J. G. Harris

Proceedings of

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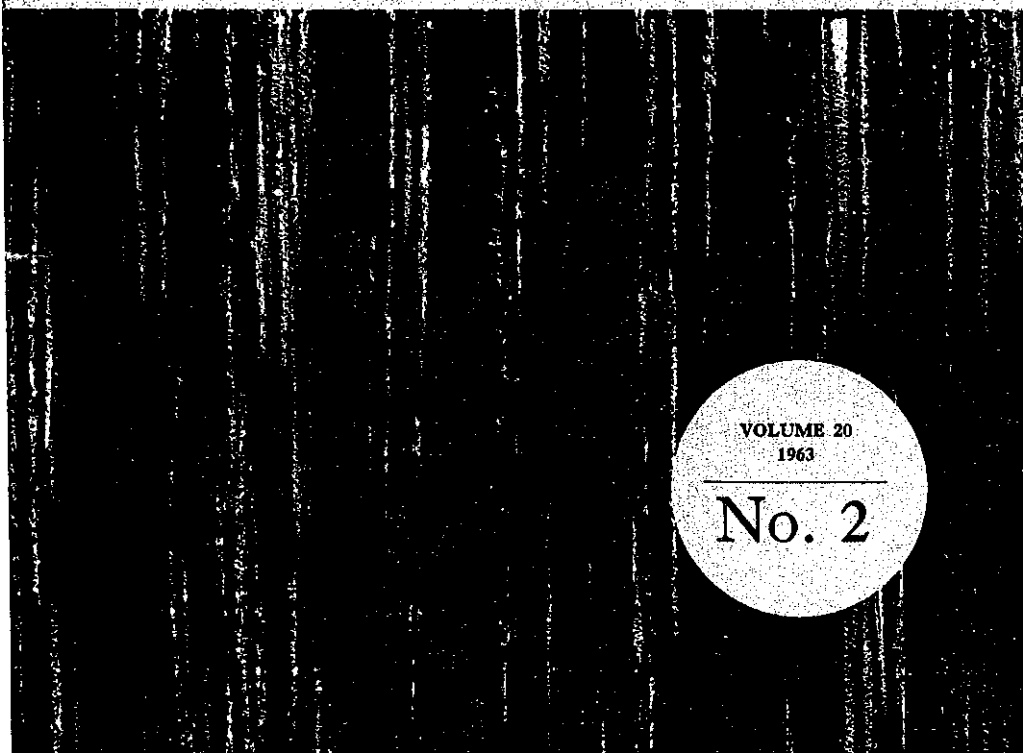

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VOLUME XX
No. 2
JUNE 1963

Editor :
M. C. CLARK, F.I.A

EDITORIAL

Those who read the editorial in No. 1 of the present volume, and were keen to see how the ideas of the new editor would develop in practice were very sorry when Dr Tyrer had to give up this office at a very early stage, before, in fact, the number had actually appeared in print. The reason was that he had to leave the Midlands to take up a professional appointment in Lancashire. He takes with him our best wishes and the assurance that the efforts he devoted to producing a publication worthy of the Society have not been wasted. His policies were fully supported by the Council of the Society, and by the committee responsible for publications, and we shall endeavour to carry them out. It is felt, however, that only one issue a year can be contemplated, both on the grounds of expense and of the amount of material available, although Dr Tyrer did have in mind the possibility of more frequent issues.

There have been some further changes in other aspects of the Society's publications. The *Bulletin*, referred to in the previous editorial, has now been discontinued, so that the Proceedings will be the sole record of the Society's activities. It is, therefore, even more important then before that it should reflect the whole of the official activities, as well as giving publicity to original papers. We have, on this occasion, managed to record briefly a considerable part of the activities of the sections, and we hope that, in future, it will become a matter of routine for each section to keep the editor

informed of what is going on by brief reports on all events arranged officially for members of the section.

We were hoping to devote a large part of the present number to an important paper summarizing certain results of the survey which has been going on for some 13 years for the revision of the Flora of Warwickshire. This paper is well advanced and will include a check-list of all species which occur in Warwickshire and neighbouring counties. The paper is also to include details for each species of the first record in the county, and it is the research necessary to ensure that these details are authoritative which has proved more time-consuming than was expected. There are also some problems of nomenclature to be settled. Rather than rush this work, with the possibility of error, the author has decided to devote a little more time to the paper before publication. We are now hoping to publish it within the next few months as a separate supplement.

We are pleased to be able to publish a paper on 'Local Rivers as Sources of Power,' based on a lecture given to the Geological and Geographical Section some time ago, and combining aspects of the geography of the Birmingham region, both natural and human, with historical research. We thank the other contributors for most interesting papers.

It would be very helpful to know whether members find sufficient interest in the necessarily brief details of the events reported under 'Society Activities.' The editor would appreciate the views of as many members as possible on this aspect, as well as on other features of the Proceedings. We wish to give members what they want, and consideration will be given to all constructive criticism made.

We ask members to assist us by looking out for suitable material for future numbers. We are sure that there are many members whose special subjects could form the basis of papers of real value. So we ask each member to consider what he can do himself, or encourage someone else to do, to make our Proceedings lively and original. Contributions from non-members can always be considered, if relevant to the Society's interests, and dealing with natural history in the Midlands.

The first number of the new series was very well received, and we shall do our best, with the support of members, to see that the standard is maintained.

The Archer Family of Liverpool and their Natural History Collections

by F. R. Woodward

The members of the Archer family of Liverpool having been eminent figures in the Natural History Societies of Liverpool and Birmingham, it is surprising that so little is known about them or their natural history collections, parts of which have passed into the possession of the Birmingham Museum and Art Gallery.

These collections were started by Francis Archer (Senior) and later added to by his two sons.

Francis Archer (Senior)

Francis Archer (Senior), M.R.C.S, was born in Belfast on 23rd April 1803, the son of a well-known Belfast bookseller, but not taking to the family business as a career, he left Belfast and settled in Liverpool. There he practised as a doctor for many years, and was appointed as surgeon to Kirkdale Gaol, Liverpool.

He married Frances Fletcher, the daughter of Joseph Fletcher, an eminent Liverpool merchant, and had two sons, Samuel and Francis, and four daughters, one of whom died in infancy.

A keen naturalist, he specialized in *Mollusca*, of which he built up what was to form the nucleus of the large family collection.

Before leaving Belfast he had been an enthusiastic founder member of the local Natural History Society and, on his settlement in Liverpool, continued his enthusiasm for promoting scientific research, being made the first President of the Liverpool Natural History Society, which was founded in 1840.

After Francis Junior was born the family moved from Renshaw Street to 49 Rodney Street, Liverpool.

The enthusiasm of Francis Archer (Senior) for natural history was passed on to his children, in particular to his sons, and it is probably as a result of his influence that they took such an active part in the promotion of natural sciences, for in his day Francis Archer (Senior) was a well-known naturalist being greatly respected by the authorities of that time.

He died just before his seventy-second birthday on 5th April 1875 at Little Crosby, Lancashire, this probably being the same address as that recorded for his younger son, Francis, namely, Boundary Cottage, Crosby, Lancashire. On his death the collection passed into the possession of this son.

Francis Archer (Junior)

Francis Arthur (Junior) was born on 17th June 1839 at Renshaw Street, Liverpool. He was educated first at the school of the Reverend Mr Payne of Faulkner Street, Liverpool, then at the Liverpool Collegiate Institution, Shaw Street. From here he obtained a scholarship to Trinity College, Cambridge, where he took a law degree with honours in 1862. Francis did not marry and upon leaving Cambridge went to work in the offices of Messrs Bateson and Robinson, a distinguished Liverpool firm of solicitors. He was admitted into the firm in 1865 and became their managing clerk, this being followed by a partnership, the firm then becoming Lownes, Thornely and Archer.

Francis practised as a solicitor for many years, but, becoming attracted by journalism and politics, he left the legal profession to act as sub-editor of the *Liverpool Daily Post*. Due to the strenuous work and late hours he reluctantly had to give up this post and returned to the legal profession, forming a partnership with a Mr Isham Gill, the partnership soon being joined by a Mr Moples. This firm, Archer, Gill and Moples, was concerned with the majority of the transactions dealing with the railways in the area, perhaps the most important being the Mersey Railway Tunnel, which passes under the River Mersey.

Professionally, Francis was held in high esteem, and he was an active member of the Liverpool Law Society, being elected as President for the year 1890-91.

Whilst at Cambridge he read Darwin's 'Origin of Species,' and was greatly impressed by it, this helping, once again, to stimulate his appetite for natural history. He joined the Liverpool Biological Society and was soon made a member of the council as a result of his great enthusiasm and activity in this field. Whilst serving in this capacity he took an active part in the establishment of the biological station on Puffin Island, just off Anglesey. This was accommodated in the disused telegraph station, but due to the fact that the island had no permanent water supply, and also to its being inaccessible due to storms in the

winter months, the station was reluctantly abandoned, and was replaced by one in the Isle of Man.

Francis was particularly concerned with the *Mollusca* obtained during the dredging trips both from Puffin Island and Liverpool, and had prepared lists of the *Mollusca* of the Liverpool Marine Biological Council's area. Unfortunately, he died before publishing them, but his manuscripts were handed to J. R. le B. Tomlin, who published them in the Proceedings and Transactions of the Liverpool Biological Society as 'Supplementary Report upon the testaceous *Mollusca* of the Liverpool Marine Biological Council's District by the late F. Archer.'

Dr Herdman had brought a large collection of *Mollusca* and *Brachiopoda* back from Norway and Francis had been engaged upon listing these at the University College on the Wednesday before he was taken ill.

It is probably partly as a result of his keen enthusiasm that Francis died, from diphtheria, on Monday, 29th February 1892, for he had been tending to neglect his health by working till all hours in order to complete his natural history researches.

Francis was well-known in Liverpool and his sudden death as a result of this illness was a great loss, since he was a person who would go out of his way to help even the beginner in any branch of natural science.

Besides being interested in *Mollusca*, Francis also had a keen interest in entomology, being an enthusiastic member of the Lancashire and Cheshire Entomological Society, and supplying many records to the county lists of Dr Ellis.

