every other creature, from the Monad up to Man, and evolve new species among themselves.

Before entering on the last branch of the subject on which I intend to speak to-night, I must say a few words more on a subject already mentioned, viz.: heredity, or the tendency of the offspring to resemble the parent. Were it not for the fact that heredity retains its powers during many generations, races and species would be nothing like so stable as they are. In all species there is a tendency to throw back, that is, to be born with a resemblance to some more or less remote ancestor. There are two races or breeds of pigeons called the fantail, which is purely white, and the spot, which is white with a red tail and a red spot on the forehead. These breed remarkably true among themselves, but cross them, and at once coloured birds, with the two black bars running across the wing, of their common ancestor the wild rock dove, will be produced.

Full consideration of the laws of heredity or the assumption of ancestral characters, is, I believe, of the greatest possible importance in dealing with the problems of human society. In every generation will be born an average percentage of individuals with certain physical and mental defects. For instance, some will be born with the nervous system unstable, either physically, rendering them liable to Epilepsy, Hysteria, and the whole train of Neurotic diseases, or mentally, lacking self-control, and prone to abuses of food and drink, and to crimes of violence and greed. Again, others are born with organizations which fall an easy prey to tubercle, when subjected to any unfavourable surroundings.

Now preventive medicine, orderly government, and the laws of Christian kindness have by their joint efforts succeeded in prolonging the average duration of human life, (in this country by something like two years). When the nature of this increase is examined it is found to be due to the survival of a larger percentage to maturity, and those preserved by these means are the feebler stocks, who would otherwise have been eliminated by the free and uncontrolled action of the forces of Nature. To illustrate this I must again confine myself to one instance. Dr. Berry Haycroft in his Milroy Lectures delivered this year, makes a careful analysis of the statistics of the prison population of those American States in which all traffic in intoxicating drink is forbidden by law, and where a genuine attempt has been made to carry out its provisions. In the state of Maine, this experiment has been going on for about forty years. He finds that the percentage of the inhabitants of prisons and reform schools to the general population has markedly increased; and, a crucial point, that this is especially seen in the young. The number per million has risen from 176 in 1880 to 256 in 1890. The statistics of insanity and pauperism give a similar result. If we think, we shall see that this is only what might have been expected from the law of Natural Selection. Although no one can doubt the evil effects of the abuse of strong drink on the bodies and conduct of men, yet, when the selective action of Alcohol in removing the less stable mental and moral organizations, before they can leave descendants behind them to resemble their parents, is taken away, it is not an unmixed good to the community at large. What effect can any legislation have on the future of the race? It may have the greatest effect; but it is a two-edged sword, and while it may be potent for good, it can be no less potent for evil; for unless legislation be in harmony with the laws of nature it will fail lamentably, and leave ruin in its wake.

It is easy enough to see the evils of insufficient government, but it is not so evident, at first sight, that laws designed to promote the greatest happiness of the greatest number, may have equally, or, even more disastrous effects. It is only by studying the records of the past that we may learn in what consists true obedience to the laws of Nature. To illustrate this, I will in a few words, cite the history of two remarkable

States where the results of legislation although brilliant for a time ensured destruction in the end. I take them because in many ways the aim was in diametrically opposite directions. The first is the ancient State of Sparta, when under the iron rule of the laws of Lycurgus. Here artificial selection was designedly applied, and in one definite direction, viz: to produce a race of valiant and invincible men. Men and women were treated as of no account; individually they were nothing, the State everything. The infant when first born was dragged from its mother and exposed to the public gaze, and if deformed or weakly, it was at once thrown out on the mountain to perish. Children were taken charge of by the State at the age of 6 years, and the male child trained to undergo cold, hunger, fatigue and pain without a murmur, and, he was not admitted to the privileges of manhood before he had been publicly scourged until the altar of Artemis was bespattered with his blood, this torture being endured without a cry escaping from his lips. At thirty he was allowed and compelled to marry, but not allowed to occupy the same dwelling, or even eat with his family, until the age of 60, for fear that he might in this way, acquire habits of luxury and effeminacy. The female child was trained, not to fit her for household duties, but to produce physical perfection, and was married at 20 in the full vigour of womanhood, in order that she might be the likely mother of strong men. Her education was also directed to discourage in her the ordinary affections of humanity, so that her sons might be warriors and warriors alone.

These laws were successful for a time, and this small community, living in the midst of hostile tribes, gained an unquestioned predominance in Greece; but they were not in harmony with the laws of Nature, they ignored the passions of avarice and ambition, and the experiment ended in complete and final ruin.

My other instance is the wonderful civilization evolved by the Peruvian Indians under the reign of the Incas, almost the only, if not the only, instance known to history, of a pure Theocracy, for rulers and subjects alike believed implicitly in the divine origin of the Inca, that he was veritably the child of their god the Sun, the purity of the Divine race being kept up by the compulsory marriage of the Inca with his sister. His will was, without question, law, and, if the forces of Nature could have been disregarded with ultimate sucess, nothing could have been wiser than his government.

Each man's dwelling, occupation and marriage were ordained by the State, and there was such a perfect law of registration in force, that no one could escape its purview. The occupation of the land was re-arranged yearly, so that each family had not only sufficient for a comfortable livelihood, but also enough to enable them to pay their contribution to the state. Wool for clothing was also issued in exact accordance with numbers. Idleness was forbidden under severe penalties, while the hours of work were regulated, so that they were burdensome to no one, and time was given for rest and recreation. Misfortune and sickness were provided for at the expense of the State, and, to the receipt of this relief, no stigma of disgrace was attached. Great public works, good roads and bridges, were executed, and every square inch of ground which could be cultivated, was irrigated by means of immense aquaducts, partly subterranean, and some four or five hundred miles in length. All this was done by a people who had no wheeled vehicles, whose only beast of burden was the Llama—an American sheep, which at the most can carry a load of but one hundred pounds—and who were ignorant of the use of iron.

The laws were enforced by the frequent visits of government inspectors, who even entered the houses to see that each woman spun her due share of wool; crime scarcely existed, for every tenth man was a magistrate, and made responsible for nine of his fellows, and any magistrate failing to bring a criminal to justice, himself suffered the penalty due for the crime.

Theft, murder, and even infractions of the laws of morality, were all punished by death. Five days only were allowed for the decision of any Court of Justice, and from its judgment there was no appeal. The whole life of the Nation was carried on without money, or any equivalent to it. The precious metals and gems were the absolute property of the Inca, and even by him were used, not for purposes of exchange or purchase, but only for the adornment of his person, and that of his Palaces, and of the Temples of the Sun.

Wonderful to relate this policy continued unbroken through the reigns of thirteen princes, each of whom trod in the footsteps of his fathers.

In the words of Prescott "*No man could be rich, no man could be poor in Peru, but all might enjoy, and did enjoy a competence. Ambition, avarice, the love of change, the morbid spirit of discontent, those passions which most agitate the minds of men, found no place in the bosom of the Peruvian.*"

What was the end of this Utopia? This great and civilized Nation which had taken centuries to build up and could put 200,000 soldiers in the field? It was absolutely destroyed by less than 200 freebooters, under Pizarro, the scum of the Spanish Chivalry, and only greedy for gold. It crumbled to pieces in the short space of time occupied by the twilight of a tropical November evening. The Spaniards were separated from the sea by a long and toilsome march, and by the difficult and snowy passes of the giant mountains of the Andes; yet, when by a treacherous trick they had seized the person of the Inca, in the face of an army of 30,000 to 40,000 men, the whole structure collapsed at once and for ever. The brain of the body politic having been destroyed, all its members were stricken with instant and absolute paralysis.

Excessive legislation had reduced them to the condition of well oiled automata, they were obedient and content, it is true, but had nothing to defend. They lived a merely vegetative life, having scarcely any more individuality than the various polyps of a colony. Under such conditions true patroitism or an active desire to maintain the State could not exist.

We know that there have been many powerful nations, and brilliant eras of civilization, anterior to our own, but they have sunk beneath the waters, leaving scarcely a bubble on the surface of the stream of time. Each nation, doubtless, thought its own power would endure as long as the world. What would have been the feelings of a priest of Osiris, as he paced the stupendous Temples erected on the banks of the Nile for the worship of his Gods, if some Cassandra had predicted that the time would come when his temples would lie in ruins, and when the once proud name of Egyptian would signify either a houseless wanderer, or a helpless and hopeless slave with his back ever bared to the lash? Without doubt he would have laughed her to scorn, as would Cæsar, had he been told that his world-wide empire would expire, and become an easy prey to Barbarian hordes from the North and East.

The great empires of Babylon, Egypt, Greece, Rome, Venice, and many others have all in turn reached a pinnacle of prosperity and then fallen to corresponding depths.

Is *our* race and is *our* civilization destined to disappear and shall its relics come to be a study for the archæologists of the future?

From history I can draw no other conclusion than this, that, while a nation is militant, and either fighting for its existence or for its aggrandisement, the forces of Nature act in favour of the race and community as a whole, while careless of the individual life. When security is attained and growth ceases, the conditions are reversed, and become favourable to the individual but unfavourable to the race; and then the process of decay begins, a continually increasing percentage of feeble individuals reaching maturity and reproducing their kind, and so the process goes on with ever increasing acceleration producing feebleness and degeneracy.

Can religion or patriotism ever acquire such power over the minds and bodies of the feeble and diseased, as to induce them, for the good of their race, to live long lives of self-abnegation and self-restraint, leaving no offspring behind them, to die at length "unwept, unhonoured and unsung?" A different and far harder task than for a Marcus Curtius to leap once for all into the abyss and thus assure the salvation of Rome.

Can legislation ever be so wise as to deal rightly with the vicious and the criminal? We know that our ancestors in mediæval times roughly solved the problem, though in a way repugnant to us now. The higher intellects, who could not find satisfaction in battle and tourney, feasting and minstrelsy—nobler in themselves although they were, but less suited to the genius of their time—voluntarily, and the feebler scions compulsorily, entered the church and monastic institutions, and perforce, lived celibate lives, so that they left no lasting impress on the race. Crime had but a short shrift, and until the time of George IV theft to the value of twelve pence was punished by death. Although cruel were the laws, they had at least the merit of preventing the breeding of a race of hereditary criminals.

Can I, whose office it is to fan the smouldering spark, and shield the flickering flame, of life, praise methods like these?

Non tali auxilio nec defensoribus istis.

Rather let the nation, like the individual, perish at the appointed time from the decrepitude of old age, than prolong its existence by recourse to such help and to defenders like these.

I know not the answer to these questions; but I do know that, if we ourselves are to progress upward and onward, and be more than the mere "heralds of a higher race," it can only be by the patient study of Nature, and of Nature's laws. We are endowed with reason, and it is both lawful and right to use all our faculties to learn in what consists true obedience to these laws. Since Nature is one, every living race is necessary to, and inextricably intertwined with every other, and no examination of any force or form of life can be too prolonged or too minute, for a perfect knowledge of every part is necessary to a proper comprehension of the whole; without this, we can only see, as in a glass, darkly, and must shuffle about with uncertain footsteps.

I will conclude by reading the words of one of the most commanding and most comprehensive intellects our race has yet produced—the man described by Pope in his famous antithesis as "The greatest, wisest, meanest of mankind"—I mean Lord Chancellor Bacon, himself an illustration of the law that great excellence in one respect is counterbalanced by corresponding inferiority in others, who, in his Essay on "The Advancement of Learning," wrote thus: "*Let no man, out of a weak conceit of sobriety, or, an ill applied moderation, think or maintain that a man can search too far, or be too well studied in the book of God's words or in the book of God's works, Divinity or Philosophy; but rather, let men endeavour an endless progress or proficience in both.*"

The Larva of the Eel.

By T. Gibbs.

Extracted from a Paper on "The Life History of the Eel," read before the Society, March 22nd, 1895.

ALTHOUGH even now the history of the reproduction and early life of the Eel has not been completely worked out, a great step forward has lately been made by two Italian Naturalists, Professor Grassi and Dr. Calandruccio, by their indentification of a member of the curious group of larval fishes known as Leptocephali as the larva of the Common Eel *(Anguilla vulgaris.)*

For the information contained in the following brief account of recent discoveries on this subject, I am indebted to two valuable papers by Mr. J. T. Cunningham, M.A., contained in the Journal of the Marine Biological Association, viz : "On the Reproduction and Development of the Conger" (vol. II., p. 16) and "The Larva of the Eel" (vol. III., p. 278) and to these papers members wishing to pursue the subject further are referred.

The Leptocephali are small, narrow, compressed fishes, devoid of scales, and having a very imperfect cartilaginous skeleton; they seem to be confined to salt water, being found both floating in the open sea, and on the sea bottom near the shore; their movements are slow and languid; they do not usually exceed 5 inches in length, though some attain a length of 10 or 12 inches.

Only one species of the group has as yet been found in British seas, although it is practically certain that at least one other species will eventually be discovered.

This sole known British species, which was also the first known species of the group, was discovered by a Mr. Morris near Holyhead in the year 1763, and was described by Pennant in his "British Zoology" published in 1769. In the 1788 edition of the "Systema Naturæ" of Linnæus this fish was included under the name of *Leptocephalus Morrisii*. In 1818 Colonel Montagu, having obtained some fresh specimens, described it under this name in the Memoirs of the Wernerian Natural History Society.

Down to the year 1861 no doubt seems to have been ra sed as to the right of *Leptocephalus Morrisii* and its allies to rank as a distinct group of fishes, but in that year a distinguished German Naturalist, Professor J. V. Carus, suggested that they were merely larvæ or young immature forms of some other fishes, and three years later a Mr. Gill, an American Naturalist, came to the same conclusion, and further expressed his opinion that *L. Morrisii* was the young of the Conger *(Conger vulgaris.)*

Dr. Günther in his "British Museum Catalogue of Fishes" published in 1870, supported Gill's view both on anatomical grounds and from the point of view of geographical distribution; he, however, differed from the American Naturalist in one important respect—Gill considered the *Leptocephalus* to be an ordinary larva which would in due course develop into a Conger; Dr. Günther on the other hand believed it to be an abnormal larva, which, owing to some unfavourable conditions, had had its structural development arrested at an early period while still continuing to grow, and which was destined to die without ever attaining the characters of the mature aňimal.

One point urged by Dr. Günther in favour of his view was that he had seen specimens of the Conger not more than 4½ inches long, while specimens of *Leptocephalus Morrisii* frequently exceed 6 inches in length.

Both Gill's and Günther's identifications were based entirely on anatomical and other resemblances which could not settle the difference between their views; but in 1886 a French Zoologist, M. Yves Delage, proved the American Naturalist's view to be the true one by observing the actual metamorphosis of *L. Morrisii* into the Conger.

M. Delage's isolated observation has since been completely confirmed by Professor Grassi and Dr. Calandruccio; these two Naturalists, who have pursued their researches in the neighbourhood of Catania in Sicily, having followed the metamorphosis through all its stages in more than 150 cases. The most remarkable feature in the process is that the fish, instead of growing, diminishes considerably in size, larvæ of 5 inches in length changing into young Congers of 3 inches only—thus showing the true explanation of the fact relied on by Dr. Günther in support of his theory. The fish also loses its transparency owing to the development of colour pigments in the skin, and from its first flat ribbon-like form becomes cylindrical.

The species which these naturalists have proved to be the larva of the Common Eel is one which has been hitherto known as *Leptocephalus brevirostris*. They have not yet been able to follow through the entire metamorphosis of one individual, but by observations and comparisons on different individuals, at different stages, they have traced a gradual transition from the structure and characters of the salt water *L. brevirostris*, to those of the Common Fresh-water Eel.

L. brevirostris is a small species scarcely exceeding 3 inches in length and less than half-an-inch in height, an individual of this size developing into a young Eel 2 inches long.

It is a curious fact that, although the Eel is so common and widely distributed a fish, the Leptocephalus which has thus been proved to be its immature form has not up to the present been found elsewhere than in the Straits of Messina; most probably the species has escaped observation in consequence of its habit of hiding under stones and weeds at the bottom of the sea. Now that attention has been turned to it we may expect to hear of some of our sea-side naturalists discovering it on British shores.

The Burton-on-Trent Natural History Society.

By Philip B. Mason, M.R.C.S., F.L.S., F.Z.S., &c.

Read before the Society, March 22nd, 1895.

A COPY of the Inaugural Address delivered by Sir Oswald Mosley, President of the Burton-on-Trent Natural History Society, at the Opening of their Museum, on Tuesday, the 6th September, 1842, has recently fallen into my hands.*

I thought it might not be without interest to our Members if I put on record some account of this Society, founded now more than 50 years ago, especially as neither Wesley nor Molyneux, in their respective Histories of Burton-on-Trent, give anything like a full account of it. It is more desirable to do this at the present time, as the house in which the Museum was placed, and which has, since its removal, being used as an Armoury by the Volunteers, will probably soon be demolished to allow the extension of the offices of Messrs. Bass & Co.; and, in addition to this, all the records of the Society were probably destroyed in the disastrous fire which took place at Rolleston Hall in the year 1871.

I am enabled to give a fuller account than I otherwise could have done by the kindness of the present Sir Oswald Mosley, and of Mr. Robert Thornewill, to whom my thanks are due for their answers to my enquiries.

*A Copy of this Address, presented by Mr. J. C. Perfect, is in the Society's Library.

I proceed to read some extracts from the Inaugural Address, in which Sir Oswald Mosley says: "I will now explain to you somewhat more fully than the Circular we have issued, may have done, the origin and purpose of the Society formed in this town for the promotion of those objects to which I have invited your attention; and here I should not be doing justice to the memory of a lady (the late Mrs. Abney, of Stapenhill), who, during a longer life than falls to the lot of most mortals, devoted her superior talents to the study of Natural History, and even at her advanced age painted many of the specimens she procured with wonderful accuracy, if I did not attribute to *her* industry the first formation of our present Society. Fortunately for us the latter part of her life was passed in this vicinity, and with that liberality which always accompanies true science, she was ever willing and desirous to exhibit the collection she had made to those who took pleasure in such pursuits. Many happy hours had been thus passed by myself and several of the friends around me. Upon her lamented decease, however, the collection was offered to public sale, and the possibility of the neighbourhood being deprived of it became a source of uneasiness to those who were acquainted with its valuable contents. The plan of contributing in shares for the purchase of the most desirable of her specimens was suggested, and no sooner suggested than adopted by many of the friends of science in Burton and its vicinity. Thus the foundation was laid of our present museum, but upon that foundation such a noble superstructure has been erected by the liberal contributions of gifts and valuable deposits, that we may even, at this our first opening, submit our treasures to the inspection of the public with some degree of confidence and satisfaction. For the present state of our museum I beg to refer you to the Report, which will shortly be read, and in which it is fully detailed, but I would briefly draw your attention to the chief objects we had in view when we decided on its formation, and then leave you to judge how far we have *yet* succeeded in carrying them out, and what probability there is of their further extension. Our principal aim in everything we have done is to encourage a taste for Natural History in persons of all ranks and employments. Now there are two ways of imparting knowledge on this subject—one by books, the other by specimens; we prefer the latter mode of instruction as being the easiest method of conveying ideas, and the best calculated to make a lasting impression on the mind."

"It may be, and, I know, has been said, that our intentions will not meet with sufficient encouragement in a small town such as this, and in a neighbourhood where no prominent features are apparent to excite the enthusiasm of a Naturalist—that the novelty of the plan may give our Society a momentary popularity, but ere long it will sink into oblivion and neglect. I cannot bring my mind to participate in any such disastrous conclusions. I am firmly persuaded on the contrary that, by the Divine Blessing, our labours will be crowned with success, and that when an interest is once created among our friends, they will never withhold their support. At our Annual Meetings we shall always hope to provide for them an intellectual feast, and I am sure they will have too much taste to decline our invitation. Besides, has there been so little attachment shown to science in this town as to warrant such gloomy forebodings? Are there not consigned to our custody valuable deposits of birds, fossils, and minerals which certain scientific inhabitants of Burton have been for years collecting for their own private amusement?—a plain proof surely of the want of a local museum, where their present acquisitions may be securely placed. With such advantages at the commencement of our career, we have little reason to fear any subsequent want of exertion on the part of our members. We invite further contributions either in the shape of gifts or deposits; in the latter instance, those friends who will leave their specimens in our hands may feel assured that they will be taken care of, as if they belonged to the Society. Whilst we are anxious, as far as our means will permit, to assist the student in gaining some knowledge of the Natural History of foreign climes, our particular attention will be given to the acquisition of Native specimens, and more especially of those found in our more immediate neighbourhood."

Sir Oswald Mosley then goes on to enumerate some of the contents of the museum, among which he speaks of the Polecat as being sufficiently common—now, fifty years later, almost if not quite extinct in this district. He also speaks of a good series of British birds. Among fresh-water fish he mentions, besides those which abounds in other parts of the kingdom, as being almost peculiar to this district: the Grayling, little known in the South; the Burbolt, which seldom occurs except in the Trent and its tributary streams; that the rare fish, the spined Loach, is not infrequent in the deeper parts of our river; and that the Ten-spined Stickleback is met with in a small brook near the Railway Station!!! He also speaks of mineralogical, geological, botanical, and antiquarian collections.

The museum remained opened to the public for a period of about 16 years, and according to my recollection of it contained very fine collections of British birds and coal measure fossils, besides other and more miscellaneous objects. In 1858 it came to an end under circumstances not very creditable to the public spirit of the town at that time. A fee of sixpence was charged for admission, but, of course, these fees went a very small way towards defraying the expenses of the Institution, the deficit being made up by subscriptions.

I will now read part of a letter received from Mr. Robert Thornewill describing its latter days and final extinction.

Mr. Thornewill writes: "The subscriptions fell off, and it was impossible to continue the museum, and it was proposed to break up the collections. Sir Oswald Mosley and my father bought it from the depositors and maintained it at their joint cost until my father's death in 1858; when his executors sold his share to Sir Oswald Mosley. As you may probably remember, Sir Oswald offered the collection to the town of Burton, conditionally on their finding a suitable room and keeping it up. The offer being declined, the specimens were removed to Rolleston."

In conclusion, I should like to make a few remarks on the subject of local museums, especially as the Burton of fifty years ago was in that respect in advance of the Burton of the present day. At the next census it is, however, to be hoped that Burton will have attained the necessary minimum of 50,000 inhabitants to enable it to assume the dignity of a County Borough. I believe in that case we shall have the spending ourselves of the £10,000 a year which the town now contributes to the County Fund of Staffordshire for Technical Instruction, instead of the beggarly pittance now doled out to us by the County Council. It will then be possible to establish a useful Institution of this kind.

Now museums fulfil two objects. The first is as a means of education, and the second is as a place of deposit where collections of more or less value may be preserved and consulted.

The British Museum serves both purposes. As a place of education, it contains typical collections sufficiently labelled to serve this purpose, and it also contains special collections which are only open to the student, aud to him only on special application and under proper safeguards.

The true purpose of a local museum is two-fold. Firstly, the exhibition of typical collections, more or less complete, according to its means of space, for the purpose of education: and, secondly, as a place for the preservation of local specimens of animals, plants, fossils, minerals, aad antiquities.

When we come to the question of the deposit in such Institutions of valuable general collections, I look upon it as a positive misfortune that they should be placed in them, unless efficient and sufficient curators can be maintained for their preservation. I have repeatedly examined collections in local museums utterly ruined and destroyed by mites, damp, and dust. It is as necessary in this case as in every other, to cut the coat according to the cloth, and nothing is sadder than to see the work of a lifetime wasted in this way, specimens invaluable to science being irretrievably lost.

However, this is a matter for the distant future, but when it does come, our Society will be able to make a very valuable contribution to the local deposits.

The Discovery of the Mummies of the Pharaohs.

By Horace T. Brown, F.R.S.

**Extracted from a Lecture on "Egypt and its Monuments," read before the Society, April 19th, 1895.*

ALONG this narrow gorge ran an old Egyptian road to the eastern valley, which ends in a precipitous *cul-de-sac.* Opening out of the steep rocky sides of the valley are numerous passages sloping gently downwards into the heart of the hills, and widening out here and there into several chambers, and at the end of each passage is the chamber which contained the sarcophagus and its regal mummy.

There are in all about 25 of these rock-cut tombs of royal personages actually known at the present time out of the forty which were known to exist in the time of Strabo, but in none of them were the mummies themselves found.

Up to fourteen years ago it was believed by Egyptologists that the royal bodies had long since disappeared under the hands of many generations of sacreligious spoilers of the dead, but in the year 1881 a most unexpected and remarkable discovery was made which has resulted in bringing to light no less than 36 coffins and mummies of the kings, princes, and princesses of the powerful XVIIIth and XIXth dynasties.

A perfectly accurate account of the circumstances under which the extraordinary find was made has never yet been

*This Lecture was published *in extenso* in the "Journal of the Camera Club," Nos. 111 and 112.

published. Even the official account given by M. Maspero the then director of the museum at Bulak, is not altogether correct.

During the three weeks which we remained at Luxor, my travelling companion and I were thrown a great deal into the company of the Arabs who had been instrumental in making the discovery, and as our interest was much excited by the strangeness of the story, we endeavoured by careful inquiries in all available quarters to arrive at a full and complete history of the affair. To get the plain unvarnished truth about anything in the east is a matter of no little difficulty. The oriental standard of veracity is altogether different from that of western nations, and one has often to approach the subject in a very roundabout way, even in cases where the interests of the man from whom you are trying to get information are in no way involved. An Arab's first endeavour is to find out what sort of information you *want*, and he will then generally supply it to you out of pure politeness. However, in this case by examining as great a number of witnesses as possible and comparing their stories, we did at last arrive at a solid substratum of truth.

I can here only give you a mere sketch of the story, the principal actor in which was a most amiable and benevolent looking old Arab, Abd er Rasoul Ahmed, who stood to me for his portrait in the Ramesseum. He is the eldest of the Abd er Rasoul family of five, and lives in a small mud house on the Theban side of the river, by the tombs of Sheikh Abd el Kurnah, just behind the Ramesseum.

A few hundred yards behind this old Arab's house the scarred and barren limestone hills which separate the Theban plain from the valley of the tombs rise up in steep, rugged, and inaccessible cliffs, which are cut back into a series of natural amphitheatres, or corries, separated from one another by spurs of rock.

In one of these natural recesses, and at some distance up the inclined heap of talus, Ahmed in one of his prowling expeditions after antiquities happened to strike an iron rod, which he always carried with him, into a hollow space in the rocks. His experience at once told him that he had chanced on the opening on one of those pits which are so numerous in certain parts of the country. On further investigation he found the mouth of the shaft, which had been carefully filled in with rubble. Taking two of his brothers into his confidence, these three, with the aid of their wives, commenced under the cover of the darkness, and with the greatest secrecy, to clear out the excavation. After each night's work the mouth of the pit had to be covered in, and all traces of their operations carefully concealed. After many nights of hard and weary toil, during which one of the women succumbed to fatigue, they reached the bottom of the well-like opening which is about 40 feet in depth. Here they discovered a chamber which is about 26 feet square, piled up to its very roof with wooden mummy cases and funerary objects of all kinds. A few of the mummies whre unswathed and taken away on this occasion, and the spoilers also loaded themselves with two or three coffers of funerary figures, scaraboei, and papyri, all objects easy to remove and hide.

For thirteen years did these Arabs carefully guard their secret, and during that time they opened the pit three or four times, of course in the night, and for a few hours only, taking such extreme precautions that not one of their neighbours suspected the importance of their discovery.

Each winter they used to sell to travellers some of their booty, waiting to dispose of the principal stores, until some scientific man, sent on a mission by his government, should come to Thebes, or a traveller rich enough to buy up the contents of the pit *en bloc* and get them passed through the Egyptian customs. Of course these men had no real idea of the enormous value and interest of their discovery, although they obtained very high prices for some of their booty, and it is sad to think of the priceless objects of antiquity which must have been dispersed and irrevocably lost during those 13 years.

Gradually it became known to the Museum Authorities that some very important papyri, and other objects of great historical value were being acquired by travellers, and this at last led to a full enquiry being made. All these objects were traced to the family of Abd er Rasoul. The elder brother Ahmed was arrested and thrown into prison, but neither bribery nor threats would induce him to disclose the source of the treasure, although as much as £3,000 was offered to him if he would divulge the secret. I am quite satisfied from the enquiries I made, that the charges which were brought against the authorities of cruelly beating their prisoner are quite unfounded, notwithstanding Ahmed's statement to the contrary. That he was severely bastinadoed on a subsequent occasion there is no doubt, but this was for another offence which well merited it.

The notables and principal men of Gournah, where Ahmed Abd er Rasoul lived, affirmed on oath that he was the most loyal and disinterested man in the country; that he had never dug for treasure, and never would dream of doing anything of the kind, and that he was incapable of making away with the smallest object of antiquity, least of all violating a royal tomb. With this evidence before the court of enquiry Ahmed was provisionally liberated, and returned home with this warrant of immaculate honesty vouched for by the notables of Gournah.

Once more among his brethren, our friend felt that as he had sustained the burden and heat of the day it was only fair that he should receive in future a larger share of the plunder than his brothers. This did not altogether meet the views of the other members of the worthy trio, and terrible and protracted quarrels ensued, which finally served as another illustration of the proverb that when rogues fall out honest men come by their own. The second brother Mohammed, seeing treason imminent, stole a march on the other two, and posting off to Kench informed the mudîr that he was ready and willing for a consideration (nothing is ever done in Egypt without a consideration) to disclose the secret which had been faithfully guarded for so many years.

A special expedition was at once despatched from Cairo to Thebes, although it was in the middle of summer, and this resulted in the most remarkable find which has ever been made in Egypt.

The pit, now known as the King's Shaft, was found to be a depository of royal mummies of the XVIIIth and XIXth dynasties, which had been removed from the tombs of the kings in the year 966 B.C. at a time when the country was so disturbed that they were unsafe in their original place of burial.

It was at once seen that that these Arabs had really disinterred entire families of Pharaohs, the most illustrious perhaps which have reigned in Egypt. Here were the bodies of the very Pharaohs who had delivered their country from the alien Shepherd Kings. Soqmounrî and Aahmes I.; the conquerors of Syria and Ethiopia. Thothmes III., Ramses I., Seti I., and his son Ramses II., the Sesostris of the Greeks, and our well known Pharaoh of the Israelitish oppression.

So cunningly has the embalmer done his work that in the Ghizeh Museum you may now see the very features and expressions of some of the greatest of the kings who 35 centuries ago erected those temples and monuments of the new Empire, some of which I have shewn you this evening.

Many of these massive buildings, built by these kings I have shewn you which were intended to last for all time, have totally disappeared, those that remain are but shadows of their former magnificence, whilst strange to relate, the frail bodies of their builders have outlived the work of their hands, giving a new application to Byron's line—

"Dust long outlives the storied stone."

THE WEATHER OF 1894.

Like its immediate predecessor, the year 1894 must be classed among the dry years, the rainfall having been deficient by nearly five inches; in other respects, however, 1894 differed considerably from 1893 as, although its mean temperature was slightly above the average, this was wholly due to the unusual warmth of the winter months, the summer being generally cold and sunless.

MEAN SHADE TEMPERATURE.

	Means for 1894.	Averages of 1876—1893.	Difference of 1894 from average.
Jan.	37·5	36·3	+ 1·2
Feb.	40·2	39·1	+ 1·1
Mch.	42·7	39·9	+ 2·8
Apl.	47·8	44·3	+ 3·5
May	46·7	50·2	− 3·5
June	54·8	56·6	− 1·8
July	58·9	59·3	− 0·4
Aug.	56·6	58·8	− 2·2
Sept.	51·4	54·4	− 3·0
Oct.	47·7	46·9	+ 0·8
Nov.	45·7	41·7	+ 4·0
Dec.	41·2	37·0	+ 4·2
Year	47·6	47·0	+ 0·6

From this table it will be seen that, while the summer months—May to September, were all below the average in temperature, the winter months—January to April, and October to December, were above the average. May and November were respectively the coldest and the warmest months of those names in the 19 years over which our record extends.

RAINFALL.

	Totals for 1894.	Averages of 1876-93.	Difference of 1894 from average.
Jan.	1·52	1·88	− 0·36
Feb.	2·19	1·81	+ 0·38
Mch.	0·91	1·65	− 0·74
Apl,	1·32	1·88	− 0·56
May	2·06	2·32	− 0·26
June	2·40	2·34	+ 0·06
July	2·64	2·60	+ 0·04
Aug.	2·07	2·68	− 0·61
Sept.	0·68	2·37	− 1·69
Oct.	2·33	2·70	− 0·37
Nov.	2·04	2·38	− 0·34
Dec.	1·94	2·46	− 0·52
Year	22·10	27·07	4·97

The year 1894 takes rank with 1887, 1890, and 1893, as one of the four dryest years in our record. With the exception of February, June, and July, every month had a total fall below the average. and the aggregate excess in those three months only amounted to ·48 inch.

September was drier than any month of that name in the previous eighteen years. and included a period of 16 consecutive days on which no rain fell. The number of days on which rain fell was slightly above the average, so that although the scanty rainfall caused in many places a serious scarcity of water, the compensating advantage of bright sunshine and pleasant weather, usually associated with a deficient rainfall, was conspicuous by its absence.

The maximum temperature in the sun, 141·8°, was reached on August 22nd, the minimum on the grass, 0·3°, on January 6th: with two exceptions viz.—1·2° on February 19th, 1892, and −0·7° on December 22nd, 1890, this is the lowest temperature which has been recorded during the past 19 years.

The maximum in the shade, 80.5°, was registered on July 6th. and the minimum in the shade, 8.5°, on January 6th. The shade temperature exceeded 70° on 21 days, 80° degrees being reached on 2 days. There were 120 frosty nights during the year. The last frost of the winter 1893—94 occurred on June 1st, and the first frost of the succeeding winter on September 30th.

South-westerly winds have again been most prevalent, having blown on 73 days.

DETAILED REMARKS ON THE MONTHS.

JANUARY.—The year commenced with frost, and slights falls of snow, the lowest temperature of the year being reached on the 6th. From the break up of the frost on the 9th until the end of the month. the weather was uniformly mild. There were 10 frosts in the air and 16 on the grass; slight falls of snow occurred on 6 days; gales blew from the west and south-west on the 19th - 21st, and 27th—28th. Though there were only 6 absolutely fair days the total fall was small.

FEBRUARY was mild and stormy; gales occurred on the 1st, 6th and 7th, 10th to 12th, and 24th to 26th, they were all from the west and south-west, those of 6th—7th and 10th—12th being especially violent and destructive. There were 8 frosts in the air and 16 on the grass.

MARCH was a mild and dry month, but less so than March 1893. The first twelve days were showery, but from the 13th until the end of the month scarcely any rain fell. Gales from the south-west occurred on the 1st, 5th and 6th, and 11th; there were 10 frosts in the air, and 23 on the grass; a fine display of the Aurora Borealis was observed on the 30th.

April.—This month was, with the exception of April 1893, the warmest April during the past 19 years. The shade temperature exceeded 70° on one day; there were 2 frosts in the shade and 12 on the grass.

May broke the series of exceptionally warm months, being the coldest during the past 19 years; the shade temperature never reached 70°, and only exceeded 60° on 5 days; there were 2 frosts in the shade and 9 on the grass, the lowest reading (24.7°) being registered on the 29th. Much damage was done to crops and vegetation by these unusually severe frosts occurring so late in the season.

June.—The first half of the month was wet and cold. nearly the whole of the month's rain falling between the 1st and the 16th. The latter half was more genial, but only on the last 4 days of the month did the temperature exceed 70°.

July commenced with bright warm weather, the highest shade temperature of the year being reached on the 6th; from the 10th until the 24th the weather was unsettled, with heavy rain on the 16th, 20th, 22nd, and 24th; the last week was fine and warm. Slight thunderstorms occurred on three days. The shade temperature exceeded 70o on 13 days and 80° on 2 days.

August.—The rainfall, although below the average, was spread over 23 days, rain falling every day from the 1st to the 13th. The shade temperature exceeded 70° on three days. A gale from the west blew on the night of the 14th—15th

September.—Although below the average in temperature, was the dryest and most pleasant month of the whole summer, The 16 days from the 6th to the 21st (inclusive) were absolutely without rain; there were 5 frosts on the grass but only one in the shade.

October was a mild but dull month; the rainfall was slightly below the average, and nearly all occurred after the 19th. There were only 2 frosts; a gale from the south-west blew on the 25th.

November was a remarkably mild month, being the warmest November during the past 19 years. A gale from the south-west and south-east blew on the 13th accompanied by heavy rain, the total full on the 3 days, 12th, 13th, and 14th, amounting to 1·46 inches. There was only one frost in the shade but four on the grass.

December was another exceptionally warm month. The first week was dry with fairly sharp frosts at night, then the weather turned very mild and continued so until the end of the month. From the 13th to the 26th was a very wet period, rain falling every day. There were 8 frosts in the shade and ten on the grass. The first fall of snow occurred on the 28th. A severe gale from the south-west and west blew on the 22nd, and one from the west and north-west on the 28th and 29th.

BURTON-ON-TRENT METEOROLOGICAL SUMMARY FOR 1894.

MONTH.	PRESSURE OF AIR.			SHADE TEMPERATURE						Temperature in the open.		HYGROMETRIC CONDITIONS.				Wind.		Cloud	RAINFALL.		
				EXTREMES.		MEANS.															
	Mean height of Barometer.	Maximum reading of Barometer.	Minimum reading of Barometer.	Maximum.	Minimum.	Mean of maximum readings.	Mean of Minimum readings.	Mean Daily Range.	Mean Temperature (corrected.)	Maximum in Sun.	Minimum on Grass.	Mean of Dry Bulb Readings.	Mean of Wet Bulb Readings.	Mean Dew Point.	Mean Relative Humidity.	Prevailing Direction.	No. of days on which it blew from that quarter.	Mean Amount (0-10.)	Total Amount. (inches.)	Number of Rainy Days.	Maximum fall in 24 hours.
JANUARY	29·83	30·66	29·33	54·2	8·5	42·73	32·58	10·15	37·45	93·9	0·3	37·25	35·39	32·82	84·4	S.W.	11	7·2	1·52	25	0·35
FEBRUARY	29·98	30·57	29.37	57·6	18·4	47·10	34·06	13·04	40·18	109·9	15·9	39·80	37·72	35·02	83·4	S.W.	12	6·9	2·19	16	0·82
MARCH	29·94	30·53	29·08	64·3	24·6	52·55	34·81	17·74	42·68	114·0	19·1	41·99	40·03	37·57	85·3	S.W.	8	6·5	0·91	13	0·19
APRIL	29·86	30·23	29·36	71·6	30·2	58·39	40·24	18·15	47·82	124·4	25·6	49·57	47·09	45·57	83·2	E.	8	6·9	1·32	15	0·24
MAY	29·95	30·41	29·57	66.5	28·8	56·04	40·75	15·29	46·69	125·9	24·7	50·36	46·63	42·70	75·6	N.E.	10	8.1	2·06	17	0·33
JUNE	30·00	30·42	29·62	79·8	32·3	64·94	48·30	16·64	54·82	131·3	28·1	5[illegible]·70	55·10	51·86	78·1	S.W.	7	7.8	2·40	16	0·64
JULY	29·87	30·23	29·30	80·5	43·3	69·84	51·86	17·98	58·95	135·7	40·6	62·60	59·04	56·00	85·2	W.	14	7·5	2·64	15	0·65
AUGUST...	29·90	30·26	29·43	72·5	42·0	65·33	51·19	11·14	56·56	141·8	36·0	58·80	56·46	54·35	85·0	W.	9	9·0	2·07	23	0·64
SEPTEMBER	30.16	30·50	29·78	69·5	30·0	60·72	44·77	15·05	51·44	126.9	26·5	55·33	50·07	45·08	73·3	N.	12	6·9	0·68	8	0.40
OCTOBER	29·95	30·55	28·98	63·8	25·1	54·85	42·56	12·29	47·70	107·5	20·2	48·58	47·42	46·16	91·9	N.	10	8·1	2·33	19	0.40
NOVEMBER..........	29·93	30·55	29·02	62·1	27·7	51·50	40·74	10·76	45·72	99·2	23·8	46·56	45·50	44.28	95·1	S.	10	7.2	2·04	16	0·83
DECEMBER..........	29·97	30·64	29·20	53·7	25·3	46·03	36·32	9·71	41·17	85·7	24·2	41·22	40·20	38·91	92·1	S.	9	7·8	1·94	19	0·30
Extremes for Year		30·66	28·98	80·5	8·5					141·8	0·3					S.W.	73		22·10	202	0·83
Means for Year	29 94					55·84	41.52	14.32	47·60			49·23	46·72	44·01	82·7			7·5			

NOTES—All the Readings are taken daily at 9 a.m. The Barometer Readings are corrected to sea-level and 32° F.; and to the Mean Temperatures in the Shade, Glaisher's Corrections have been applied. The Thermometers in the Shade are placed in a Stevenson's Screen, 4 feet from the grass, as are the Dry and Wet Bulb Thermometers. The Maximum Temperatures in the Sun are taken with a Black Bulb Thermometer, in vacuo. The mouth of the Rain Gauge is 1 foot above the ground and 153 feet above sea-level. In calculating the Mean Relative Humidity, 100 is taken to represent a saturated atmosphere and 0 a perfectly dry one.

JAMES C. WELLS.
T. GIBBS.

THE WEATHER OF 1895.

The most remarkable Meteorological feature of the year 1895 was the prolonged and severe frost of January and February. Other remarkable features were the drought of May and June, and the unprecedented warmth of the last week in September.

MEAN SHADE TEMPERATURE.

	Means for 1895.	Averages of 1876—1894.	Difference of 1895 from average.
Jan.	31·2	36·3	− 5·1
Feb.	28·0	39·1	− 11·1
Mch.	40·9	40·0	+ 0·9
Apl.	45·9	44·4	+ 1·5
May	52·2	50·0	+ 2·2
June	56·6	56·5	+ 0·1
July	57·9	59·3	− 1·4
Aug.	58·4	58·7	− 0·3
Sept.	58·4	54·3	+ 4·1
Oct.	44·2	46·9	− 2·7
Nov.	45·0	41·9	+ 3·1
Dec.	37·9	37·3	+ 0·6
Year	46·4	47·1	− 0·7

Had it not been for the very exceptional character of the first two months, the year's mean temperature would have been rather above than below the average. The Spring and early Summer months—March to June—were warm and pleasant, and, although there was a cold and wet period in July and August, the latter part of the Summer was delightful, culminating in the week of 23rd to 29th September—the hottest in the whole Summer. After a few rather severe frosts in October, the rest of the year was mild and open.

RAINFALL.

	Totals for 1895.	Averages of 1876-1894.	Difference of 1895 from average.
Jan.	3·11	1·87	+ 1·24
Feb.	0·22	1·83	− 1·61
Mch.	1·66	1·61	+ 0·05
Apl.	1·66	1·85	− 0·19
May	0·66	2·31	− 1·65
June	2·36	2·35	+ 0·01
July	3·67	2·60	+ 1·07
Aug.	2·25	2·65	− 0·40
Sept.	0·48	2·28	− 1·80
Oct.	2·71	2·68	+ 0·03
Nov.	2·57	2·36	+ 0·21
Dec.	2·00	2·43	− 0·43
Year	23·35	26·82	− 3·47

The rainfall, although in excess of that of any of the three preceding years, was still considerably below the average of the period 1876—1894. September was the dryest month of that name in our record, while January was the wettest January within the same period. There was one "Absolute Drought" or period of more than 14 consecutive days without measurable rain, this being from 5th to 19th February (both days inclusive.) There were also two "Partial Droughts," or periods of more than 28 consecutive days with a rainfall not exceeding ·01 in. per day; these were, February 1st to March 5th, with a fall of ·22 in. in 33 days, and May 2nd to June 25th with a fall of ·55 in. in 55 days.

The maximum temperature in the sun, 141°, was reached on June 21st, the maximum in the shade, 81·6°, on September 24th. The minimum in the shade, 4·6°, and on the grass 2·1° both occurred during the night of 8th—9th February.

The shade temperature exceeded 70° on 54 days, 80° being exceeded on six occasions.

There were 121 frosty nights during the year. The last frost of the Winter 1894—95 occurred on June 21st, and the first of the winter 1895—6 on September 21st.

South-westerly and Westerly winds were most prevalent throughout the year, the former having blown on 63, the latter on 59 days.

DETAILED REMARKS ON THE MONTHS.

January.—The wettest January in our record, and the coldest since 1881. The first fortnight was dry and frosty, with shade minima of 8·5° and 9·5° on the 11th and 12th. A fall of snow on the 13th preceded a week's mild wet weather, during which the Trent was in flood. Continuous frosts with slight falls of snow marked the remainder of the month.

February.—The coldest month in our record, with the exception of January 1881. The frost was continuous until the 23rd, when it partially broke up. The coldest period was from the 6th until the 14th, the shade temperature falling below 10° on 7 of the 9 nights; the lowest temperature (2·1° on the grass) was registered on the 9th. The month was almost rainless, and there was practically no snow.

March was cold in the earlier part, ground frosts being registered on 12 of the first 18 nights. The latter part was milder with only two slight frosts. The rainfall mostly occurred in the second and last weeks.

April was mild, especially the latter half. The rainfall mostly occurred between the 17th and the 27th, while the 10 days preceding were rainless. There were 8 frosts on the grass but only 2 in the shade.

MAY.—Except for a heavy fall on the 1st was practically rainless; it was also bright and warm except during the third week. Shade temperature exceeded 70° on eight days, reaching 80·4° on the 30th, after which slight thunderstorms occurred. Ground frosts were registered on 4 days.

JUNE.—Temperature was generally normal and evenly distributed, but in the middle of the month some very low night temperatures occurred, the thermometer on the grass falling below freezing point on 3 occasions. Very little rain fell before the evening of the 26th, when a violent thunderstorm brought a fall of 1·42 in. in about 2½ hours. After this the weather became showery and thundery. Shade temperature exceeded 70° on 11 days and 80° on 2 days (25th and 26th.)

JULY.—The first fortnight was dry, with a warm period from the 5th to the 11th. From the 17th until the 28th there was scarcely a dry day, nearly 3 inches of rain falling. Thunderstorms occurred on 3 days. Shade temperature exceeded 70° on 7 days.

AUGUST.—The first half was wet and cold, only one day of the first 15 being without rain; the latter half was bright and on the whole warm and dry. There were slight thunderstorms on 3 days. Shade temperature exceeded 70° on 11 days.

SEPTEMBER.—A remarkably fine warm month; the 8 days, 23rd to 29th forming one of the most remarkable features of the year's weather. In this period the shade temperature exceeded 80° on 3 days, the reading on the 24th, 81·6°, being the highest in the year. During the month the shade temperature exceeded 70° on 16 days. There were only 2 slight frosts. There were slight thunderstorms on the 3rd and 23rd.

OCTOBER.—A cold and damp month. The rainfall mostly occurred during the first ten days, On the 1st the shade temperature reached 72°, but afterwards only twice exceeded 60°. There were 10 frosts in the shade and 13 on the grass. Snow fell on the 24th, 26th, and 29th.

NOVEMBER was mild and damp. There was a very wet period 4th to 22nd, in which there were only two days without rain. No snow fell. There were 3 frosts in the shade and 5 on the grass.

DECEMBER.—The first half was mild and rainy; from the 17th to the 27th was sharp and dry, with slight snow at Christmas; on the 28th mild rainy weather again set in. There were 15 frosts in the shade and 22 in the grass. Snow fell on 8 days. Gales from the S.W. and N.W. occurred on the 5th, 6th, 12th, and 13th; from the East on the 24th.

BURTON-ON-TRENT METEOROLOGICAL SUMMARY FOR 1895.

MONTH.	PRESSURE OF AIR.			SHADE TEMPERATURE						Temperature in the open.		HYGROMETRIC CONDITIONS.				Wind.		Cloud	RAINFALL.		
				EXTREMES.		MEANS.															
	Mean height of Barometer.	Maximum reading of Barometer.	Minimum reading of Barometer.	Maximum.	Minimum.	Mean of maximum readings.	Mean of Minimum readings.	Mean Daily Range.	Mean Temperature (corrected.)	Maximum in Sun.	Minimum on Grass.	Mean of Dry Bulb Readings.	Mean of Wet Bulb Readings.	Mean Dew Point.	Mean Relative Humidity.	Prevailing Direction.	No. of days on which it blew from that quarter.	Mean Amount (0-10.)	Total Amount. (inches.)	Number of Rainy Days.	Maximum fall in 24 hours.
JANUARY	29·70	30·55	28·94	44·0	8·5	36·46	26·36	10·10	31·21	84·6	—	32·04	30·81	27·97	83·8	N	6	7·4	3·11	21	0·86
FEBRUARY	30·12	30·54	29·75	44·4	4·6	35·29	21·53	13·76	28·01	99·4	2·1	27·53	26·25	20·56	75·5	N.E.	9	6·1	[illegible]	6	0·13
MARCH	29·68	30·34	28·68	61·7	25·3	48·94	34·83	14·11	40·88	112·8	22·1	41·74	39.91	37·64	86·8	W.	7	8·2	1.66	16	0·23
APRIL	29·90	30·39	29·30	63·0	27·7	55·58	39·21	16·37	45·90	125·6	24·8	47·75	45·52	43·07	85·1	S.W.	7	7·7	1.66	11	0·56
MAY	30·11	30·60	29·74	80·4	33·2	64·19	43·57	20·62	52.18	135·0	26·8	55·80	51·41	47·28	73·5	N.E.	10	5.2	0·66	6	0·48
JUNE	30·08	30·45	29·66	81·5	34·3	69·09	47·66	21·43	56·57	141·0	26·3	61.50	55·70	50·70	68·0	W.	8	6.0	2·36	9	1·42
JULY	29·84	30·27	29·45	77·6	42·2	67·73	51·95	15·78	57·94	135·0	37·9	60·82	56·35	52·46	74·0	W.	11	7·7	3·67	14	0·92
AUGUST	29·87	30·25	29·30	77·2	40·6	68·58	51·68	16.90	58·43	136·2	35·0	62·30	53·34	55·00	77·2	W.	8	7·4	2·25	21	0·39
SEPTEMBER	30·15	30.45	29.66	81·6	34·2	71·55	47·85	23·70	58·40	124·8	29·1	57·74	55·55	53·58	85·9	S.W.	8	4·7	0·48	11	0·17
OCTOBER	29·83	30·57	29·19	72·0	23·6	52·65	37·85	14·80	44.25	118·4	19·1	43·94	42·48	40·76	88·3	N&SW	5	7·4	2·71	22	0·67
NOVEMBER	29·86	30·44	29·09	61·8	27.4	50·95	39·87	11·08	45·01	103·8	23·5	44·95	43·85	42·57	91·2	N.E.	11	8.5	2·57	22	0·38
DECEMBER	29·78	30·33	28·98	54·9	22·0	43·16	32·63	10·53	37·89	92.1	20·6	37·68	36·59	34·81	90.9	S.W.	9	8·5	2·00	19	0·38
Extremes for Year		30·60	28·68	81·6	4·6					141·0	2·1					S.W.	63		23·35	178	1·42
Means for Year	29·91					55·34	39·58	15·76	46·39			47·82	45·23	42·38	82·7			7·1			

NOTES.—All the Readings are taken daily at 9 a.m. The Barometer Readings are corrected to sea-level and 32° F.; and to the Mean Temperatures in the Shade, Glaisher's Corrections have been applied. The Thermometers in the Shade are placed in a Stevenson's Screen, 4 feet from the grass, as are the Dry and Wet Bulb Thermometers. The Maximum Temperatures in the Sun are taken with a Black Bulb Thermometer, in vacuo. The mouth of the Rain Gauge is 1 foot above the ground and 153 feet above sea-level. In calculating the Mean Relative Humidity, 100 is taken to represent a saturated atmosphere and 0 a perfectly dry one.

JAMES C. WELLS.
T. GIBBS.

The Flora of Burton-on-Trent and Neighbourhood.

COMPILED BY THE BOTANICAL SECTION.

WHEN, in the Session of 1887-88, the Botanical and Microscopical Section of this Society was established, the first work undertaken was the compilation of a "Flora" of the district on the lines of the list of the Lepidoptera already published in the Society's Transactions.

Owing to lack of time among the small number of members on whom the work devolved it has from time to time been laid aside for long periods, and on each occasion of again taking up the work it has been found necessary, owing to additional material having come in, and to other causes, to re-commence the work.

The plan as originally conceived was to include a district of 20 miles around Burton; but the fact that in so large a district a large proportion of the records would necessarily come from other sources than the members of this Society has led to a limit of ten miles only being adopted.

A first instalment of this "Flora" is now presented to members, and it is proposed to continue the work in future volumes of the "Transactions" until completed, adding at the same time any further records which may each year be made to the part previously published.

The arrangement and nomenclature adopted are those of the 9th Edition of the "London Catalogue of British Plants."

The following is a list of the published Floras which contain any records from localities within our area; all such records have been inserted in our list and credited to the works from which they are taken.

	Quoted as
Shaw's History of Staffordshire 1798	*Shaw.*
Withering's Botany, 4th Ed., 1801	*Withering.*
Natural History of the County of Stafford, 1844. By Robert Garner, F.L.S.	R.G.
Natural History of Tutbury, 1863 (containing "the Fauna and Flora of Burton-on-Trent," by Edwin Brown.)	E.B.
Contributions to the Fauna and Flora of Repton, 1881. By William Garneys.	W.G.
The Flora of Leicestershire, 1886. Leicester Literary and Philosophical Society.	F.L.
A Contribution to the Flora of Derbyshire, 1889. By the Rev. W. H. Painter.	W.H.P.

The present and past members of the Section who have contributed to the list are P. B. Mason, F.L.S., (Chairman), T. Gibbs, J. E. Nowers, James G. Wells, (Hon. Sec.,) and the late Mr. J. T. Harris; their several contributions being denoted by their initials.

PHANEROGAMIA.

DICOTYLEDONES.

I. Ranunculaceæ.

1. **Clematis vitalba,** L.
 Ticknall Quarry; W.G. Yoxall Lodge; R.G.

7. **Thalictrum flavum,** L.
 Common in Osier beds in the Trent Valley.

9. **Anemone nemorosa,** L.
 Generally distributed.

12. **Adonis autumnalis,** L.
 Tutbury; Moira; E.B. Burton, J.E.N.

13. **Myosurus minimus,** L.
 Barton; R.G. Stapenhill; Drakelowe Hall; Catholme, near Wichnor; E.B. Hamstall Ridware Hills; Elford; *Shaw.*

14. **Ranunculus circinatus,** Sibth.
 Rivers Dove and Trent; Moira; E.B Repton; W.G. Calke; W.H.P. Bretby Ponds; T.G. Rollestone; J.T.H. Branston; J.E.N.

15. **R. fluitans**, Lam.
Common in Trent and Dove; *Section*. Canal at Snarestone and at Moira; F.L.

17. **R. trichophyllus**, Chaix.
Brizlincote; J.E.N. Bretby; T.G.

18. **R. Drouetii**, Godr.
Branston; J.E.N. Twyford Brook; W.G. Ticknall; W.H.P.

19. **R. heterophyllus**, Web. exp.
Tatenhill; J.E.N. Litchurch, Derby; W.H.P.

20. **R. peltatus**, Schrank.
Repton; Twyford; Moira Reservoir; P.B.M. Derby; W.H.P.

var. **floribundus** (Bab.)
Ticknall; Dimminsdale limeyard, Calke; W.H.P.

21. **R. Baudotii**, Godr.
Lily Pits, Branston; J.T.H.

23. **R. Lenormandi**, D.C.
Branston; J.E.N. Between Calke and Melbourne (extinct) W.H.P.

24. **R. hederaceus**, L.
Fairly common.

25. **R. sceleratus**, L.
Fairly common.

27. **R. flammula**, L.
Common in marshy places.

var. **radicans**, Nolte.
Linton Heath; J.T.H.

30. **R. Lingua**, L.
Formerly at the Cow Ponds, Woodville; E.B.

31. **R. auricomus**, L.
Fairly common.

32. **R. acris**, L.
Very common everywhere.

33. **R. repens**, L.
Common everywhere.

34. **R. bulbosus**, L
Common everywhere.

35. **R. sardous**, Crantz.
Burton; R.G. Stretton; Brizlincote, &c.; E.B. Near Anchor Church; W.G. Burton road, Ashby; F.L.

36. **R. parviflorus**, L.
Outwood Hills, Burton; Tutbury; E.B.

37. **R. arvensis**, L.
Locally common.

39. **R. Ficaria**, L.
Very common.

var. **incumbens**, F. Schultz.
Burton meadows; J.T.H. Sudbury; J.G.W.

40. **Caltha palustris**, L.
Common.

43. **Helleborus viridis**, L.
Drakelowe and Branston; E.B.

45. *Eranthis hyemalis*, *Salisb.*
Stapenhill; Coton Hall; E.B.

46. **Aquilegia vulgaris**, L.
Near Willington; W.G. Drakelowe; Calke Park; Foremark; E.B. Yoxall; R.G. Needwood Forest; J.E.N.

47. *Delphinium Ajacis*, *Reichb.*
Needwood Forest; R.G. Willington; W.G.

48. **Aconitum Napellus**, L.
Drakelowe Brook; E.B. Willesley Park; F.L.

II. Berberideæ.

51. **Berberis vulgaris**, L.
Winshill; Branston; Moira; E.B. Drakelowe; J.T.H. Bretby, probably planted; T.G. Snarestone Tollgate; F.L.

III. Nymphæaceœ.

53. **Nymphæa lutea**, L.
Common in Trent; Ponds in Bretby Park; Ponds in Calke Park; Foremark; W.H.P. Branston; *Section.* Repton; W.G.

54. **Castalia speciosa**, Salisb. (**Nymphæa alba**, L.)
Lily Pits, Branston; Walton; E.B. Trent near Burton; R.G. Decoy, Drakelowe; J.E.N. Calke Park; W.G. Weston-upon-Trent; W.H.P.

IV. Papaveraceæ.

56. **Papaver somniferum**, L.
Stapenhill; E.B. Drakelowe,; J.T.H. Tutbury Castle; R.G. (extinct; *Section.*)

57. **P. Rhœas**, L.
Generally distributed, but not abundant.

58. **P. dubium**, L.
Common throughout the district.

59. **P. Argemone**, L.
Repton; Linton; Cauldwell; Ticknall; W.H.P. Between Drakelowe and Stanton; E.B. Repton; W.G. Coton; R.G. Burton; P.B.M. Alrewas; T.G.

65. **Chelidonium majus**, L.
Locally common.

V. Fumariaceæ.

67. *Neckeria* (*Corydalis*) *lutea*, *Scop.*
Walton Hall; E.B.

68. **N. claviculata,** N.E. Br.
Smoile Wood, Staunton Harold; E.B. Coleorton Wood; F.L.

69. **Fumaria pallidiflora,** Jord.
Burton; P.B.M. Canal side, Shobnall; E.B. Repton; W H.P.

73. **F. densiflora,** D.C.
Occasional; E.B.

74. **F. officinalis,** L.
Common throughout the district.

75. **F. Vaillantii,** Loisel.
Tutbury Castle; E.B.

VI. Cruciferæ.

79. **Cheiranthus Cheiri,** L.
Abbey walls, Burton; R.G. Ashby Castle; E.B. Tutbury Castle; J.T.H. Repton; W.G. Breedon Hill Quarry; F.L.

80. **Nasturtium officinale,** R. Br.
Common throughout the district.

81. **N. sylvestre,** R. Br.
Burton; R.G. Wetmore; E.B. Trent at Ingleby; E.B. Trent at Repton; W.G. Derwent, Derby; W.H.P. Moira Pool, J.E.N.

82. **N. palustre,** D.C.
Common in the Trent,

83. **N. amphibium,** R.Br.
Locally common.

84. **Barbarea vulgaris,** R.Br.
Common.

88. *B. Præcox, R.Br.*
Burton; R.G. Winshill; J.T.H. Calke; E.B.

93 **Arabis hirsuta,** Scop.
Tutbury; *Shaw.*

95. **A. perfoliata,** Lam.
Burton; R.G. Drakelowe; Woodville; E.B. Repton; W.G. Banks between Ticknall and Hartshorne, and between Ticknall and Milton; Bretby; W.H.P.

96. **Cardamine amara,** L.
Burton; Drakelowe; Rollestone; E.B. Repton; W.G. Milton; Calke; W.H.P. Bretby; T.G. Staunton Harold; Netherseal; F.L. Clay Mills; J.G.W. Sutton-on-the-Hill; J.E.N.

97. **C. pratensis,** L.
Common throughout the district.

98. **C. hirsuta,** L.
Common throughout the district.

99. **C. flexuosa,** With.
Common.

100. **C. impatiens**, L.
Bretby; J.T.H.

101. *C. bulbifera*; *R.Br.*
Needwood Forest; R.G.

109. **Erophila vulgaris**, D.C.
Common.

118. *Cochlearia Armoracia*, *L.*
Near Repton; J.E.N. Burton; E.B.

119. *Hesperis Matronalis*, *L.*
Near Ashby; E.B.

120. **Sisymbrium Thalianum**, J. Gay.
Common.

121. **S. officinale**, Scop.
Common.

123. **S. Sophia**, L.
Burton: R.G. Tutbury Castle; *Shaw*. Walton Lane; Netherseal; E.B. Ticknall; W.H.P. Coleörton; Staunton Harold, F.L.

125. **S. Irio**, L.
Road between Burton and Ashby when first made; E.B.

126. **S. Alliaria**, Scop.
Common throughout the district.

127. **Erysimum cheiranthoides**, L.
Old Hall Gardens, Netherseal; E.B.

132. *Brassica Napus*, *L.*
Occasional.

134. **B. rapa**, L.
Burton; P.B.M.

137. **B. Sinapioides**, Roth. (**B. nigra**, Koch.)
Tutbury; *Shaw*. Barton; R.G. Sinai Park; E.B. Repton; W.G.

139. **B. Sinapistrum**, Boiss.
Common.

140. **B. alba**, Boiss.
Occasional, *Section*. Cauldwell; P.B.M. Repton; W.G.

143. **Diplotaxis muralis**, D.C.
Stapenhill; E.B. Willington Junction; W.G.

144. **Bursa (Capsella) Bursa-pastoris**, Weber.
Common.

145. **Coronopus didymus**, Sm.
Yoxall Lodge; R.G.

146. **Coronopus Ruellii**, All.
Barton; R.G Repton; W.G. Stapenhill; Calke; W.H.P. Shobnall; Overseal; E.B. Stretton; Wetmoor; J.G.W.

148. *Lepidium ruderale*, *L.*
Near Willington Junction; W.G. Burton; J.E.N.

149. *L. sativum L.*
Branston; E.B.

150. **L. campestre**, R.Br.
Shobnall; Needwood Forest; E.B. Repton; W.G. Calke; W.H.P. Cauldwell; J.T.H. Lount; Moira; Overseal; Oakthorpe; F.L.

151. **L. hirtum**, Sm. (**L. Smithii**, Hook.)
Shobnall; E.B.

153. **Thlaspi avense**, L.
Barton; R.G. Burton; E.B. Brizlincote; Bretby; J.T.H.

157. **Teesdalia nudicaulis**, R.Br.
Catholme, near Barton-under-Needwood; E.B.

159. *Isatis Tinctoria, L.*
Willington; J.T.H.

162. **Raphanus Raphanistrum**, L.
Not uncommon; E.B. Repton; W.G. Stapenhill; J.T.H. Burton; P.B.M.

VII. Resedaceæ.

165. **Reseda lutea**, L.
Midway, near Burton; Breedon Cloud Wood; E.B. Drakelowe; J.T.H.

166. **R. Luteola**, L.
Newton Road, Burton; Tutbury Castle; Bretby; Moira; E.B. Ticknall Quarry; W.G. Old Quarry, Stanton-by-Bridge; W.H.P. Breedon Hill and Breedon Cloud; F.L.

IX. Violariæ

172. **Viola palustris**, L.
Repton Rocks; Moira Reservoir; Seal Wood; E.B. Needwood Forest; *Withering*. Calke; W.H.P. Staunton Harold; Woodville; F.L.

173. **V. odorata**, L.
Common.

174. **V. hirta**, L.
Breedon; E.B. Ticknall; W.H.P.

176. **V. Riviniana**, Reich.
Common throughout the district.

178. **V. ericetorum**, Schrader (**V. canina**, L.)
Dry banks near Seal Wood; E.B. Seal Wood; J.T.H. Tatenhill and Needwood Forest; J.E.N.

181. **V. tricolor**, L.
Common on cultivated land.

182. **V. arvensis**, Murr.
Common on cultivated land.

X. POLYGALEÆ.

185. **Polygala vulgaris**, L.
Common about Calke; W.H.P.

187. **P. serpyllacea**, Wimm.
Knightley Park and Sinai Park (sub: nom: P. vulgaris) E.B. Bretby Park, Repton Rocks, Tatenhill; T.G.

XII. CARYOPHYLBEÆ.

193. *Dianthus Armeria, L.*
Morrey Hills near Yoxall; *Shaw.*

199. *Saponaria Vaccaria, L.*
Occasionally on ballast heaps, Burton; J.T.H.

200. *S. officinalis, L.*
Burton; Hamstall Ridware; R.G. Stretton some years ago; Near Snareston Church; E.B. Coleorton; F.L.

201. **Silene Cucubalus**, Wibel.
The Outwoods, Burton; Railway Cuttings, but not common; E.B. Repton; W.G. Between Repton and Hartshorne; Ticknall, W.H.P. Bretby Colliery; T.G. Coleorton; Ashby; Moira; F.L.

211. **S. noctiflora**, L.
Breach Farm, Cauldwell, 1861; Drakelowe, Overseal, and Moira; E.B. Repton Rocks; W.G. Gresley, Linton, and Cauldwell; Bretby Mill; Ticknall; W.H.P. Foremark Hills; J.T.H. Stanton Lodge; Old Parks, Ashby, 1851; Packington; F.L.

213. **Lychnis alba**, Mill.
Occurs frequently throughout the district.

214. **L. dioica**, L.
Common throughout the district.

215. **L. Flos-cuculi**, L.
Common in marshy places.

218. **L. Githago**, Scop.
Frequent in cornfields.

220. **Cerastium quaternellum**, Fenzl.
Repton; W.G. Not seen there in recent years; W.H.P.

223. **C. semidecandrum**, L.
Walls, Breedon; E.B. Walls, Repton; W.G. Near Burton, near Melbourne (?) W.H.P.

224. **C. glomeratum**, Thuill.
Common.

225. **C. triviale**, Link.
Common throughout the district.

228. **C. arvense**, L.
Fields, Repton; W.G.

230. **Stellaria aquatica**, Scop.
Stretton and Branston; E.B. By the old Trent, Repton; W.G. Trent Valley; J.T.H. Horninglow; P.B.M. Osmaston by Derby; W.H.P. "Very common"; F.L. Tatenhill; T.G.

232. **S. media**, Cyr.
Common everywhere.

var. **Boræana** (Jord.)
Newton Solney and Bretby; J.T H.

var. **major**, Kock.
Midway; P.B.M. Branston; near Sutton-on-the-Hill; J.E.N.

234. **S. Holostea**, L.
Common throughout the district.

235. **S. palustris**, Ehrh,
Drakelowe; Walton lane and Catholme; E.B. In meadows below Repton, W.H.P. Egginton; P.B.M.

236. **S. graminea**, L.
Common everywhere

237. **S. uliginosa**, Murr
Common in wet places.

242. **Arenaria trinervia**, L.
Common.

243. **A. serpyllifolia**, L.
Fairly common.

250. **Sagina apetala**, L.
Burton; Newton Solney; Drakelowe; E.B Ticknall; near Knowle Hills; Repton; W.H,P. "Common," F,L.

253. **S. procumbens**, L.
Common throughout the District,

258. **S. nodosa**, Fenzl.
Repton Rocks; W.H.P,

259. **Spergula arvensis**, L.
Common in cornfields.

260. **Buda rubra**, Dum. (**Lepigonum rubrum**, Fr.)
Burton; Drakelowe; Netherseal; E.B. Repton; Milton; near Foremark; Melbourne; W.H.P. Bretby; T.G. Willington; J.E.N. Ashby; Moira; Measham; F.L.

XIII Portulaceæ.

267. **Montia fontana**, L.
Linton; E.B. Cauldwell; Repton Rocks; W.G. Seal Wood; P.B.M. Bretby; J.E.N.

XVI. Hypericinaceæ.

271. **Hypericum Androsæmum**, L.
Forest Banks, Needwood; J.T.H.

274. **H. calycinum**, L.
Knowle Hills; W.G.

275. **H. perforatum**, L.
Common throughout the district.

276. **H. dubium**, Leers.
Stretton; Barton; R.G. Henhurst; P.B.M. Tatenhill; T.G.

277. **H. quadratum**, Stokes.
Common throughout the district.

279. **H. humifusum**, L.
Breach Farm, Cauldwell; Needwood Forest; E.B. Near Willington; W.G. Near Calke, W.H.P. Burton; J.T.H. Drakelowe. South wood, Staunton Harold; Packington; F.L. Bretby; T.G.

281. **H. pulchrum**, L.
Common throughout the district.

282. **H. hirsutum**, L.
Scalpcliff hill; Henhurst; E.B. Tutbury; *Shaw*. Repton; W.G. Bretby; T.G. Tatenhill; J.E.N. Common on Needwood Forest; T.G.

283. **H. montanum**, L.
Stapenhill and Winshill; E.B. Ticknall Quarry; W.G.

284. **H. elodes**, L.
Needwood Forest; *Shaw*.

XVII. Malvaceæ.

289. **Malva moschata**, L.
Drakelowe; Needwood Forest; E.B. Foremark; Bretby; Calke; Stanton-by-Bridge; W.H.P. Burton; *Section*. Near Somershall Herbert; T.G. Breedon; Gresley.

290. **M. sylvestris**, L.
Common.