Geological interests and collections

He also took a keen interest in geology, joining the Liverpool Geological Society in 1866 and acted as their Treasurer from 1867 to 1872. He was asked several times if he would accept the Presidential chair, but could never be persuaded to accept this post.

His main geological interests lay in the field of palaeontology and he accumulated a large collection of fossils especially rich in Jurassic *Mollusca*.

These geological collections were presumed to have been dispersed upon his death in 1892. However, on 3rd March 1925, Mr A. E. Whitelock and his sister, Miss E. Whitelock, presented their father's collection of Recent *Mollusca* to the Natural History Department, Birmingham Museum and Art Gallery. Combined with these Recent *Mollusca* there was a large 42-drawer mahogany cabinet containing an extensive collection of fossils from the British Isles.

In the Natural History Department's accession book for 3rd March 1925 there is the following statement :

No. 6. A Collection of shells and fossils collected by the late Registrar, W. H. Whitelock, comprising many thousands of British and exotic marine, freshwater and land shells.

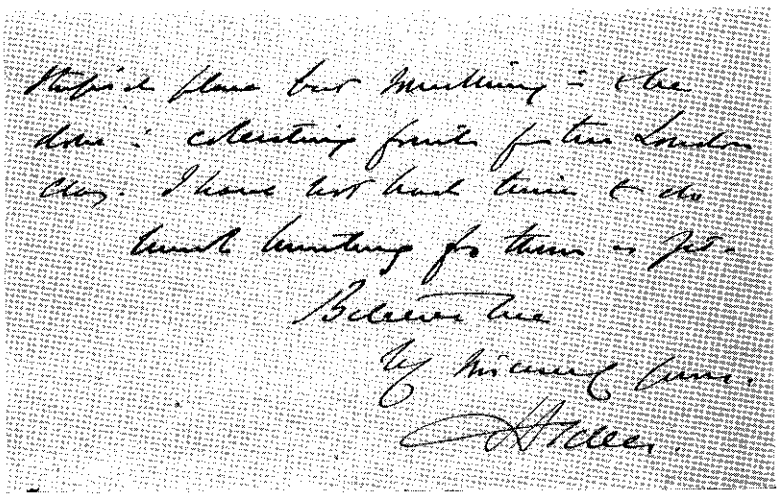
No. 6*A*. Also an extensive collection of fossils ('Archer Coll.') contained in the large 42-drawer mahogany cabinet.

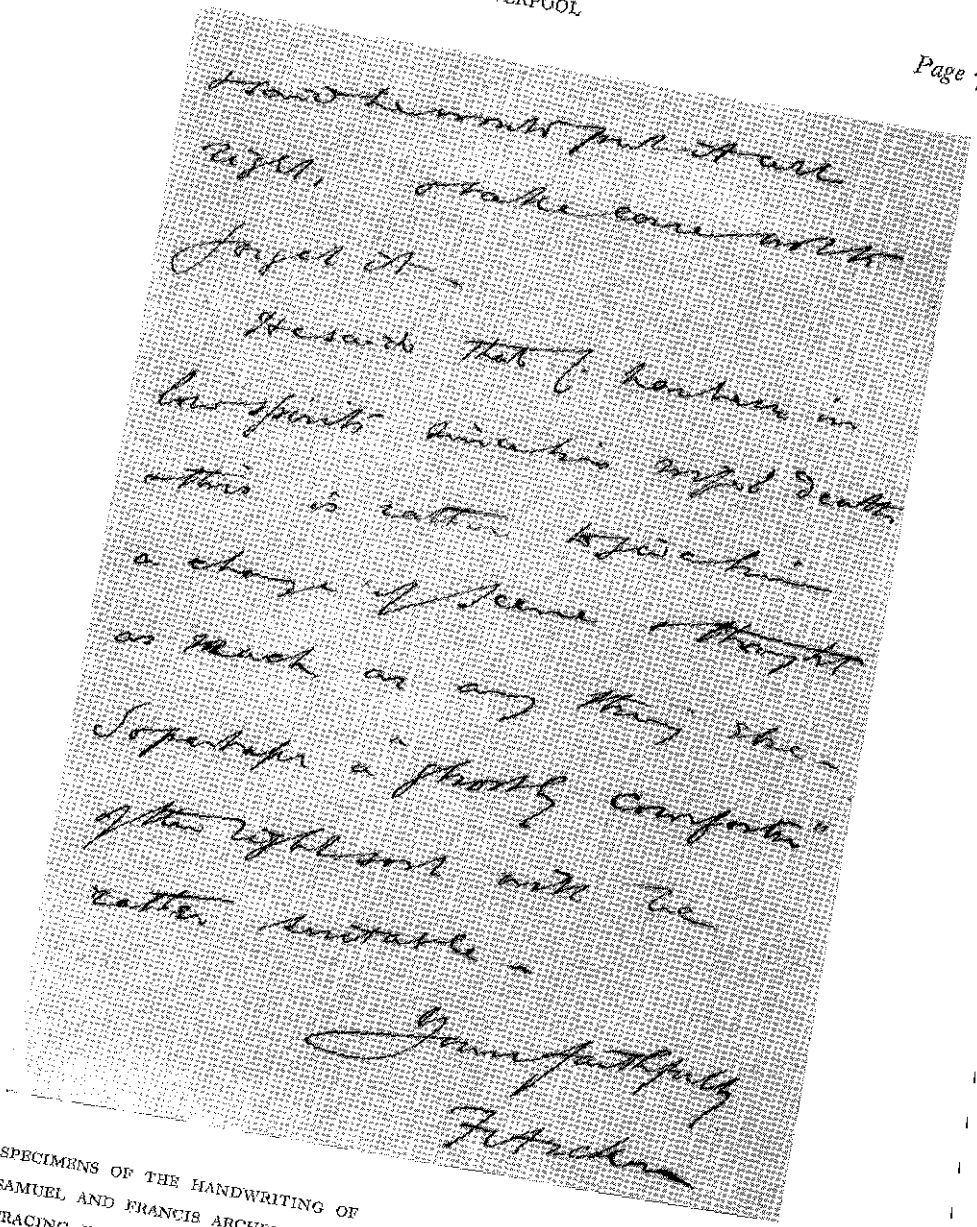
Subsequent to this date the collections have been amalgamated into the general reference collection, but on looking through these it has been possible to extract a large number of these 'Archer' fossils and in many cases their accompanying labels.

These are handwritten in the characteristic style of Francis Archer (Junior) and in many cases bear his initials, F.A., in one corner, this proving that this collection of fossils is, indeed, that of Francis Archer of Liverpool.

Many of these labels state that the specimens were originally in the Bowerbanks collection. Presumably this refers to J. S. Bowerbank, who wrote the Ray Society's 'Monograph on the British Spongeadae (1864-82).' This indicates that Francis Archer probably added to his collections by means of purchasing specimens. Many of these fossils are in excellent condition and comprise examples of Polyzoa, Coelenterates, Echinoderms, Arthropods and Mollusca, the latter group being especially rich in Jurassic Gastropods.

The manner in which these Archer fossils came into the possession of W. H. Whitelock is unknown, but since both Francis Archer and W. H. Whitelock were eminent figures in legal circles, it may have resulted from a friendship struck up during their legal transactions; on the other hand, since W. H. Whitelock was an active member of the Birmingham Natural History and Philosophical Society during the





SPECIMENS OF THE HANDWRITING OF
SAMUEL AND FRANCIS ARCHER WHICH HAVE BEEN USEFUL IN
RACING ITEMS FROM THEIR ORIGINAL COLLECTIONS

same period as Miss Annie Archer (Francis Archer's sister) he may have acquired them from her, either by purchase or gift.

Interest in Anthropology

Besides being renowned as a geologist, Francis Archer also took a keen interest in anthropology in later years, being considered an authority on stone age man. As a result of this enthusiasm he paid a visit to the valley of the Somme, several visits to the West of England, and also to the neighbourhood of Kilroot, Co. Antrim, Ireland. It was from here he obtained a fine series of flint implements, which were subsequently added to his fast-increasing collections upon the history and development of early man.

His two chief contributions to scientific literature were upon this subject – his paper of November 1879, 'Notes on flint implements from a raised beach at Kilroot, Co. Antrim,' being followed by 'Notes on the worked flints of the raised beaches of the north east coast of Ireland' in 1881; besides these he gave numerous addresses to the Liverpool Geological Society on a similar subject, which, being from notes, were not published. In addition he also made several contributions to 'Nature' besides reviewing numerous scientific works in the columns of the *Daily Post*.

The bulk of his anthropological collections have been dispersed. Some items have found their way into the archaeological collections of Birmingham Museum.

In the Natural History Department Register for 3rd June 1921 there is the following entry :

3rd June. Ethnology. Presented by Mr John Humphreys, 69 Harborne Road, Edgbaston, Birmingham.

Prehistoric stone implements, comprising :

Bronze Age. 1 Neolithic axe or hammer head of basaltic stone found at a great depth in High Street (facing the Town Hall), Shrewsbury, 15th September 1886.

1 Quartzite pebble – hammer stone. Near Brandon.
1 Palaeolithic implement. Milton Street, Kent.
4 Flint flakes – kitchen midden. Larne, N. Ireland.
1 glass arrow head – Patagonia.

Attached to this page is the following note, referring to the first item :

Perforated stone axe head. Length, 7¾ in.

This implement was formerly in the possession of Dr Archer, of Liverpool, whose daughter, when an elderly lady, gave it to the late John Humphreys F.S.A, who after retaining it for some time, presented it to the Natural History Department of the Birmingham Museum 1920-21.

This implies that Francis Archer's anthropological collections came into the possession of his sister upon his death and that she, in turn, dispersed them to her acquaintances interested in this subject.

The specimens noted above are now in the Department of Archaeology, Birmingham Museum and Art Gallery, having been transferred there in April 1953.

On Francis's death at the early age of 52 at his home at 21 Mulgrave Street, his collections passed into the possession of his elder brother, Samuel.

Samuel Archer

Samuel was born in 1836, and inherited his father's enthusiasm for natural history, taking a keen interest in the family shell collections. Samuel married, but there appears to be no record of the names of either wife or children.

Like his father, Samuel took to the medical profession, becoming an army surgeon in Her Majesty's Forces, and according to J. R. le B. Tomlin, who knew the Archer brothers personally, reaching the rank of Surgeon-Colonel (a post which no longer exists). Samuel retired from the forces as a Deputy Surgeon-General, but continued to travel abroad a great deal. During his extensive travels, both in the forces and during retirement, Samuel collected a vast amount of natural history material, the shells of which he sent home to help swell the family collections.

Besides collecting shells he also obtained numerous curiosities, which he had brought back to England, the majority of which were presented to Liverpool Public Museum. Perhaps one of the most outstanding of these was a new species of sponge which Samuel, at that time Staff-Surgeon-Major at Belize, obtained from Dr Barry, who was Staff Surgeon at Corosal. This sponge was described as a new species by Thomas Higgin in the 'Annals and Magazine of Natural History' for September 1875 under the name of *Luffaria archeri*, in honour of Samuel.

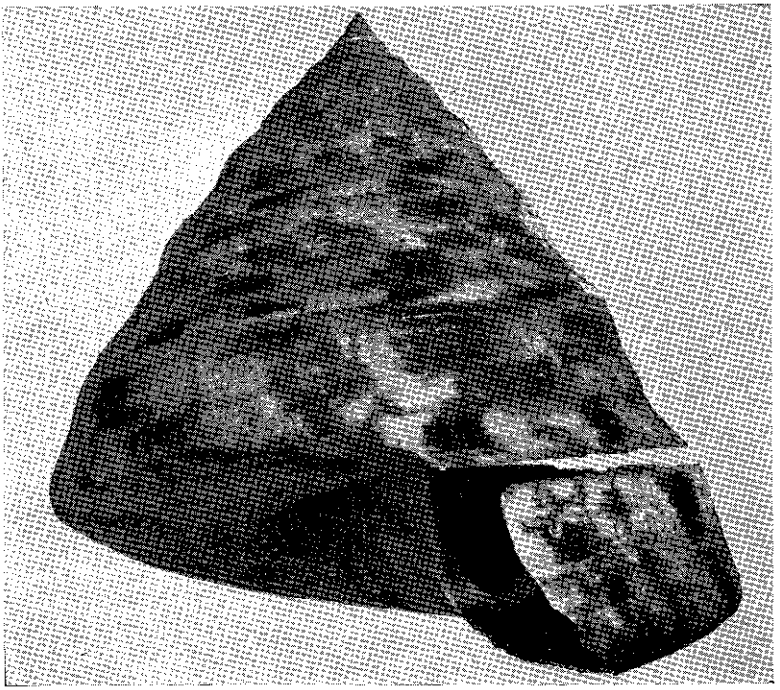
It was originally obtained from Ambergris Island, just off the coast of Yucatan, Gulf of Honduras, and it is much to Samuel's credit that he managed to bring such a delicate object back to England in almost perfect condition. The feat seems even more remarkable, when one learns that this sponge consisted of two trumpet-shaped tubes arising from a common base, the larger being 3 ft. 9 in. high with a basal diameter of 2 in. and distal measurement of 5 by 4 in., the smaller being 1 ft. 7 in. high with a basal diameter of 1 in. and distal diameter of 2½ in.

At that time the type specimen in Liverpool was considered unique, but Samuel subsequently came across another specimen which was

nearly 5 ft. 6 in. long. Unfortunately, the type of the Neptune's Trumpet Sponge, *Luffaria archeri*, was destroyed as a result of enemy bombing in the Second World War.

A rare shell

Another important donation to Liverpool Museum survived the blitz, this being a large and fine example of *Pleurotomaria adansoniana*, Crosse and Fischer. According to J. R. le B. Tomlin, Samuel obtained two examples of this shell, the first being obtained from a curio shop in Barbados, its original locality being Tobago, West Indies. Years later Samuel revisited this curio shop, and there, to his amazement, saw a second specimen in exactly the same place. This he also purchased and sold to the British Museum for £55.



THE ARCHER SPECIMEN OF *Pleurotomaria adansoniana* CROSSE AND FISCHER, IN LIVERPOOL MUSEUM

Delightful though this story may be, considerable doubt was thrown on to its validity since, in the Liverpool Museum's stock book the locality quoted for Samuel's Shell is 'from St. Lucia' not Tobago, as quoted by Tomlin, Dean, etc. Furthermore, an enquiry regarding the supposed specimen in the British Museum (Natural History) brings to light evidence which again seems to oppose this view, for although a specimen of *Pleurotomaria adansoniana* was purchased in 1895 for £55, this was apparently from the Weymouth dealer, R. Damon. Damon had acquired it from R. Lechmere Guppy, who in turn had purchased it from a gentleman of Tobago, off which island it had been collected. From this it would appear that Samuel, in actual fact, had only a single example of *Pleurotomaria adansoniana*, not two as is generally believed.

However, diligent enquiry has brought to light a further specimen in the Manchester Museum, Manchester University. This shell is stated to have been purchased from R. Damon of Weymouth who, in turn, had bought it from a Col. S. Archer. Therefore, it would seem that Samuel did obtain two examples, but that his missing specimen went to the Manchester Museum and not the British Museum as is often quoted.

The major portion of the shells obtained by Samuel on his travels were sent home to his brother Frank (Francis), who added them to the joint family collection. However, Samuel retained a small collection of shells, which he had made in Singapore and which he bequeathed to J. R. le B. Tomlin. Amongst the shells in this Singapore collection was the specimen of *Eulima candida* Marratt, the unique type of which is now with Tomlin's collection in the National Museum of Wales, Cardiff.

Samuel also presented a collection of shells to the Museum of the Chester Society of Natural Science, this being reported in their Twenty-ninth Annual Report (1900-1901) as follows :

> Surgeon-Col. Archer's generous gift of the collection of land, freshwater and marine shells is a most valuable one. It embraces nearly all the known British species, including many that are rare; also extensive series of the majority of species but more especially so of the variable species of the genus *Helix*. As the nomenclature and the classification of the *Mollusca* has considerably changed since the collection was last arranged, it will need careful revision and reclassification. The collection was chiefly made by Col. Archer's late brother, Mr F. Archer of Liverpool, who, as an accomplished naturalist and archaeologist, was well known to many of the leading scientists of this Society. He showed the keenest possible interest in the welfare of our Museum, and at its commencement made many valuable suggestions to your curator with reference to the formation and preparation of various collections; the valued gift is, therefore, a pleasant tribute to his memory.

This collection is not entered in the accession book of the present museum in Chester, the Grosvenor Museum, hence the collection may have been destroyed. However, an old label amongst some specimens of *Helix* in their shell collections has certain similarities with Samuel's handwriting, but is unfortunately insufficient to give positive confirmation.

Miss Archer and the shell collection

Samuel died suddenly at Rapallo, near Genoa, in 1902. The whereabouts of the joint family collection was lost sight of, but in 1903 the Zoology Department of Birmingham University was presented with a collection of shells by a Miss Archer. This donation was recorded in Council minute number 1149 for the 6th May 1903 as follows :

> *Minute* 1149. A letter addressed from Professor Bridge to the Principal, having been read, in which the Professor reported a gift by Miss Archer to the Zoological Museum of a collection of shells.
> RESOLVED that the cordial thanks of the Council be conveyed to Miss Archer . . . etc.

This collection of shells was housed in four oak cabinets, the upper glass fronted portion having 12 drawers, and the lower portion 8, 11 or 12 drawers, respectively.

The cases each had a chinaware plaque fitted to the top, measuring 23 by 2 in., and having the inscription 'The Archer Collection.' That collection remained in the possession of the University until 1950 when it was presented to the Birmingham Natural History and Philosophical Society in whose possession it remained until October 1961, at that date being transferred to the Natural History Department of the Birmingham Museum and Art Gallery. Since then a large portion of it has been amalgamated with the general collection, the rest being housed in store boxes.

As a result of the frequent movements the collection had fallen into a state of neglect with the result that many of the specimens and labels were jumbled together in the corners of the drawers. The majority of these labels proved to be in the handwriting of Francis Archer (Junior), whilst one or two are in the characteristic hand of J. R. le B. Tomlin, indicating that the Archer brothers had, in all probability made exchanges with Tomlin.

Any documentation concerning the collection has apparently been destroyed, although in a letter dated the 22nd March 1955 from the Zoological Department of Birmingham University to the Natural History Department of the Museum, it is stated that the University was in possession of a modern catalogue of the Archer Collection at that date. Further enquiry into this proved fruitless, the catalogue referred to having been mislaid or destroyed since 1955. Miss Archer, who presented the collection to Birmingham University, was a sister of Francis and Samuel, and like them had inherited the family flair for natural history. She apparently took no active part in amassing the natural history collections, but on her brother's death came into possession of their joint collections.

In 1896 she was living in Birmingham at a boarding house in

Frederick Road, Edgbaston, and in that year joined the Birmingham Natural History and Philosophical Society to which she belonged until 1914.

From 1898 to 1905 she lived at another boarding house on the Hagley Road, Birmingham, this possibly explaining why she disposed of the family shell collection to Birmingham University in 1903, the collections having come into her possession upon the death of Samuel in 1902.

Miss Archer took an extremely keen interest in natural history museums and was one of the original petitioners, along with the eminent scientists of the Birmingham area, to the Lord Mayor of Birmingham regarding the formation of a natural history museum in the City. In a petition which appeared in the local newspapers, she was quoted as being the Honorary Secretary of the Birmingham and Midland Branch of the Selbourne Society. In this petition it is pointed out that many valuable collections had been placed elsewhere since there was no museum in the area, and one wonders if the Archer collection may have been one of those referred to. Miss Archer presented a box containing 11 large shells towards the formation of a natural history museum, these remaining in trust with the Natural History and Philosophical Society until 4th July 1912.

She had also gained possession of the ethnological collections and gave some of these to Professor John Humphreys, telling him her father was a Dr Archer from Liverpool, this proving her relationship.