291. **M. rotundifolia**, L.
Stapenhill; Packington; E.B. Repton; W.G. Willington; near Calke; W,H.P. Sinai Park, T.G.

XVIII. Tiliaceæ.

295. *Tilia platyphyllos*, *Scop.*
Calke Park, planted; W.H.P. Planted about Burton; T.G.

296. *T. vulgaris*, *Hayne.*
Frequent in woods, but not indigenous.

297. **T. cordata**, Mill.
Calke park, probably planted; W.H.P. Needwood Forest, R.G. Moira; E.B. Norris Hill, near Ashby; F.L. Boylestone, planted; T.G.

XIX. Lineæ.

299. **Linum cartharticum**, L.
Not uncommon.

301. **L. angustifolium**, L.
Burton; R.G. Between Willington and Etwall; W.G.

302. *L. usitatissimum*, *L.*
The Outwoods; Knightley Park; E.B. Repton; W,G. Lount Wood; Ashby; Overseal; Moira; F.L.

XX. Geraniaceæ.

306. *Geranium phæum* L.
Calke; W.H.P.

307. **G. sylvaticum**, L.
Burton; R.G.

398. **G. pratense,** L.
Burton; *Section.* Repton; W.G. Common about Derby; Calke; W.H.P. Etwall; Cauldwell; T.G.

309. **G. pyrenaicum,** L.
Barton; R.G. Stapenhill; W.H.P.

310. **G. molle,** L.
Common.

311. **G. pusillum,** L.
Stapenhill; Shobnall; Overseal; E.B. Repton; W.G. Abou; Calke; W.H.P. Milton; Alrewas; T.G.

312. [*G. rotundifolium*, *L*
Burton Road, Repton; W.G. Probable error.]

313. **G. dissectum,** L.
Common.

314. [*G. columbinum*, *L.*
Burton Road, Repton; W.G. Probable error.]

315. **G. lucidum,** L.
Repton; W.G. Anchor Church; *Section.* Bretby; Pistern Hill, near Ticknall; doubtfully wild; W.H.P. "Frequent on Sandstone;" R.G. Tatenhill; Draycott; *Section.*

316. G. **Robertianum**, L.
Common everywhere

317. **Erodium cicutarium**, L'Hérit.
"Common in sandy soil," R.G. Breedon; E.B. Foremark; W.G. Stanton-by-Bridge; Near Calke Abbey; Weston; W.H.P. Cole-orton; Ashby; F.L.

320. **Oxalis Acetosella,** L.
Common

321. *O. corniculata*, L.
Naturalized in Rolleston Hall grounds; E.B.

XXI. Ilicineæ.

326. **Ilex Aquifolium,** L.
Common in woods and hedges; especially abundant in some of the woods on Needwood Forest.

XXII. Celastrineæ.

327. **Euonymus europæus**, L.
Drakelowe; Breedon Cloud Wood; E.B. Winshill; J.T.H. Repton Rocks; W.G.

XXIII. Rhamneæ.

328. **Rhamnus catharticus**, L.
Between Drakelowe and Walton; Oakthorpe; E.B.

329. **R. Frangula**, L.
Repton Rocks; Grange and Seal Woods; E.B. Drakelowe; W.H.P Short Wood; Swannington; F.L. Repton Shrubs; Foremark Bottoms; T.G.

XXIV. Sapindaceæ.

330. *Acer Pseudo-platanus*, L.
Common in woods and hedges.

331. **A. campestre**, L.
Common in woods, parks, and hedges.

XXV. Leguminosæ.

333. **Genista anglica**, L.
Needwood Forest near Bannister's Rough; E.B. Ashby Wolds; F.L. Willington; W.G

335. **G. tinctoria**, L.
Between Burton and Derby; Tutbury; E.B. Needwood Forest; P.B.M. Etwall; T.G. Lount Wood; Worthington Rough; Coleorton; Normanton; F.L. Outwood Hills; J.G.W.

336. **Ulex europæus**, L.
Common everywhere.

337. **Ulex Gallii**, Planch.
Moira; Bretby; Hartshorne, &c.; E.B. Ashby Wolds; P.B.M. Gresley; Calke; W.H.P. Staunton Harold; Moira; Ashby; F.L. Repton Rocks; W.G. Boylestone; Needwood Forest; T.G.

339. **Cytisus scoparius**, Link.
Frequent on railway banks, occasional elsewhere.

340. **Ononis repens**, L.
Horninglow; E.B. Common about Derby; W H.P. Mickleover; Bretby; T,G. Repton; W.G.

341. **O. spinosa**, L.
Stretton and Rolleston; E.B. Normanton; Willington; Ticknall; near Etwall; W.H.P.

344. *Medicago sativa*, L.
Burton; R.G. & E.B. Willesley; F.L.

347. **M. lupulina**, L.
Common.

350. **Melilotus officinalis**, Lam.
Tutbury; Yoxall; R.G. The Oaks Plantation and Drakelowe; E.B Bretby; Chellaston; Ticknall; W.H.P. Burton; *Section*. Repton; W.G. Brizlincote; T.G.

356. **Trifolium pratense**, L.
Common everywhere.

357. **T. medium**, L.
Moira; Bretby and Knightley Park; E.B. Pistern Hill; Ticknall and Calke; W.H.P. Coleorton; Ashby Old Parks; Breedon Osier bed; Alton Grange; F.L. Repton; W.G.

358. [*T. ochroleucon*, Huds.
Repton; W.G. Wants confirmation; W.H.P.]

360. *T. incarnatum*, L.
Occasionally in cornfields after cultivation, not truly wild; E.B.

363. **T. arvense**, L.
Lichfield; R.G. Railway Slopes at Branstone; E.B. Burton; Foremark; W.H.P. Repton; W.G.

365. **T. striatum**, L.
Stretton and Branstone; E.B. Drakelowe; W.H.P. Breedon; Measham; F.L. Repton; W.G.

366. **T. scabrum**, L.
Burton; P.B.M.

370. *T. hybridum*,
Cultivated fields, introduced.

371. **T. repens**, L.
Common everywhere.

375. **T. procumbens**, L.
Common.

376. **T. dubium**, Sibth.
Common.

377. **T. filiforme**, L.
Burton; E.B. Milton; W.G.

[*T. patens*, L.
Railway Cutting near Ashby; E,B.]

378. **Anthyllis Vulneraria**, L.
Linton; Calke; Moira Stone Pit; E.B. Measham; Ticknall; W.H.P. Willington Road, Repton; W.G.

379. **Lotus corniculatus**, L.
Common throughout the district.

380. **L. tenuis**, Waldst. & Kit.
Woodville; Cauldwell; E.B. Moira Reservoir; P.B.M.

381. **L. uliginosus**, Schkuhr.
Common.

386. **Astragalus glycyphyllos,** L.
Lane near Midway; Breedon Cloud Wood; E.B. Redhill; Worthington; F.L.

389. **Ornithopus perpusillus,** L.
Netherseal; Moira Stone Quarry; Stretton; Wichnor; E.B. Repton; W.G. Cauldwell; Melbourne; W.H.P.

393. **Vicia hirsuta,** Gray.
Common.

304. **V. gemella,** Crantz (**V. tetrasperma,** Moench.)
Barton; R.G. Walton; Rollestone; E.B. Canal bank near Willington; W.G. Drakelowe; Repton; near Calke Abbey; W.H.P.

396. **V. Cracca,** L.
Common throughout the district.

398. **V. sylvatica,** L.
Repton Rocks; W.G. Cauldwell Bridge; W.H.P.

399. **V. sepium,** L.
Common throughout the district.

453. *V. sativa*, L.
Common.

404. **V. angustifolia,** L.
Branston and other places, but not very common; E.B. Gresley; Calke; W.H.P. Draycott; T.G;

var. **Bobartii,** Koch.
Dimminsdale, Calke; W.H.P.

407. **Lathyrus Aphaca,** L.
Houndshill; P.B.M.

408. **L. Nissolia,** L.
Near Barton-under-Needwood; E.B.

409. [*L. hirsutus*, L.
"South Normanton; Mr. Coke in Pilkington's History"; W.H P.]

411. **L. pratensis,** L.
Common throughout the district.

414. **L. sylvestris,** L.
Tatenhill; R.G. The Oaks wood, Shobnall; Aston Quarry: E.B. Weston-upon-Trent; W.H.P.

417. **L. montanus,** Bernh. (**L. macrorrhizus,** Wimm.)
Fairly common.

var. **tenuifolius,** Reich. fil.
Occurs occasionally with the type.

PERFECT, PRINTER, BURTON.

VOL. III.—PART III.

TRANSACTIONS

OF THE

BURTON-ON-TRENT

Natural History

AND

ARCHÆOLOGICAL SOCIETY,

WITH

Annual Report, Balance Sheet, &c.,

FOR SESSION 1895-96.

EDITED BY
THOMAS GIBBS,
Hon. Secretary.

BURTON-ON-TRENT:
JOHN C. PERFECT, PRINTER, 204 & 205, STATION STREET.

MDCCCXCVII.

BURTON-ON-TRENT

NATURAL HISTORY & ARCHÆOLOGICAL SOCIETY,

30, High Street.

Annual Report, Balance Sheet,

&c., &c.,

FOR THE

YEAR ENDING SEPTEMBER 30TH, 1896.

BURTON-ON-TRENT:
John C. Perfect, Printer, Station Street.
1897.

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1895-96—F. E. LOTT, Esq., Assoc. R.S.M., F.I.C.

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1896—1897.

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PHOTOGRAPHIC.

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MR. R. CHURCHILL.

Hon. Secretary:

MR. H. H. PORT, 103, Scalpcliff Road.

Members wishing to join either of the above Sections are requested to communicate with the respective Secretaries.

Annual General Meeting, 1896.

The Twenty-first Annual General Meeting was held in the Masonic Hall, on Thursday, October 29th, 1896.

In the unavoidable absence of the President, Mr. P. B. Mason (Vice President) took the Chair.

The Honorary Secretary read the Report and Balance Sheet for the past year, as follows:

REPORT OF THE COMMITTEE FOR YEAR ENDING SEPTEMBER 30TH, 1896.

Your Committee have pleasure in presenting their Report of the 20th Session of the Society's existence.

At the Monthly Meetings a plentiful supply of good papers has been forthcoming, and an average attendance of 44 shows a continued interest in the Society's proceedings.

The papers read and their authors, and other business transacted at these meetings are given in the following list.

1895.
Oct. 24.—Annual General Meeting and Exhibition of Lantern Slides.

Nov. 14.—President's Inaugural Address.

Dec. 12.—"The Struggle for Life within the Animal Body."
Philip B. Mason, F.L.S.

1896.
Jan. 23.—"Fountains Abbey, Ripon and Durham." R. Churchill.

Feb. 13.—"The Ground Plan of Burton Abbey." H. A. Rye.

Mch. 12.—"The Scenery and Geology of the British Islands."
Prof. J. W. Carr, F.G.S.

April 9.—Election of President for Session 1896-97.
Paper on "The Burton Abbey Dissolution Inventories." H.A.Rye.

Of three excursions which had been arranged, two were successfully carried through. The first was on May 16th, when Mr. R. Moxon took a party of 24 Members to Norbury, where a very pleasant afternoon was spent in viewing the Old Manor House and the Church. The other excursion took place on July 11th, when a small party, under the leadership of Mr. Gibbs, drove to Croxall. In connection with these excursions the Society is much indebted to the Rev. D. Adamson, Rector of Norbury, and the Right Rev. Bishop Staley, Vicar of Croxall, for the courtesy with which they put their time at the disposal of the members, and pointed out the objects of historical interest. The thanks of the Society are also due to S. W. Clowes, Esq., of Norbury Hall, and T. Levett-Prinsep, Esq., of Croxall Manor, for the privilege of viewing their beautiful gardens and pleasure grounds. A whole day excursion to Monsal Dale and Ashford, which had been arranged by the President, unfortunately fell through.

At the April meeting, Mr. F. E. Lott was unanimously re-elected as President for the session 1896-97.

A further part of the Society's Transactions has lately been published and despatched to Members; this part brings the Society's published Transactions down to the beginning of last session, and contains, in addition to the papers read before the Society during the sessions 1893-94 and 1894-95, the first part of the transcript by the Rev. Vicars A. Boyle of the Parish Church Marriage Registers, and the commencement of the Botanical Section's Flora of the District.

In dealing with the work of the Sections, mention must be made of the loss the Society has sustained in consequence of Mr. R. N. Blackburn, late Honorary Secretary of the Photographic Section, having left the town. This Section gave a capital Lantern display at the Society's Annual Meeting, and the Society is much indebted to Mr. T. A. Gaved, one of its members, for preparing slides to illustrate some of the papers read before the Society. The Botanical Section has not held any meetings, but, as already mentioned, the 1st part of the local "Flora" is included in the part of Transactions lately published.

The membership of the Society shows a slight decline, the number of subscribing members for the past Session being 190 against 202 in the previous Session. There are, in addition, 11 Honorary Members and 2 Associates, making a total membership of 203.

The Society's Finances remain in a satisfactory condition, the balance in hand standing at £36 17s. 10d. It must however be borne in mind that Mr. Perfect's account for printing the Transactions and Report has not yet come in, and this will absorb a large proportion of the above balance. There is also a sum of £41 10s. 6d. standing to the credit of the Investment Account.

In accordance with Rule II, Messrs. R. N. Blackburn and G. Morland Day retire from the Committee, and are not eligible for re-election.

The Report and Balance Sheet were adopted on the motion of Mr. Perfect, seconded by Mr. Port.

The Officers, Committee, and some new members were then elected.

A vote of thanks to the Chairman brought the Meeting to a close.

Balance Sheet for Year ending 30th September, 1896.

Dr.

	£ s. d.	£ s. d.
To Balance in hand, 30th September, 1895		24 4 6
,, Members' Subscriptions—		
190 Members at 5/-	47 10 0	
1 Arrears	0 5 0	
2 Associates' Subscriptions ...	0 2 0	
		47 17 0
,, Price of Transactions sold ...		0 4 6
		£72 6 0

Cr.

	£ s. d.	£ s. d.
By Rent of Room, 30, High Street .		10 0 0
,, Gas		0 2 5
,, Insurance		0 3 9
,, Hire of Masonic Hall		2 16 0
,, Printing and Stationery—		
J. C. Perfect, Notices, &c. ...		5 3 2
,, Publication of Report and Transactions A/c. (Illustrations)—		
The Meisenbach Co. ...	2 2 0	
Bemrose & Sons	0 18 6	
		3 0 6
,, Postages		4 4 $10\frac{1}{2}$
,, Collector's Commission		2 8 0
,, Addressing Notices		1 7 0
,, Refreshments at Meetings		1 13 10
,, Purchase of Books—		
The Gresley Charters ...	0 10 6	
Derbyshire Archæological Journal, 1885 ...	0 7 0	
Camera Club Journal ...	0 2 0	
		0 19 6
,, Thornewill & Warham—Pressure Guage ...		1 11 6
,, Birmingham Oxygen Co.—Oxygen & Carriage		0 9 7
,, Hallam—Lime Cylinders		0 3 6
,, Bindley—Repairing Gas Bags		0 2 6
,, Simnett—Assisting with Lantern		0 2 6
,, Wilson—Hire of Chairs		0 2 6
,, Secretary's Sundries		0 17 $0\frac{1}{2}$
,, Balance in hands of Treasurer		36 17 10
		£72 6 0

Investment Account.

	£ s. d.
To Balance on 30th September, 1895 ...	40 14 9
,, Bank Interest	0 15 9
	£41 10 6

Examined and found correct, October 28th, 1896. H. H. PORT.

REPORT OF THE BOTANICAL & MICROSCOPICAL SECTION, 1895-96.

Chairman - - P. B. Mason, Esq.

The work of this Section during the past Session has consisted solely in the publication of the first instalment of the Flora of the District. This comprised the families *Ranunculaceæ* to *Leguminosæ*, and was included in Part 2 of Vol. III of the Transactions. Progress is being made with a further instalment for publication in the next part of the Transactions.

The following records have been made:

By Mr. T. Gibbs:

Dipsacus pilosus, L.	... ...	Tatenhill.
Chenopodium rubrum, L.	...	Near Sutton-on-Hill.
Carex curta, Good.	... ...	Repton Rocks.

JAMES G. WELLS,
Hon. Sec. of Section.

REPORT OF THE PHOTOGRAPHIC SECTION, 1895-96.

Chairman - - R. Churchill, Esq.

The Section has had the misfortune to lose the services of Mr. R. N. Blackburn, their Honorary Secretary, who has removed to Liverpool, and, as his successor was not immediately appointed, few meetings were held.

No Lantern Slide Competition has been held in the year, but, at the General Meeting, several members exhibited specimens of work done during the summer months.

The Section will be pleased to add to their number any member of the Society interested in Photography.

Meetings are held at the Society's Room, 30, High Street, on the first Thursday in each month, at 8 p.m.

H. H. Port, *Hon. Sec.*,
203, Scalpcliff Road.

EXCURSIONS, 1896.

NORBURY, MAY 16TH.

Leader—R. MOXON.

A party of twenty-two travelled to Norbury by train, and were joined there by a few bicyclists, and also by some friends from the neighbourhood, including the Rev. D. Adamson, lately Curate at Winshill, and now Rector of Norbury. The first object to which attention was directed was the Old Manor House. Some of the most ancient and interesting features of the exterior having been examined, the party assembled inside, and the leader read a short paper chiefly dealing with the history of the family of Fitzherbert, who, either as tenants of the Priory of Tutbury, or, as lords of the manor, possessed this property from 1125 till quite recently. The house was at first probably a timbered or half-timbered dwelling, but was rebuilt in stone on a larger scale by Sir Henry, the fifth lord, who came into his inheritance in 1267. The great hall and state rooms above still remain, though now only used as stabling or store rooms. There is very little domestic work left in England of so early a date. Extensive alterations and additions were made by some of Sir Henry's successors. The most eminent of the family was Sir Anthony, the thirteenth lord, born in 1470, and made Justice of the Common Pleas in 1522. A handsome room on the first floor is known as "Sir Anthony's Study." The oak panels of this room are covered with texts taken from the Vulgate, believed to be in Sir Anthony's own handwriting. Sir Anthony's son, Sir Thomas, filled the principal apartments with coloured glass, chiefly the blazonry of his ancient family and their numerous important alliances, some of which still remains to be seen. There are also some curious medallions in coloured glass representing the months January to June inclusive, the other six having disappeared. Another beautiful medallion of sixteenth century Flemish work represents the scourging of Christ. In later years the house was partly pulled down and partly encased in bricks, becoming the residence of tenant farmers. The chief points of historical interest in the house were described in detail by the leader and Mr. Adamson, and the party then proceeded to visit the church, a fine building of the fourteenth and fifteenth centuries, containing several most interesting monuments, including a very remarkable palimpsest brass to the memory of Sir Anthony Fitzherbert. Here also is a quantity of ancient stained glass of great beauty and interest. Eight large windows in the Chancel still retain the glass of the fourteenth century. The designs are decorated scroll work with twenty shields of arms. Mr. H. A. Rye, who was one of the party, rendered great assistance by readily identifying most of the families to whom the arms belonged.

By permission of Mr. S. W. Clowes, the present lord of the manor, the party were permitted to walk through the gardens and grounds of the Hall, built on the site of the old Rectory.

Tea was provided at the Bromley Arms, Ellastone—a place in itself interesting—being the scene of the story of "Adam Bede," whose author, "George Eliot," resided there.

Those who may wish to read the full history of the Fitzherbert family, and a complete description of the many objects of interest to be found at Norbury, are referred to the Transactions of the Derbyshire Archæological Society for the years 1882, 1883, and 1886, and also to Dr. Cox's "Churches of Derbyshire," Vol. III, Pages 229, et seq.

CATTON AND CROXALL, JULY 11TH.

Leader—T. GIBBS.

A small party drove to Croxall, via Drakelowe, Walton, and Catton. At the last named place they were met by the Right Rev. Bishop Staley, Vicar of Croxall, and, under his guidance, they inspected the chapel and grounds, seeing in the latter some remains of the old chapel pulled down in the last century. A further short drive took the party to Croxall, and here, under the same experienced guidance, the interesting and picturesque little church and the other antiquities of the place were visited, and a short time was spent in the gardens and grounds of the fine Elizabethan Hall. From the Conquest until the seventeenth century, Croxall belonged to a branch of the Curzon family, being one of the Lordships given by the Conqueror to the Norman ancestor of that family. In the seventeenth century it passed, by marriage, to the Earls of Dorset, and in the last century it was sold by the then Earl of Dorset to the ancestor of the present owner, Mr. T. Levett-Prinsep, J.P. The hall was the residence for some years of the poet Dryden, being lent to him by his friend and patron The Earl of Dorset, then Lord Chamberlain, on the poet's dismissal from the laureateship for refusing to take the oaths after the accession of King William III. The path along the hill top between Croxall and Catton was a favourite walk of the poet, and is still called "Dryden's Walk." This path was visited by the party, and from it a fine view of the surrounding country obtained. Other points of historical interest are a burgh or mound, situate near the church on the banks of the Mease, and probably made for the defence of the country against the inroads of the Danes; and the site of the old hamlet of Croxall, also near the church, close to which Queen Henrietta Maria encamped with the Royalist army in the Civil War.

LIST OF MEMBERS.

SESSION, 1895-96.

HONORARY MEMBERS.

BAKER, G., Rozel Road, St. Jacques, Guernsey.
BLATCH. W. G., Temple Road, Knowle, Birmingham.
BROWN, HORACE T., F.R.S., F.G.S., &c., 52, Nevern Square, Kensington, W.
DAWKINS, W. BOYD, M.A., F.R.S., F.G.S., &c., Owen's College, Manchester.
HARRISON, W. J., F.G.S.
HERON, J., B.E., F.C.S., F.I.C., 343, Clapham Road, London, S.W.
MARTIN, T. C., 44, White Ladies' Road, Clifton, Bristol.
MELLO, Rev. J.M., F.G.S., &c., Mapperley Vicarage, near Derby.
MORRIS, G. HARRIS, Ph.D., F.I.C., F.C.S., 18, Gwendwr Road, West Kensington, W.
THORNEWILL, Rev. C. F., M.A., F.E.S., Calverhall Vicarage, Salop.
TRIPP, C. U., M.A., F.R.Met.Soc., The Grove, Addlestone, Surrey.

Allsopp, Hon. G. H., M.P., J.P.	Foston Hall.
Anderson, D. V.	Alexandra Road.
Auty, R. H.	Arthurlie House Ashby Road.
Auty, Mrs. R. H.	,, ,, ,, ,,

Baggley, C.	13, Sydney Street.
Barnes, Rev. E. G.	Horninglow Street.
Baxter F.	Lichfield Street.
Beaven, Rev. F. H.	St. Paul's Vicarage.
Beck, H.	Branston Road.
Beckett, Rev. T. W., M.A.	The Grammar School.
Beels, G.	Ashby Road.
Bence, H., B.A.	Clay Street.
Bernard, Mrs.	Holly Bank, Scalpcliff Road.
Blackburn, R. N.	Blackpool Street.
Blackhall, G. L.	The Abbey.
Blackhall, Mrs.	,,
Blackhall, Miss	,,
Boyle, Rev. Vicars A., B.C.L.	The Vicarage, Orchard Street.
Boyle, Miss	,, ,, ,, ,,
Bradbury, H. K., M.R.C.S., L.R.C.P.	Horninglow Street.
Bradbury, Mrs. H. K.	,, ,,
Bramell, Rev. J.	Branston Vicarage.
Bridgman, H. E., M.R.C.S., L.R.C.P.	Bridge Street.
Briggs, S.	Branston Road.

Briggs, W. C.	Borough Road.
Brown, Adrian J., F.C.S., F.I.C.	6, Alexandra Road.
Brown, Mrs. A. J.	,, ,,
Brown, Edwin A.	Bank House, High Street.
Brown, Mrs. E. A.	,, ,, ,, ,,
Burton, Right Hon. Lord	Rangemore.
Burton, Lady	,,
Butt, H. G.	258, Branston Road.
Bing, Mrs.	182, Ashby Road.

Cartmell, A.	119, Alexandra Road.
Cartmell, Mrs. A.	,, ,, ,,
Caney, E.	Messrs. Charrington & Co.
Chatfield, E. J.	Cricketers' Arms.
Charrington & Co.	Lichfield Street.
Churchill, R.	Rangemore Street.
Churchill, Mrs. R.	,, ,,
Churchill, R. A. T.	,, ,,
Churchill, H.	,, ,,
Churchill, L. A.	,, ,,
Clarke, R.	St. Paul's Square.
Connett, W.	93, Derby Street.

Daltry, Rev. T. W., M.A., F.L.S.	Madeley Vicarage, Newcastle, Staffs.
Daniel, E. F.	89, Derby Street.
Dannell, J. O.	206, Ashby Road.
Day, Miss M. E.	40, Lichfield Street.
Day, G. Morland	8, Alexandra Road.
Drewry, W. J., J.P.	Drakelow.
Dunwell, F. S.	28, Stapenhill Road.

Eadie, J.	Barrow Hall, Derby.
Evans, W.	71, Branston Road.
Evershed, S., M.P., J.P.	Albury House, Stapenhill.
Evershed, Mrs. S.	,, ,, ,,
Evershed, Percy	The Oaks, Shobnall.
Evershed, S. H.	Clay Street, Stapenhill.

Fisher, S. J.	32, Derby Road.
Fletcher, Mrs	Routhven, Ashby Road.
Fletcher, Miss	,, ,, ,,
Fox, A.	Cumnor House, Branston Road.

Gaved, T. A.	99, High Street.
Gibbs, T.	45, Grange Street.
Gibson, Thomas	87, High Street.
Gorton, T.	62, Branston Road.
Graham, W. N.	Branston Road.
Grinling, J. C., J.P.	Barton-under-Needwood.

Hallam, Mrs. F.	High Street.
Hallam, Miss	St. Paul's Church Institute.
Hanson, C., Jun.	195, Ashby Road.
Hardy, J. A.	29, Moor Street.
Harlow, Miss A.,	27, Rangemore Street.
Harper, J.	Richmond House, Wyggeston Street.
Harris, W. P.	117, High Street.
Harrison, C., J.P.	Branston House.
Harrison, C. R.	123, Alexandra Road.
Harrison, Rev. G. R.	60, Branston Road.
Harrison, R.	Beech House, Stapenhill.
Harrison, Mrs. R.	,, ,, ,,
Healey, Miss	125, Alexandra Road.
Hearn, R.	High Street.
Hincks, H. S.	Shortlands, Linton.
Hogg, Miss E. J.	The Grammar School, Ashby-de-la-Zouch.
Hooper, A.	Horninglow Street
Hopkins, T.	The Oaks, Newton Road.
Howarth, W.	151, High Street.
Jackson, J. T.	7, Alexandra Road.
Jeffcott, W. T., B.A.	Sutherland House, Branston Road.
Jenkins, T.	Laurel Bank, Stanton Road.
Lathbury, G.	Hunter's Lodge, Horninglow Road.
Lawson, H.	32, Alexandra Road.
Lott, Frank E., Assoc. R.S.M., F.I.C.	Glenthorne, Alexandra Road.
Lott, Mrs. F. E.	,, ,, ,,
Lowe, C.	1, Alexandra Road.
Lowe, T. B., J.P.	1, Alexandra Road.
Lowe, S.	490, Stanton Road, Stapenhill.
Lowe, W. G., M.D.	Horninglow Street.
Lowe, C. H., M.R.C.S., L.R.C.P.	Clay Street, Stapenhill.
Lowe, Mrs. C. H.	,, ,, ,,
Madeley, F.	163, High Street.
Mason, P. B., J.P., M.R.C.S., F.L.S., F.Z.S.	Bridge Street.
Mason, Mrs. P. B.	,, ,,
Matthews, C. G., F.I.C., F.C.S.	58, Charing Cross, S.W.
McAldowie, A. M., M.D., F.R.S., Edin.	Brook Street, Stoke-on-Trent.
Meakin, Lewis J.	Tatenhill.
Meakin, George	Callingwood.
Meredith, J. H.	Sansome Street, Worcester.
Miers, Miss	27, Rangemore Street.
Miller, Rev. S. O., M.A.	Horninglow Vicarage.
Morris, J.	Primrose Hill, Newton Road.
Morris, Mrs. J.	,, ,, ,, ,,
Moxon, R.	206, Newton Road.
Moxon, Miss W. M.	,, ,, ,,
Nowers, J. E.	282, Blackpool Street.

Odling, W., F.I.C., F.C.S.	132, High Street.
O'Sullivan, C., F.R.S., F.I.C., F.C.S.	High Street.
O'Sullivan, J., F.I.C., F.C.S.	High Bank, Ashby Road.
Oswell, B. L.	70, Spring Terrace Road, Stapenhill.
Pearson, W. P.	26, Bridge Street.
Perfect, J. C.	Stapenhill.
Perks, C., M.R.C.S., L.R.C.P.	High Street.
Peters, W. N.	Stapenhill Road.
Peters, Mrs. W. N.	,, ,,
Port, H. H.	103, Scalpcliff Road.
Porter, H.	Donithorne, Horninglow.
Pullin, T. J.	16, Ashby Road.
Ramsden, F. L.	Corporation Gas Works.
Randell, H.	Derby Road.
Ratcliff, Miss F.	Holly Bank, Scalpcliff Road.
Ratcliff, Robert	Newton Park.
Ratcliff, Richard, J.P.	Stanford Hall, Loughborough.
Ransford, Miss	The Infirmary.
Reeve, A.	Matlock Villa, Derby Road.
Reynolds, R.	31, Stapenhill Road.
Riddell, R.	87, Horninglow Street.
Robinson, F.	30, Stapenhill Road.
Robinson, G.	88, Horninglow Street.
Robinson, R. M.	244, Branston Road.
Robinson, T., M.R.C.S., L.R.C.P.	Horninglow Street.
Rugg, H., M.R.C.S., L.R.C.P.	Guild Street.
Rye, H. A.	Stretton.
Sadler, J. W.	11, Market Place.
Sadler, L.	,, ,,
Sadler, Mrs. M. T.	10, Lichfield Street.
Salt, E. D.	Newton Solney.
Salt, Mrs. E. D.	,, ,,
Salt, W. C.	Willington Hall.
Samble, J.	Stapenhill.
Samble, Mrs. J.	,,
Sharpe, B.	55, Stanton Road.
Slator, Henry	9, Lichfield Street.
Smith, D.	145, High Street.
Smith, Mrs. D.	,, ,,
Smith, E.	1, Alma Terrace, Sandown Lane, Wavertree, Liverpool.
Smith, W.	Sydney Street.
Soar, W.	120, Alexandra Road.
Starey, E.	26, Stapenhill Road.
Starey, Mrs. E.	,, ,,
Stern, A. L., D.Sc., F.C.S.	Ashby Road.
Stocker, C.	High Street.
Swindlehurst, J. E., Assoc. M. Inst., C.E.	138, Alexandra Road.
Swindlehurst, Mrs. J. E.	,, ,,
Swinnerton, W.	73, Branston Road.

Tabberer, Miss	10, Alexandra Road.
Talbot, J.	Lichfield.
Tarver, G.	Station Street.
Taverner, W.	1, Stapenhill Road.
Thoday, A.	21, Ashby Road.
Thompson, Frank	Newton Road.
Thompson, Mrs. Frank	,, ,,
Thompson, Miss M.	Ivy Lodge, Stapenhill.
Thompson, Miss S.	,, ,,
Thornewill, F.	364, Rosliston Road.
Thornewill, R., J.P	Craythorne.
Tod, A. Maxwell	160, Newton Road.
Tomlinson, H. G.	The Woodlands.

Underhill, C. F.	151, New Street.

Van Laer, N.	195, Derby Street.
Walters, W.	144, Alexandra Road.
Wartnaby, G.	195, Newton Road.
Wartnaby, Mrs. G.	,, ,,
Wells, James G.	Selwood House, Shobnall Street.
Whitehead, T. N.	Bridge House, Bridge Street.
Wilkinson, J.	141, Alexandra Road.
Wilkinson, Mrs. J.	,, ,,
Willcox, J. B.	86, Claremont Terrace, Branston Road.
Wilson, Miss Anne R.	Girls' Grammar School, Ashby-de-la-Zouch.
Wright, Josh.	64, Branston Road.
Wyllie, Miss	27, Stapenhill Road.

ASSOCIATES.

Hind, H. L.	Ash Villa, Ashby Road.
Wells, E. L.	8, Derby Road.

RULES.

1.—That this Society be called the "BURTON-ON-TRENT NATURAL HISTORY AND ARCHÆOLOGICAL SOCIETY," having for its object the promotion and encouragement of the practical study of Natural History. Archæology, and General Science.

2.—That the Officers of the Society consist of a President, two or more Vice-Presidents, Treasurer, General and Excursion Secretaries, Assistant Secretary, Curator, and Librarian; these officers to retire annually, but to be eligible for re-election.

That the Committee consist of nine Members, and that the two Members who have made the least attendances retire annually, and be not eligible for re-election for the ensuing year. All Officers shall be *ex-officio* Members of Committee. Three to form a quorum.

3.—That a General Meeting be held not later than the end of October in each year, for the purpose of electing Officers for the ensuing year, and transacting any other business which may be brought before it.

4.—That Candidates for Membership shall be proposed and seconded (in writing) at any Meeting of the Committee, and may be elected at the next General Meeting by a majority of the Members present.

5.—That the Society commences its year with October 1st. That an annual subscription of five shillings be paid by each member *in advance*, and that all Members whose subscriptions are six months in arrear be considered to have forfeited their privileges as Members of the Society; that all Members who have not given notice to the Treasurer or Secretary of their intention to retire before the Annual General Meeting in October shall be held responsible for the current year's subscription.

6.—That the Committee may elect as Associates any persons under the age of eighteen, and that the subscription of such Associates be one shilling per annum, payable in advance; Associates to have no voice in the appointment of officers or the management of the Society, except in the election of their own Secretary, who shall be considered as a Member of the General Committee.

Note.—Associates must be elected Members in the ordinary way on exceeding eighteen years of age.

7.—That the Committee may recommend as Honorary Members any person distinguished for scientific attainments, or who may have in any special manner advanced the interests of the Society.

8.—That Field Meetings or Excursions be held during the year, in suitable localities, and that timely notice of each be given to the Members by circular.

9.—That in addition, the committee may organize a series of Field Meetings for Junior Members, under the leadership of one or more Members of the Society, to be invited for that purpose by the Committee; such Meetings to be devoted to practical explanation and the collecting of specimens.

10.—That Evening Meetings be held during the Winter months at such times and places as the Committee may appoint, for the exhibition of speciments, and the communication or discussion of any subjects connected with the objects of the Society; **that at Evening Meetings Members may introduce one friend, but no one resident in or within five miles of Burton may be present at more than two Evening Meetings in one Session**; that the notice of Meeting sent to each member be the entrance ticket, admitting bearer and one friend; that the secretary be empowered, on application, to issue additional tickets when necessary; and that a book be kept at the door of the place of Meeting in which Members must enter the names of any friends they introduce.