In 1913 she is reported as living at The Cottage, Greenhill, Blackwell, near Bromsgrove in Worcestershire. It is assumed she died at this address in 1914, since there is no further trace of her after this date.

The only information which can be found about the other sisters is that in the centenary volume of the Belfast Natural History and Philosophical Society, a Miss E. F. Archer supplied information on Francis Archer (Senior). It may be assumed that this Miss Archer was also one of his three surviving daughters.

Acknowledgments

I would like to express my thanks for valuable assistance in the preparation of this paper to Mrs N. F. McMillan in particular, for the use of her notes and letters concerning the Archer family, and also to Messrs S. P. Dance, C. Matheson, T. Pain and W. Belcher and Miss Schofield.

Thanks are also due to the staff of Birmingham Central Reference Library, Birmingham Museum and Art Gallery, Liverpool Public Museums, Grosvenor Museum, Chester, and the National Museum of Wales, Cardiff.

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Marsh Dandelions in Warwickshire

by M. J. Harvey and J. G. Hawkes

We are informed by Professor S. L. van Soest, the Netherlands *Taraxacum* expert, that the marsh dandelions of Warwickshire which he has kindly determined for the Flora of Warwickshire Revision belong to section Spectabilia (*T. spectabile* agg.). So far as we know at present only two species within this aggregate seem to occur here, namely, *T. faeroense* Dahlst. – a predominantly northern microspecies – and *T. nordstedtii* Dahlst. – a species with a more southerly distribution area. *T. faeroense* is by far the commoner of the two and is to be found quite frequently in marshy or boggy areas in the north and north-eastern parts of Warwickshire.

Since the chromosome number of *T. faeroense* had not previously been determined (van Soest, written communication) we collected ripe achenes of this species from Sutton Park (Grid ref. 42/0998) in June 1963 and made chromosome counts from root tips. All seedlings examined gave a clear count of $2n=40$.

The basic chromosome number in *Taraxacum* is 8 and *T. faeroense* is therefore a pentaploid. This is not without interest, since Professor van Soest informs us that Spectabilia are mainly tetraploid ($2n=32$), whilst *T. nordstedtii* is hexaploid ($2n=48$). It may therefore be possible to elucidate the mode of origin of *T. faeroense* by cytological information of this sort, coupled with more classical taxonomic methods.

The Subspecies in Flowering Plants

by J. G. Hawkes

The subspecies has been defined in many different ways, at one extreme to typify infra-specific variants of a minor nature that would normally be designated as forms or varieties, and at the other to include populations that would generally be considered as distinct species.

We shall examine various definitions of the subspecies category in an attempt to see whether we can find a generally acceptable position for it between the two extremes just mentioned.

The oldest and still the most widely accepted concept of the subspecies in flowering plants is that of the geographical race, 'Rassenkreis', or regional facies. This developed from the work of Wettstein, Engler and others. Rensch (1929) applied the term 'Rassenkreis' (race chain) to all species that could be divided into distinct mutually exclusive geographical races, each race differing from the others by well-marked, though sometimes small, morphological characters. Present-day subspecies concepts differ little from that of Rensch, except that they include a great deal of variation that Rensch himself would have excluded, since he did not admit of any type of subspecies other than the geographical one.

Within this restricted use of the term we should expect different subspecies within a species to be connected to each other by distinct but short zones of intergradation. Most taxonomists would also include geographical variants isolated by small but complete barriers within their concept of subspecies, even though zones of intergradation were not present. They would assume, however, that the morphological variation between the subspecies was of a minor nature. If the morphological and other differences were large, and zones of intergradation were absent even when there were no geographical barriers, then the taxa under consideration would generally be considered as species and not as subspecies.

Numerous examples of geographical subspecies can be cited from the British flora. Thus, *Salix cinerea* exists as two subspecies in Britain, ssp. *cinerea* from the south eastern counties, spreading eastwards into N.E. and C. Europe, and ssp. *atrocinerea*, with a western atlantic distribution. A similar geographical separation occurs with ssp. *ericetorum* and ssp. *maculata* of *Dactylorchis maculata*, though in this case the typical subspecies is not known in Britain. The three geographical subspecies of *Tragopogon pratensis* and the two of *Betula pubescens* are other examples, as also is *Cirsium eriophorum*, with its subspecies *britannicum*, endemic to this country.

A special kind of geographical subspecies in Britain is where a cultivated introduced subspecies is distinguished from the wild indigenous one, though the two may occur side by side and often form intermediates by hybridization. Examples of this may be seen in such species as *Beta vulgaris*, *Daucus carota*, *Malus sylvestris*, *Dipsacus fullonum*, *Asparagus officinalis*, etc. Here the cultivated subspecies has been introduced by man, often originating in S. W. Asia or elsewhere, and has not only been subjected to many thousands of years of artificial selection but even originally was adapted to climatic conditions rather different from those in Britain. Other examples may be quoted of an introduced subspecies establishing itself as a weed, or becoming naturalized, even though it was never cultivated; e.g. *Calystegia sepium*, sspp. *pulchra* and *silvatica*. These are geographical subspecies which often thrive in Britain, far away from their original range.

In addition to the geographical subspecies we must consider altitudinal variants within species which may also perhaps best be classified as subspecies. Obviously, a lowland species may diverge into a number of distinct mountain subspecies, agreeing in every way with Rensch's 'Rassenkreis' concept; but disjunct mountain forms without any interconnecting lowland 'parental' species must be considered on their own merits either as distinct species or subspecies, according to similarities or dissimilarities. The *Euphrasias* on Malaysian mountains spreading from S. Japan to New Zealand studied by Du Rietz are interesting here. Each shows a local facies, and is most similar to the others closest to it geographically. As Van Steenis (1957) points out "this is justly the state of affairs required by a species separated into disjunct subspecies."

Altitudinal subspecies, which to some extent may be considered as ecological or habitat subspecies, are also quite common in the British flora. For example, *Cochlearia officinalis* possesses mountain and lowland subspecies (ssp. *alpina* and ssp. *officinalis*) and so also does *Salix caprea*. In northern Europe the mountain subspecies are generally to be found also in the same climatic conditions at sea level much further north, but in the tropics this is not the case, so far as the present author is aware.

In many instances ecotypic variation may also conveniently be given sub-specific ranking. Variants within a species separated from each other by distinct ecological and physiological requirements and differing by

certain easily recognizable morphological characters are generally thought of as subspecies. However, if the morphological differences are very small and difficult to distinguish or if there is a large number of such minute variants, difficult to identify or only recognizable statistically, and all intergrading with each other – then most taxonomists are agreed that it would be better not to give them latin names but to use terms appropriate to experimental taxonomy only, e.g. ecocline or ecodeme.

Ecological variants among species are very common (see Salisbury, 1940) and it has been suggested by Van Steenis (1957) that many of these ought to be demoted to subspecies rank e.g. *Silene vulgaris* and *S. maritima*, *Geum urbanum* and *G. rivale*, since perfectly fertile and intergrading offspring arise when they hybridize together. The same would presumably apply to *Silene dioica* and *S. alba*. Most taxonomists would consider, nevertheless, that this process should not be taken too far, and that it is more convenient to consider such vicariads as species pairs, developing under ecological isolation. They remain distinct in nature and even though there are no intrinsic barriers to gene exchange the ecological barriers are effective enough unless, as sometimes happens, they are partially removed by man. This takes place occasionally with the species pairs of *Geum* and *Silene* just referred to; but they differ so clearly morphologically and remain so distinct that most taxonomists would consider them as good species, *not* as subspecies. Other ecological vicariads that differ by much smaller characters are ranked as subspecies, e.g. *Tripleurospermum maritimum* ssp. *maritimum* and its subspecies *inodorum*, *Erodium cicutarium* ssp. *cicutarium* and ssp. *dunense*, *Ranunculus peltatus* ssp. *peltatus* in still water and ssp. *pseudofluitans* in fast flowing streams.

Certain subspecies seem to present an intermediate situation between the truly geographical and the clearly ecological types. Thus *Centaurea nigra* ssp. *nigra* is prevalent in the north of Britain or on heavier moister soils in the south, whereas ssp. *nemoralis* is seen chiefly in the south and especially on calcareous soils. No doubt a complete range of intermediates from the geographical to the ecological subspecies exists.

Most flowering plant taxonomists would thus agree, even though possibly with some reservations, that the subspecies category could be used both for geographical and ecological variants, *provided* that the morphological differences between them were not too great. The presence of zones of intergradation would be a reassuring factor as also would the evidence of hybridization without loss of fertility in the intergrading zones if they existed.

One of the reservations in this definition would have to do with the presence of clines, smooth gradients of variation running through a species over all or part of its distribution area. As Huxley (1939) points out "The relation of clines to subspecies depends on the character of the clines. If they are continuous over long distances and if the extreme types are relatively limited in distribution, as with the clines in *Pinus*

sylvestris, then they cannot form the basis for classification. But if a number of clines run parallel and are partly discontinuous, with a steep gradient in some regions and a moderate one or a constant level in others, then the different levels of variation in the characters forming the clines may constitute part of the basis of local races or subspecies."

Thus, if a species changes gradually and continuously over its geographical or ecological range, then this variation must not be characterized by classical taxonomic terminology. Subspecies rank can only be given to geographical or ecological variants which are relatively discontinuous. Ecoclines, as described by Gregor (1938) in *Plantago maritima*, due to the selective action of a graded environment on a large assembly of genotypes, should be described as such, and left without any latin nomenclature. A further difficulty, perhaps more apparent than real, is that different clines may run through a widespread population in different directions, as Cain (1957) points out. Classifications based on these would differ significantly according to which cline was considered more important; however, if we refuse to base subspecies on the clinal type of continuous variation, this difficulty will be at once resolved. It is therefore of the greatest importance in dealing with infraspecific variation to be certain : (a) that there are breaks or partial discontinuities, which may be used as boundaries between the subspecies concerned, and (b) that we are not obscuring the presence of a cline by trying to fix names and descriptions to several arbitrarily selected points along its length.

Thus, the presence of 'joints' between the subspecies is of the greatest importance. How is the partial isolation maintained between the various subspecies within a species, to prevent them from grading imperceptably into each other and thus ceasing to be distinguishable, but not so great as to separate them completely ? The narrow zones may represent partial geographical discontinuity through which gene-flow is delayed or restricted. They may mark abrupt environmental change, i.e. plain to mountain, inland to maritime, or may perhaps be due to some reduction of fertility or viability in the hybrid offspring between different subspecies, each of which is adapted modally to a very different environment.

This partial isolation, as we have stated, may or may not become complete. It has been suggested that at times it never does so, and that the constituent subspecies of a species may never evolve into distinct species. This may be correct in certain circumstances; but in many plants, and especially those with restricted powers of pollen and seed dispersal, the partial isolation is sooner or later likely to become complete. We have seen, furthermore, that some species are composed already of a number of isolated units which it is appropriate to call subspecies even though zones of intergradation are absent. If the morphological differences between these isolates are small, most taxonomists would hesitate to class them as distinct species, but would prefer to give them subspecific rank. These are subspecies which will in all probability become species in the process of time, when they have been separated from each other for a very long period. To begin with

they would presumably be potentially capable of crossing with each other, but eventually would probably develop genetical barriers to gene-exchange.

Obviously, the taxonomist will encounter populations of plants at different stages in this continuous process. Those that had just become spacially separated but were morphologically very similar could hardly be considered as distinct at all; some way along the line they would appear to be reasonable sub-species and further on still, they would differ from each other sufficiently to be classified as good species. Since all intermediate stages are possible the taxonomist would at times find difficulty in judging what rank to give them. However, because there are cases where a decision cannot easily be made the whole system of nomenclature should not be discarded for this reason alone.

Species may also evolve by means of isolating mechanisms other than geographical and ecological ones. If we agree to recognize subspecies, at what often seems to be a half-way stage towards species formation under conditions of geographical or ecological isolation it should be legitimate to do the same with species that are evolving under physiological, cytological and genetical isolating mechanisms. We are here on much more delicate ground, since many taxonomists would not admit that subspecies other than geographico-ecological ones should be considered as valid. Nevertheless, the recognition of cytological subspecies is becoming much commoner, as we shall see later.

A very large number of species in Britain and elsewhere consists of two or more cytological races or cytotypes that cannot usefully be given taxonomic status because of the impossibility of distinguishing them (e.g. races of *Cardamine pratensis*, *Adoxa moschatellina*, *Campanula rotundifolia*, *Valeriana officinalis*, etc.).

When the cytologically differing components of species are morphologically distinguishable it has become common to rank these as subspecies, especially when there is some ecological or even geographical difference involved. Thus *Ranunculus ficaria* ssp. *ficaria* (2n=16) is found in sunnier situations than ssp. *bulbifer* (2n=32); *Hypericum maculatum* ssp. *maculatum* (2n=16) is found mainly in W. Scotland, whilst ssp. *obtusiusculum* (2n=32) is widely distributed; *Odontites verna* ssp. *verna* (2n=40) has a more northerly distribution than ssp. *serotina* (2n=20). Other cases are known where cytological variants are given species rank and are often grouped as an aggregate species (e.g. *Rumex acetosella* agg.; *Polypodium vulgare* agg.). Here, although the differences may not be any larger and the species no more readily distinguishable from each other than the cyto-ecological subspecies just referred to, the underlying assumption is that the species in the aggregate are formed by hybridization and amphidiploidy, whilst the subspecies are formed by autopolyploidy. Since all intermediates are possible between the true allopolyploid and the true autopolyploid, one cannot hope to apply this rule rigidly, and in the end the taxonomic judgement of the monographer

of the group in question must be used to decide whether a specific or subspecific distinction is the more appropriate.

To sum up this section, the current practice with cytologically differing races seems to be as follows : if the chromosome races are barely distinguishable or completely indistinguishable morphologically then they are not considered worthy of formal taxonomic rank; they may indeed be perfectly good *biological* species, but since they can never be distinguished without a chromosome count it is considered highly undesirable to give them different botanical names, even at the level of variety or form. If the morphological differences are minor ones, but fairly well-marked, and especially if they are accompanied by some difference of ecological or geographical preference (as they generally are) then they are ranked as subspecies, especially if it is thought that they are formed by autopolyploidy, or their mode of origin is uncertain or completely unknown. If the morphological differences are greater and there is some evidence that they are good allopolyploids, formed by the hybridization of rather distinct parent species, then the cytological 'races' are generally ranked as distinct species.

Have species that were produced by means of *cytological* isolating mechanisms passed through a preliminary subspecies stage ? This statement cannot be said to be true with polyploid species in flowering plants, which have arisen suddenly by interspecific hybridization followed by chromosome duplication. We must presuppose that in such cases the two original parents were genomically distinct. Where they were not, however, the situation would become much more complex, and may not be worth discussing separately from that in which apparently autopolyploid 'races' of a diploid species have arisen. Many of these may not be distinguishable from the parent form or from each other.

From this brief survey of the use of the subspecies category in flowering plants we can see that it would be in many ways simpler to limit our concept of the subspecies to geographical or ecological races within a species, preferably with linking steps or zones of intergradation. However, this seems automatically to limit us to typifying only one sort of important infraspecific variability. If we decide to include also those geographical or ecological races that are *not* connected to each other by means of linking zones but are apparently separated by distinct barriers and are evolving apart more and more, then it seems that we must also consider many other processes of isolation under which species are evolving. Isolation can be brought about by many different factors, not only geographical, but ecological, mechanical (differences of floral structure), physiological (e.g. differences in time of day or year at which anthesis takes place) and cytogenetical. In the first stages of isolation few differences between the isolated sections of the original species will be seen. However, these differences will eventually become large enough to warrant the delimitation of species and presumably in the end genera and even higher taxonomic categories. Some way along the line from zero variation to the species level we must place the subspecies, bearing in

mind that our concept of subspecies must vary as does our concept of species, since their pattern of variability and mode of evolution is not uniform and depends very largely on the breeding mechanisms and isolating mechanisms adopted by the organisms in question.

It is therefore as impracticable to give one rigid definition of the subspecies as it is of the species. Nevertheless, a fairly reasonable general definition (adapted from that given by Tutin, 1957) might run as follows :

"Taxa differing from one another in minor morphological characters and either partially or completely isolated from each other by means of geographical, ecological, physiological, cytogenetical or other barriers, (but in some cases potentially capable of interbreeding without substantial reduction in fertility)."

The drawback to a definition such as this is that it could equally well apply to the sort of variation seen in apomictic groups or in self-fertilizing species or groups of 'microspecies,' which consist of a number of pure lines differing from each other by minor characters and partially or completely isolated by genetical or physiological barriers. Yet it has never been the practice to give subspecific names to such apomicts or autogamous species. Apomicts are a special case which must be considered as such from a taxonomic point of view. The various sub-units of autogamous species normally seem to show little ecological or geographical preference and it is this, perhaps more than any other fact, together with the lack of any character correlation, which makes one reluctant to include them in a subspecies grouping. In fact the modern opinion with these is that no taxonomic status should be given to pure lines that are barely identifiable since they merely represent the 'frozen' segregates of past hybridizations. Those which are more readily identifiable are normally noted as botanical varieties or forms, or are given specific status.

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Local Rivers as Sources of Power

by John Morris Jones

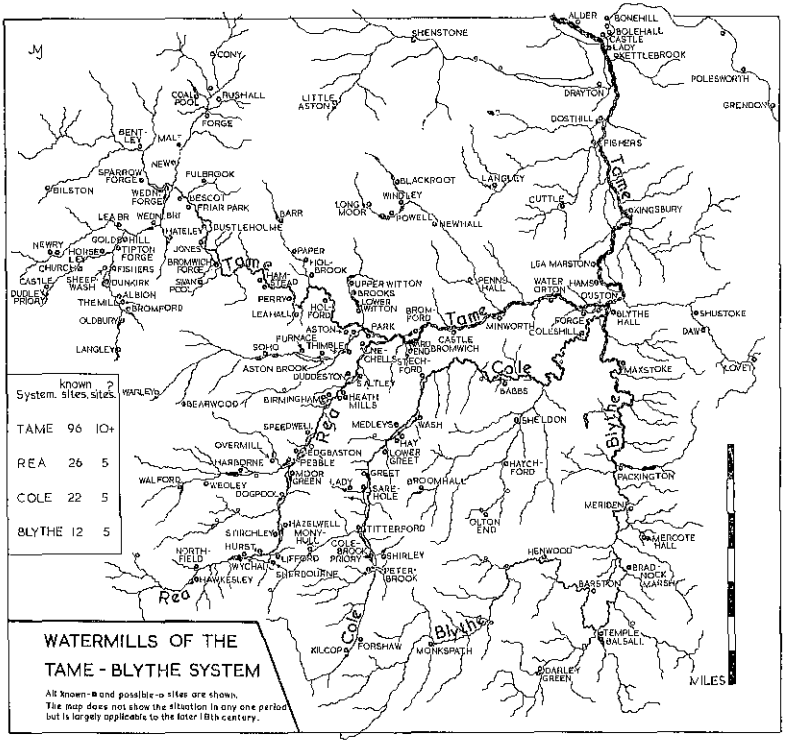
This study is confined to the Rivers Tame and Blythe, their tributaries the Rea and Cole, and smaller streams which flow into them. Having their sources almost wholly among the western ramparts of the Birmingham Plateau, except for a few tributaries of the Blythe which rise in the East Warwickshire Heights, they constitute the central drainage of the plateau.

By 'Sources of Power' is meant waterpower in the ancient sense; there are only two known instances of a waterwheel's use for the generation of electricity in this system. A vanished aspect of rural and urban industry will be studied herein – for nowadays, on about 300 miles of once usable waterways there is only one site where power is still being obtained from running water. Yet at the start of the nineteenth century there may well have been a hundred such sites. This was not exceptional for the time, other systems being in greater use, but few can have been so fully employed so near to their watershed. On the 156 known watermill sites hardly any buildings survive, very few leats and pools can be traced, and in a number of cases even the site cannot be positively identified. This is an antiquarian, even an archeological, study.