11.—That the Committee may select and recommend to be given annually a series of prizes for the best selection of specimens in any one of the branches of Natural History made by Associates individually during the preceding year, and that Members be invited to offer Prizes or Special Subscriptions for that purpose.

12.—That the Committee have power to make such arrangements as they may consider advisable for the establishment of a Museum in connection with the Society, for the preservation of specimens illustrating the Natural History and Antiquities of the district.

13.—That after providing for the payment of all incidental expenses, the funds of the Society shall be applied to the maintenance of a Museum, the purchase of Books, Journals, etc., or in any other way the Committee may think likely to advance the interests of the Society.

14.—That the Committee have power to make rules for the circulation amongst the Members generally, of Books, Periodicals, etc., belonging to the Society.

15.—No rules of the Society shall be altered except at a General Meeting called for that purpose.

LIBRARY.

NUMBER.	TITLE.	AUTHOR
1	School Botany	*Lindley.*
2	Manual of Botany	*Balfour*
3	Elements of Botany	*Balfour.*
4	Handbook of the British Flora	*Bentham.*
5	Elementary Botany	*Grugeon.*
6	Useful Plants	*Johnson and Sowerby.*
7	Elements of Metallurgy	*Phillips.*
8	Elementary Course of Geology	*Ansted.*
9	Students' Elements of Geology	*Lyell.*
10	Introductory Text Book of Geology	*Page.*
11	Advanced Text Book of Geology	*Page.*
12	School Manual of Geology	*Jukes.*
13	Laws of Winds prevailing in Europe	*Ley.*
14	Elementary Geology	*Skertchley.*
15	Geology and Mineralogy	*Buckland.*
16	Manual of Geology	*Harrison.*
17	Popular History of the Aquarium	*Sowerby.*
18	The Aquarium	*Taylor.*
19	The Fresh Water Aquraium	*Hibberd.*
20	Mineralogy	*Ramsay.*
21	British Butterflies and Moths	*Newman.*
22, 23	Manual of Butterflies and Moths—Vols. I & II	*Stainton.*
24	Notes on Collecting and Preserving Natural History Objects	*Taylor.*
25	British Coleoptera	*Spry & Shuckard.*
26	Modern Meteorology	*Ley.*
27, 28, 29	Nests and Eggs—Vols. I, II, III	*Morris.*
30	Lepidopterist's Guide	*Knaggs.*
31—40	Circle of the Sciences, Vol. I to IX	*Orr.*
41	Popular History of British Ferns	*Moore.*
42, 43.	British Mosses—Vols. I and II	*Tripp.*
44	Popular History of British Mosses	*Stark.*
45	Synopsis of British Mosses	*Hobkirk.*
46	Natural History of Selborne	*White.*
47	Dale and its Abbey	*J. Ward.*
48	History of Uttoxeter	*Redfern.*
49	British Mollusks	*Tate.*
50	The Bone Caves of Creswell Craggs	*Mello & Dawkins.*
51	Old English Churches	*Markland.*
52	Moab's Patriarchial Stone	*King.*
53	A List of Diurnal Birds of Prey	*H. Gurney.*
54	History of British Butterflies	*Rev. F. O. Morris.*
55	Lepidopterist's Calendar	*J. Merrin.*
56	Larva Collecting and Breeding	*Rev. J. S. St. John.*
57	British Beetles	*Rye and Fowler.*
58	British Pyralides	*J. H. Leech.*
59	British Tortrices	*S. J. Wilkinson.*
60	Insect Hunter's Companion	*Rev. J. Green.*
61	Flora of Derbyshire	*Rev. W. H. Painter.*

62 Flora of West Yorkshire ... ... *Yorkshire Naturalists' Union.*
63 Flora of Repton ... ... *Garneys and others.*
64 Lectures on the Physiology of Plants ... ... *Sachs.*
65 Flora of Warwickshire ... ... *J. E. Bagnall.*
66 Flora of Leicestershire ... ... *F. T. Mott and others.*
67 Naturalistic Photography ... ... *Dr. P. H. Emerson.*
68 Chemistry of Photography ... ... *R. Meldola.*
69 Dictionary of Photography ... ... *E. J. Wall.*
70 Book of the Lantern ... ... *T. C. Hepworth.*
71 Negative Making ... ... *Capt. W. de W. Abney.*
72 Processes of Pure Photography ... ... *Burton and Pringle.*
73 Chemistry of Light and Photography ... ... *H. Vogel.*
74 Reports of the Burton-on-Trent Natural History
and Archæological Society, 1876-84.
75-76 Transactions do. do. do. Vols. I and II.
100-104 Year Book of Scientific and Learned Societies, 1889-91.
110-118 Reports of the British Association, 1886-96.
120-129 Midland Naturalist, 1884-93.
135 Handbook of Cardiff—*Compiled for British Association Meeting.*
140 Optical Projection ... ... *Lewis Wright.*
141, 142 The Year Book of Science, 1891, 1892 ... ... *Bonney.*
143, 150 The Grevillea (1872-1889.)
151 Handbook of British Fungi ... ... *M. C. Cooke.*
152 Birds of Staffordshire ... ... *Dr. A. Mc Aldowie.*
153 Staffordshire Knots ... ... *Edited by Dr. A. Mc Aldowie.*
154 Gresley Charters ... ... *I. H Jeayes.*
155 Beginner's Guide to Photography ... ... *Perkins, Son & Co.*
156-157 Journal of the Derbyshire Archæological and
Natural History Society, 1885 & 1891.

PAMPHLETS AND REPORTS OF SOCIETIES.

Geography of Warwickshire ... ... *Fretton.*
On Quartzite Pebbles ... ... *W. J. Harrison.*
On the occurence of Hæmatic Nodules in Leicestershire *W. S. Gresley.*
Foundation Charter of Burton Abbey ... ... *Duignan & Carter.*
Education and Culture ... ... *Rev. A. Mackennal.*
The Atmosphere of the Birmingham Town Hall *Dr. G. H. Morris.*
Recently discovered Insects in Carboniferous and Silurian Rocks *H. Goss.*
Prehistoric Factory of Flint Implements at Spiennes *Rev. J. M. Mello.*
History of the Creswell Caves ... ... ,, ,,
Les Grottes de Creswell ... ... ,, ,,
Microscopical Structure of Rocks ... ... ,, ,,
Report on Prehistoric Inhabitants of Great Britain *British Association.*
The Lepidoptera of Burton-on-Trent and Neighbourhood *Entomol. Section.*
Prominent Moths of Bucks ... ... *Rev. H. Harpur-Crewe.*
History of Tatenhill ... ... *Upton.*
Dale Church: its Structural Peculiarities ... ... *John Ward.*
Method of taking Phenological Observations ... ... *E. Mawley.*
Ordnance Map of Burton-on-Trent and District.
A Contribution to the Chemistry and Physiology of Foliage Leaves ... ... *H. T. Brown and G. H. Morris.*
Variation in the Shells of the Mollusca ... ... *P. B. Mason.*
Mosses and Hepatics of Staffordshire ... ... *J. E. Bagnall.*
British Museum (Natural History) Guides to the Zoological,
Geological, Mineralogical, and Botanical Departments.
British Association, Illustrated.
Programme of Toronto Meeting, 1897.

SOCIETIES WITH WHOM PUBLICATIONS ARE EXCHANGED.

Birmingham Natural History and Microscopical Society (1880-91)
Dulwich College Science Society 1890-92)
Elisha Mitchell Society, North Carolina, U.S.A. (1889-94)
Holmesdale Natural History Club (1888-95)
Leicester Literary and Philosophical Society (1890-96)
Marlborough College Natural History Society (1889-94)
North Staffordshire Naturalists' Field Club and Archæological Society (1877-95)
Nottingham Naturalists' Society (1878-91)
Yorkshire Naturalists' Union (1877-1864)
Yorkshire Philosophical Society (1849, 1855, 1886-94)
Sheffield Naturalists' Club (1894, 1895)

LIBRARY REGULATIONS.

1.—Books shall be issued to Members by the Librarian, General Secretary, or Assistant Secretary only,

2.—No Member shall have more than two Books at any one time.

3.—Any Book may be retained for one month from date of issue provided no other Member has applied for it in the meantime, in which case it must be returned within 14 days of date of issue, or on demand, as the case may be.

4.—On returning a Book, a Member may renew it for a further period of one month should no other application be made for it.

5.—All Books required for Sectional Meetings must be applied for beforehand in the usual way by the Secretary of the Section, who will be held responsible for their safe custody and return.

6.—All Books must be returned to the Library by September 1st in each year, and will not be re-issued until October 1st.

7.—The Officer who issues or receives a book shall make an entry of the same in the book provided for that purpose, and initial it.

8.—Members will be held responsible for Books issued to them, and will be required to replace all Books lost or damaged while in their custody

TRANSACTIONS

OF THE

BURTON-ON-TRENT

Natural History & Archæological Society.

EDITED BY

THOMAS GIBBS,

Hon. Secretary.

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BURTON-ON-TRENT

Natural History and Archæological Society.

A Resumé of the History of our Society.

By Frank E. Lott, Assoc. R.S.M., F.I.C., &c.

Presidential Address, delivered November 14th, 1895.

[condensed.]

I PROPOSE in this paper briefly relating the history of this Society, more especially as regards the work it has done up to the present, and I hope a consideration of that work and of the difficulties that have beset those who have had the management of the Society will enable me to make it clear to you all in what direction we should look for future success, and how each individual member may take a part in promoting it.

Previous to the formation of our Society there had been two attempts to maintain Societies with similar objects in our district. The first was that inaugurated by the late Sir O. Mosley in 1842, an account of which appeared in the last part of our Transactions. The second was called

The Midland Scientific Society, and during the Sixties, met alternately at Derby, Nottingham, Burton, Lichfield, and Leicester, the late Mr. E. Brown being its leading spirit.

Our own Society largely owes its existence to the enterprise of three gentlemen—the late Head Master of the Grammar School (Mr. C. U. Tripp), the Rev. C. F. Thornewill, and the late Mr. William Molyneux. These gentlemen called a Public Meeting in the Grammar School, on October 27th, 1876, and at this meeting our Society was formed.

The election of Mr. Evershed as the first president, and the reading of a most interesting paper on "The Old Bridge of Burton-on-Trent" by Mr. Molyneux at the first meeting, were steps which well indicated the thoroughly representative local character of the movement. In four months nearly 250 members and junior members had enrolled themselves, and I believe the only approach the Society has made to that number, since those early days, was in 1894, when the total number of members and associates was 242.

I will now briefly consider the work done by the Society during the Presidentships of Mr. Evershed, the Rev. C. F. Thornewill, Messrs. Henry Tomlinson, W. Molyneux, and Robert Thornewill, that is to say, from 1876 to 1881. During the whole of this time Mr. Tripp was our indefatigable Honorary Secretary. The subjects introduced and discussed were of a varied nature; thus of Archæological interest, besides the paper on "The Old Bridge," Mr. Molyneux read papers on "The History of Burton" and on "Bosworth Field"; Mr. Robert Thornewill read two papers on "The History of Burton Abbey." Mr. J. C. Cox gave us a paper on "The Churches of Derbyshire," and the Rev. J. King one on "Underground Jerusalem."

Entomologists were well provided for, the Rev. C. F.

Thornewill, the Rev. W. Fowler, Messrs. J. T. Harris, W. C. Owen, and W. G. Blatch reading papers, some of which were of special interest to Agriculturists. Messrs. Jerome Harrison and H. T. Ford read papers of considerable Geological value, and the Rev. T. F. Fenn, Dr. Lawson Tait, and Mr. J. C. Grinling treated of Nature from a Botanical point of view. In the department of Zoology there was Mr. Henry Tomlinson's delightful paper on "Birds and their Habits," Mr. Auty's paper on "British Fresh Water Fish," and Mr. Mason's "Introduction to the Jelly Fish" with his most beautiful glass models. Finally, papers by the Rev. J. M. Mello, provided for those who took an interest in recent discoveries as to pre-historic man.

During this period of the Society's life, two Soirées or Conversaziones were held, the first, in the original home of the Society—the Grammar School, the next in 1878, on a larger scale, in St. George's Hall.

In addition to the general meetings, there were special meetings for the junior members, who then formed a not inconsiderable portion of the Society, and I think we may look upon the introduction of many of our present members as due to their early connection as juniors and the interest fostered by those meetings.

During this period there arose certain conditions which seemed to form the very ideal for an Archæological Society to build up a reputation upon. I refer to the discovery of an ancient, and possibly, pre-historic, burial ground at Stapenhill. and the exposure of the foundations of the old Burton Abbey when preparing the ground for our Market Hall. The Society having obtained permission to fully investigate these two sites, a provisional Committee of members and others was appointed, and a special fund started to pay for systematic exploration. As you have a very complete account of the work done at Stapenhill in the first Volume of Transactions I need not further describe our operations there, and with regard to the Old Abbey foundations, they were traced very carefully, and fully confirmed the plans given in Shaw's History of Staffordshire.

Of other special work, Entomology and Botany alone seemed to attract workers, although I must not forget the regular Meteorological observations so carefully made and recorded by our Honorary Secretary.

During the next five years, 1882-1887, the Presidential chair was held by Mr. C. O'Sullivan, Mr. Geo. Allsopp (then Mayor), and Mr. J. T. Harris. For more than half this time I had a much closer association with the working of the Society, having the honour to act as your Honorary Secretary.

Unfortunately this period was one during which we had to chronicle a gradual decline of interest, and the work of the Committee and Officers was more trying, I believe, than at any time, so few members really interesting themselves in the work or success of the Society: as a natural result our numbers fell off considerably. Financially we made the necessary upward start, clearing off our debt, and in the last two years our economies enabled us to increase our balance rapidly.

A great blow to the Society at this time was the loss of its originator and Honorary Secretary—Mr. C. U. Tripp, for, although he was followed by a most ardent enthusiast—Mr. J. Heron—the latter had not been long in Burton, and had not, therefore, the personal influence that Mr. Tripp had. Mr. Heron was most active in organising our museum and working sections, and his enthusiastic conduct of the Stapenhill explorations is but faintly reflected in his admirable paper on the subject.

If we glance rapidly over the list of papers read during these years we shall find a slight reduction in the number read at *general* meetings, but this is more than compensated by a number of most valuable papers read at *sectional* meetings.

During the Winter of 1882-83 the Society made its first venture on Popular Lectures, a series of four being given in St. George's Hall; the Rev. H. W. Crosskey lecturing on "The Age of Ice in Great Britain"; Professor Tilden on "Water: its history, sources, and impurities"; Sir John Lubbock on "Savages"; and Dr. H. E. Bridgman on "Food." The success of this series (the average attendance was over 500) led to another attempt in the Winter of 1894-95: Dr. Barfield and Mr. Wilson Hartnell giving two Lectures on "Electricity" and "Electric Lighting" respectively. These were, however, less successful, for, although well attended, they were a financial loss, the whole of the balance from the previous course being required to make up the deficiency.

Papers by Drs. Perks, Harrow, and Morris, and Messrs. C. O'Sullivan, Heron, Knowles, Horace Brown, Andrews, Matthews, Harris, and Lyle, on such widely different subjects as "The Bayeux Tapestry," "Crystals," "Coal," "The English Alphabet," "Old Burton Manuscripts," and "Bacteria," indicate the comprehensive character of the Society's work, even at a time when interest in it was somewhat flagging. In order to widen the working field we had in 1882 added the words "General Science" to our definition of the work of the Society in Rule 1, thus securing some of the papers above named.

In 1885 we discontinued having Junior Members, or Associates, a change necessitated by our removal to the Institute: this move also deprived us of many other members who objected to the necessity of becoming members of the Institute. A general falling off in our total membership was thus commenced, and continued even after we severed our connection with the Institute.

It was during this period that Mr. Horace Brown began to take an active interest in the Society, becoming our delegate to the Conference of Delegates of Scientific Societies at the British Association Meeting at Birmingham, and reading a paper on Geological work done in the field, which did much to establish his reputation as a practical geologist.

The third period of five years, 1887-1892, was under the Presidentships of Mr. Horace Brown, Dr. Mason, and Mr. T. Knowles. In connection with Mr. Brown's Presidentship it is interesting to note how much the personal element has affected the success of our Society. At the commencement of this period, although holding a substantial balance at the bank, our list of members was at its lowest, and Dr. Morris took over the Honorary Secretaryship conditionally on Mr. Horace Brown accepting the office of President; these two together rapidly worked the Society up into a more vigorous state, personally introducing between thirty and forty new members. Mr. Horace Brown's papers have been numerous, and on a great variety of subjects; and invariably most interesting and attractive. "A Chapter in the Physical Geography of the Past" was both generally and locally interesting, and "The Permian Rocks of the Leicestershire Coal Fields" was the parent paper to one read before the Geological Society. "A Grain of Barley" has been frequently quoted as one of the best short expositions of this subject in the English language, and no local Society could have a more suitable paper, with the staple industry of the town dependent entirely upon the subject treated. "A Tour in Norway" was a more popular subject perhaps, and was most charmingly illustrated.

The subject matter of the papers read at this time is equally varied with that of the papers read during the previous years. Special local scientific work, which appears to me the most valuable of all work for such a Society, is still to be noted, and of this Messrs. Nowers and Wells' paper on "The Salt Marsh at Branstone," and Mr. Knowles' paper on "Ancient Burton Manuscripts" are good examples.

To instance the great diversity of subjects, I will mention the following: "Monumental Brasses," by Mr. Bromwich; "The Idylls of the King," by Mr. Thrift; "Cyclones," by Mr. A. J. Brown; "Trout and Grayling," by Mr. Morland Day; "British Ferns," by Bishop Mitchinson; "The Peasants' Revolt in 1381, by Mr. Bence; and "Westminster Abbey," by Mr. Moxon. I must here refer to Dr. Mason's first Presidential Address in 1889, on "The Functions of Natural History Societies," as it was not until I had considered the subject matter of my paper for this evening and made a sketch of the headings under which to treat it, that I recalled that paper, and, reading it over, saw how thoroughly I had been forestalled in that portion of my subject.

Popular Lectures were again tried with varying success, four in 1888, by Professors Rudler and Clowes and Mr. Whitworth Wallis, and four in 1889 by Miss Amelia B. Edwards, Professor Tilden, Max O'Rell, and the Rev. J. G. Wood, but the average attendance being under 200 they were financially a failure. Mr. Whitworth Wallis was again engaged in 1890, and the Rev. T. Wood and Mr. Herbert Ward lectured in 1891, the attendance being somewhat more satisfactory.

In January, 1890, a very successful Conversazione was held in St. Paul's Institute.

Since 1892 the Office of President has been held by Drs. Morris and Mason, whilst Messrs. Morland Day, J. E. Nowers and J. G. Wells, and T. Gibbs, have successively carried out the duties of Honorary Secretary. The work done in this period is well known to most of you, and, by comparison, proves the interest of members to be as wide and well sustained as ever.

It will thus be seen that the original aim of the promoters of the Society in so far that it should provide Scientific Papers for members and popularise science has been well and continuously sustained, while the introduction of sectional work has been a very important departure, and one which I believe has done much to strengthen the position of the Society, as it has clearly shewn the Executive the direction in which the majority of our active members are interested, and thus enabled your Committee to arrange for increasingly attractive programmes each session. The youngest of all the sections—the Photographic—has proved how valuable an adjunct this science is to all other sciences as well as how absorbing a scientific study it is in itself, and a most delightful conversazione given in St. Paul's Institute three years ago under the auspices of this section, emphatically proved this.

The Calendar of Nature and Phenological chart have, after a continuous and useful life, been abandoned. The Meteorological Observations have been continuously kept, since Mr. Tripp's departure, by Messrs. A. Reeve, J. G. Wells, and T. Gibbs, and form a most useful portion of the Society's publications.

I have so far said little as to the part the excursions have played in the past, but this is not because I fail to appreciate their importance. I am sorry to say, however, that the interest shewn by members has not been proportionate to the amount of trouble taken by those organising these excursions, and members have, not infrequently, shewn anything but consideration for the leaders—sending in their names after the time requested, or, having sent in their names, failing to join the excursion. So much has this matter disarranged your Committee's plans, that fully half the excursions arranged have had to be abandoned. Sectional excursions have frequently been carried out with great advantage to those taking part in them, and in this direction I think we may continue to advance. I cannot leave this part of our Society's history without calling attention to the valuable work done by Mr. T. C. Martin, who, from the formation of the Society until his recent departure from the town was our Excursion Secretary, and who by his energy conduced greatly to the success of the excursions.

I must finally refer to the Volumes of Transactions published by the Society. During the first five or six years the Annual Reports included papers recommended to be printed by vote of the members. This was abandoned about 1881, when the condition of the Society's funds shewed it to be absolutely necessary. Several papers worthy of publication were consequently lost, but an improvement in its finances enabled the Society in 1889 to issue a Volume of Transactions, which I feel satisfied cannot be surpassed for intrinsic worth by any similar Society's production in the kingdom. The second volume might well have been deferred until more papers of value had been accumulated, for, good as the papers are, they are few in number, and, as a volume, it does not compare with its predecessor. Parts i and ii of Volume III are published and contain papers of great interest.

I cannot think that anyone, considering the epitome of work done, can come to any other conclusion than that this Society has been, and is, a successful one; we have had ups and downs, and more than once your Executive have felt that the interest of the few enthusiasts was not shared by the mass of the members, and that it was very doubtful if a Society depending almost entirely on the energy and enthusiasm of a small number of workers was successful enough to be continued; members like our present and late Secretary, who have persistently continued the work of regular observations, meteorological, entomological, and botanical, are, I believe, the mainstay of a Society like this, and it is this slow accumulation of more especially local scientific facts which should be one of the most valuable features of our work, although I am afraid it cannot appeal very strongly to the mass of our members.

Before further considering how far we have done the work that might have been expected, it would be as well to consider what are the objects of such a Society as ours?

I should classify the special work we ought to keep in view somewhat as follows:

1st.—The systematic observation of local natural history facts and their accumulation, together with all the reliable information connected with the historic and prehistoric past of the immediate district, in such a way that they are always available for future workers.

This is more especially the *work* of the Society, and is usually carried out by the few. Undoubtedly it is best done by sections, and I think it is not necessarily the number of members forming any particular section that indicates its success, so much as the enthusiasm of the individual members.

2nd.—The promotion and encouragement of the study of Natural History, Archæology, and General Science. This is what our Meetings, Lectures, and Excursions aim at, and I need hardly say that every member can assist in this by attending, introducing friends, and joining discussions both formal and informal.

The rules which enabled us to have Junior Members in the early days and lately Associates, were framed with the idea of assisting in this part of the Society's work, but I would point out that experience leads us to the conclusion that it is not desirable to elect actual school-boys, but rather boys who have just left school; the former are best under the care of masters, whereas the latter have arrived at a time in life when the introduction of some interest outside the daily routine of business is extremely desirable.

3rd.—The collection of specimens and establishment of Museum and Library. Except in such towns as possess a public museum to receive such collections, and a curator to take proper care of them, the establishment of a Museum is, I believe, best left to private individuals, and our late President's delightful museum is, I think, an ample proof of my contention, especially when compared with our own feeble store-room of specimens.

No doubt the Library is a much more useful adjunct, but in these days of Free Reference Libraries, I doubt if there is the same necessity for it that there used to be. A Society's Library should, of course, be a special one, restricted almost to the standard text books and books of reference to the various sciences, together with the usual scientific periodicals, year books, and transactions.

4th.—The purely social side, that is to say the bringing together of people of like interests, more especially those who feel that their brains are worthy of more use than simply money making and "getting on"; in fact, that there is a "getting on" in intelligence and a storing up of brain power, which is of somewhat greater value. Our meetings and excursions attempt this and I believe have been fairly successful, but I hope in the future that success may be even more marked, and that short papers and long discussions, which to my mind indicate the true vitality of a society, may be more numerous. It appears to me that at the present time this is the special direction in which we must look for advance. I should feel somewhat inclined to propose reducing the number of evenings devoted to long papers, and replacing say two such evenings a season by two evenings devoted to discussions on scientific subjects of immediate special interest and the asking of questions that members may wish to have information upon, and surely a society, numbering so many members with letters indicating degrees or membership of learned societies, could well conduct such evenings of discussion.

Considering these questions in the light of our Society's past history, it is, I think, necessary to point out the changes which have taken place in the world of science during the years of our Society's life—practically the past 20 years. During that time the science of all subjects has been enormously developed, special societies for those interested in almost every individual science have been established, and at the present day there is hardly a single important interest in life, the facts concerning which have been accumulated in a scientific manner to form the *science* of that interest, which has not its own special Society.

Take for instance, Chemistry. For many years the Chemical Society, Royal Society, and Royal Institution, practically received and brought before the public almost the whole of the new chemical work of each year, together with the great bulk of investigations in Physics, Mineralogy, Photography, and several other sciences, but during the intensely active years since our Society was established, The Society of Public Analysts, The Society of Chemical Industry, each issuing well filled monthly journals, several Photographic Societies, the Mineralogical Society, and the Physical Society, have all been established, and gladly welcome papers on the chemical work of the day.

As with Chemistry, so with all the other sciences, and the great difficulty any worker now has with regard to placing his work before the scientific public, is to decide to which of these bodies he shall offer his papers. Then the annual gatherings of the British Association, with its sectional meetings for special subjects, and of the Geological Association, are openings which enable many workers to publish their results.

The enormous increase in the number of scientific periodicals, and in fact the opening of the press generally to scientific articles, has had a very great effect in reducing the amount of new work to be recorded and brought to light by local societies.

On the other hand, many more people are interested in science generally; there are more subjects open for discussion, and it is gradually becoming clear to most thinking people that they have long been more or less scientific without knowing it, and that there is no necessity to be either a recluse, or a long-haired spectacled stoic, to be interested in or undertake scientific studies.

Whereas, twenty years ago, we in Burton might well have expected our scientific brewers to have read papers on the science of brewing and the subjects allied to it, before this Society, now we know that besides the Chemical Society claiming more especially research work, there are other societies for the consideration of Chemistry, Geology, and Microscopy; four Brewing Institutes; three or four brewing journals, besides a daily press omnivorous in its capacity for scientific and technical communications. We may thus feel satisfied that what was originally a most important feature in the work of societies like ours—I mean the providing an opportunity for placing new scientific work permanently on record—is now less likely to be required, and moreover, a greater general knowledge of scientific facts makes it less necessary to provide papers on the simple elementary aspects of science. There are however now such a vast number of subjects upon which members may expect information, that the duties of your Secretary and Committee in arranging a programme should be less difficult.

Our late President made a new departure which appealed very strongly to my present tastes, when, in his last presidential address he took up the more philosophical side of science, and I hope members will see the advantage of such a departure, and by their interest in such papers show

how much the general advance of the doctrine of evolution has formulated the daily affairs of life upon a scientific basis, and made not merely individuals scientific, but the whole intelligent mass of society so. Just as much as the advance of scientific workers has so interested and benefited the practical manufacturer, that he instinctively follows on the lines laboriously worked out by the student, and thus himself becomes a scientific worker, so gradually will every interest in life tend to be shaped on the lines which the scientific worker indicates as correct.

For many years the pleasure of collecting, classifying, and comparing specimens, was to me all-satisfying, but now I feel there are greater pleasures to be obtained in the pursuit of science. Interesting, and in some instances, valuable as it may be, I do not *now* want to discuss rare trilobites, new varieties of oak-fern, or even the exact atomic weight of Argon, and I do not much care if the Charnwood Forest Rocks are Cambrian or pre-Cambrian, but I do want to know what it all means and what my actual relationship to it all is; of course I am fully aware that it is only by the accumulation of an enormous number of facts, such as I have referred to, and the accompanying classification, &c., that it is possible for us to obtain that information which I now feel to be the more interesting. I am however sure, that what was seen but dimly as through a cloud, when this Society was formed, can now be demonstrated to be a very definite and a very beautiful design, and that wonderful all-embracing theory, Evolution, is the magnifying glass or cloud-dispeller which enables us to piece together the enormous number of facts and observations before referred to, and to see how marvellously interwoven is the whole fabric of the universe, and how essential and yet insignificant a portion of it is each one of us.

The Struggle for Life within the Animal Body.

By Philip B. Mason, M.R.C.S., F.L.S.

Read before the Society, December 12th, 1895.

IN the Address to which you did me the honour to listen at the commencement of our last Session, I attempted to prove, that men and animals, not only individually, but also in communities, are engaged in a ceaseless struggle for life; and further, that the condition of the world at any given moment, represents the momentary equilibrium produced by the sum of these struggles. From this I made the deduction, in truth a matter of the easiest observation, that this condition must and does vary from moment to moment.

To-night I am again asking your indulgence while I endeavour to show that what is true of the macrocosm of the world, is also true of the microcosm of the animal body. For this purpose I will as shortly, and in words as plain as possible, sketch the fundamental plan on which the animal body is constructed, how it increases in complexity as the scale of animal life is ascended, how it grows, how it is nourished, and finally, how it is protected from its enemies, both domestic and foreign. I do this the more willingly, because the researches of the last few years have not only opened up new vistas of knowledge, but also completely revolutionised opinions, held universally but a short time ago.

I intend now to confine myself to the problems of Animal, ignoring those of Vegetable, life. These in the higher members of each kingdom differ too widely to be treated together, I say in the higher members, because the lower animals and plants approach each other so closely, that it has been proposed to form a third or intermediate Kingdom of Nature, the "Protista," to include them both.

The simplest animal consists of a single cell, and the cell is the unit of the animal body. Every part of the highest animal, however modified it may be in form, and however exalted may be the function it subserves, depends for its origin on one or more cells. In fact every animal has been at one stage of its existence nothing more or less than a single cell. As the cell plays a leading part in what I have to say, I will briefly describe a typical animal cell.

An animal cell is a microscopic mass composed of a substance named Protoplasm. The cell is generally originally roundish or ovoid in shape, and under the microscope seems to be made up of three distinct structures, viz: the Nucleus, the Cell-contents, and the Cell-wall. Of these the Nucleus is the essential portion, the others being probably derived from it, the contents being highly vitalised near the Nucleus, while they are nearly if not quite dead at the periphery, where they form the cell-wall.

The simplest forms of animal life consist of a single cell such as the *Monas crepusculum*, this is so minute, that eight millions of them would only occupy the same space as is filled by a grain of mustard seed. The *Amœbæ* are masses of protoplasm, constantly varying in shape, and they feed literally by getting outside their prey, extruding the debris at any convenient part of the body. I refer to these creatures because I shall have to mention them again in connection with the defence of the structures of the higher animals from foreign bodies and other harmful particles.

The animal kingdom is divided into two sub-kingdoms, the Vertebrata and the Invertebrata, or those with, and those without backbones. The Invertebrata were in existence long before the others, which trace their descent through them, from their primordial single-celled progenitors.

Time prevents my treating of the internal life-history of any Invertebrata, and even of the Vertebrata I must confine myself to their highest and most complex member.

Whatever the size, complexity, or mental endowments of any individual animal may be, in every case, it owes its origin to a simple cell. So far as we know, and in this case, probably the whole truth is known, there is no such thing as spontaneous generation, and the saying "Omne vivum ex ovo," or that every living thing comes from an egg, is absolutely true. The originally simple cell has however to go through much growth and development before it leaves the body of its mother, as may be shown by an examination of the egg of the domestic fowl, when in a fit condition to be placed on the breakfast table.

In all cases the first change is the division of the nucleus into two, and this process is continually repeated until the yelk is formed: this when complete, consists of a mass of very small cells. These during the process of incubation become arranged into layers from which the various organs of the body are developed. What a wonderful process! The originally single and simple cell breaks up into parts which acquire the potentiality of forming such diverse organs as bone, muscle, and brain.

However diverse the organs of the body may appear to be, when laid bare by the scalpel of the anatomist, they are all built up of cells, although they may no longer be recognisable as such, owing to their alteration during growth; and further, they are all descended from the one primordial germ or egg-cell. The hard framework on which the body is built up, or bones, the muscles which move the bones, the nerves which call the muscles into play, the glands by which the nutrition of the body is effected and its waste removed, the blood, the heart and vessels by which the circulation of the blood is carried on, and the delicate structures of the brain, the organ of thought, are one and all "ab origine" cells. Even the surface of the skin, which requires constant renewal in order that we may maintain relations with the external world is covered with cells. If the skin be lightly scraped, or a fragment of a finger nail be taken and treated with caustic potash, and the result examined under the microscope, a single glance will show its origin. The secretions of the glands themselves, whether they are destined for further use in the body, or are mere waste to be got rid of, have been at one time parts of cells.

If this were not so, how could a wound of any organ or tissue be repaired? If they were formed of a homogeneous substance, as of India Rubber for example, repair would be impossible. The nuclei of the adjoining cells however, retaining their pristine powers of division, nature can and does form new cells, and so repairs the continuity by processes similar to the original growth.

In every living animal there are two kinds of life, viz: the life of the animal as a whole, that is, the bodily or somatic life, and the separate lives of every individual cell of which it is built up. The lives of the separate cells are so independent of each other, that an old friend of mine, one of the most distinguished Zoologists of the second quarter of this century, actually published a classification of the Animal Kingdom, in which he grouped the different forms of the cells in the body into distinct genera, as independent animals. He was moreover, no mere theorist, but an able and acute observer, as you may conclude from the fact that he was the first to demonstrate the animal nature of the sponge. I do not mention this in order to affirm the truth of his theory, but to emphasise the fact that there is a cellular life, quite independent of the general life of the whole body. Once however the somatic life is destroyed, the lives of the separate cells soon come to an end, and this also occurs, even when they are merely separated from the living body without the destruction of the life of the whole animal. On the other hand, the destruction of a certain proportion of the constituent cells, at once puts an end to the collective life of the whole.

We here come, as we so constantly do when examining these problems, to the insoluble mystery of *Life*. In one sense the life of the individual is the sum of the lives of his constituent cells, yet, take away millions of these cells, as is done when a limb is amputated, the wound once healed, life goes on as before. When the collective life is destroyed, at once the force which held the complex organic compound of protoplasm together is lost, and what is called decay begins, and the Scavenger Bacteria commence their work, and the body is reduced to simpler constituents, which can then again and again, in myriads of ways, be used in the laboratory of Nature, for the construction of new bodies, and so continue their function in the never-ending cycle of life.

Nor is this all. No animal is the same for any appreciable period of time: the so-called man of to-day, is not the man of yesterday, after the lapse of a few years, very little of the material body of the individual remains unchanged: whatever identity there be, is in the mind, and who shall say that this remains the same from day to day? Not I, for one, since the impressions left on the brain by earlier events become obliterated, and the halls of memory filled with new guests. But for all this the general appearance of the individual remains unchanged.

Thus the life of the body, is in a way the lives of its constituent cells, and the material of which they are formed is in a state of continual change. Further than this, these cells are themselves ever going through a constant cycle of youth, growth, maturity, and removal from the body, either by absorption, or by casting off the whole cell. To prove this, I need only mention the case of the hair and nails, which are as truly parts of our bodies as are the heart and lungs. This change which comes about by a descent from cell to cell, no more alters the identity of the body than would a journey from here to London. These facts, I think, justify my previous assertion, that mysteries exist, enshrined within our bodies, likely to ever remain incomprehensible to merely human faculties, and pushed to their logical conclusion they almost justify the school of thinkers, headed by Bishop Berkeley, who assert that there is no such thing as matter, that it does not exist at all.

We can, to a certain extent, by the exercise of our wills, influence the growth, and increase or decrease, of the cells of particular organs of our bodies. But this can only be effected in one way, that is, by increasing or decreasing the use of that organ. For example, the arm of the blacksmith, by constant use, increases in bulk and strength until it becomes capable of feats of power and endurance. quite unattainable by the purely brain-worker, and vice-versa. It follows from this, that the attainment and maintenance of perfect health, the "mens sana in corpore sano," or a sound mind in a sound body, depends on a due balance in the use of each and every organ of the body and mind, so that no undue development or wasting shall take place in any of them. Unfortunately this condition cannot be maintained for more than a limited time, since old age must come, and some structures are more highly vitalised or stronger than others from the beginning, so that they grow old more rapidly, in the one case one tissue or organ being the weaker, in the second another, and so on.

I have now to enter on the second branch of my subject, which is, the means by which the life of the individual cell is maintained, and how it is nourished. The exercise of any organ involves the expenditure of force, and as, in the machinery of the body, as in the machinery designed by man, force cannot be created, but only evoked and directed, it is certain that the performance of every action of the body and of every process of thought entails the destruction of pre-existing tissue, originally derived from a cell, since this is the only form in which force can be stored up in the body. If this is to be replaced, it can only be replaced by matter taken in from without, since "ex nihilo nihil fit," out of nothing, nothing comes. I must therefore ask your indulgence while I say a few words on the Physiology of nutrition—a vast subject indeed, and one to which I can only allude in the briefest manner—and mention a few facts, in order that I may make myself intelligible to you, when I describe some of the ways in which Nature protects the body corporate from disease and death.

To the question; how is the necessary pabulum provided? It seems at first sight a sufficient and self-evident answer to say "by the food taken into the body through the mouth." This is in one sense true, but in another, absolutely untrue. because no food is ever directly taken into the body at all. Anatomically the stomach, together with the remainder of the alimentary canal, is nothing but a prolongation of the skin, and is completely continuous with it. If an animal be examined during its early development, this will be easily recognised, and not only so, but in some of the lower animals, such as the Sea Anemone, the skin and stomach may be made to change places, simply by turning the animal inside out, the former skin will then be found to act as an efficient stomach. In the higher animals, differentiation has proceeded so far that the glands with which the two organs are provided have acquired entirely different functions, and fulfil widely different purposes. The glands of the skin are organs of excretion and their action is absolutely necessary to life, as the poor fellow found whose whole skin was gilded to enable him to take part in an Italian pagent, since the result was to kill him.

On the other hand, the glands of the alimentary canal secrete various substances, which so change the food, as to render it capable of absorption into the vessels of the body. I have neither time nor wish to describe the process of digestion, this would in itself require many evenings for its discussion. I need only say that the resultants of the interaction of the food with the secretions of the food-canal, differing in themselves widely, at different parts of its course, are absorbed, partly by delicate vessels called Lacteals, which finally pour their contents into a great vein at the root of the neck, and partly by the veins, these carry it into the liver where it is subjected to the influence of the cells of that organ before it also is allowed to mingle with the rest of the blood-stream.

The amount of food which can be digested, absorbed, and made fit for the nutrition of the various parts of the body, strictly limits the supply of material available for nutrition. It necessarily follows from this, that, if one organ appropriates more than its fair share of the supply, other cells and tissues must go short and consequently suffer from the deficiency.

In order that you may understand the remainder of my paper, I must give a short description of the blood, and of its circulation through the body.

"The blood is the life," said the Mosaic law. This, in one sense is quite true, for if the whole body be deprived of blood, or if it remain stagnant in the vessels for a short space of time, the animal dies at once. Cut off the supply from any part, as may be done experimentally by tying a ligature round a limb, the part beyond the constriction will quickly mortify. In passing, I may say, that this prohibition by Moses, was most probably dictated, not by any idea that there was anything sacred about the blood, or that it partakes in an exceptional manner of the essence of life. The more probable reason is, that the blood is an easily putrescible body, and its consumption, especially in hot climates, would have caused disease. It was part of the wonderful sanitary code promulgated by Moses, which is, in some respects, even in advance of modern regulations. Moses made his Sanitary Bye-laws part of the religion of the Israelites, and to their observance, was doubtless due, in a great measure, their preservation during trying circumstances, and also their eventual predominance among the insanitary Orientals among whom they lived. And who shall say that the continued existence of the Jews as a peculiar race, never absorbed by any of the nations among whom they dwell, is not due, to some extent, to their continued observance of the Mosaic law? At all events it is a well known fact, that the Jews rarely suffer from some of the diseases common among their neighbours.

As both the continued life, and also the due performance of the functions of every cell of the body, depend on the free access to it of the nutrient fluid, that is the blood, I will now give a short sketch of the manner in which the blood circulates through the body.

If an animal be opened after death, there will be found in its body a number of tubes, some of these have thick walls, are empty, and are called Arteries, while others have thinner walls, contain blood, and are called Veins. Tracing these tubes in one direction, they will all be found to end in the heart, while in the other they keep on giving off branches, until they become so small as to be invisible to the naked eye. After death, one side of the heart and the arteries are found to contain air, whence the name. The other side of the heart and the veins contain blood. Thus much has probably been known, since primeval man first began to speculate on the nature of life, and used his flint knives for other purposes than to cut the juicy steak from the bones of his prey. But, although there were dim streaks shooting up above the horizon, heralding the coming dawn of knowledge, it was reserved for our countryman, the immortal Harvey, first to understand the whole truth concerning the circulation of the blood, and so lay, broad and deep, the indestructible foundations of Medicine and the allied sciences.

Harvey inferred from his dissections and experiments, that small channels, now called capillaries, must exist, and connect the smallest branches of the arteries with those of the veins, and that the arteries during life contained blood, instead of Vital Spirits, as had been supposed. He stated that during life there is a ceaseless circulation of the blood, from the right side of the heart, through the lungs, the left side of the heart, the arteries, capillaries and veins, back again to the starting point. The blood therefore is constantly circulating in a closed channel as long as life lasts. Harvey himself never saw a capillary except with the eye of his mind, but now, thanks to the invention of the microscope, the veriest tyro can demonstrate their existence and use, and show the actual passage of the blood through them. The central organ of the circulation is, of course, the heart, and, Alas for the poets! the heart is nothing more or less than a pump! and has no more to do with the affections and emotions than has the great toe. Like other pumps it is provided with valves, so that the blood can only be propelled in one direction.

Briefly, the scheme of the circulation is as follows. The arterial, or purified blood, received into the left side of the heart from the lungs, is propelled through the arteries at the average rate of from 70 to 80 strokes a minute; these vessels keep on dividing until they end in fine hair-like or capillary channels, where the blood gives up its oxygen, purveys nutriment to the tissues, and also partly takes up the waste of the body. The capillaries end in the smaller veins, which themselves keep on uniting into larger and larger trunks, and finally pour their contents into the right side of the heart, whence it is sent into the lungs. Here a similar distribution and re-collection takes place, and, during this process, the blood being exposed in the walls of the air-cells to the air, absorbs Oxygen, its impurities are burnt off and expelled from the body through the air passages, chiefly in the form of Carbonic Acid. After this process, the purified blood is again returned to the left side of the heart, thence again to be sent in a vivifying stream through all the tissues of the body. If, however, the air-cells of the lungs are blocked up so that there is insufficient exposure to the Oxygen of the air, the blood leaves them unpurified and the whole body gradually dies, poisoned by its own waste. To make my scheme complete, I must add, that in one part of the body, viz: the liver, the venous blood coming from the alimentary canal is distributed and re-collected in a method similar to that seen in the lungs, before it mingles with the rest of the venous blood destined to be poured into the right side of the heart. This, however, is effected without the aid of any subsidiary pump.

By means of the circulation, the blood is brought within the reach of every cell of the body, and not only brings nourishment to it, but also carries away from it the products of its own waste, substances which, if not removed, would quickly poison not only the cell itself, but also its neighbours.

In addition to this method of removing waste, another system of vessels exists, called Lymphatics, which also help in the removal of used-up material, and convey it, by means which I need not specify, to discharge it into the great vein at the root of the neck. The contents of these lymphatics is called Lymph, and during its journey, it passes through certain glands, called lymphatic glands, in them, no doubt, its injurious properties are modified, and these glands also act as filters to arrest the passage of harmful solid particles into the blood. It is a well-known fact, that the glands, through which the lymphatics coming from tuberculous or cancerous tissues pass, do arrest, at all events for a time, the tubercle Bacilli and cancer cells, and stop their further progress towards infecting new parts. I have only to add, that the lymphatics of the intestine are called Lacteals, and that it is through them that the fat contained in the food is chiefly absorbed for the nutrition of the body.

I am now in a position to speak of that wonderful fluid, the blood. I shall however, not describe its chemical composition, but only the characters it presents to the eye when seen through the microscope.

If I prick my finger, draw a small drop of blood, and compress it between a glass slide and a cover glass, you will see that the apparently red and fluid blood consists of three distinct elements. There will be seen a great number of yellowish disks, the red blood corpuscles; a few granular bodies, the white blood cells; and these are floating in a clear fluid. These three elements are very distinct in nature and use, and I must say a few words about each of them.

Firstly, about the fluid or blood plasma. This, so long as it is contained in healthy vessels, is fluid, but contact with the wall of a diseased vessel, or with a foreign body, or even with the air, causes it to solidify or coagulate, and it also coagulates after death. It is to this property that the arrest of hemorrhage is due, for if the blood remained fluid after a vessel was damaged, the smallest wound might cause fatal bleeding. After coagulation, the plasma separates into two portions, one fluid, called serum, and the other more solid, called fibrine. The fibrine, during the formation of the coagulum, or clot, entangles the red disks and white cells in its meshes, it then contracts, and gradually squeezes the serum out of the clot, the latter is then seen to be a pale yellow fluid. I have already said that the blood subserves two offices, viz: to promote nutriment, and carry away waste. The plasma then, fibrine and serum together, contain both the nutriment and the refuse.

The refuse produced by the waste is removed from the blood, partly by oxidation in the lungs, and partly by the agency of certain secreting glands; these extract the noxious elements, and the secretions thus formed are conveyed away out of the body.

The plasma contains, in addition to the refuse, not only the fresh nutriment elaborated from the food taken into the stomach, but also, various secretions produced by glands like the Thyroid, which are not provided with ducts to carry away their secretions. I cannot resist the temptation, to add to the mention of the thyroid gland, a few words concerning one of the most brilliant achievements of Medicine during the last few years, especially as it is strictly germane to this part of my subject. Enlargement of the thyroid, Derbyshire, or Newhall neck, as it was formerly called in this neighbourhood, is the cause not only of great deformity, but also sometimes of danger to life, while absence or deficiency of this gland is the cause of a much more distressing condition, called Cretinism: this latter disease takes away from the sufferer almost all power either of physical or mental exertion. It has now been proved, that daily feeding the patient with portions of the thyroids of animals, introduces the necessary secretion into the blood, and remedies nearly, if not completely, the effects produced by the loss of that organ in the patient. To complete, as far as is necessary for my purpose, the account of the uses of the blood plasma, I have only to add that it furnishes the materials, from which the glands secrete the chemical and other compounds, such as the bile and gastric juice, essential to digestion and to other purposes. In this way, also, the secretions of the glandular cells are essential to the health of the other cells of the body.

I next come the red Blood-corpuscles. These are round in outline, slightly concave on each side, and of so uniform a diameter, viz: one three thousand two hundredths of an inch, that they are frequently used as a measure of the size of other microscopic objects. Their principal function is to carry Oxygen from the external air to the cells of the body, and when their number falls much below four millions in a cubic centimetre, the whole body suffers and the person becomes anaemic.

The third element is the white cells. These are true cells, provided with a nucleus, have a granular appearance, and are a little larger than the red disks. I have already said that they are much fewer in number than the others, and of their function I shall speak presently.

If we examine through the microscope the blood as it flows through a living capillary, we observe that it always flows in one direction, and that the red disks pass in a rapid stream along the centre of the vessel, while outside, or rather, around them is a layer of transparent plasma, in this the white cells are carried along more slowly. The white cells may be looked upon as policemen, always on the watch to protect the body from its enemies, introduced from without, such as Bacteria, or from erring portions of the body itself, but I shall explain this more fully later on.

When the body is in a state of perfect health, every cell is not only furnished with sufficient food for its nourishment, but its waste products are also completely removed, and interference with either of these conditions produces disease. It follows from this, that if any part or organ appropriates an undue proportion of the available nourishment, other parts and organs must necessarily suffer from starvation, partial or complete. On the other hand, if the refuse be insufficiently removed, the whole body will be poisoned in a corresponding degree.

I will now briefly describe some of the ways in which the various elements of the blood assist in the struggle for life, and also some of the means by which the body is defended from its enemies, domestic and foreign. The researches of the past few years have fundamentally altered all our conceptions of these processes, and bid fair to furnish us with new and powerful weapons, and new defensive armour, to aid us in our struggle against disease and death, or rather against death from certain diseases. And yet, as is generally the case, when a striking advance of knowledge is made, there have been premonitions of the truth, but these have not been understood, or have been merely looked upon as isolated facts, instead of as examples of a general law. More than a century ago, Edward Jenner, a country Surgeon, showed that by means of Vaccination, Small-pox, that most loathsome scourge of communities, could be robbed of nearly all its terrors. No one now living can realise the horrors of Small-pox, how it destroyed its thousands, and what wrecks it often made of the survivors, leaving them blind and in other ways helpless members of Society.

The two elements of the blood known to participate in the struggle against injurious matter are the serum and the white cells, their modes of action, however, are of very different natures. But, before I begin to describe the way in which they act, I have one other statement to make, which is this, that the white cells of the blood are scarcely distinguishable from the nuclei of the connective tissue cells, that is, the tissue which binds together the various organs of the body. These nuclei probably possess similar powers, and they are both capable of acting in the same way as I lately described the Amœba as doing when taking food into its body. They are also able to change their shape in the same way.

I am now going to speak of the changes seen under the microscope, when the web of a frog's foot is lightly touched by the point of a hot needle. The current of blood previously flowing through the capillaries stops at once, and they become filled with a mass of red disks and white cells mingled indiscriminately together. The frog's foot is, however, hardly transparent enough for the examination of the minuter changes, so that other tissues have to be used for further research. It will then be found that the white cells, which are still living and active, actually pass through the walls of the capillaries, and they do not seem to pass through pre-existing openings, but through the nearest part of the vessel. The white cells, apparently reinforced by the nuclei of the connective tissue cells, of which I have already spoken, range themselves between the living and dead tissue. The same thing happens when foreign substances have entered the body. But this is not all, when the irritating particles, such as Bacteria, are very small, the white cells proceed to eat up, or include in their own bodies, the dead or foreign particles which would be injurious to the body, from this they have been called Phagocytes, from the two Greek words, phagein, to eat, and kutos, a cell. These cells, after having performed their office, that is, by destroying the invaders, or eating up the damaged structures which they have rendered harmless, themselves die, and are gradually absorbed. If present however in too great numbers, they cannot be removed by absorption, and the dead soldiers or policemen, as they may be styled, collect together to form an abcess, this makes its way to the surface by the easiest route, and this progress is effected by the same process of local death, and by the eating up of the dead material. If, however, the abcess is so situated that it cannot make its way to the surface, the battle has been in vain, fresh poisonous products are formed in it, and these being absorbed by the lymphatics, are conveyed into the blood-stream, and the blood itself is poisoned by them. Again, if so many Bacteria have found entrance, that there is an insufficient number of scavenger cells or phagocytes to cope with them, the defence breaks down, the Bacteria get past the policemen, and enter the general circulation, to find lodgement and multiply in the vulnerable tissues. And the same thing happens when the mass of dead tissue is too large for the number of white cells which can reach it.

The remainder of my paper will refer almost exclusively to the Bacteria, the way in which they are injurious, and the methods by which the body is defended against them. It will be seen from what I have said, that the extent of the danger depends greatly on the number of invaders, and not only so, but also on their character, because some races of the same species are much more active and virulent than others. This partly explains why some epidemics of the same disease are much more fatal than others, I say partly, because there is no doubt that the sanitary surroundings have a great influence on the power of the body to resist the poisons generated by them. I have omitted to say that, broadly speaking, all epidemics are produced by the entrance of poisonous Bacteria into the body, every contagious disease being caused by its own specific Bacterium, and not only these, but also some other diseases, not usually called epidemic, such as tubercle.

Bacteria, when they have effected a lodgement in the body, multiply, and do mischief in two ways: in one, by the local injury they do to the tissues themselves, and, in the other, by the production of a poisonous secretion to which the name of toxine has been given. This may be produced in such quantities as to directly destroy life before the defenders have time to oppose it. But in some way not yet understood, the living cells have the power, *pari passu* with the production of the toxine, to form a substance directly antagonistic to it, and to this has been given the name of antitoxine. The antitoxine is to be found in the blood serum, and has in some cases been separated from it; but there is no evidence that it does not also occur in other portions of the body. There is every probability that it is the formation of this substance which puts an end to the further growth of the Bacteria themselves, and this may perhaps explain why some epidemic diseases have a fixed and limited duration.

I think that these facts explain why Vaccination protects the body against the poison of Small-pox. The vaccine disease is really Small-pox which has been modified by passing through the cow for countless generations, and it is so modified that it has never been known to produce true Small-pox when inoculated into the human subject, or to give rise to an epidemic. At the same time, it apparently makes sufficient antitoxine to protect the body, at all events for many years, from its parent disease.

It has been proved, that if into an animal there be injected a small dose of the Bacteria causing one of these diseases, it will afterwards bear a stronger dose without injury, and this process can be repeated with larger and larger doses, until it cannot be affected by any possible amount that can be given. And now comes the most wonderful fact of all; if the serum of the blood of an animal so rendered insusceptible, or immune to that disease, be taken and injected into the tissues of another animal, even in a comparatively small quantity, that animal will also share its immunity, and further still, this injection, if made into an animal already infected, will, to some extent, modify its progress. This has been proved, over and over again, by the injection of similar doses of the poison into two animals, the one protected, and the other not protected by the injection of this serum.

It is on these facts that the modern treatment of some of the terrible diseases to which the human body is liable, by the injection of serum containing the appropriate antitoxine, is based, the serum being taken from the veins of an animal artificially rendered immune to that disease.

Jenner, long ago, by the patient observation of facts, learnt that the development of the vaccine vesicle in any individual, rendered his tissues unfit to propagate small-pox, but he was quite ignorant of the reason. With the modern methods of the treatment of these diseases, the name of Louis Pasteur is inseparably linked. He proved, that by systematic injection of artificially weakened cultivations of the Bacillus of Hydrophobia, during the stage of incubation in the body, the mortality might be reduced to something very small indeed, a discovery fraught with untold blessings to humanity! Now that it has been proved that immunised serum is efficacious for the treatment, among other things, of Hydrophobia, Lock-jaw, and probably of Diphtheria, new paths of knowledge have been opened up, and no one yet knows, what in the future, may be the use found for materials elaborated in Nature's living laboratory in the treatment of disease, since we have as yet, hardly passed over the threshold of these investigations.

Before I conclude, I might just mention one other fact, which is at the least quite as mysterious as anything I have yet mentioned. It is this: if there be an overgrowth of any particular tissue, as of the fat for example, and if this occurs in a position where the fat normally is found, although it may form an enormous tumour, it will do no particular harm, except perhaps by the pressure exercised by its bulk, and by the undue amount of nourishment diverted from other parts of the body. But if cells belonging to one tissue gain entrance to, and take root in, another tissue, they acquire the strange and fatal power of destroying that tissue in their own growth, and also of eating into any other structure with which they may be in contact, and even more than this, they are capable of sending off colonies to again take root and repeat their destructive action wherever they may lodge; in other words, a *Cancer* is formed. This is a strange mystery of life indeed, that the misplaced cells of one's own body should become the agents of its destruction.

I hope I have now justified the title chosen for my paper, and shown that a real "Struggle for Life" does take place within the animal body; and not only a struggle for the life of the individual as a whole, but also that, in spite of the mutual inter-dependence of the various parts and organs, there may be internecine struggles among themselves. There are struggles, both to obtain sufficient nutriment and also to get rid of noxious material, that is, between the processes of destruction and repair. The powers of good and evil are alike potent, both in the physical and psychical bodies, and the momentary equilibrium is but the resultant of a constant warefare. Incessant warfare is indeed the essence of life, and rest means death.

To this I may add, that our bodies and minds are, to a great extent, what we make them ourselves; use, or allow to lie idle one tissue or organ, and it will grow or decrease to a corresponding degree. Education, both physical and mental, is nothing more or less than an attempt to favour, in the struggle within the body, certain organs and faculties. This process, continued through long periods of time, must, and does, play an important part in the evolution of the race. The wise or unwise directions in which they are educated will influence, not only the present, but also future generations, and they will be better or worse accordingly, as education has strengthened or enfeebled the bodies, minds, aye, and even the moral characters of their ancestors.

For there is as true a correlation between the different organs of the body, and between the different faculties of the mind, as has been proved to exist between the various forms of the physical forces of Nature. It is a well-known fact that it is possible to convert all the physical forces one into another, and moreover, their exact equivalents in terms of each other have been determined. Now no dividing line can be drawn between the purely physical and the vital forces, since the life of the cell can not only be changed into the motion of a limb and the production of heat, but also into the process of thought: the chemical combinations of our food may, therefore, be called the physical basis of the mind. Nature is one and indivisable, and governs all bodies, both of the organic and inorganic worlds, and all the forces of Nature are linked together under a "Reign of Law."

Ripon, Fountains and Durham.

By R. Churchill.

Read before the Society January 23rd, 1896.

[condensed.]

RIPON.

THE inhabitants of the city are pleased to call it "Historic Ripon," and it would appear that the fact of its being built on the banks of a river suggested, in this very particular instance, its name, as the latin word "ripa" signified that position. Not that it was, or is, at all singular to build towns on the banks of a river, but here we have the distinct fact conveyed by its name. In Anglo-Saxon times we find it spelt HRYPPUN and HRYPON, and after that, 'RIPUM and RYPON; still later, and in fact, until quite recently, RIPPON, and now RIPON. The word being latin, it indicates a Roman origin, and within a distance of seven miles lies the "Iseur" of the Brigantes, the "Isurium" of the Romans, or the "Bure" of the Saxons, now known as Aldborough. There are also, within a mile, traditional primitive dwellings of the ancient Britons and evidences of the Druids.

For several centuries its monasteries, churches, schools, and hospitals, practically constituted the town, but in the year 660, Eata the Abbot and other monks founded the "Scots' Monastery"—supplanted by Wilfred's basilica—superseded by a convent of Augustinian canons, afterwards converted into a collegiate church, and finally made the cathedral of the diocese. This Wilfred, whose monastery and churches far excelled any previously built in England, lived in sumptuous style, refused to be consecrated by English bishops, and was eventually deposed and banished. He was, however, afterwards restored to his former dignity, and this event is annually commemorated on the first Saturday in August. The first governors of the town were called "Wakemen" from the Saxon word "wach"—to watch and guard—and this word still continues in the municipal work of the town. Upon the suppression of Fountains Abbey in 1539, the welfare of the town was seriously affected, and then the manufacture of spurs and rowels sprung up, and gave the city a world wide reputation, insomuch that a spur was adopted as the crest of the town arms. Its prosperity, however, dwindled until the 18th century, but the reconstruction of the diocese in 1836 caused a revival, and now the population is double what it was in 1801. There are some curious old customs still extant in this peculiarly old fashioned city, but the limits of this extract do not permit of further reference.

The cathedral has been restored within the last thirty years. Why the celebrated architect who was responsible for this work did not restore the old features instead of destroying them is a matter of regret. I have been enabled to obtain some old photographs of the west front, in which there is positive evidence that he converted the two light windows into lancets, besides other doubtful improvements. Perhaps the most interesting feature of the cathedral is the unfinished central tower, as seen from the interior. The spire of this tower, which was 120 ft. high, fell in 1660, having been struck by lightning seven years previously, and destroyed the greater portion of the choir. The walls of the nave had also been blown down, and the church was practically a heap of ruins. A royal edict of Charles II caused subscriptions to flow in, and a re-building was commenced. Now the original basilica of Archbishop Rogers (tempo. 1100) was without aisles, but when the church was put in repair in the 15th and 16th centuries, the nave was re-erected with these additions. At the same time the south and east arches of the tower were rebuilt in the style of the period, and the piers of the other sides were cased in, evidently with the intention of putting in new arches also, but probably funds failed, and the builders, bowing to the force of circumstances, courageously left the work unfinished in a manner that is perhaps absolutely unique if not architectural.

The choir contains some beautiful oak tabernacle work of about the year 1489. This is without doubt, as the date is carved upon it.

The crypt, probably built 1200 years ago, is attributed to St. Wilfred, and is supposed to have been a vault under the high altar for the deposition of the relics of the saints.

FOUNTAINS ABBEY.

ONE of the first things to strike the mind of the observer is the immense size of this abbey, the monastery and grounds, originally covering ten or twelve acres, the ruins now occupying about two acres The river Skell skirts the site, which is one of the most beautiful that can be imagined. In 1132 certain Benedictine monks of the Abbey of St. Mary's, at York, fell out with their brethren upon points of discipline, and severed their connection therewith. These dissentients, viz: the prior, sub-prior, and eleven monks, appealed for Archbishop Thurstan's protection, and he sent them to Ripon. Joined by Robert of Whitby, they were allowed a settlement in Skelldale, and here they lived under the shelter of the trees only, for a few years. The dean and two canons of York then joined them, and, being rich, they devoted all their wealth to the erection of the building constituting this Abbey, and applied to St. Bernard to instruct them in the rules of the Cistercian Brotherhood. In 1204-47 the more elaborate portions of the Abbey were built, and the choir was rebuilt in the Early English style. It is remarkable that the architectural feature of the north wall of St. Mary's at York is reproduced in the north wall of the choir of St. Mary Fountains, but more elaborately treated, by reason no doubt, of its later date. This consists in the formation of blank windows on either side of the pierced windows of the aisles and an arcading below the cills. Neither of these may be particularly singular in its way, but the similarity of the lines and general details would tend to prove that the old monks of York had brought away ideas from their former residence, or at the later date some communication existed between the two Abbeys, although the brotherhoods were, to some extent, antagonistic.

The tower, originally built at the intersection of the nave with the transept, showed signs of weakness, and was removed. A new tower, a fine example of the Perpendicular period, was erected over the north transept during the 15th century.

Perhaps the most unique portion of the church is the Chapel of the Nine Altars, built at the east end of the choir, magnificent in conception and execution, and surpassing all else. The group of two arches each on the north and south sides, dividing the chapel (or, more correctly, eastern transept) into three parts were supported in the centre by a clustered column of marble shafts. Of these nothing remains but the bases and caps and the octagonal core, which is about 2 feet in diameter and 50 feet high, reaching well up into the clerestory before the arches commence. All authorities are unanimous as to the graceful and splendid treatment of this chapel.

Another interesting part of this great Abbey is the Cellarium, Crypt, or Great Cloisters. It does not appear that the original and subsequent uses of this building are positively known, but in any case, it supports the Dormitory of forty cells above, and consists of two parallel vaulted aisles, each 300 feet in length and 21 feet in width, built during the 12th and 13th centuries.

There is no doubt that at the zenith of its history this Abbey exercised great hospitality. There is the evidence of the large area covered by the outer buildings to support this. The great hall was unquestionably one of the most magnificent apartments ever erected in this kingdom, measuring 178 feet by 70 feet (wider than Westminster Hall, and only about 50 feet shorter), and divided into aisles by eighteen columns shafted and banded with marble.

Again, the Refectory was of immense size, capable of dining between 300 and 400 persons. Here may be found the pulpit from which the brethren were read to during their repasts. To these buildings may be added the Hospitium, the Gate House, and the Infirmary for strangers, and numerous others offices necessary for the administration of one of the finest ecclesiastical residences in England. It is pleasant to know that the Marquis of Ripon keeps this ruin in decent order, and takes sufficient steps to prevent its utter decay and obliteration.

DURHAM CATHEDRAL.

THE length of my paper rendered it necessary to confine my remarks to general rather than particular reference to the interesting details of this magnificent edifice. One cannot help feeling, upon the first glimpse of this stately pile, perched on the top of the rock covered with verdure and trees right down to the river's edge about a hundred feet below, how enhanced these massive buildings are by their surroundings. Their builders, these old monks, had their wits about them when they selected their sites and laid out their plans. The Cathedral particularly occupies a most unique position. Built on the top of a hill, at the base of which on three sides flows the river Wear, the east and west ends are particularly devoid of any intermediate obstruction, and as the hill at these ends slopes somewhat precipitously to the river and is thickly covered with trees, the effect is altogether charming.

The Cathedral is 469 ft. 6 in. in length, 81 ft. wide, and about 73 ft. high, and its similarity to Fountains Abbey in plan and arrangement in regard to the monastic buildings and its Chapel of Nine Altars, as well as the Crypt, is remarkable. This building is perhaps the finest specimen of Norman, or more properly, Romanesque architecture we have. The foundation stone being laid in 1093, the work was carried on with such energy that in 40 years the great body of the church was completed and roofed in. In illustration of the massive character of this Cathedral, I have ascertained that if all the walls and piers could be got together, the stonework would cover an area equal to the whole length and breadth of the nave and of its full height. An American lady visiting the edifice stated that it was the only English cathedral she had seen that was not "gingerbread." As St. Cuthbert is responsible for the inception of this cathedral, it follows that it suffers by his antipathy to the female sex. A legend to the effect that the proposed erection of a lady chapel was stopped by its continued dangerous settlements under the influence of the deceased St. Cuthbert, necessitating its entire removal to the west end, where it now forms the beautiful Galilee, may reasonably be put on one side in favour of the more likely reason of bad foundations on the edge of the cliff.

The central tower is 218 ft. in height, and the two western towers 144 ft. 6 in. The large tower is practically

15th century work above the roof, but the lower part of the other two towers is Early English. In 1200 all the towers were surmounted by dwarf spires.

The great piers of the nave and choir are fine specimens of Norman incised work, each opposite pair being decorated spirally and otherwise in similar designs. Other objects of archæological interest are the sanctuary knocker on the north door, and some beautiful old ironwork in the bands of the south door leading to the cloisters.

It is a matter of regret to note how this cathedral has suffered under the hands of would-be "restorers" and "improvers." For what reason a former Dean and Chapter were allowed to pull down wholesale, features of beautiful work that can never be replaced, is an enigma requiring solution: but it is a certainty that the edifice has suffered more by so-called restoration since 1796 than by natural decay. The restoration of the east end by Wyatt is severely criticised by all authorities, and the removal of four inches of stone from the exterior of the walls is a barbarism hardly to be tolerated, resulting, as it has, in the demolition of the architectural characteristics of the windows, mouldings and recesses. It was a good thing that at last public interest was aroused, and steps taken to put an end to these vandalisms. In the future it is probable that a proper restoration of vanished buildings may be put in hand, and that, in any case, a rumoured destruction of the Galilee may not come to pass.

The Registers of the Parish Church (St. Modwen's), Burton-on-Trent.

Transcribed by the Rev. Vicars A. Boyle, M.A., B.C.L.,
Vicar of Burton-on-Trent.

THE MARRIAGE REGISTER, 1538-1686.

(continued from page 130.)

1566. Jan. 13. Richard Carter to Margery Troyt.
,, ,, 20. John Wylsune to Catherine Turner.
,, ,, 26. William Ensune to Yesabell Campyon.
,, ,, 28. William Bladune to Anne Maxwell (?)
,, Feb. 2. Henry Bolsune to Cateryne Goodcolle.
,, May 12. William Buckstans to Margyt Gybsune.
,, June 10. John Thrype to Elsabeth Turner.
,, ,, 15. William Hale to Margery Mery.
,, July 15. Thomas Cowper to Secyly Unsyns (?)
,, Sep. 22. Wyllyam Harrysune to Issabell Smyth.
,, ,, 23. Jamys Bacar to Catherine Smyth.
,, ,, 23. Henry Smyth to Anne Heys.
,, Nov. 28. Robert   to Alys Orgyll.
,, ,, 30. John Horobyn to Margery Budworth.
,, Oct. 5. Lenard Ylsley to Alys Cane.
,, ,, 18. Thomas Wast to Margytt Smyth.
,, ,, 31. Robert Hawkins to Alis Dubryg.
,, Dec. 4. Wylliam Asshane to Ellyn Bacar.
1567. Jan. 20. William Jacsune to Maud Bentley.
,, ,, 26.   Watsune to   Hensune.
,, ,, 28. John Jacsune to Agnes Bacar.
,, April 8. John Ossbostun to Margery Townsyng.
,, May 5. Yedward Vyccars to Anne Mallabar.
,, ,, 27. Henry Yeddyall to Agnes Morecoke.
,, June 20. Thomas Elkyn to Margery Plommer.
,, Sep. 15. Rychard Budworth to Margery Astyll.

1567. Oct. 5. Thomas Cogl to Margery Wyrley.
,, ,, 26. Thomas Bladon to Secyly Mylner.
,, Nov. 3. Thomas Sanders to Jone Boucke.
,, ,, 4. Wylliam Haster to Jone Malton.
,, ,, 30. Lenard Sayggar to Agnes .
,, Dec. 1. Wylliam Cowper to Allys Graton.
,, ,, 14. Rychard Adams to Margery Moar.
1568. Jan. 28. Nycolas Turner to Mary Rese.
,, Feb. 1. Crystofor Myddlyton to Senes Bladune.
,, Apl. 23. John Cowper to Crystyan Dycar.
,, May 23. Robert Bakewyll to Dorythe Walker.
,, June 11. John Wyley to Yssat Lowe.
,, ,, 15. Wylliam Burgys to Alys Bracley.
,, ,, 20. Henry Yedward to Yssabell Wakefelt.
,, ,, 26. Rafe Balyntun to Margytt Agarmon.
,, July 12. John Moysley to Ellyn Hawcoke.
,, Oct. 11. Wylliam Beddow to Jone Yegg.
,, ,, 11. Wylliam Jordyn to Johanna Maryatt
,, ,, 24. Wylliam Fyltun to Margytt Stathery.
,, Nov. 21. John Fynny to Agnes Wytmore.
,, ,, 30. Thomas Wyllys to Jone Ball.
,, Dec. 5. Wylliam Wryght to Elsabeth Staffard.
1569. Apl. 18. Robert Robynsune to Sesyle Hychcok
,, ,, 19. Rychard Knygth to Agnes Warde.
,, May 16. Jamys Horttun to Jone Lee.
,, Oct. 19. Rychard Storer to Margyt Sydbotham
,, Nov. 19. Thomas Byrd to Susand Smyth.
1570. Apl. 16. Wyllyam Annyley to Alys Fysshwyke.
,, ,, 18. Wylliam Morgune to Alys Caldwall.
,, ,, 29. Rafe Byrde to Jone Suttun.
,, May 2. Wyllyam Cowper to Agnes Stubys.
,, ,, 28. Wylliam Watsune to Alys Budworth.
,, June 12. Rychard Hemmyng to Ellyng Tone.
,, July 30. John Sherat to Elsabeth Byrde.
,, Sep. 23. Robert Chapplene to Mary Beardmore.
,, Oct. 1. Henry Genny to Elsabeth Andsune.
,, ,, 8. Thomas Amys to Edyt Fulshawe.
,, ,, 9. Rychard Wyke to Catheryne Baxster.
,, ,, 19. Rychard Fransys to Emme Wytley.
,, ,, 19. Jamys Boxstoms to An Hewes.
,, ,, 20. Jamys Budworth to Alys Ball.
,, ,, 24. George Smyth to Mary Alynne.
,, Nov. 1. John Morley to Jone Cottyge,
,, ,, 25. George Stele to Agnes Blont.
1571. Jan. 30. Henry Hyrelond to Alys Fremon
,, Feb. 5. Thomas Hunter to Syssele Chambers.
,, ,, 7. Wyllyam Fermer to Susand Wyttyll.
,, May 14. John Smyth to Alys Clarke.