Watermills were formerly as common as smithies, and as little recorded; a note in the County History, a passing reference in a guidebook, a symbol on a Georgian map which may be inaccurate – these are the easily accessible sources of information; otherwise, rental rolls, account books, and similar estate documents must be sought, often without success.

Early history of watermills in Britain

The mechanics of watermills were well-known by the Romans, but they usually preferred the muscle-power of slaves and animals to waterpower, and are unlikely to have made much use of British rivers; certainly the Birmingham Plateau, which had no attractions for the town-builder, would have had no Roman watermills.



The Saxons brought the knowledge of crude watermills from the continent, and many of their settlements had a mill. In 1086, the Domesday Survey tells us, there were 7,500 mills in the country – and these were all worked by water, for the windmill did not reach Britain until the end of the twelfth century. This number does not imply 7,500 separate buildings, however, since for taxation purposes each pair of

stones counted as a mill, and one building might house two or more pairs. As there were about 10,000 parishes at the time of Domesday, a very rough guess might be that about half of them had a mill; some of them may well have been quite new erections by Norman lords to whom they were a source of income.

In our region, there were the following :

TAME	11 mills
BLYTHE	6 mills
COLE	1 mill
REA	0 mills
	Total 18 mills

It seems strange that virtually no use was then being made of the Cole (25 miles long) and the Rea (17 miles), the only Cole mill being that at Coleshill, just above the Blythe confluence. But if the complaint of the Anglo-Saxon Chronicler be accepted, nothing taxable was overlooked by the Conqueror's survey teams – and a watermill could not be hidden ! Domesday Book may therefore be relied upon in this instance. In view of the relation of mills to fisheries, it is of interest that none of the latter are recorded for the Tame-Blythe system. There was settlement along Cole and Rea, but the people were few; Arden was too densely wooded and heavy-soiled to support a large population at that time. The lower Tame had been earlier and more densely settled, though the terms are relative in an area of late and sparse Saxon colonization.

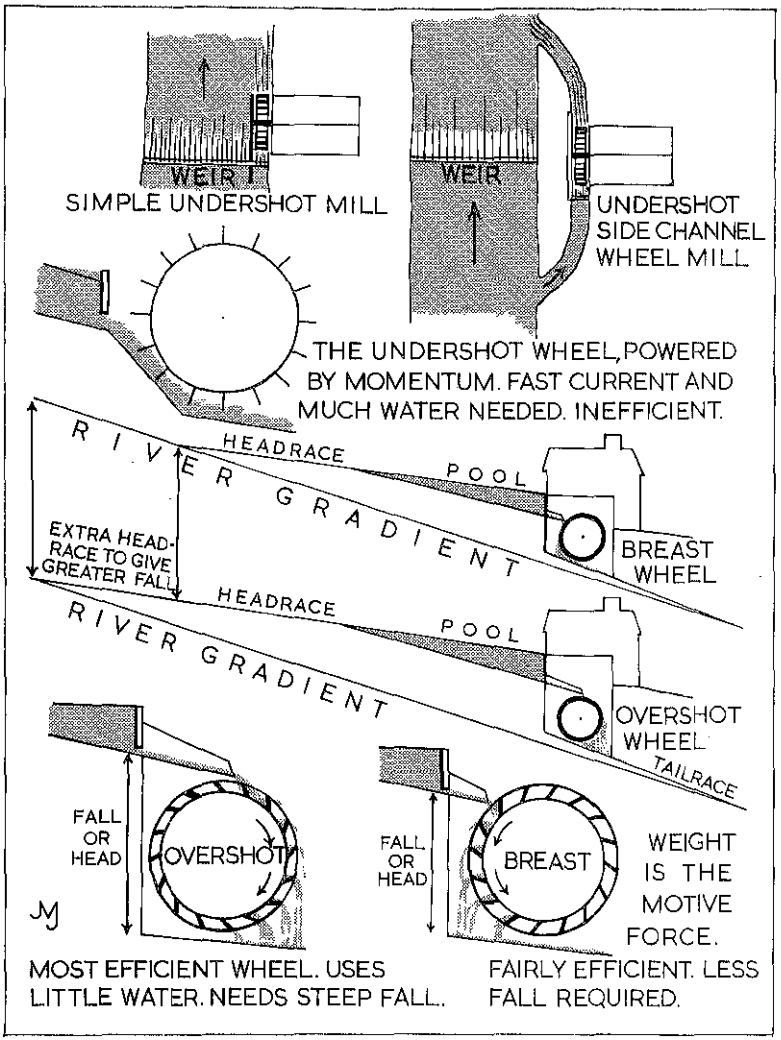
Of the Domesday mills on the Tame, that of Middleton was worth as much – 20 shillings – as the whole manor of Birmingham, which had no mill, unlike its neighbour Aston. Lea Marston and Kingsbury mills were worth about 10 shillings each, and the rest yielded two to three shillings, except for little Rushall, which paid only 4d. Some of these mills have survived, with rebuildings, almost to the present, while on other sites great factories maintain industrial continuity.

Types of waterwheel

Before dealing briefly with the history of the four rivers as sources of power, it may be of value to show how the power was obtained. The earliest type of Saxon waterwheel was the paddle, set either horizontally or vertically in the stream. Practicability and ease of maintenance caused the vertical paddlewheel to become usual. (It is interesting to note that the most modern waterwheel, the turbine, is set horizontally.) A stout frame of timber supported the paddle beside the stream, the lower third being in the water. Too much water or too little being usual on so many of our rivers, weirs were built to regularize the flow; an earth dam strengthened by stones and timbers, a sluice on the wheel side to deliver

the pounded water, and a floodgate to release excess water, were early improvements, as was the building of a house over the millworks. This not only kept grain and flour dry, and helped sustain the vibrations of the wheel, but made a home for that unpopular man, the miller.

For good reasons it became usual on all but the smallest streams to build the mill on a side channel cut from the main stream above the weir, although in some cases it is the river itself which is diverted



through sluices into a side channel. In each case the pounded water rushes down a ramp to strike the lower paddles of the wheel; it is shot *under* the wheel, hence the name 'Undershot' for the paddle-type wheel. The water's momentum turns the wheel, and a plentiful supply is needed. The Undershot Wheel is no more than fifty per cent efficient at best, but this is unimportant in a simple grist mill having abundant water.

Another type of wheel, only less ancient than the paddle, is the Overshot Wheel, which employs not the force of water but its weight. Water falls from above into so-called 'buckets' on the farther side of the vertical axis, the resulting imbalance causing the wheel to turn in the direction of flow. Water remains in the buckets for about $\frac{1}{3}$ revolution, and it is claimed that the Overshot Wheel can be as much as 90 per cent efficient. Relatively little water is required, but there must be a good fall or 'head,' greater than the wheel's diameter. In hilly country this presents no problem – a stream can be diverted over a cliff edge beneath which a wheel has been placed, and only a short timber flume is needed to bring the water over the wheel's axis. The Overshot Wheel is sparing of water, but produces relatively little power; to obtain an adequate drive, the wheel must be large – 12, 15, even 30 feet in diameter. But this necessarily implies that the 'head' be greater still : if 13 feet of 'head' be required, the water must be able to fall 13 feet and continue to fall so that it does not linger at the bottom of the wheel-chamber, thus slowing or stopping the wheel. As much as 15 feet of fall may be needed, most of it concentrated at one point, the wheel. How to obtain this on rivers whose gradient is less than 15 feet in a mile ? If, lacking sufficient water for a paddle wheel, a millwright sought to install an Overshot type, he was obliged to concentrate his fall by the use of a long millrace. This was cut from the river well upstream and practically followed a contour, having only the smallest gradient, so that at the mill-site the river was well below and far enough away to permit the making of a pool which the race fed. The pool was not dug into the meadow – often the gravel terrace – but was banked up from it, so that the hard-won 'head' was retained. The mill was built against the end dam of the pool, and water flowed from the bottom of the pool down a short flume to the wheel. Beyond the wheel-chamber, the water might well be actually below river level, but the tail-race maintained the lesser gradient and was at length able to discharge into the river at a downstream level.

Considering now the gradients of local rivers, and taking only the central reaches of each, where most mills have been concentrated, the following figures are obtained :

TAME	13 feet lessening to 6 feet in a mile.
BLYTHE	16 feet lessening to 5 feet in a mile.
COLE	10½ feet average.
REA	26 feet lessening to 10 feet in a mile.

It is at once clear that except on the upper Rea a 12-foot Overshot Wheel would require races between one and two miles in length, which would be impracticable : such wheels of any great size could not therefore have been employed. It was possible to compensate for small diameter by increasing width, as was done at Edgbaston, but until the later eighteenth century at least the Undershot Wheel was probably the normal type of installation.

It is certain that whether small Overshot or wasteful Undershot Wheels were in use, they were unsatisfactory, either because of inadequate power or lack of water, and since water power was in greatest demand, and the number of mills sited along every stream was at peak, in the latter half of the eighteenth century, it is not surprising that the needed innovations appeared at that time.

John Smeaton conducted a number of experiments into the design of both windmills and watermills, and his paper on these won him the Royal Society's medal in 1759. He made windmill sails more efficient, and improved both the Overshot and Breast Wheels. The latter term was in use in Tudor times, and referred to a wheel whose buckets received water at breast height, below the vertical axis, on the side nearest the inflow, so that the wheel turned against the flow. Smeaton's development of this type was of particular value on our rivers, since a smaller 'head' was required; it was less efficient than the Overshot, because water remained in the buckets for only $\frac{1}{4}$ revolution, and still demanded long races, but there was a considerable saving, as the diagram shows. Most of the few mill-buildings that survive are eighteenth century rebuildings and several have Breast Wheel installations; they were economical of water, produced adequate power, and required not impossibly long leats.

The River Tame

After Domesday there was a steady growth in the number of mills. Sandwell Priory, founded in 1112, owned three or four mills, Castle Bromwich mill was recorded in 1154, and in the thirteenth century (perhaps earlier) there were mills at Dudley Priory, Tipton, Bromford (Oldbury), Pelsall, Walsall, Warley, Bearwood, Minworth, Hams Park, Shustoke, Ouston Grange (Merevale Abbey), and Tamworth. A mill was not only a useful asset in a manor, but a source of food and revenue. The lord either built it or financed its building, obliged everyone to use it and pay to do so, and reaped the harvest of fish, especially eels, which were caught in the weir-traps. (Mill values in Domesday Book were often recorded as so many pence or shillings and so many sticks of eels, at 25 to a stick.)

At Tamworth in 1334 there were three water corn mills and one fulling mill. This is the first local reference to the adaptation of a mill for an industrial process; by the end of the fourteenth century 12 fulling mills were at work, some adapted and some built for the purpose, like Holford in 1358. This figure testifies to the great increase in wool production during that period, with the accompanying decline in corn. Meanwhile the mining of coal and the production of iron were developing about the Tame headwaters; the metal was smelted in small bloom smithies using charcoal as fuel, and water-driven bellows to provide the blast. Shortages of charcoal and water were causing smiths to migrate downstream even before the end of the fourteenth century, and this was to continue.

The introduction of water-powered hammers on the Tame was late – they had been in use in the Weald from the twelfth century, but reached our area only in 1549, when Bromwich Forge was built. Holford was adapted to a hammer mill in 1591, and Bustleholme three years later. Perry Mill, a bloomery since 1538, using charcoal from Perry Woods, was rebuilt in 1597. This period also saw the introduction of blade-milling, at Oldbury, Bromford, 'The Mill,' and along the Hol and Hawthorne Brooks. There were four blade mills in Handsworth in 1561. Little power and thus little water were required for blade-grinding, so that quite small streams could be employed. Forges needed plenty of power for their hammers and slitting shears, and were therefore usually sited on the main stream; thanks to its many tributaries from a large catchment area, this had an abundant and regular flow, tending rather to flood than to low water. But as speed of run-off increased with the cutting-down of woods, so did the supply diminish with the increased ponding of the river above new mill-weirs.

Bustleholme and Sandwell became slitting mills in the mid-eighteenth century, and Hamstead became a blast furnace. Meanwhile, two mills at Tamworth and one at Witton had converted to paper-making, and Shustoke was later to join them. Grist mills continued to work on most sites downstream from the Rea confluence, and at Bilston, Dudley, Bentley, Bescot and Walsall. Perry re-opened when Hamstead converted, and new grist mills were built at Tipton, Wednesbury and Walsall. But most corn grinding was now done in windmills, often sited near the watermills that had been adapted. Wm Hutton's paper mill, built at Birchfield in 1759, was a windmill.

Hockley Brook provided power for Aston Furnace from 1615 and in its heyday worked six watermills. Soho Pool was made before Matthew Boulton leased the estate and built the Soho Works (1762). All the many small mechanical processes carried on there used power from wheels, and it was the annual inadequacy of the brook to keep the pool supplied that interested Boulton in Watt's steam-engine. It was not then seen to be a form of power that would eventually make watermills obsolete, but as a means of pumping water from the tail-race back into the pool for repeated use. When rotary motion had been perfected in 1781, the

steam-engine began slowly to supersede the waterwheel, but its early unreliability and unevenness of stroke balanced its independence of water supply, and the triumph of steam was still not complete by the time other forms of power became available. Engines were sometimes installed at mills to supplement rather than replace the wheels; as late as 1889, Wednesbury Forge had five large breast wheels, which could be wholly driven by water in rainy weather. The supply for these, two large pools fed by leats from two source-streams of the Tame, had been improved in 1848; there are other examples locally of mills being made more efficient or rebuilt during the first half of the nineteenth century, which indicates a continuing faith in waterpower where supply was sufficient. But the inability of the Tame to satisfy all the demands made upon it is shown by the closures between 1775 and 1816 of Rushall, Walsall and Hamstead Furnaces, Hateley Mill, and the Hol Brook mills, and the reversion of Bustleholme and Sandwell to grist milling. Tamworth's three Tape Mills were employing steam by 1845, and Shustoke Paper Mill became a steam forge four years later. Industry could have developed no further on the Tame without additional power. One example will show the potentialities of steam : in 1775, one forge had a tilt-hammer of 7 cwt., water-driven; in 1817 it had steam-driven helve hammers weighing 2-3 tons, a seven-fold increase in power.

The steam-engine was not the sole cause of the steady decline of waterpower during the nineteenth century. The Tame and our other rivers were never made navigable by other than the smallest boats, so that local millers were spared the problems of Avon and Severn; but the coming of canals affected them most adversely. Between 1770 and 1790 the navigations came wriggling along the valleys, sending out their branches, altering drainage, diverting and absorbing streams, throwing banks across leats and pools. Mining too diminished supply, both through surface subsidence which produced swag-pools, and through seepage into underground workings. Quarrying caused abandonment of sites. Finally came the railways, paralleling the canals and altering landscapes still more drastically. The Oldbury Tame mills were all put out of action by the building of several canal branches nearabout; Hateley Heath site is a huge excavation, Bescot Forge a railway marshalling yard. Other sites are covered by large factories : Oldbury Corn Mill is still at work in Victorian buildings which have never used waterpower, 'The Mill' is Izons and Wednesbury Forge is Elwells, Horseley and Bromford Works are on those millsites. Holford Mill is the I.C.I., and Bromford Forge (Erdington), the last mill to be converted from grist-milling, has been succeeded by the great Tube Works. Of mill buildings on the main stream only Bustleholme and Sandwell Forge remain within the conurbation. Kingsbury Mill no longer uses water for its power. Alder and Kettlebrook Mills, near Tamworth, are now large factories, Fazeley is derelict. Fisher's Mill has been demolished in river improvement works, such as were responsible for the disappearance of several mills north-east of Birmingham.

The River Rea

There was in the eighteenth century a remarkable concentration of mills on the Rea, a river always noted for its variability. In 1526 Edward de Birmingham allowed his tenants to take their corn to Thomas Holte's mill at Saltley. He thus forewent his milling soke through necessity, because his own mill was often out of use through lack of water. Heath Mill was placed at the downstream end of Birmingham's stretch of the Rea, a short one, so that its ponding of the river would not raise the level too much at the Deritend ford and bridge upstream, but even so the crossing was often impassable, while the mill for lack of reserve would be idle soon after floods. When in 1540 Holte rebuilt Saltley and added Duddeston Mill, the Steward of the King, then lord of Birmingham, brought an action against him, but Holte won the case, being able to prove that Heath Mill had long been inadequate for the town's requirements, so that he could pose as a public benefactor while making a handsome addition to his income.

All the Reaside manors had their mills on or near it. The earliest recorded is that of Kings Norton, 1165. There were two in Northfield in 1291. It is notable that the manor houses, such as Hazelwell, Moor Green, and Edgbaston Halls, were built up on the pleasant sides of the valley, and the mills of necessity in the marsh and mist of the often-flooded meadows. It was said that watermillers were morose and lonely men, from years of living in damp valleys, whereas windmillers were brisk and cheerful!

In 1553 there were three watermills in Birmingham. These were Heath Mill, Malt Mill, which was fed by the manor house moat stream, and a corn mill supplied partly by the moat and partly by a new leat cut from the Rea. The conversions and new erections for industrial purposes already noted on the Tame were paralleled on its tributary, but as would be expected thus far from the ironstone workings, there were no bloom smithies. Fulling and blade mills were at work on the Edgbaston sites during the sixteenth and seventeenth centuries, and downstream the processes of slitting, rolling and hammering iron were all powered by Rea water. Digbeth Blade Mill, said to have turned out 15,000 blades for Parliament, was burnt by Prince Rupert in 1643, but soon rebuilt. Five years later Speedwell had been converted to blade-grinding, and in 1672 Pebble Mill, powered by Bourn Brook, changed from fulling to blades and at about the same time Hawkesley also became a blade mill.

Because of the Rea's steeper gradient, the races tended to be shorter and the mills close to the river, so that they suffered from the frequent floods which 'tailed' the wheels and caused damage. The necessary river works were not carried out until the mills were in decline, and then to their detriment.

In 1698 Sampson Lloyd came to Birmingham and took over the corn mill, using the power both for grist-milling and for slitting. The mills

and the family prospered together. In 1741 there was a spinning mill in Birmingham, and in 1760 the Moat House, formerly the manor Hall, was in use as a thread mill, having been a blade mill since 1700. The Rea was so much altered in the quest for power at this time that William Hutton noted having come upon two channels of the river close together and flowing in opposite directions !

Because their water supply problems were so acute, the Rea Valley millers were most hostile to the proposal to construct the Worcester Canal; they contrived, with other objectors, to have the Bill twice rejected, and allowed it to pass in 1791 only when the Company had undertaken to build several large reservoirs to compensate millowners for any losses of water to the canal. These included Wychall and Lifford Reservoirs. Harborne Reservoir was made in 1804 to provide compensation water for Bourn Brook mills affected by the Dudley Canal branch to Selly Oak. Harborne Mill was then only ten years old, a steel-rolling mill on an ancient site. It used a 15-foot overshot or breast wheel. Wychall was a steel-rolling mill also, and flood-water from its great pool was passed on to the canal by a feeder built by the Company. Railway building affected both Northfield and Hawkesley Mills. After the disastrous Rea floods of 1852, drastic straightening and deepening of the channel was begun, an operation which has proceeded by stages to the present. Duddeston millweir was demolished at once, thus removing an obstacle to drainage which had produced a mile-long pool of Birmingham's raw sewage in recent years. Speedwell Mill was damaged in the later floods, and went out of use in the 60's; it had been engaged in wire-drawing, and latterly in rolling and tube manufacture.

Several of the upper millsites have continued in use. Thus : Hurst Mill, a chemical plant manufactory; Sherborne, now Kings Norton Paper Mills; Lifford, a chemical works, whose wastes cover the actual millsite; Hazelwell, a Gun Barrel Mill in the 80's, now an India Rubber factory; and Dogpool Mill, still so called, making brass and copper tubes in buildings surrounding the poolsite. The Edgbaston mills survived, though not in use since the early 80's, into this century, but now only one building of Over Mill, and the house of Edgbaston Mill, remain. A museum stands on the site of Pebble Mill, and the great hollow of its pool – drained in 1883 because of its popularity for suicides – is now being built upon. Of the lower mills even the sites are difficult to establish, though street-names are of some assistance.