1571. May 14. Harry Benytt to Mare Harrysune.
,, ,, 18. Wyllyam Banke to Alys Jacsune.
,, June 13. Robert Lese to Anne Masse.
,, ,, 6. Wyllyam Jordane to Elner Cowper.
,, ,, 21. John Byward to Jone Bladune.
,, ,, 29. John Smyth to Caterynne Sherat.
,, Aug. 13. Wylliam Harrysune to Rachell Percar.
,, Oct. 17. John Henley to Mary Turner.
,, ,, 21. Rogyar Jaks to Jone Yncarfale.
,, Nov. 11. Robert Baxstar to Margyt Hygl.
,, ,, 13. Thomas Warde to Kateryne Duttune.
,, ,, 26. Jamys Swene to Agnes Blont.
,, ,, 26. Nycolas Garcer to Jeys Pryntope.
,, Dec. 23. Crystopher Robynsune to Katherine Bech.
1572. Jan. 12. Thomas Allt to Yssabell Marryatt.
,, ,, 15. Thomas Macham to Anne Hyll.
,, Feb. 5. Jamys Budworth to Margery Budworth.
,, ,, 7. John Yomans to Alys Bruer.
,, ,, 10. Harry Morte to Margyt Wodcoke.
,, ,, 12. Thomas Warde to Margyt Weler.
,, ,, 20. Wyllyam Fysswycke to Jone Bee.
,, Apl. 21. Thomas Wrygth to Margery Blest.
,, ,, 26. Rafe Toobe to Jone Abell.
,, May 17. Wyllyam Awys to Margyt Wylder.
,, June 11. Wyllyam Shyppley to Elsabeth Bromley.
,, ,, 16. John Morley to Elsabeth Bredunne.
,, July 13. Wyllyam Byarde to Elsabeth Wrygth.
,, ,, 16. Robert Morley to Jone Bredunne.
,, Sep. 15. Thomas Ferne to Ellyne Hensune.
,, ,, 20. John Campyon to Alys Smith.
,, Oct. 5. John Bostocke to Alys Bladune.
,, ,, 13. Robynsune to Margery .
,, ,, 18. Robert Wyley to Bennyt Watsune.
,, ,, 26. Yedwarde Mowseley to Cateryne Jorden.
,, Nov. 16. Henry Hoge to Jone Roberts.
,, ,, 24. George Ball to Mongyt Batemon.
,, Dec. 15. Wyllyam Smyth to Alys Murecoke.
,, ,, 16. John Batmone to Alys Suttune.
1573. Jan. 19. John Hussharwod to Agnes Asshune.
,, Apl. 11. John Howys to Alys Metley.
,, May 30. Elary Gylbertt to Margytt Fynben. (?)
,, ,, 25. Wylliam Byrde to Alys Smyth.
,, June 15. Wylliam Wodcoke to Bettrys Synsane.
,, July 13. Thomas Fene to Cateryne Cartwryth.
,, ,, 14. Thomas Bond to Emmot Lathbery.
,, Aug. 18. Jamys Skalisbery to Alys Bache.
,, Oct. 11. Rychard Bond to Alys Fycchyt.
,, Nov. 22. Wylliam Wall to Yssabell Forde.

1573. Nov. 26. Wylliam Etune to Agnes Bonde.
,, Dec. 6. Charlys Coke to Mary Hyll.
1574. Jan. 21. Thomas Gybsune to Alys Duffelt.
,, ,, 23. Wylliam Yedward to Agnes Browne.
,, Feb. 15. Robert Budworth te Agnes Cowper.
,, June 3. John Symsune to Jone Ensor.
,, ,, 12. John Home to Ellyne Goodday.
,, ,, 22. Thomas Cartwrygth to Alys Perlbe.
,, July 3. Robert Tunsune to Jone Symsune.
,, ,, 11. George Astyll to Alys Pyckfortt.
,, ,, 17. Wylliam Goodday to Alys Henworth.
,, ,, 18. Thomas Chapmond to Helena Wyfand.
,, ,, 20. John Cowper to Alys Wakefelt.
,, Aug. 5. James to Agnes Baker.
,, ,, 6. Thomas Flemyng to Margery Burrows.
,, ,, 13. Wylliam Bagshaw to Elsabeth Tayt.
,, ,, 18. Robert Kyrkcam to Mudwyne Browne.
,, Oct. 5. John Frygth to Mudwyne Suttune.
,, Nov. 5. Homfre Smethley to Margery Prynsoppe
,, ,, 14. Henry Denstone to Mary Fullshall
,, ,, 18. Wylliam Incarfale to Jone Ygecoke.
,, Dec. 18. Rycharde Ardyne to Emmot Bonks.
,, ,, 22. John to Elsabeth Becke.
1575. Jan. 23. Wylliam Burchyll to Alys Soloway.
,, Feb. 17. Thomas Stanley to Alys Dane.
,, Jan. 26. Yedwarde Bywarde to Margery Geffery.
,, Feb. 1. John Wall to Mary Henworth.
,, ,, 15. John Myddylltune to Yssabell Jacsune.
,, ,, 15. Wylliam Shyltune to Alys North.
,, Apl. 11. Rychard to Margyt Tayt.
,, ,, 13. Wylliam Wrytth to Mary Stapuls.
,, May 16. George Bayte to Mawde Smethley.
,, June 24. Olever to Alys Whryth.
,, Aug. 18. John Butler to Susand Feny.
,, ,, 13. Roland Goodday to Jone Pole.
,, ,, 22. Rychard Mortune to Margery Hampe.
,, Nov. 20. Wylliam Toft to Ellyne Turner.
,, ,, 23. Rychard Allt to Margery Sanders.
,, Dec. 5. Fransys Henshaw to Agnes Warde.
,, ,, 10. John Fynny to Margery Mylnehowse.
1576. Jan. 3. John Botham to Jone Baxstar.
,, ,, 15. Hew Plasterer to Ellyne Hemmyngway.
,, Feb. 21. John Bacar to Alys Day.
,, Mch. 3. Robert to Ellyne Pole.
,, ,, 4. John Halle to Margery Wrygth.
,, May 7. Hew Porte to Elsabeth Warryne.
,, June 25. Wylliam Bromley to Jone Wonde.
,, ,, 20. Robert Syke to Alys Yncarfale.

1576. July 1. William Bladune to Jone Blont.
,, ,, 3. Wylliam Russyl to Jone Baxstar.
,, ,, 14 Wylliam Gudrych to Agnes Bladune.
,, Aug. 12. Wylliam Caldwall to Elsabeth Moltune.
,, ,, 12. John Hawke to Agnes Caldwall.
,, Sep. 24. George Pole to Agnes Nevalde.
,, Dec. 18. Robert Betsune to Jone Smyth.
1577. Jan. 14. John Botham to Mary Campyon.
,, ,, 21. Wylliam Percar to Elsabeth Berdmore.
,, ,, 5. Nycolas Wylkynsune to Agnes Stovbe. (?)
,, May 25. Rychard Beardmore to Ann Hakyn.
,, Aug. 29. Wylliam Walle to Emmot Crockyt.
,, Oct. 21. Thomas Jonys to Ellyne Kenderdyne
,, Nov. 8. Rychard Browne to Alys Harrysune.
,, ,, 28. Richarde Knygth to Yssabel Moar.
1578. Jan. 13. Wylliam Smyth to Mawde Walle.
[No date] Thomas Bladune to Anne Budworth.
,, Jan. 27. Rogyar Wood to Sara Becke.
,, Feb. 5. John Perlebe to Susand Turner.
,, Apl. 4. Jarram Horobyne to Annes Morecoke.
,, ,, 27. William Smith to Alice Bramley.
,, June 11. John Finny to Margery Hawkes.
,, ,, 19. William Inkarfen to Anne Bagshaw.
,, July 31. John Jones to Joan Robenson.
,, Aug. 7. James Webster to Joan Hees.
,, Sep. 1. John Butler to Agnes Sheperd.
,, Oct. 15. William Harryson to Alice Woodward.
,, Sep. 22. Edmund Wells, of Coventry, to Joane Goodcoll, daughter of Agnes Goodcoll, of Wightmere, widow.
,, Nov. 10. Laurence Teyte to Ellyn Moysley Widdow.
,, ,, 17. (beinge the gladsom anniversarye daie of the Q's. Maty.) Thomas ffytchet mercer to Agnes Biddell, of Newton Nethercott, in the parish Swepston.
,, ,, 18. William Porte, of Coventry, to Susanne Wrightman.
,, Dec. 16. John Henson, of Horninglowe, to Seynts Watson, of Stretton.
The Banns of Marriage between Roger Bull, of this Parish, and Mary Weyte, of the Parish of Myckleowre, were certified by me, Anthony Geffcock, to the Minister of Micklowre, on Sat. 29th Nov., and on the following Sunday (being St. Andrew's day) the parties were married by the same Minister of Mickleowre.
,, ,, 16. Richard ffrancis to Agnes Watson, of Stapenhul, of this Parish, were maryed by Robert Jervis, curate of Stapenhull, at Stapenhull Church, on account of the inclemency of the weather, by license of A. Geffcock, Minister of Burton.
1579. Jan. 17. Thomas Walker to Agnes Browne, daughter of Robert Browne, late of Branston.
,, Feb. 8. Raffe Asteley, of Horninglowe, to Agnes Kenderdine, of Burton.
,, ,, 15. Edward Stables to Anne Atkins.

1579. May 3. James Morte to Katherine Watson, sister of Henry Watson, of Burton Extra.
„ „ 16. William Adams, of Winshill, to Marye Browne of the same.
„ June 20. Thomas Robinson, servant of Jo. Clerke, Clothier, to Margerye Jackson.
„ July 21. William Woode, of Winshill, to Joane Moar, daughter of Widdowe Moare, of the same.
„ Sep. 27. James Gilbert, boucher, to Agnes Burges *alias* Dane.
„ Oct. 3. Thomas Jeffrey to Margerye Parker.
„ „ 26. Thomas Chaplin to Agnes Yate.
„ Nov. 2. Roger Bagshawe *alias* Smithe to Izabell Stringer.
„ „ 23. William Lowe to Elizabeth Dingley
„ Dec. 23. Lawrence Browne to Ellin ffishwick.
1580. Feb. 8. Nicholas Hurd, of Repton, to Katherine Harbuckle, servant to Thomas Dutton, of Winshill.
„ „ 11. Richard Baker to Joane Barker.
The banns of marriage between John Betson and Joan Vernam, of Clifton Camvile, were certified Feb. 2, and the said John and Joan were married the next day at Clifton by the minister of the same.
„ Apl. 20. Nicholas Bentley to Elizabeth Nycholas, a stranger and sister to Margaret Dethicke, the wife of William Dethicke, the Lawyer, by licence from th' ordinarie at Stapenhill, by Robert Jervis, Curate of the same.
„ May 27. John Asshemore, of Burton Extra, widower, to Katherine Warde, of Winshill.
„ Apl. 30. William Hill, boucher, to Elinour Vicars (daughter of John Smithe, of Branston, the eldest.)
„ May 7. Richard ffenton, of Branston, to Margaret Hwon of the same.
„ „ 8. ffrancis Walker to Agnes Bladon.
„ June 18. German Gretton, of Shenston, to Elizabeth Sharpe, of Branston, widdowe.
„ „ 20. William Toone, of Hartshorne, to Elizabeth Heathcott, of Horninglowe.
„ „ 27. William Warrin, of Stapenhill, to Elizabeth Illsley, of the same, widdowe.
„ Aug. 8. Edward Goodcoll, of Bryscote, to Margery Adams, widow, only daughter of Henry Hoome, of Hathecote, Greisley, formerly Bailift of Ashbie de la Zouch, by licence of the Bishop (at Greisley).
„ Oct. 3. John Henworthe to Alice Turner.
„ „ 9. Richard Blounte to Anne Johnston.
„ Nov. 3. Richard Redwood *alias* Sharpe to Ellin Astell.
„ „ 20. John Knyght to Anne Budworth.
„ „ 21. Richard Blackburne to Sibill Brodeley.
„ Dec. 11. Jherome Horobin to Elizabeth Wallton, of Langford, Derbyshire (at Langford).
„ „ 13. James Shillton to Margery Cotton.
1581. Jan. 31. Reginald Wharton, apprentice to Richard and Gabriell Cartwright, Allablasterers, to Joyes Hamp, of Winshill.
„ Apl. 22. Thomas Bladen, the midwives sonne of Stretton, to Emmot Beynard, of Branston.

1581. June 6. John Barker to Agnes Gilbert.
,, July 3. Thomas Powno to Jane Streete, strangers from Staley, Derbyshire.
,, ,, 26. Ralph Saunders to Isabell Eyton, of Stretton.
,, July 29. Thomas Browne, of Horninglow, to Katherine Boroman, of Barowne, Derbyshire.
,, Aug. 3. Richard Newton to Margery Wright.
,, Sep. 4. Otiwell Petcher to Agnes Smithe, of Stapenhill (at Stapenhill.)
,, Oct. 2. Henry Bowman to Isatt Smithe *alias* Bullocard.
,, ,, 8. Nicolas Hollmes to Margery Storer.
,, Nov. 6. Nathanaell Hodgeson to Margery Spencer.
,, ,, 27. William Greeneleafe, of Stretton, to Margery Henworth, of Branston.
,, ,, 28. Henry Coxe to Jane Gryff.
1582. Jan. 9. James Bande, of Stretton, to Izabell Bakewell, of ffinderne, Derbyshire.
,, ,, 24. William Sharpe, of Stretton, to Ellen Shorthose.
,, ,, 22. Robert Smythe to Margery ffoxe, of Drakelow, Graysley.
,, ,, 29. Robert Ireland to Ellen Marshall.
,, Feb. 18. John Jackson to Margery Burrowes, of Orton-on-the-hill, Leicestershire.
,, Apl. 28. Henry Mecock, of Whightmere, to Katherine Thurnton.
,, July 16. Thomas Chaplin to Izabell Bache.
,, Aug. 5. Thomas Hampe, of Winshill, to Alice More, daughter of widow More.
,, Sep. 17. John Henworthe to Jane Morley.
,, Oct. 1. William Harryson to Elizabeth Jeffrey.
,, ,, 14. Gabriell Hallam to Elizabeth Townsend, of Horninglow.
,, Nov. 4. William Henworthe to Margaret Adams.
,, ,, 18. John Sawforde to Ellen Carter.
,, ,, 26. John Browne to Elizabeth Whitmore.
,, Dec. 10. John Breerley to Alice Greenesmithe.
1583. Jan. 28. Robert Shenton to Alice Harrison.
,, Feb. 4. William Clarke to Izabell Hicklin, of Langley, Derbyshire.
,, ,, 6. John Hanburye to Joan Bassett.
,, ,, 6. William Swynnerton *alias* Cundeth to Ellen Smith.
,, Apl. 29. Nicolas Atkins, of Rollston, to Ellen Doughtie of Wightmere.
,, May 13. Robert Myllner, of Stapenhill, to Agnes Mercer.
,, June 9. Richard Jordeyne to Elizabeth Wright.
,, ,, 10. Robert Peyke to Joan Sherrat.
,, July 29. James ffichett to Izabell Bladon, of Winshill.
,, Aug. 25. Nicolas Rawlinson to Joan Shenton.
,, Sep. 16. William Bate to Ellen Redwood.
,, ,, 23. William Harp to Maria Adams, of Winshill, widow, by licence of the Bishop.
,, Oct. 6. Ranulph Hardinge to Elizabeth Plummer, widow.
,, ,, 6. Richard Bladen, of Winshill, to Izabell ffytchett.
,, ,, 22. Edmund Hollowaye, son of widow Joan, to Isabell Dingley, daughter of John Deynes.

1583. Nov. 3. Oliver Mecocke, of Stretton, to Margery Malyn, of Branston
,, ,, 5. Thomas Eyton, of Wynshill, to Joan Bladon, daughter of Hugh.
,, ,, 9. Robert Hyde to Jane Enzor.
,, ,, 9. John Hanby to Katherine Gilbert, of Stapenhill.
Misplaced
[1584. Apl. 2. Thomas Mosse to Katherine Leeche, strangers, by licence.]
1583. Nov. 18. Clement Taylor to Judith Walker, strangers, lodging in the houre of John Thrupp, by licence of the Bishop.
,, ,, 19. Richard Ozunne *alias* Sellary, of Stapenhill, to Beatrice Greenesmith.
,, ,, 26. John Sanders, of Poole Greene, to Joan Myllner.
,, Dec. 2. John Heathe, of Burnaston, Derbyshire, to Ellen Illsley, of Stapenhill.
,, ,, 9. John Ratclyffe to Agnes Bullfeeld
1584. Jan. 12. William Baker to Joan Bradshawe.
,, ,, 19. Gerard Brackley, of Stapenhill, to Suzan Plummer.
,, Feb. 4. Lawrence Bande, of Rollston, to Ellen Dakin, of Horninglow.
,, Mch. 3. John Mercer to Elizabeth Williamson, of Newall, Stapenhill, by licence.
,, Apl. 25. Richard Allmonde to Alice Parke, of Stretton.
,, June 14. John Sparkes, of ffleete syde, to Agnes Onesbye.
,, ,, 16. William Baxter, of Branston, to Agnes Orgill.
,, ,, 22. Robert Abbott, of Applebye, Leicestershire, to Agnes Gilbert, of Winshill.
,, July 22. Nicolas George, of Newton Sooney, to Alice Byard, of Brysicote.
,, Sep. 28. William Potter *alias* Walker, the blind man of Winshill, to Alice Newbold, of Linton, Greysley.
,, Oct. 11. Robert Atkins, of Winshill, to Agnes Haste.
,, ,, 25. William Orgill, of Burton Extra, to Agnes Wright.
,, ,, 25. John Stubbs to Margaret Sherat, of Yoxall.
,, Nov. 1. John Meacocke, ot Wightmere, to Izabella Doughty.
,, ,, 8. ffrancis Noone, of Egginton, to Elinor Edge *alias* Marston.
,, ,, 16. William Hyde to Suzanne Porte, widow.
,, ,, 30. John Lowe to Izabell Woodcock.
,, Dec. 13. William Woodcock, the younger, to Anne Melbourne.
,, ,, 14. John Honnisbey, of Norton juxta Twycrosst, to Margaret Seeley, of Winshill.
,, ,, 14. John Hallam, of Horninglow, to Jane Henson.
1585. Jan. 24 Richard Cowper to Joan Saunders.
,, ,, 26 ffrancis Walker to Morgaret Browne.
,, Feb. 3. Hugh Bladen, of Winshill, to Margaret Hampe.
,, ,, 17. Richard Teate to Elizabeth Bradeley.
,, ,, 22. John Massye, of Branston, to Margery Wall.
,, Apl. 25. Ralph Browne, of Branston, to Elizabeth Asperye.
,, May 3. William Wright, wheelwright, to Agnes Heyward.
,, ,, 23. Thomas Allsopp to Joan Jenkins.
,, June 6. Henry Millner, the Younger, of Stapenhill, to Agnes Hallam
,, ,, 20. John Allinne to Elizabeth Daye.

1585. July 11. William Merye, of Tatenhill, to Elizabeth Allcock.
,, Sep. 6. Richard Arnalde, of Netherseale, Leicestershire, to Alice Blount, of Branston, widow.
,, ,, 19. Richard Townson to Alice Bagshawe, of Ashburne.
,, Nov. 26. Richard Babbs to Mary Budworthe.
,, ,, 26. Richard Allsopp to Katherine Campian.
,, Oct. 11. Robert Toone to Elizabeth Dutton (daughter of Thomas, of Winshill). The Preacher being John Caldwall.
,, ,, 25. Robert Wallton to Margery Bullfeelde.
,, Nov. 14. William Denstone to Ann Adye.
,, ,, 15. John Aplebee to Agnes Gilberte.
,, ,, 15. Thomas Stone, Minister of the Word of God, Rector of Warckton, Northamptonshire, to Dorothea Clarke, daughter of John and Izabelle, of Burton. Preacher—Mr. Hugh Blythe.
,, ,, 22. John Marple, of Burton Extra, to Alice Moare.
,, Dec. 6. John Cheyde, of Stapenhill, to Dorothea Wigston (at Stapenhill.)
1586. Feb. 7. William Hofarde to Modwen ffrythe.
,, Apl. 27. Henry Reynalde to Joan Budworthe, daughter of Hugh and Maud.
,, May 2. Henry Dickson, of Burton Extra, to Agnes Byrchill.
,, June 25. Richard Baker, the deaf man, to Joan Holines *alias* Jackson.
,, ,, 20. John Adams, of Tatenhill, to Cicily Bladen, of Stapenhill, widow (at Stapenhill).
,, July 11. Henry Esaye *alias* Grene to Agnes Millner, of Stapenhill.
,, ,, 18. Thomas Daye to Anne Haies, of Shackerston, Leicestershire.
,, ,, 24. Thomas Townerowe, of Eginton, to Joan Cotton.
,, Oct. 3. Thomas Blake to Margery Barker, widow.
,, ,, 11. William Sharpe to Joan Belcher, of Wightmere.
,, ,, 12. Thomas Gilberte, piper, of Winshill, to Margaret ffisher.
,, ,, 24. Reginald Whatton to Joan Barton.
,, Nov. 14. Robert Jackson, of Stapenhill, to Elizabeth Browne, of Branston.
,, ,, 28. William Babbe to Izabell Dakinne, widow.
,, ,, 28. William Marche, of Horninglow, to Elizabeth Kildale.
,, Dec. 10. William Robertes to Alice Woodcock.
1587. Feb. 7. Thomas Baker, Under-Bailiff of Burton, to Frances Bowed.
,, ,, 14. Thomas Morley, of Branston, to Margery Bankys, of Bromley.
,, ,, 7. Edward Wynter, of Worthington, Leicestershire, Esquire, to Katherine Hamner, daughter of William and Elinore Hamner, of ffennes Hall, Brunnington township, Hamner parish, Flyntshire Wales, Esquire, by licence of Richard, Father in Christ, Bishop of Coventry and Lichfield.
,, ,, 27. John Madder to Agnes Applebie.
,, ,, 27. William Wright, of Burton Extra, to Cicily Boltbee.
,, June 26. John Meacocke, of Wightmere, to Elionore Joanes.
,, ,, 26. William Plumer to Izabell Hayes.
,, Aug. 29. George Greyye to Ellen Baxter, widow.
,, Sept 3. Charles Astle to Margaret Bulkley.

(To be continued.)

The Ground-plan of Burton Abbey.

By Henry A. Rye.

Read before the Society, February 13th, 1896.

WE are indebted to a writer whose name is unknown, but whose work is dated 1593, for the key to the knowledge we possess as to the life in, and the various uses of the monastic offices. The work I refer to is "The Ancient Rites and Monuments of Durham," published by Davies in 1672, and Canon Raine in 1844.

Nearly all the monastic orders of the West built on the plan adopted by the Benedictines, which had become fixed early in the 9th century. This plan seems to have been taken from that of a Roman country house, the key note of the monastic plan, like the villa, being the square enclosed court with porticos round, which formed the general living place, and also the approach to the various apartments of special use, which were grouped round it.

From the first an Abbey was laid down according to a regular plan: it often took many years to build, and, in some cases, the work round the cloister spread over one hundred years or more.

The ordinary course was for the Monks, on settling in any spot, to make a temporary wooden building or shelter, clear the ground, and set out their future house as they hoped to build it, setting up temporary wooden buildings in the place of the permanent ones, which were then built as the means of the house or generosity of its benefactors allowed. The course of the building was not exactly the same with all orders, but the church always came first, the Benedictines generally built its eastern half first, as they did at Burton. Then they began the cloister and regular buildings round it; if the nave was not finished, enough of its wall next to the north walk of the cloister was built, to allow of the completion of the cloister. Next came the east walk with chapter house and monks' dorter; next the south walk with frater and kitchens; finishing with the west walk, usually occupied by the Abbots' house in Benedictine Abbeys. If the church had not been finished it was usual to complete this next. Then came the infirmary built towards the east, and then the buildings of the outer court towards the west, guest house, workshops, stables, &c. Many of these often remained only as wooden or half-timber buildings to the time of the suppression.

In dealing with a monastic plan we must first try and find which was the approach, for upon this, in a great measure, the arrangement depended; for instance, at Durham the approach was from the east, instead of west which was more usual, and in using the Ancient Rites as a guide we must bear this in mind, for the normal arrangement was there in a great measure reversed. The parlour and Priors' lodgings being at the east, as more accessible to strangers, while the dorter, common house, and infirmary were on the west for the opposite reason. Burton followed the more usual plan, as the ruins of the Abbey gate, opposite the end of New Street, show that the approach was from the west.

THE CHURCH.

Of this noble building we have nothing left above ground, and very little seems to have been done in the excavations that were undertaken by this Society to make a plan that could have been worked up. Shaw's plan (plate I, fig. 1,) said to be from one at Beaudesert, is of great value, but it is hard to understand unless you know something of the monastic plan, for it is, in part a ground plan, and, in part a first floor plan; it proves however, that Burton followed the normal Benedictine plan. This plan must have been made after the dissolution, for note "these chambers *were* the Abbot's." I should be inclined to think it was made either directly after the first surrender to the King, or just before the surrender of the Collegiate Church, the latter date being the more likely, and I have no doubt the plan would be found to apply to this surrender, which is also said to be Beaudesert, and of which there is no other copy known. The Benedictine church was divided into two, the Upper and lower church. The upper being the Choir of the Monks, the Lower the Parochial church. At Burton the Upper church was built first, as we shall see later on. Round the Upper church were grouped many small chapels, and of these we have numerous notices in an extract preserved in The Monasticon, the original of which was at Beaudesert in 1640. Shaw gives a translation which, however, contains some rather startling inaccuracies. My extracts are taken from Dugdale's "Monasticon."

The work is called "Chronicle of the Abbey of Burton;" this must not be confused with the "Annales of Burton," sometimes called "The Burton Book," this latter containing only two entries of use to us, namely, the founding of the Abbey, given as 1004, and the commencement of the Church, given as 1114, this was the lower church.

Now let us see what we can learn from the Chronicle about the Church. Lawrence, 3rd Abbot, spoiled the feretrum of St. Modwene; this would be at the back of the High Altar. Nigell, 5th Abbot, 1104-1114, began the new work at the west part of the Church; this shows that at Burton the monks had stopped short at their choir, as shewn by the dotted line on plan, and gone on with the, to them, more important parts of the monastic buildings; now

PLATE I.

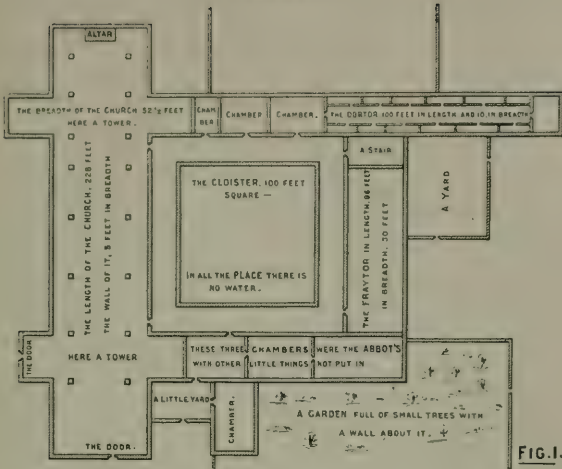


FIG. I.

FIG 2

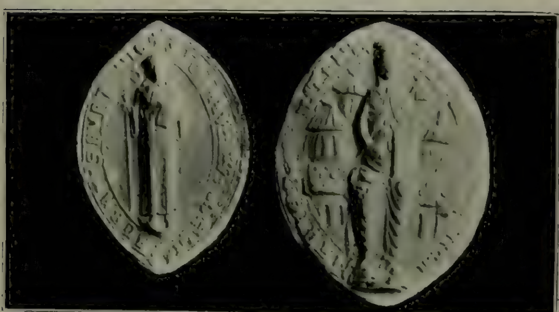


FIG. 3

they go on with the lower or parochial church. We may safely say that the east end of the upper church was finished, as all Norman work with apsidal terminations to the choir and aisles. How long this work was going on we have no definite date to show, but there is evidence which I think proves that it was completed about the early part of the 13th century. This evidence is the Conventual Seal (plate I, fig. 3,) evidently late 12th or early 13th century, which shows a church with central tower, and a west end having two towers.

I will point out something more we may learn from this seal. Our plan is a combination of a plan made of the excavations carried out by this Society upon the site of the Market Hall, and of Shaw's plan (plate I, fig. 1). Shaw's plan, although only a rough sketch plan, was fairly accurate. At the west end of the church some foundations were uncovered (plate II, fig. 1), which show that the west end finished at the line of what looks like transepts in Shaw's plan. Now this makes Hollar's sketch (plate I, fig. 2) fit in exactly with the plan, for he shows the west end finishing with a tower and turret, but if so, what is the part that is shewn in front? Hollar does not show it. Let us turn to the seal again (plate I, fig. 3). A figure sits on the roof of a low building. I think this gives us the key to the whole. At Durham, we find the Galilee in this place, built by Hugh Pudsey, 1153-1194; we know that Rievaulx, Byland, Fountains, and others had such erections at the west end; the seal shows it, the plan points to it; further, Shaw's sketch plan will not work with Hollar's drawing without, for he notes here a tower. The trees in Hollar's sketch hide it. I think we may safely say there was a Galilee at Burton, and this might easily have been proved at the time of the excavations.

Galfridus, 6th Abbot, 1114-1150, built a belfry over the choir, and covered it with lead; this was Norman work.

The seal shows this tower, so this places the seal certainly not earlier than the middle of the 12th century.

Nicholas, 12th Abbot, 1188-1197, was buried in front of the Altar of S. Modwene, between his two brothers, the altar would, in all probability, stand at the west of the Shrine. Nicholas was the first Abbot buried in the church; the usual place for the burial of an Abbot was in the Chapter House at the east end, in front of the Abbot's seat, and this is where the earlier Abbots were buried.

Under Lawrence, 17th Abbot, 1229-1260, the chapel of Blessed Virgin Mary was begun. The convent must have been very flourishing in his time, for there were 300 monks, including servants and lay brothers.

In the time of John Stafford, 18th Abbot, 1260-1280, the prior Michael finished the Chapel of the Virgin Mary.

Under Thomas Packington, 19th Abbot, 1280-1305, the chancel of the upper church was built new and finished (Shaw gives it as the Chapel of S. Mary); it would be during the roofing-in on the 16th December, 1292, that a boy fell from the beams of the church where he was working, at the time of the Vespers, and was killed in front of the High Altar. This is confirmatory evidence of the short apsidal terminations to the Norman choirs, outside which the new decorated chancel and chancel aisles were being erected, and this fully accounts for the work going on at the same time as Vespers.

In the time of John Fisher, 20th Abbot, 1305-1316, the high altar and the altars of the Apostles and Martyrs were dedicated. Before this time the apsidal terminations had been cleared away, and the new Choir thrown open.

Robert Longden, 22nd Abbot, 1329-1340, made the chapel of the Confessors with its vault.

Robert Brickhull, 23rd Abbot, 1340-1348, made the great window (i.e., the painted glass for the window) above the high altar.

John Ibstocke, 24th Abbot, 1348-1369, rebuilt the north side of the Parochial Church, having first pulled down the same and a large synagogue.

John Sudbury, 26th Abbot, 1400-1424, died in 1439, and was buried in the middle, before the Altar in the Confessors' Chapel, under a white stone. In his time Richard Creyton, Sacrist, made a new stone screen, and new roofed the lower church. Also John Babe, Prior and Sacrist, made new stone work to the belfry of the upper church, and new stalls in the choir, with a new shrine for St. Modwen.

William Mathew, 27th Abbot, 1424-1430, was buried in the chapel of the Blessed Mary, above the step against the seat in the wall. In 1426, John Babe, Prior, died, and was buried in the middle of the choir, under an alabaster stone. There is good evidence that William Mathew caused this Chronicle to be written.

Ralph Henley, 29th Abbot, 1432, resigned 1454, was buried in the north walk of the cloister. In his time the belfry in the lower church was finished and a bell hung in it.

William Bronston, 30th Abbot, 1454-1472, was buried in the chapel of the Blessed Mary, under a marble tomb.

Thomas Field, 31st Abbot, 1472-1493, was buried near the vestry door. In 1474 the tower of the lower church fell, bringing down with it the roof of the church and the walls of the precious choir. These Norman towers were usually only case-work, filled in with very loose uncoursed rubble, and the result is that most of them have met the same fate as this one at Burton. That at Durham owes its strength to its enormous area. In 1475 the Abbot rebuilt the roof of the church, repaired the wall of the choir, repaired one of the four columns against the upper choir on the north side, and rebuilt the arch between the upper and lower church and the belfry; he also erected the high altar and steps to the same, and adorned it with tabernacle work.

Here we must leave the church, just saying that we have nothing to guide us in locating the sites of the chapels, but the usual places where such occur.

We leave by the Cloister door of the Upper Church the way the Monks entered and left except when they came to the night offices; they would then enter by the night stairs from the Dorter: these are usually to be found in the South Transept; we are now in

THE CLOISTER.

This was the living place of the monks, and, in the early days, consisted of an arcade, open on all sides to the cloister garth, and roofed with a lean-to against the various buildings. Entering the cloister from the church by the door of the upper church, which was found in the excavations, (plate II, fig. 2), we might expect to find on our left hand the common book case, in Norman work, which we should have here; it was usually a large arched recess in the transept wall. We come next to a doorway shewn on Shaw's plan: this might have led into the Treasury, or, as the "Rites" say, "The Register, wherein certain old written Books of Records and Evidences did lye"; which would most likely be divided, the Sacristy being to the east, and having a door into the south transept. We next come to

THE CHAPTER HOUSE,

the door of which was discovered in 1850 by Mr. Robert Thornewill; the original chapter house would be Norman, and, most likely, have an apsidal termination; the present doorway we are able to see to this day at the back of the Market Hall, and we have the dates of the work from the Chronicle, which tells us that Robert Longden, Abbot, 1329-1340, rebuilt the chapter house from the foundation to the middle height, and Robert Brickhull, his successor, finished the work. How far he altered the rest of the building can only be settled by excavation in the Abbey ground; very likely the apsidal terminations were done away with, and the old chapter house made a vestibule to

PLATE II.

fig. 2

fig. 1

fig. 3

an octagonal building, as at Westminster. The chapter house was the place where the monks met daily, and all the public business of the monastery was transacted, and all offences against discipline were dealt with.

Mr. Robert Thornewill tells me that the building was 62 feet long, and that burials were met with in it. The place of the burials of the earlier Abbots I have already stated was here.

Next to the chapter house door we find a round headed Norman doorway, this was the entrance to the

PARLOUR,

a place for talking, silence being observed in the cloister. This was often a passage, and is mentioned in the Rites "the Parloure Doure, where through the Monncks was caried to be buried," and again, "the Parler Dor, as thei go through into the Senturie Garth." Shaw shows in his plan (plate I, fig. 2,) three chambers, but, as I shall mention further on, this must be taken for the upper floor, yet, as walls in an upper floor generally imply walls in the lower, I think there may have been room for a door, before we come to the angle of wall, at foot of the dorter stair, but I am told none was met with in the excavations; which would lead into the sub-vault of the dorter: this was generally a long vaulted room, having down the centre a row of columns, and divided into various apartments, the use for which must remain matter for conjecture, until a systematic exploration of their remains be undertaken. Most probably first would come the common house, described in the Rites of Durham (where it occupied three bays of the vault) "The house being to this end, to have a fyre keapt in yt all wynter, for the Monnckes to cume and warme them at, being allowed no fyre but that onley * * * " the other bays may have been for storages, here may also have been the buttery. We now come to the

SOUTH WALK.

In the corner was a stair, the doorway of which was met with in the excavations (plate II, fig. 3). This agrees with the plan given in Shaw, for he shows a space with here a stair. The measurements given came very near, Shaw gives the cloister as 100 feet square, the actual measurement being 91 feet from the church wall to this door. Shaw gives more space than is required for a stair, and, I think, if the line of this door had been carefully followed, we should have come upon another door or opening, as at Westminster, where it is called the dark cloister; this would give access to the communicatiou that must have existed between the Infirmary and the Necessaria. From this opening to the frater house door we should expect to find a "a faire long Bench of Stone almost to the Frater house dour," as described in the Rites of Durham; this was provided for use at the monks' Maundy.

Close to the doorway would stand the towel closet, the Rites say "at the end of the said bench, betwixt it and the Frater house dour, ther was a faire Almerie joyned in the wall, and an other of the other syd of the said dour, and all the forepart of the Almeries was thorowgh carved worke and iij dors in the forpart of either almerie and a locke on every doure, and every Monncke had a key for the said almeryes, wherin did hinge in every almeryes, cleane towels for the Monncks to drie there hands on, when they washed and went to dynner." Now we arrive at the door to the

FRATER HOUSE.

Had proper search been made the whole plan of the subvault of this building would have been found, and we should have been able to trace the connection with the kitchen, and determine where the misericorde, or apartment where flesh meat was allowed to be eaten by any of the monks not in the infirmary who had that indulgence granted to them, was situated.

We can only draw our conclusions from Shaw's plan and the description given in the Rites. Entering by the door you would ascend some stone stairs, the sub-vault under containing the cellars, the pantry or covey, where the remains of the food from the monks' table was taken, and afterwards handed through a little window to two children of the Almerie, who came daily for it for the use of the poor children of the Infirmary School, so say the Rites. On entering "within the said Frater House door, on the left hand as one goes in, there is a strong Ambrie" which held the Mazers and plate, and another on the right hand against the west wall, "wherein lay table-cloaths, salts, and mazers, a basin, an ewer of latten, with other things pertaining to the Frater House." Each monk had his own mazer cup of wood with silver gilt edges. The high table stood across the east end and aside near the south end of the high table stood that of the novices. Close against the south wall, built into it, was the pulpit where one of the novices read aloud during meals. The meals were served from the kitchen by hatches in the side wall near its west end; this is where we should expect to find it, and it would then, as at Durham, have served the Abbot's house, the frater, and also the guest hall. I should quite expect to find this building octagonal, as at Durham, Glastonbury, and other places. From the frater house door to the angle we might find "a stoole with iiij feete, and a back of wood joyned to the said stoole, which was maid fast in the wall for the porter to sytt on, which did keape the Cloister doure." We now turn into the

WEST WALK,

and at the corner next the frater we should meet with the parlour door; this was the outer parlour described in the Rites "a place for marchannts to utter ther waires." It was the main entrance to the cloister, and a place where the monks might see and talk with friends from the outer world; this may have been divided, as at Westminster, into two, the outer half being the entrance into the Abbot's house. Next we might find the lavatory as at Westminster: at Durham the lavatory stood in the middle of the cloister garth as a separate building. We learn from the Rites that the north part of this walk was the school for the novices, and we often find a curious illustration of this where the stone bench exists in the cloisters of our old abbeys and cathedrals that have been abbeys, for if you look carefully you will find 9 holes  thus, at Westminster you may see them very plainly, and I have notes of them at many other places. I don't know if the game is played by the children in Burton, but, in many places, it is played to this day by children with three pebbles, and I believe goes by the name of Knockings, in and out, and these are no doubt the work of the novices in their spare moments; the Rites describe the school, the novices sat on the bench against the garth side and their master on that against the wall.

Shaw's plan shows a door leading into the Abbot's house, which seems to have occupied the whole of this side. It is a great misfortune that this was not thoroughly explored, and the chance has gone for ever of so doing, the site being under the Market Hall. We find William Bromley, 1316-1329, gave the convent the long building near the church gate, this may mean he built the long range of the Abbot's house, as these are the only buildings near that part. John Ibstock, Abbot 1348-1366, built the Abbot's private chamber between the great hall and the outward chamber of the same, and we are able to fix where this lay, for there is a projecting chamber which we may safely take to be the outward chamber, and this would bring the Abbot's private chamber close to the parlour and entrance. Thomas Field, 1472-1493, is also mentioned as building the Abbot's private chamber. This brings us to

THE NORTH WALK,

and here we come to the west door from the church to the cloister; this led into the lower church, and was for the use of the servants of the monastery who attended the services in this part of the church. We have an interesting note in the Chronicle that in the cloister Lady Elswitta, the dear wife of Wulfric Spott, is buried under a stone arch against the door of the lower church.

The whole of this walk was used by the monks for study, and, if we turn to the Ancient Rites again, we find how it was fitted up at Durham, and we may safely say at Burton as well. "In the north syde of the Cloister, from the corner over against the Church dour, to the corner over againste the Dorter dour, was all fynely glased, from the hight to the sole within a litle of the grownd into the Cloister garth. And in every wyndowe iij Pewes or Carrells where every one of the old Monks had his carrell severall by himselfe, that when they had dyned they dyd resorte to that place of Cloister and there studyed upon there books, every one in his carrell, all the afternonne, unto evensong tyme. This was there exercise every daie. All there pewes or carrells was all fynely wainscotted and verie close, all but the forepart which had carved wourke that gave light in at ther carrell doures, of wainscott. And in every carrell was a deske to lye there bookes on. And the carrells was no greater then from one stanchell of the wyndowe to another. And over against the carrells against the church wall did stande sertaine great almeries of waynscott all full of Bookes, wherein dyd lye as well the old auncyent written Doctors of the Church as other prophane authors, with dyverse other holie mens wourks, so that every one dyd studye what Doctor pleased them best, havinge the Librarie at all tymes to goe studie in besydes there carrells." We have now gone round the cloister and come to the place we entered—the door of the upper church. The Chronicle gives us a note, that Wulfric

Spott was buried in the cloister under a stone arch against thc door of the upper church. In the excavations, a stone coffin was found close to this door, but Dr. Perks informs me that the skull was that of a Norman, not a Saxon.

Before we leave the cloister let us see what we can get from the Chronicle about the building. Robert Onsbey, Abbot 1430-1432, in 1430 laid the first stone of the new cloister which was rebuilt from the north west angle, but which way is not said; it could not have been a total re-building, for the work was finished the same year, and we have evidence that more work was done after. for in Abbot Ralph Henley's time, Bishop William Heyworth, of Coventy and Lichfield, left £40 towards the building of the cloister; Henley being buried in the north part, points to that being done in his day, as it was the custom to bury an Abbot close to the work he had done. We now leave the cloister and ascend the stairs in the south east corner. This brings us to the

MONKS' DORTER.

This, at first, was one long open room, extending the full length from the church, but later, it was divided into cubicles for each monk, with a passage down the centre, the novices having those to the south end. As the monks became fewer rooms were taken off, and finally, the range was divided into small rooms for each monk. Shaw's plan (plate I, fig. 1) gives the late division of the dorter, and is most interesting, as it shows that about the time of the dissolution the number had shrunk to 12 monks. What the other chambers were used for we have no evidence, but, very likely, here was the library. At the end of the dorter, towards the south, Shaw shows a room which must have been the rere dorter, or necessaria, entered from the dorter as at Westminster. Descending the stairs and passing through the door or opening that there must have been between the stair and the frater house, and going south, we pass on the right some walls discovered in the excavations, most likely these were the walls of the kitchen. Nicholas, Abbot 1188-1197, and William Melburne, Abbot 1197-1210, are said by Shaw to have been benefactors to the kitchen: if so, the walls should have been Norman work. There should be a passage under the dorter and between it and the rere dorter shown on the plan of floor above, leading east, and giving access to the Infirmary or Farmery buildings. Going through this we should have running East and West, on our right hand, the long hall of the rere dorter, or necessaria, and passing this we should come to the

FARMERY BUILDINGS

These stood where the house now called The Abbey stands. This house is largely composed of the ruins of this once important building. Originally it would be formed round its own cloister. To the north of the present building are evidences of a large building, this, I believe, was "The great Hall near the waters of the Flete," built by William de Bramley, 1316-1329. There is every evidence of a large hall, with a stone groined vault over, and this would be an interesting site for excavation. South of this, now used as hall and breakfast room, and running at right angles to the great hall, are the remains of the chapel of the infirmary, built, I believe, by Richard de Insula, Abbot 1222-1229, for he made the chapel of S. Edmund. This agrees well with the date of the east and west windows (plate III, figs. 2 & 3); these are now only to be seen from inside the roof. Shaw gives a sketch of this building (plate III, fig. 4) showing the window from the outside before it was cased up with stone as at present.

This chapel was most likely open to the great hall, only divided under the existing arches by screens. Again, to the south of this came another large hall, but not so wide as the farmery great hall. This again can now only be traced in the roof. It was a stone building from the ground to the first floor, and was then a half-timbered building with a very fine open timber roof (plate III, fig. 1). The timbers are of oak, very massive, and from the form and mouldings of about the same date as the chapel, or a little earlier. This may have been the house of the Farmerer or Master of the infirmary. Unfortunately, we have nothing left to show the connection of the buildings with the main building, but I have no doubt if excavations were carried out on the west side, we should be able to clear up the whole plan.

All the buildings we have before glanced at have been situated within the inner court, the wall of which, separating it from the outer court, is still standing, and runs at the south side of the Market Hall, from the garden wall of what is now called The Abbey, nearly to the Abbey Gate, opposite the end of New Street; and the precinct wall branches out of it at right angles and runs along the west boundary wall of Mr. Smith's garden, part of it being in his passage; it would then return and join the south wall of the church.

The Precinct wall may be seen more or less perfect running from the Abbey Gate down Lichfield Street, Abbey Street, and returning along Fleet Street down to the river.

THE ABBEY GATE.

The basements of which remain, is given in a drawing in Shaw, and remains much as it was in his time. We have the date of this building in the Chronicle. William Mathew (1424-1430) laid the first stone of the south part of the Abbey gate. Shaw calls this the south gate of the Abbey, which makes a very different thing of it. Ralph Henley (1432-1454) built the north side of the Abbey gate, not the north gate as Shaw has it. The two parts were connected by a big arch, as at Repton, having a small arched doorway on the north side, as shewn by the springers of the arches.

PLATE III.

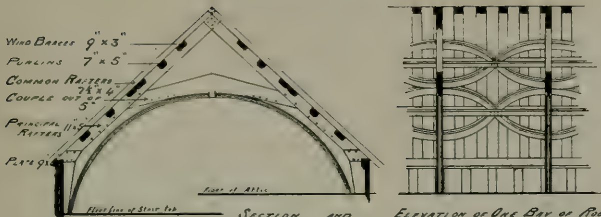


FIG 1

Section and Elevation of One Bay of Roof In Farmery Buildings Six Bays Remain

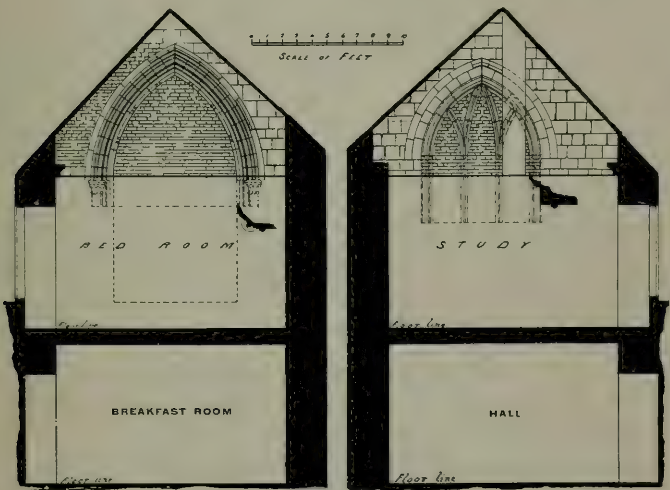


FIG. 2 Looking East Section through Farmery Chapel Looking West FIG. 3

Within the walls as above described was the outer court of the Abbey; this would contain many of the buildings that we have notice of but of which the sites have passed away.

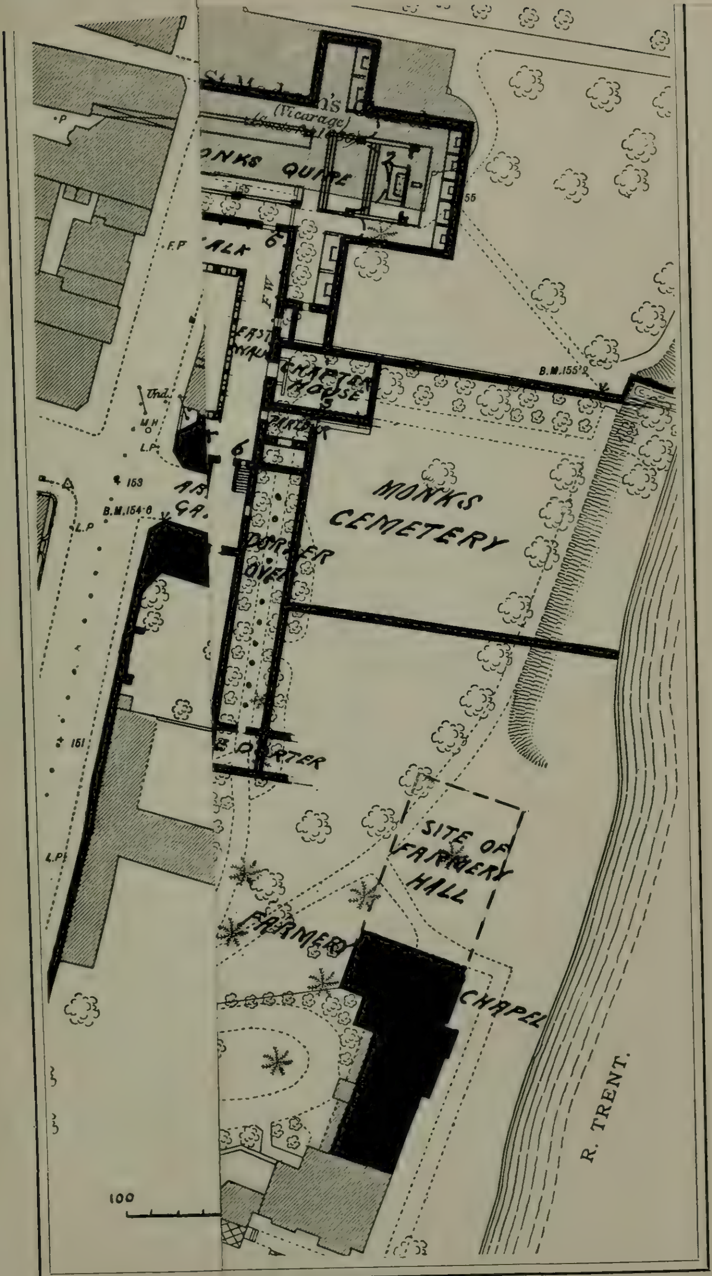
The stone house near the church, for the reception of the poor, given, not built, by Laurence, Abbot, 1229-1260, may have been the "synagog," or large hall, pulled down by John Ibstocke, (1348-1366). In this case he would have removed, what to them was equal to our casual ward, within the precinct's wall. It must have been outside before, which was very unusual, and most likely was only a temporary make-shift. John Fisher, (1305-1316), made the long edifice near the Abbey gate which looks like the guest house: there are ruins showing where this stood.

From the Gresley Charters we learn there was an arbitration about a grey horse of the Abbot's that a certain bailiff broke into the guest stable and took away, 1397. Ralph Henley, 1432-1454, pulled down (Shaw says built) the guest house stable and the winter hall.

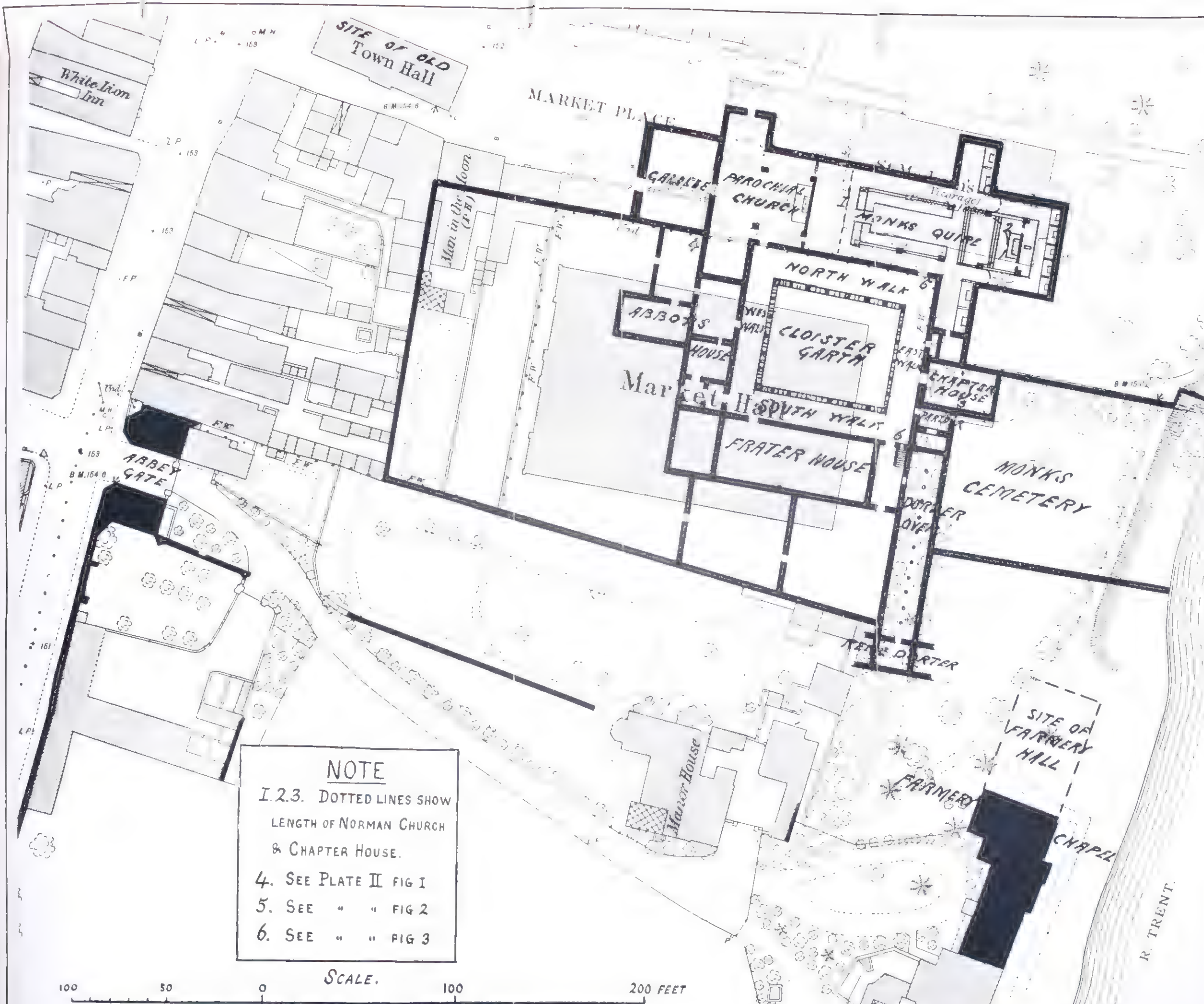
John Fisher, (1305-1316), also built "Helle"—this may have been one of the Abbot's chambers, as we have a Jerusalem chamber at Westminster, so named from the paintings on the wall, which was the Abbot's withdrawing room, and in the Palace of Westminster there were two rooms called "Heaven" and "Hell" from similar wall paintings. I am told that in the times of the Great Rebellion there was an incident when some of the officers of the Cromwellian party were attending a debate in the house, and their men "sat drinking in hell."

The entry going into the Dean's Hall would no doubt be part of the Abbot's house, most likely the outer part of the outer parlour. The "Gret Chamber" may have been part of the guest house, and I believe this was so, for the next entry is the "Kyng's Chamber." The "Rites" describing the the guest hall says "This haule is a goodly brave place, much like unto the body of a Church with verey fair pillers supporting yt on ether syde, and in the mydest of the haule a most large rannge for the fyer. The chambers and lodginges belonging to yt weare swetly keept, and so richly furnyshed that they weare not unpleasant to ly in, especially one chamber called the Kyngs Chamber, deservinge that name, in that the King him selfe myght verie well have lyne in yt, for the princelynes thereof."

Before I close this paper I must acknowledge my indebtedness to all those who have assisted me in its preparation. My thanks are first due to Mr. G. L. Blackhall, of the Abbey, for his great kindness in permitting me to roam at pleasure about his most interesting house and grounds. I have also to thank Dr. C. Perks for permitting me to use his plan of the excavations carried out under his supervision; and last, but not least, Mr. Robert Thornewill, J.P., for much information and assistance, which he alone was capable of giving. Finally, I must not omit to mention the debt I owe to Mr. J. T. Micklethwaite, F.S.A., and Mr. W. St. John Hope, F.S.A., who first encouraged me in the study of the monastic plan, and to whose able teaching anything that may be of value in this paper is to be attributed.



(Vicarage)
MONKS QUIRE
CHAPTER HOUSE
MONKS CEMETERY
SITE OF FARMERY HALL
FARMERY
CHAPEL
R. TRENT.
B.M. 155·2
B.M. 154·6
153
151
L.P.
M.H.
F.P.
100



BURTON ABBEY—GENERAL PLAN.

Note on Bos Longifrons.*

THE fragment of bone, the subject of this note, was turned up in February, 1896, in the course of excavations for building purposes in Bass & Co's. Middle Yard. It was resting on a bed of clay about 9 feet below the surface; immediately above it was a bed of peat about $2\frac{1}{2}$ feet thick, then 2 feet of blue clay, above which was principally made ground. There was evidence of an old river course having existed here. An old oak tree in good preservation and perfectly black was found in the peat, lying from S.E. to N.W.; hazel-nuts were also found, apparently perfect, but crumbling to pieces when touched. The lowest bed of clay rested on a bed of sand and gravel of considerable depth. Dr. Mason sent the fragment to Prof. W. Boyd Dawkins, F.R.S., and his opinion on it was as follows: "The enclosed is the distal end of the metatarsal bone of hind foot of Ox, probably large domestic *Bos longifrons*, cut with a metal saw."

Bos longifrons was, at the time of the Roman invasion, common in a wild state, and probably also domesticated, all over this country, and was hunted and largely used for food. Its remains have been found in great profusion in many places, especially in the Irish bogs and the Fen districts,

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*For the details of this interesting find we are indebted to Mr. J. J. Hunter. The explanatory note is by Dr. P. B. Mason, and was read at a Meeting of the Society on 12th March, 1896, when the fragment was exhibited.

sometimes associated with Roman antiquities, sometimes with the great Irish Elk, or even with the much earlier extinct Carnivora. Although once so common, this Ox does not appear to have been the ancestor of our present breeds of cattle. Owen has suggested that the Romans imported an already domesticated breed, thinking this an easier process than to tame afresh the wild indigenous race.

Bos longrifrons was a smaller animal than the present domesticated ox, and may possibly be the ancestor of the small dark breeds of Wales and Scotland. It must not be comfounded with the great wild ox of this country, the Urus of Cæsar (Bos primigenius), which was almost certainly extinct, at all events in the Southern portions of these islands in pre-historic times. This latter is considered by some to be the ancestor, by crossing with domesticated cattle, of the Chillingham and Chartley breeds of wild white cattle.

Those who have been in Dublin may remember that the Rotunda is ornamented on the outside with a ring of the skulls of *Bos longifrons* sculptured in stone.

Some Documents from the Burton Parish Chest.

By the late T. Knowles, M.A., and A. J. Lyle.

A short Abstract of a Paper read before the Society 20th March, 1884.

THE Documents were numbered for reference.

No 1 is an account of money laid out in paving in the year 1607.

No. 2 is a receipt dated 30th March, 1607, from John Hawkes and Jerome Horrobin to John Mould, of Orton-on-the-Hill, due to the school of Burton-on-Trent, and signed by George Spurret.

No. 3 is a similar document dated 12th December, 1607. The school referred to is the Burton Grammar School.

No. 4 (undated) is headed "Money lade out att the Commission." The Commission probably met to arrange for the collection of a subsidy. A quart of sack costs 12d., and a quart of claret 8d., and the dinner of 12 persons is charged 8/- It is stated that the bill was discharged by the "Town's Masters."

No. 5 is a warrant dated 14th September, 1630, ordering one of the constables at Burton-on-Trent to bring two persons to Stafford to give evidence.

No. 6 (undated) is "A note of the charges for the carriage of our armour to Lichfield, and the charges of ourselves and soldiers, and other things."

The head note of No. 7 is "A proposition made this 24th of February for those who are thought men of ability to contribute towards the repair of Paul's Church (1635)" The paper is a list of contributors drawn up in answer to the brief or letters patent sent to the Churchwardens of Burton-on-Trent in accordance with the Commission issued by Charles I, April 10, 1631, for the restoration of St. Paul's Cathedral. The highest contribution is 2/-, the lowest 6d.

No. 8 is the account of Jerome Horobin and Robert Tailor, the constables for the year 1601. Two items may be quoted:

> "Given to a soldier that was hurt and maimed in Her Majesty's wars and had a grant under her own hand to levy money in every town in the shire, the 27th day of April."

> "Gave to a very poor man that had his pass-port under the hand of the Council of York to travel to Bath."

Throughout the constables' accounts are found items of money given to poor persons with passes.

No. 9 is the account of Christopher Morley and Roger Ramson, the constables for the year 1610-11. There are a few items worth notice:

> "Paid to John Massie for a staple when we locked Thomas Edge's wife to the post."

> "Paid to William Onesbie for watching upon the bridge one night for William Fellor's wife, her coming home from Hartshorne when it was suspected the sickness had been there, 6d."

> "Paid to William Harryson for going with a letter to Hartshorne to bring certificats of the sickness from the inhabitants, 6d."

> "Paid for the presentment of Recusants and Victuallers unlycensed, for acquittance and spent."

The papers marked 10 are the accounts of the constables of Burton-on-Trent for the years 1628, 1633, 1641 (fragment), 1650, 1654, 1661, and an undated account apparently anterior to 1655. Some of the items present points of interest:

"1628. Item paid for provision for His Majesty's household the 6 of February, 10d."

"1633. Paid Richard Bagally for having the wooden handed man before the Justice, 8d."

"Given to Richard Aderley for watching a mad preeste in the cage one night, 8d."

"Given to a mad preeste, 4d."

"1650, Feb. 1. Gave a soldier come over from Ireland, had the flux and had a passe with Cromwell's own hand, 3d."

"Feb. 3. Gave a companie from Ireland who had a parchment passe with a broad seale, 3d."

"May 3. Pd. atte the monthly meeting at Litchfield for defraying a suite for a robbery in this hundred, 8/-"

"1661, Nov. 25. Paid then to Mr. Lie for arranging a Peticon concerning the Forestallers and Regraters that frequented our market, 2/6."

"Paid for an order then agt forestallers and Regraters, 2/6."

"1661, March 27. Paid for writing our Presentment for Innholders and Alehouse keepers to appear before the Justices at Shenstone the 31 March to take licenses and to summon all alehouse keepers, Victuallers and Butchers that had not entered into Recognisance for due observing of Lent, 8d."

"1661, August 5. My charges at Overstonnell, when I gave in a list of the Firehearths."

Nos. 11, 12, 13, and 14 are the acconnts rendered by the "Town's Masters" to the Feoffees of the Town lands, No. 11 for the year 1597, No. 12 for 1636, No. 13 for 1638, and No. 14 for 1640. They are simply accounts of rent, money received, and money paid, and present no items of interest.

The last document consists of seven pages of names arranged in a list, accompanied by three columns of figures, headed, "horses," "beast," "sheep," but in the "sheep" column for the most part appear figures denoting small sums of money, there being only thirteen entries of sheep in a list of some 190 odd names. The last page concludes with the words "Sessed the 9th July, 1600," followed by a list of names apparently of the assessors. This appears to be an assessment for a fifteenth, a view supported by some entries on the back of paper No. 6. These begin, "Unpaid of the fifteen," and resemble the present document in form. The assessors count on the old plan, by the score, thus the first three lines on the last page run

horses 9 score and 10 at 4d.
beast 10 score and 13 at 3d.
sheep 12 score and 15 at 8d. the score.

According to this paper, Burton, in the year 1600, consisted of New Street, High Street, Horninglow Street, and Anderstaffe Lane.

THE WEATHER OF 1896.

Like so many recent years the year which has just closed is remarkable for a deficiency of rainfall; in other respects its weather record does not show any abnormal feature.

MEAN SHADE TEMPERATURE.

	Means for 1896.	Averages of 1876—1895.	Difference of 1896 from average.	
Jan.	39·9	36·1	+	3·8
Feb.	39·2	38·6	+	0·6
Mch.	42·9	40·1	+	2·8
April	46·5	44·5	+	2·0
May	51·8	50·1	+	1·7
June	59·4	56·5	+	2·9
July	59·9	59·2	+	0·7
Aug.	55·9	58·7	–	2·8
Sept.	54·6	54·5	+	0·1
Oct.	43·3	46·8	–	3·5
Nov.	39·2	42·0	–	2·8
Dec.	38·7	37·3	+	1·4
Year	47·6	47·0	+	0·6

The only remarkable feature in this table is the long series of warm months with which the year began; this series ended with July, the remaining months, with the exception of September and December, being somewhat below the average in temperature.

RAINFALL.

	Totals for 1896.	Averages of 1876-1895.	Difference of 1896 from average.	
Jan.	1·25	1·93	–	0·68
Feb.	0·82	1·75	–	0·93
Mch.	2·26	1·61	+	0·65
April	1·00	1·84	–	0·84
May	0·42	2·23	–	1·81
June	1·66	2·35	–	0·69
July	1·42	2·65	–	1·23
Aug.	1·98	2·63	–	0·65
Sept.	3·37	2·19	+	1·18
Oct.	2·11	2·69	–	0·58
Nov.	1·38	2·37	–	0·99
Dec.	3·20	2·41	+	0·79
Year	20·87	26·65	–	5·78

The rainfall up to the end of August only amounted to 10·81 in., this being the smallest fall in the first eight months of the year during our record. The fall in the last four months was nearly as much, 10·06 in The nearest approach to this record was in 1887, when the fall in the first eight months was 11·02.; in that year, however, the last four months only produced 7·70 in., the total for the year thus only reaching 18·72 in., 2 inches less than last year's total, and the smallest year's fall in our record.

There has been in the past year one "absolute drought," viz: the 18 days from 1st to 18th May. The period from 17th April to 20th May was a "partial drought," only 0·30 in. of rain falling in the 34 days.

The maximum temperature in the sun 138·9° was reached on July 6th, the maximum in the shade 81·8° on June 15th and 16th. The minimum in the shade, 19·9°, occured on November 6th, the maximum exposed on the grass, 18·1°, on February 27th.

The shade temperature exceeded 70° on 40 days, 80° being exceeded on 6 days.

There were 120 frosty nights during the year. The last frost of the winter 1895-96 occurred on May 25th, and the first of the winter 1896-97 on September 21st.

South-westerly winds have, as usual, been most prevalent, having blown on 73 days. The year has in this district been remarkably free from destructive gales, and there has been very little snow and few thunderstorms.

NOTES ON THE MONTHS.

January.—A very mild and dry month. The Barometer was unusually high, the reading on the 9th (30·96 in.) being, with the exception of a doubtful one of 31·07 in January, 1882, the highest within our record. There were 9 frosts in the shade and 14 on the grass, but no snow fell.

February was very dry and fairly mild. There were 11 frosts in the shade and 16 on the grass, but no falls of snow. The barometer was again unusually high. A gale from the S. occurred on the 7th.

March was mild and rainy. Gales occurred on 5 days, chiefly from W. and S.W. Thunder and lightning occurred on the 24th. There were five frosts in the shade and 10 on the grass, but no snow fell.

April was mild and dry, the rain nearly all fell between the 9th and the 17th. There were 11 frosts on the grass but only one in the shade. A gale from the N.W. blew on the 13th.

May.—A warm and excessively dry month, being the dryest May in our record. Rain fell on 3 days only, the 19th, 21st, and 22nd. The shade temperature exceeded 70° on 6 days. There were no frosts in the shade but 10 on the grass, the low reading of 23·8° occurring on the 21st.

JUNE opened with a wet period, but after the 9th little rain fell, and the total was again below the average. The temperature was very high, 70° being exceeded on 14 and 80° on two days. There was a heavy hailstorm on the 7th.

JULY was also warm and dry, the rain nearly all falling near the beginning and end of the month. The shade temperature exceeded 70° on 18 and 80° on 4 days.

AUGUST.—The rainfall was again below the average, and nearly all fell in the last fortnight. The temperature was much below the average, 70° being reached on two days only.

SEPTEMBER was a very wet month, only four days being rainless, and the total fall being much above the average. Temperature was about normal, warm nights making up for the cool days. There was one frost, on the the grass only. A gale from the W. occurred on the 23rd.

OCTOBER.—The first ten days were mild, but the remainder of the month was cold. Rain fell on 26 days, but the total was below the average. The first snow of the winter fell on the 10th and the 11th, the hills being covered on the latter day. There were 7 frosts in the shade and 16 on the grass. Gales from the S.W. blew on the 5th and 9th.

NOVEMBER.—Temperature and rainfall were both below the average. There were 6 frosts in the shade and 23 on the grass. No snow fell.

DECEMBER began wet and gloomy. From the 15th to the 23rd was dry with a good deal of fog and frost, a little snow falling on the 21st. The last week was very mild and wet. There were 12 frosts in the shade and 19 on the grass. A sharp shock of earthquake occurred in the early morning of the 17th.

RAINFALL AT BURTON-ON-TRENT FOR 20 YEARS, 1876-1895.

		5 Years' average.			5 Years' average.
1876 ...	31·96		1886 ...	32·74	
1877 ...	31·29		1887 ...	18·72	
1878 ...	30·53	30·48	1888 ...	22·99	24·53
1879 ...	28·96		1889 ...	28·42	
1880 ...	29·68		1890 ...	19·80	
1881 ...	27·31		1891 ...	27·22	
1882 ...	37·97		1892 ...	22·15	
1883 ...	27·95	28·69	1893 ...	19·72	22·91
1884 ...	23·24		1894 ...	22·10	
1885 ...	26·96		1895 ...	23·35	
Ten years' average 1876-1885		29·58	Ten years' average 1886-1895		23·72

Twenty years' average, 1876-1895 26·65

BURTON-ON-TRENT METEOROLOGICAL SUMMARY FOR 1896.

MONTH.	PRESSURE OF AIR.			SHADE TEMPERATURE.						Temperature in the open.		HYGROMETRIC CONDITIONS.				Wind.		Cloud	RAINFALL.		
				EXTREMES		MEANS.															
	Mean height of Barometer.	Maximum Reading of Barometer.	Minimum reading of Barometer.	Maximum.	Minimum.	Mean of Maximum Readings.	Mean of Minimum Readings.	Mean Daily Range.	Mean Temperature (corrected.)	Maximum in Sun.	Minimum on Grass.	Mean of Dry Bulb Readings.	Mean of Wet Bulb Readings.	Mean Dew Point.	Mean relative Humidity.	Prevailing Direction.	No. of days on which wind blew from that quarter.	Mean Amount (0-10).	Total Amount. (inches.)	No. of days on which rain fell	Maximum fall in 24 hours.
JANUARY	30.33	30.96	29.39	53.0	23.5	45.05	35.05	10.00	39.85	97.4	20.3	39.65	38.58	37.19	91.6	S. & W.	6	8.1	1.25	14	0.35
FEBRUARY	30.32	30.73	29.66	54.7	22.2	46.22	33.00	13.22	39.21	101.7	18.1	38.00	37.01	35.66	91.0	S.W.	6½	7.2	0.82	9	0.27
MARCH	29.74	30.31	28.66	62.4	26.4	51.30	36.49	14.81	42.89	114.8	22.0	43.07	41.82	39.28	82.8	S.W.	8½	7.8	2.26	24	0.30
APRIL	30.14	30.52	29.65	64.8	28.9	56.15	39.88	16.27	46.51	122.8	22.0	49.01	46.15	42.45	76.4	N.W.	12	7.1	1.00	15	0.15
MAY	30.26	30.51	29.85	77.6	32.8	64.39	42.54	21.85	51.76	131.7	23.8	55.16	51.16	47.32	75.0	N.	9	6.5	0.42	3	0.35
JUNE	29.93	30.23	29.55	81.8	42.3	71.11	51.27	19.84	59.39	137.5	34.5	63.03	58.21	54.11	72.9	S.W.	7	7.9	1.66	15	0.34
JULY	30.01	30.30	29.67	81.7	41.6	71.47	52.12	19.36	59.89	138.9	37.0	63.55	58.29	54.87	71.3	W.	8	7.3	1.42	13	0.50
AUGUST..........	30.02	30.25	29.62	72.7	41.3	65.02	50.20	14.82	55.91	130.1	33.3	58.66	55.00	51.72	77.7	W.	13	8.6	1.98	13	0.53
SEPTEMBER	29.72	30.44	28.68	68.8	35.0	61.86	49.04	12.82	54.65	128.9	29.2	55.95	53.80	52.78	86.1	W.	8	8.1	3.37	26	0.70
OCTOBER	29.68	30.45	29.14	60.5	25.0	51.07	37.47	13.60	43.27	110.6	20.4	43.98	42.83	41.37	90.8	S.W	14	7.3	2.11	26	0.26
NOVEMBER......	30.12	30.64	29.33	52.4	19.9	45.41	33.72	11.69	39.16	97.3	18.9	38.01	37.44	35.88	90.7	N.&S.E.	7	6.1	1.38	13	0.45
DECEMBER......	29.75	30.32	28.72	53.2	22.3	44.04	33.33	10.71	38.61	90.1	19.8	38.60	37.75	36.61	93.5	S.	6½	8.3	3.20	25	0.54
Extremes for Year ..		30.96	28.66	81.8	19.9					138.9	18.1					S.W.	72½		20.87	196	0.70
Means for Year	30.00					56.09	41.18	14.91	47.59			49.06	46.50	43.74	82.2			7.5			

NOTES—All the Readings are taken daily at 9 a.m. The Barometer Readings are corrected to sea-level and 32° F.; and to the Mean Temperatures in the Shade, Glaisher's Corrections have been applied. The Thermometers in the Shade are placed in a Stevenson's Screen, 4 feet from the grass, as are the Dry and Wet Bulb Thermometers. The Maximum Temperatures in the Sun are taken with a Black Bulb Thermometer, in vacuo. The mouth of the Rain Gauge is 1 foot above the ground and 153 feet above sea-level. In calculating the Mean Relative Humidity, 100 is taken to represent a saturated atmosphere and 0 a perfectly dry one.

JAMES C. WELLS.
T. GIBBS.

The Flora of Burton-on-Trent and Neighbourhood.

COMPILED BY THE BOTANICAL SECTION.

PART II.—ROSACEÆ TO CAPRIFOLIACEÆ.

NOTE.—Since the first part of this Flora was published an interesting addition to our sources of information has come into our hands through the kindness of Mr. Edwin A. Brown. This consists of a series of lists contained in a port-folio formerly belonging to the late Mr. Edwin Brown, and labelled "Fauna and Flora lists of Trent district"; the contents of the port-folio were intended to form the basis of a work on the Natural History of the basin of the Trent, a scheme which was however never carried out.

The date of the collection appears to be 1864-1866, but many of the records contained in the lists are of a much earlier date.

The following are the lists which contain records of use in this Flora:—

	Quoted as
Notes "Extracted from a copy of *Hudsoni Fl. Anglica* ed. 2, once the property of the Rev. T. Gisborne, of Yoxall Lodge, by C. C. Babington, 1864" (many of these notes are dated, the dates ranging from 1791 to 1794.)	*Gisborne.*
List by W. Birch, Barton-under-Needwood (undated)	*Birch.*
"Plants found about Calke Abbey." By the Rev. A. Bloxam (undated).	*Bloxam.*
"Plants of S. Derbyshire and adjoining parts of Leicestershire." By the Rev. W. H. Purchas (1858-1865)	*Purchas.*
"Flora of the neighbourhood of Derby." By the Rev. H. H. Crewe and Joseph Whitaker (1864)	C. & W.

We have also to add to the list of works quoted

"The Flora of Warwickshire." By J. E. Bagnall, A.L.S. (1891) J.B.

To the list of observers must be added the name of the Rev. W. R. Linton, M.A., to whom we are indebted for notes from the North Western portion of our area.

For the list of *Rubi* Mr. T. Gibbs is entirely responsible. The basis of the list is the fine set collected by the late Rev. W. H. Coleman, in the neighbourhood of Ashby, about 1847-1849, and now in Dr. Mason's herbarium. These are all marked in the list "P.B.M." The few other local specimens in Dr. Mason's herbarium are distinguished by the name of the collector, in brackets thus, "(Bloxam) P.B.M." The Rev. W. Moyle Rogers, F.L.S., has kindly looked through this collection, and, as far as possible, brought the nomenclature up to the present standard of knowledge. Mr. Gibbs is also indebted to the same gentleman for like assistance with his own collection. In dealing with two other sources of information, viz: the late Mr. Edwin Brown's Flora (E.B.) and the "Flora of Leicestershire" (F.L.), considerable difficulty has been encountered in identifying the plants intended by the writers; where there is no doubt as to the species meant, although a different name is used than that adopted in this list, the former is given in brackts; where there is some doubt as to the species meant, the record is given in italics.

XXVI. Rosaceæ.

419. **Prunus spinosa**, L.
Common.

420. **P. insititia**, Huds.
Bretby; W.G. Breedon; J.E.N.

421. **P. domestica*, *L.*
An escape from cultivation at Calke Mill; W.H.P.

422. **P. Avium**, L.
Drakelowe and Bretby, probably planted; E.B. Repton Rocks; W.H.P. Seckington; J.B. Staunton Harold and about Ashby; F.L. Tatenhill; J.E.N.

423. **P. Cerasus**, L.
Near Measham; E.B. Repton; W.G. (doubtful, *Section*). Between Measham and Snarestone; F.L.

424. **P. Padus**, L.
In several plantations in the district, but probably planted there; E.B. Copse by Burton Road (Repton); W.G.

425. *Spiræa salicifolia, L.*
Needwood Forest; R.G.

426. **S. Ulmaria**, L.
Common.

427. **S. Filipendula**, L.
Walton Bridge; R.G. Repton; W.G. Between Chellaston and Weston-on-Trent; between Ticknall and Hartshorne; and between Swarkestone and Ingleby; W.H.P. Pastures at Calke, rare; *Purchas.*

428. **Rubus idæus**, L.
Common in woods.

429. **R. fissus**, Lindl.
Moira Reservoir; P.B.M.

430. [*R. suberectus, Anders.*
Near Moira Reservoir; F.L. Error, probably R. fissus, above, T.G.]

432. **R. plicatus**, W. & N.
Between Boothorpe and Moira; P.B.M. Rosliston (Harris) P.B.M. *Seal wood and Brackenhurst; E.B. South and Short woods; F.L.* "Bog at Repton Rocks, probably correctly named, but might be R. fissus" (Purchas); W.H.P.

442. **R. carpinifolius**, W. & N.
Bamborough, Moira; P.B.M. Repton Rocks; T.G.

443. **R. incurvatus**, Bab.
Etwall; Findern; Willington; Midway; T.G.

444. **R. Lindleianus**, Lees.
Common.

446. **R. durescens**, W.R.Linton.
Between Church Broughton and Sutton-on-the-Hill; W.R.L.

447. **R. rhamnifolius**, W. & N.
Measham (Bloxam); P.B.M South wood, Ashby; P.B.M. Lount and Seal woods; F.L. Hedges about Calke; W.H.P. The Outwoods, Burton; T.G.

449. **R. pulcherrimus**, Neum.
Common.

450. **R. Lindebergii**, P. J. Muell:
Repton Rocks; between Anslow and Tatenhill; T.G.

451. **R. dumnoniensis**, Bab.
Near Repton Church and Repton Park; T.G.

453. **R. villicaulis**, Koehl: var. **Selmeri**, (Lindeb).
Lane between Packington and Ravenstone (doubtful, *W. M. Rogers*); Smoile wood, Staunton Harold; P.B.M. Between Alrewas and Croxall (Staffs.); Repton Rocks; T.G. Byrkley and Knightley Park ("*R affinis, W. & N*"); E.B. White Leys and Repton Road, Ticknall ("*R affinis, Blox*" *Purchas*); W.H.P. Worthington Rough, Ashby ("*R. affinis, W. & N.*"); F.L.

var. **calvatus**, Blox.
Packington Lane, Ashby; P.B.M. Pistern hill; Dimminsdale, Calke; W.H.P. Repton Rocks; near Repton Park; Findern; T.G. *Moira; *E.B. Spring wood, Staunton Harold; about Breedon; frequent about Ashby; *F.L.*

458. **R. argentatus**, P. J. Muell: var. **robustus** (P. J. Muell:)
South wood; Bryan's Coppice, Smisby; P.B.M.

459 **R. rusticanus**, Merc.
Common.

461. **R. thyrsoideus**, Wimm.
Moira; P.B.M. Stanton; E B. About Calke; W.H.P. Swarkestone and Chellaston; W.R.L. Stapenhill; Repton; Milton; Findern; Etwall; T.G.

463. **R. macrophyllus**, W. & N. (sp: collect.)
Knightley Park; E.B.

var. **amplificatus**, Lees.
Old Park Lane, Ashby; P.B.M. "Either this or a form of (var) *Schlectendahlii* at Melbourne; *Purchas*."

467. **R. Colemanni**, Blox. (?)
Packington; (Bloxam) P.B.M. (The specimen is poor and so cannot now be certainly determined; the label however is in Mr. Bloxam's handwriting.)

468. **R. Sprengelii**, Weihe.
South wood; P.B.M. Repton Rocks and Seal wood; E.B. Talbot Lane, Ashby; F.L. Between Calke and Melbourne; W.H.P. Outwoods, Burton; Boylestone; T.G.

471. **R. pyramidalis**, Kalt.
Rough Heath wood, Staunton Harold; Packington; P.B.M Seal wood; E.B. Repton Shrubs; T.G.

472. **R. leucostachys**, Schleich.
Common.

476. **R. mucronatus**, Blox.
Moira Reservoir (Brown); Rosliston (Harris); P.B.M. Seal, Grange, Short, and Potter's woods; F.L.

477. **R. Gelertii**, Frider. var. **criniger**, Linton.
Breach hill, Ashby; Bryan's Coppice; Boothorpe; P.B.M. Hatton; W.R.L. Outwoods, Burton; Repton Rocks; and near Milton; T.G.

*These records are as "*R. Salteri Bab*" but are more probably R. calvatus, which was until lately treated as a variety of *R. Salteri*; T.G.

479. **R. infestus,** Weihe.
Packington; P.B.M. "I think a poor specimen of R. infestus, but I am not sure" *(W. Moyle Rogers).*

*Although these plants are so placed by the Rev. W. M. Rogers, I am doubtful whether they are not rather *R. Bloxamianus (Coleman)*, as in all essential particulars they seem to agree with Bloxam's specimen in Dr. Mason's herbarium, so named by Mr. Rogers. The Cauldwell plant, however, which Mr. Rogers was inclined to agree with me in naming *Bloxamianus*, Mr. J. E. Bagnall, who knows that plant well, refused to recognise as such, and placed under *podophyllus*. On the other hand, the Rev. W. H. Purchas in "Journal of Botany," 1886, p. 102, describes as "*R. radula var Bloxamianus*" a plant which seems to me identical with our "*podophyllus*." T.G.

483. **R. radula,** Weihe (sp. coll.)
Moira and Tutbury; E.B. Packington; P.B.M.
var. **anglicanus,** Rogers.
Breach hill farm, Ashby; P.B.M. Bretby; Findern; T.G.
var. **echinatoides,** Rogers.
South wood; P.B.M. Etwall: T.G.

484. ***R. podophyllus,** P. J. Muell:
South wood; P.B.M. Bretby; Repton; Willington; Cauldwell; Linton; Henhurst; T.G.

485. **R. echinatus,** Lindl.
Fairly common.

486. **R. oigoclados,** Muell & Lefv (sp. coll.)
Hedges near Repton Shrubs; Repton Rocks; T.G. "Very near var. *Newbouldii*" (W. M. Rogers.)
var. **Bloxamianus,** (Coleman.)
"Common near Ashby on the Leicester Road" (Bloxam, labelled "*R. fusco-ater*"); P.B.M. Between Ticknall and Stanton-by-Bridge; Calke; Repton; Gallows Lane, Measham; *Purchas.* Lount and Ashby: ("*R Bloxamii*, Lees" but as "*R Bloxamianus*," is given as a synonym probably this is the form meant. T.G.), F.L.

497. **R. fuscus,** W. & N.
Byran's Coppice; P.B.M. *Woodville; Knightley Park;* E.B.

502. **R. foliosus,** W. & N.
Ticknall; Bryan's Coppice; P.B.M. Seal wood and Knowl Hill (*R. Guntheri, W. & N.*); E.B. South wood and Willesley wood (*R. Guntheri, W, & N.*.); F.L. Repton Shrubs; Repton Rocks; T.G.

503. **R. rosaceus,** W. & N. var. **hystrix**(W. & N.)
Between Alrewas and Croxall (Staffs.); T.G.
var. **infecundus,** Rogers.
Stanton; Swadlincote; Henhurst; Knightley Park; (*R. hystrix, W. & N.*) E.B. Ashby, frequent (*R. hystrix, W. & N.*); F.L. Woody places about Calke, (*R. hystrix, W. & N.*); W.H.P. Repton Shrubs and Rocks; T.G.

506. **R. Koehleri**, W. & N. var. **pallidus**, Bab.
Common.

509. **R. fusco-ater**, Weihe ?
Tramway near South wood; P.B.M.

517. **R. hirtus**, W. & K.
Bryan's Copse; P.B.M. Near Hanbury; T.G.

522. **R. dumetorum**, W. & N.
var. **ferox**, Weihe.
Near Packington Bar; Near Ashby; P.B.M. Anslow; T.G.

var. **diversifolius**, Lindl.
Very common.

var. **rubriflorus**, Purchas.
Etwall; Boylestone; Longford; T.G.

var. **tuberculatus**, Bab.
Packington; P.B.M. Seckington; J.B. Near Calke, *Purchas.* Repton; Milton; Bretby; T.G.

var. **concinnus**, Warren.
Anslow; Branston; Willington; T.G. Common about Calke: *Purchas (R. dumetorum, W. & N.)*

523. **R. corylifolius**, Sm., var. **sublustris**, Lees.
Fairly common.

var. **cyclophyllus**, Lindeb.
Common.

524. **R. Balfourianus**, Blox. ?
Branston; Outwoods; Burton; T.G. (Not typical; *W. M. Rogers.*)

525. **R. cæsius**, L.
Lount wood, Ashby; P.B.M. Tutbury; Rolleston, &c.; E.B. Derby; W.H.P. Tatenhill; J.E.N. Bretby; Willington; Mickleover; Shobnall; T.G.

529. **Geum urbanum**, L.
Common.

530. **G. rivale**, L.
Henhurst; Grange and Seal woods; E.B. Repton; W.H.P Willesley and Overseal; F.L.

X **urbanum**, (G. intermedium, Ehrh).
Henhurst; E.B.

531. **Fragaria vesca**, L.
Fairly common.

532. **F. elatior**, Ehrh.
Branston, near the Trent; E.B. Spring wood, apparently wild; *Purchas.*

535. **Potentilla Fragariastrum**, Ehrh.
Common.

538. **P. silvestris**, Neck. (P. Tormentilla, Nesl.)
Common.

539 **P. procumbens**, Sibth.
Willesley wood; F.L.

540. **P. reptans**, L,
Common.

541. **P. anserina**, L.
Common.

543. [*P. argentea, L.*
"Markeaton road, Derby, (Glover's History)." W.H.P.]

545. **P. palustris**, Scop. (P. Comarum, Nestl.)
Moira Reservoir and Catholme; E.B. Repton Rocks; W.G. Gresley; W.H.P. Ponds, Moira: F.L. Foxholes, Yoxall; *Gisborne.*

547. **Alchemilla arvensis**, Scop.
Common.

548. **A. vulgaris**, L.
The Outwood hills, &c., but not very common; E.B. Osier beds (Repton); W.G. About Derby; about Calke; W.H.P. Bretby; T.G. Sinai Park; J.G.W.

551. **Agrimonia Eupatoria**, L.
Outwood Hills and Knightley Park; E.B. Common about Derby; about Calke; W.H.P. Walton; J.E.N.

552. **A. odorata**, Mill.
Spring wood, Staunton Harold; E.B.

553. **Poterium Sanguisorba**, L.
Breedon Hill; Stretton; Branston; Cauldwell; E.B. Willington; W.G. Ticknall and Calke; W.H.P. Railway bank by Moor Street, Burton; T.G.

555. **P. officinale**, L.
Common.

556. **Rosa pimpinellifolia**, L., var. **spinosissima**, L.
In lane from forest to Yoxall, abundant; *Gisborne.* Near Overseal; P.B.M. Between Stretton and Netherseal; E.B. Between Stretton and Staunton Harold; F.L.

559. **R. mollis**, Sm.
Mickleover; near Derby; Heath End; W.H.P.

560. **R. tomentosa**, Sm.
Near Burton; Knightley Park; E.B. Stanton by Bridge; The Scaddows, Ticknall; W.H.P.

var. **Scabriuscula** (Sm).
Mickleover; near Derby; between Melbourne and Castle Donington; W.H.P.

561. **R. rubiginosa**, L.
Anslow, &c., but generally planted; E.B. Near Coleorton; Appleby; F.L. Near Burton; P.B.M.

562. **R. micrantha**, L.
Breedon Cloud wood; Packington; E.B.

563. **R. sepium**, Thuill., var. **inodora**, (Fr.)
Donisthorpe; F.L.

564. **R. obtusifolia**, Desv., var. **frondosa**, Baker.
Ashby; F.L.

var. **tomentella** (Leman).
Between Longford and Boylestone; W.R.L. Between Heath End and the foot of Pistern hill; W.H.P.

565. **R. canina**, L.
Very common. The following varieties have been identified:

var. **lutetiana** Leman.
Common; F.L. Frequent about Derby; Repton; Calke; Ticknall: W.H.P. Burton; P.B.M.

var. **dumalis**, Bechst.
Very common; F.L. Repton; between Calke and South wood; W.H.P.

var. **urbica**, (Leman.)
Frequent; F.L. Repton; about Derby; Willington; Ticknall; W.H.P. Stretton; P.B.M.

var. **cæsia**, Sm.
Heath End, Calke; W.H.P. Formerly at Repton; *Purchas.*

var. **arvatica**, Baker.
Swarkeston; P.B.M.

568. **Rosa arvensis**, Huds.
Common.

var. **bibracteata**, (Bast.)
Stretton; P.B.M.

576. **Pyrus torminalis**, Ehrh.
Rolleston; Uttoxeter; R.G. Needwood Forest; Henhurst and Knightley Park; E.B. Repton; P.B.M.

577. *P. Aria, Ehrh.*
Foremark; W.G. Drakelowe; P.B.M. Dunstall; T.G.

581. **P. pinnatifida**, Ehrh.
Ashby; P.B.M.

583. **P. Aucuparia**, Ehrh.
Common.

584. **P. communis**, L.
Needwood Forest and near Ashby; E.B. Anchor Church; W.G. (doubtful; W.H.P.) Coleorton; F.L.

var. **Pyraster** (L.)
Needwood; P.B.M.

586. **P. Malus**, L.
Common.

588. **Cratægus Oxyacantha, L.**
Very common.
var. **oxyacanthoides, Thuill.**
Burton; W.H.P. Seckington; J.B.

SAXIFRAGEÆ.

589. **Saxifraga tridactylites, L.**
Burton Abbey Walls; *Shaw.* Tutbury Castle, and frequent on house and wall tops; E.B. Repton; W.G. Ticknall; Boulton; W H.P. Ingleby; T.G.

601. **S. granulata, L.**
Fairly common.

608. **Chryosplenium oppositifolium, L.**
Henhurst Dingle; E.B. Rocks below Churchyard (Repton); W.G Burton; Calke; W.H.P. Hanbury and Callingwood; *Gisborne.* Tutbury; Tatenhill; J.G.W. Repton Shrubs and Rocks; T.G.

609. **C. alternifolium, L.**
Near Yoxall Lodge; R.G. Walker's Brook (Barton); *Birch.* Knowle Hills; Milton; W.H.P. Longford; W.R.L.

610. **Parnassia palustris, L.**
Milton; W.G. Now extinct; W.H.P. Between Over and Nether Seal; F.L.

611. *Ribes Grossularia, L.*
Frequent in hedges and woods, but probably always an escape.

612. **R. alpinum, L.**
"On Needwood Forest Banks, in hedges; but possibly sown in the neighbourhood for game to feed upon"; E.B. Marchington Cliff; P.B.M.

613. *R. rubrum, L.*
Frequent as an escape.

614. *R. Nigrum, L.*
Frequent as an escape.

CRASSULACEÆ.

616. **Cotyledon Umbilicus, L.**
Anchor Church; E.B.

620. *Sedum album, L.*
Roof at Yoxall, wild (?); R.G. Ashby Castle; E.B. Milton; W.G.

623. **Sedum acre, L.**
Common on walls.

625. *S. reflexum, L.*
Burton Abbey walls; *Shaw.* Tutbury Castle; W.G. Stapenhill; E.B. Repton; W.H.P. Shed in Barton; *Gisborne.*

628. *Sempervivum tectorum, L.*
Frequent on roofs.

DROSERACEÆ.

629. **Drosera rotundifolia**, L.
Needwood Forest ; *Shaw.* Repton Rocks, formerly ; E.B. Efflinch, Barton ; *Birch.* Now extinct in district ; *Section.*

HALORAGEÆ.

632. **Hippuris vulgaris**, L.
Burton ; R.G. Trentside, Fleet Green, Burton ; ponds in Bretby Park and pool at Hartshorne ; E.B. Swarkestone Bridge ; W.G. Near White Hollows, Ticknall ; W.H.P. Staunton Harold ; Canal near Snarestone ; F.L. Melbourne Pool ; C. & W. Wood mill, Yoxall ; 1791 ; *Gisborne.*

633. **Myriophyllum verticillatum**, L.
Railway pits, south of Burton ; E.B. Repton ; Pond by Swarkestone Bridge ; W.H.P.

634. **M. spicatum**, L.
Common in the Trent ; E.B. Old Trent, Repton ; W.H.P. Bretby Ponds ; T.G. Sudbury ; W.R.L. Calke ; *Purchas.*

635. **M. alternifolium**, D.C.
Moira Reservoir ; E.B. Barrat Pool, Moira ; F.L. Seckington ; J.B.

636. **Callitriche verna**, L.
Common ; E.B.

637. **C. stagnalis**, Scop.
Repton Shrubs ; Meadows near Burton, &c. ; E.B. Calke ; W.H.P. "Frequent" ; F.L. Near Branston Road ; J.E.N.

639. **C. hamulata**, Kuetz.
Burton and elsewhere ; E.B. Near Branston Road, J.E.N. Marston-on-Dove ; W.R.L. Near Seckington ; J.B.

640. **C. obtusangula**, Le Gall.
Calke ; W.H.P.

XXXI. LYTHRARIEÆ.

643. **Peplis Portula**, L.
Moira Reservoir, and Pond near Willesley wood ; E.B. Lount wood ; E.L. Woodmill, Yoxall ; *Gisborne.* Moor Lane ; *Birch.*

644. **Lythrum Salicaria**, L.
Ditches and rivers, common ; E.B. Old Trent (Repton) ; W.G Frequent ; F.L. Burton ; Calke ; W.H.P.

645. **L. hyssopifolia**, L.
Once found by Mr. Bloxam in Calke Park ; E.B.

XXXII. Onagrarieæ.

646. **Epilobium angustifolium**, L.
Etwall; Repton; W.H.P. Near Willington; W.G. Bretby; T.G.

var. *brachycarpum*, *Leight.*
Bretby; W.H.P. Burnaston; P.B.M.

647. **E. hirsutum**, L.
Common.

648, **E. parviflorum**, Schreb.
Common; E.B. Ticknall Road, Repton; W.G. Burton; Canal banks, Derby; about Calke; W.H.P. Willington; J.E.N. Seckington; J.B.

649. **E. montanum**, L.
Common.

651. **E. roseum**, Schreb.
Winshill and Stapenhill, and as a garden weed at Burton; E.B. Calke; W.H.P. Norris Hill, Ashby; E.L. By the Dove, near Sudbury; W.R.L.

652. **E. adnatum**, Grisebach. (E. tetragonum, L. in part.)
Repton Rocks; J.E.N.

653. **E. obscurum**, Schreb.
Common in watery places.

655. **E. palustre**, L.
Moira Reservoir; Repton Rocks; Newhall, &c.; E.B. Gresley Common; Calke Park; W.H.P. Repton; W.G.

661. **Circæa lutetiana**, L.
Lanes at Stapenhill; Henhurst, &c.; E.B. Repton; W.G. About Calke; W.H.P. Bretby; T.G.

XXXIII. Cucurbitaceæ.

663. **Bryonia dioica**, Jacq.
Common at Burton and elsewhere; E.B. Repton; W.G. About Derby; near Calke Abbey; W.H.P.

XXXIV Umbelliferæ.

664. **Hydrocotyle vulgaris**, L.
Drakelowe; Byrkley; and Moira Reservoir; E.B. Repton Rocks; W.G. About Calke; W.H.P.

668. **Sanicula europæa**, L.
Common in all our moist woods; E.B. Repton Shrubs; W.G. Near Burton; about Calke; W.H.P. Tatenhill and Anslow, frequent; *Birch*.

670. **Conium maculatum**, L.
Shobnall; Stretton; Drakelowe; Tutbury; E.B. Ticknall Quarry and Fox Covers at Findern; W.G. Foremark; Stapenhill; between Milton and Foremark; sparingly at Calke; W.H.P. Branston; J.E.N. Near Tutbury and Sudbury; W.R.L.

671. **Smyrnium Olusatrum**, L.
Formerly at Woodville; E.B

677. **Apium graveolens**, L.
Branston saltmarsh; E.B.

678. **A. nodiflorum**, Reichb. f.
Common.

679. **A. inundatum**, Reichb. f.
Trent side, Fleet Green; Moira Reservoir; E.B. Old Trent, Repton; W.G. Efflinch, Barton; *Birch*. Swarkestone Bridge; W.H.P. Ashby Woulds; P.B.M. Bagot's Park; J.E.N.

680. [*Cicuta virosa, L.*
Between Barton Mill and Borough End, Barton-under-Needwood; (W. Birch); E.B. Ditches (Repton); W.G. Probable error, in both cases.]

683. *Carum Petroselinum, Benth. & Hook. f.*
Breedon Hill Quarries; Ashby Castle; E.B. Tramway, Old Parks, Ashby; F.L.

685. *Carum Carvi, L.*
Repton Village; W.G.

687. **Sison Amomum**, L.
Near Ashby; E.B. Lullington; W.H.P.

690. **Sium erectum**, Huds. (S. angustifolium, L.)
Common; E.B. Marsh near Willington Junction; W.G. About Burton; Canals, Derby; near Calke Abbey *(Bloxam)*, but not seen there by Mr. Purchas; W.H.P. From Sudbury to Scropton; W.R.L.

691. **Ægopodium Podagraria**, L.
Common.

692. **Pimpinella Saxifraga**, L.
Frequent; E.B. Parson's Hills (Repton); W.G. About Derby; Ticknall Quarries; W.H.P. Branston; Tutbury Castle; J.E.N. Barton; Marchington Cliffs; *Birch*.

693. **P. major**, Huds.
Needwood Forest; The Oaks, near Burton; E.B. Between Melbourne and King's Newton; Calke; W.H.P. Tutbury; Willington; J.E.N. Tatenhill; Tutbury Castle; *Birch*.

694. **Conopodium denudatum**, Koch.
Common.

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696. **Chærophyllum temulum,** L.
Common.

697. **Scandix Pecten-Veneris,** L.
Cornfields, common, especially on the Outwood Hills; E.B. Occasionally about Repton; sparingly at Calke; W.H.P. Bretby; Cauldwell; T.G.

698. **Anthriscus vulgaris,** Bernh.
Barton; Stanton by Bridge; E.B. Repton; W.G. Swarkestone; sparingly at Ticknall; W.H.P. Willington; P.B.M. Milton; T.G. Branston; J.E.N. A solitary plant at Calke; *Purchas.*

699. **A. sylvestris,** Hoffm.
Very common.

704. **Œnanthe fistulosa,** L.
Common; E.B. Parson's Hills; W.G. Burton; Swarkestone Bridge; Near Calke Abbey; W.H.P. From Sudbury to Scropton; W.R.L. Bretby; T.G.

709. **Œ. Phellandrium,** Lam.
Near Walton; R.G. Stretton; E.B. Swamp near Willington Bridge; W.G. Near Wichnor Bridge; *Birch.* Swarkestone Bridge; Burton; W.H.P. Barrat Pool, Moira; F.L.

710. **Œ. fluviatilis,** Coleman.
Common in the Trent; E.B.

711. **Æthusa Cynapium,** L.
Common.

713. **Silaus flavescens,** Bernh.
Branston and Drakelowe; E.B. Between Melbourne and Derby; W.H.P. Houndshill; P.B.M. Mickleover; Etwall; T.G.

717. **Angelica sylvestris,** L.
Common.

722. **Peucedanum sativum,** Benth. & Hook. f.
Trent side, Burton; Tatenhill; between Breedon and Lount; E.B. Calke Park; W.G.

723. **Heracleum Sphondylium,** L.
Very common.

726. **Daucus Carota,** L.
Not uncommon; E.B. Repton; W.G. Calke and Repton; near Burton; W.H.P. Fields near Repton Shrubs; Stapenhill; T.G.

729. *Caucalis daucoides, L.*
Milton Road; W.G. Doubtful; *Section.* A casual on Malthouse rubbish; Burton; J.E.N.

730. **C. arvensis**, Huds.
Not uncommon near Burton; E.B. Moira; F.L.

731. **C. Anthriscus**, Huds.
Very common.

732. **C. nodosa**, Scop.
Tutbury Castle; R.G.

XXXV. Araliaceæ.

733. **Hedera Helix**, L.
Very common.

XXXVI. Cornaceæ.

735. **Cornus sanguinea**, L.
Fairly common.

XXXVII. Caprifoliaceæ.

736. **Adoxa moschatellina**, L.
Common.

737. **Sambucus nigra**, L.
Very common.

738. **S. Ebulus**, L.
Braunston (sic); Tutbury; R.G. Mamerton, Longford; W.R.L.

739. **Viburnum Opulus**, L.
Common.

740. **V. Lantana**, L.
Near Measham; E.B. Repton Shrubs; W.G. (wants confirmation: W.H.P.)

742. *Lonicera Caprifolium*, *L.*
Gardens and hedges, but introduced; E.B. Sinai Park, P.B.M.

743. **L. Periclymenum**, L.
Common.

744. *L. Xylosteum*, L.
Needwood Forest; R.G. Sinai Park; Hartshorne, and other places, but probably introduced; E.B. Calke; W.H.P. Bretby, planted; T.G.

PERFECT, BURTON-ON-TRENT.

206 Station St.
Burton on Trent
6 July 1896

Sir,

I am much obliged for the series of Guides sent me for the Burton Nat: Hist and Archaeological Society. I send you by this post our last published Volume of Report and Transactions. A Vol: is in the press and will be forwarded when ready.

Will you please send me ~~the~~ for myself the Guides to the Fungi* and Mycetozoa*, for which I enclose 9d stamps.

Yours truly
Thos Gibbs

* Forwarded July 8.96. A.S.

To Mr. B. B.
Woodward,
8 July, 1896.