The Rivers Cole and Blythe

These rivers may be considered together, since their histories are not dissimilar. Both continued to power corn mills into this century; that the Cole had some conversions to industrial use while the Blythe had none may be attributed to their respective distances from ironstone and

coal workings. It was easier to produce charcoal in Arden and carry it to existing forges on Tame and Rea, where fuel was scarce from the seventeenth century, than to move the forges. Increasing use of coal and coke, the construction of the Birmingham-Wolverhampton Canal and its branches, and the introduction of steam-power, were factors which made the development of these far-off rivers unnecessary. The cost and difficulty of moving raw materials and products by pack-horse made distances of even a few extra miles from sources and markets too great to be economic.

Coleshill Mill existed in 1086; Stechford and Greet Mills were recorded in 1249 and 1261. Hay, Lea, and Broom Halls were sub-manors within Yardley and two of these at least had their own mill. Yardley was the property of Pershore Abbey for several centuries, but that rich establishment which had five Avon mills at Domesday seems to have made no early use of its nine miles of the Cole. True, the manor had probably no more than 50 inhabitants scattered over 17½ square miles. In 1385 the Earl of Warwick owned Yardley, and he gave Roger Bradewell timber and a site for a mill, receiving 6s 8d annual rent. This may have been Wash Mill. Sarehole Mill was mediaeval, paying annual tribute to Maxstoke Priory. In 1689 there were two watermills and a windmill in Moseley and Yardley, owned by the Grevises of Moseley Hall; one of the wheels, that of Lady Mill, had been converted for wire-drawing, and the windmill nearby probably replaced it as a grist-mill.

Wythall, a sub-manor in Kings Norton, used a mill called Wythworth, later Kilcop, and on the opposite bank Forshaw, a sub-manor of Solihull, had a mill which went out of use with the abandonment of the manor-house site. Other Solihull mills were those of Peterbrook and Colebrook Priory; though both reverted to corn-grinding in their last years, the former may have powered a small forge, and the latter was a needle mill. The brick tower windmill nearby, built 1644, may have been a replacement. Stechford and Babbs Mill were manorial : the former was making paper before going out of use about 1830, but the latter ground corn until 1914. Sheldon's other mills, on Cole tributaries, were out of use by 1840, but a windmill remained at work for some years, and at Olton End a water and windmill were working during the century.

Matthew Boulton's father retired to Sarehole in 1759. It was then called Little Mill and though close to the Cole received water only from the Coldbath Brook descending from Lady Mill. One wonders whether the younger Matthew, riding out from Snow Hill, ever considered developing Sarehole as he was shortly to develop Soho. At the latter, the pool was already made when he leased the estate, and both materials and labour were to hand. Sarehole was too far away. It was left to Richard Eaves to rebuild it, supply it from the Cole by a half-mile leat, and install two Smeaton breast-wheels. They are 12 feet in diameter, one being 6 feet wide and the other 4 feet 6 inches. (The wheel at Colebrook Priory, rebuilt at about the same time, was like these; in power it was

perhaps comparable with the overshot wheel at Edgbaston, 7 feet 6 inches diameter, 8 feet width.) Sarehole was rebuilt to grind corn, as was Greet Mill, another Eaves venture in 1775. This was built across the river, taking advantage of a sudden break of slope to obtain a fair head behind its weir. Titterford seems to have been a completely new construction, being advertised in 1783 as 'a new water corn mill, two waterwheels, four pairs of stones, and . . . garners (for) . . . 2,000 bags of wheat.' Clearly the capital outlay for these mills, especially Titterford where a pool of nearly eight acres had to be banked high above the Cole alongside, would not have been incurred without expectation of profit; due to conversions and lack of power in and near Birmingham, where population was growing rapidly, there was probably a shortage of grist-mills, and it was sound economics to make better use of the Cole.

Yet by the end of the eighteenth century Sarehole was wire-drawing, possibly in addition to grinding, and later it was producing edge tools and gun barrels; the Stratford Canal could have brought materials to within 1½ miles of the mill. Greet was little farther away from that or the Warwick Canal, and so could obtain supplies for the steel-rolling to which it converted. However, Greet was out of use by 1850 : one reason for this was almost certainly lack of water. When all pools were low following drought, the upper mills would divert the river into their races by means of plank weirs and little water would get down to Greet. Like Heath Mill and others set on a small main stream, Greet suffered in flood but could not retain enough water to keep it going in dry times. The Cole has a fast run-off and few tributaries above the millsites, so that it rises and falls quickly.

Sarehole and Titterford were also finding waterpower inadequate about mid-century, and both had steam-engines installed at that time, as did Wychall. That of Titterford produced 20 h.p., whereas the wheels produced only 6 h.p. This small figure, obtained only by long head and tail races and an embanked pool covering 7½ acres, is explanation enough for the introduction of steam engines when they became reliable and steady in performance, and when fuel could be brought near by canal. A few years later Titterford became a steel-rolling mill, its corn-grinding machinery going to Sarehole; it seems likely that the latter could not compete with the new B.S.A. factory two miles downstream, and so reverted to corn as so many mills did in their last years.

The two Hay Mills shown on the map were not in existence at the same time, the lower replacing the upper as late as 1830, a testimony to the continuing regard in which waterpower was then held. But with the transfer to the site of wire-drawing machinery from Penns Hall in 1860, and the enlargement of the works to produce wire for the Atlantic Cable, the watermill disappeared.

The slump in arable farming due to American wheat imports in the 80's, the invention of roller-mills, the establishment of large steam-driven mills at ports, and the spread of building across farmland, brought

the closure of nearly all watermills in the next three decades. Thus Sarehole, whose income from milling in 1894 was less than £55, went out of use in 1919, and Colebrook Priory Mill soon afterwards, following the construction of a roller mill at Shirley Station near by. Titterford and Wash Mills had already closed; Coleshill, the first on the river, was the last to go, being intermittently in use until 1930. The buildings of Sarehole, (the wheels still in place), Colebrook Priory, and Babbs Mill are still standing.

The story of the River Blythe as a source of power is quickly told. In 1086 there were mills at Temple Balsall, Barston, Hampton, Packington (two) and Maxstoke. The first-named was worth 60 shillings. Great and Little Packington had six mills between them in the sixteenth century. Solihull seems to have made little use of the Blythe, (its four Cole mills were nearly four miles from the village), but Henwood Priory had its mill, and there was one at Monkspath. No evidence is available that any Blythe mill was in use for other than corn-grinding until recent times, but that some at least prospered in so doing the surviving structures show. While Monkspath, Barston, Balsall and Bradnock Mills have disappeared, the large brick buildings of Darley Green (1768), Henwood, Mercote Hall, Meriden and Maxstoke, all of late eighteenth or early nineteenth century date testify to flourishing agriculture and profitable milling.

The Blythe has a small gradient but an abundant flow : thus it could drive undershot wheels, 9 feet diameter at Henwood, and 15 feet at Maxstoke and Blythe Hall. Its tributaries having a steeper fall, overshot wheels were employed thereon, at Darley Green, Mercote Hall and Packington, 12-15 feet diameter. Meriden also had an overshot wheel, although powered by the main stream as well as side ones; this was possible because the race could be cut across a mile-long loop of the river and the wheel set at the terrace edge, with a good fall. The surviving wheels are of light metal construction; the ruins at Packington show the wheel there to have had metal rims and spokes, timber spindle and buckets.

Meriden and Bradnock, probably Darley Green, went out of use early this century, but the first remained intact until 1956, and consideration was given to using it during the 1939-45 War, when port mills were out of action due to bombing. Henwood was in use until 1934, and the wheel can still be turned. Mercote Hall could still be used, and its last task was the generation of electricity for farm use during the War. Maxstoke was in use intil 1945, when the main spindle collapsed : it may thus hold the local record for length of service as a millsite.

At the end of this account of the development and decline of water-power on local rivers, it is pleasant to be able to record that one mill survives and flourishes. This is Blythe Hall Mill, a 1754 rebuilding of a mill first erected about 1100. It lies athwart a wide arm of the Blythe, the main stream falling over a weir 100 yards above it. The 15 foot diameter

wheel, 4 feet wide, has 45 metal paddles and weighs 20 tons. At full speed it can generate 80 horsepower. Three pairs of 5-foot burr stones have been replaced by hammer-milling equipment, but the wheel still provides power for all processes and has been used to generate electricity. Various grains are milled, grown locally or imported via Avonmouth and collected by the millers' own vehicles.

Conclusion

Watermills, like windmills, were used wherever possible as long as there was no other form of power and on certain sites contrived to compete with steam for a considerable time. Water was used but not consumed, cost nothing except the rental of the channels by which it was brought to the mills and provided steady and reliable power. Canals and railways often used valleys and mills had as good access to them as any other sites, as the continued use of so many millsites proves. True, water supply was sometimes affected by the new lines of communication, and mills were subject like any other undertaking to landowners' finding a more profitable use for the land they occupied. But of all the reasons given in this study for the decline of watermills, the over-riding one was the amount of power that could be produced; many of the wheels in our area were, because of their size, which was dictated by relief and supply of water, hardly more powerful than the horses by which they had on occasion to be replaced. When steam-engines had added reliability and economy to power and compactness and the factory had ruined the workshop, the end of the watermill was inevitable.

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VICTORIA COUNTY HISTORIES OF STAFFORDSHIRE WORCESTERSHIRE AND WARWICKSHIRE

Pyrola minor L. in South Shropshire

by S. W. Greene and Jennifer M. Gray

While studying the flora of Knowle Wood during a student field excursion on the 18th May, 1963, one of us (J.M.G.) collected an immature specimen of a plant which appeared to be a species of *Pyrola*. The site was revisited on the 26th June, 1963, when the majority of the plants were found to be in full flower, with a few stems already bearing immature fruits. The plants were identified as *Pyrola minor* and a voucher specimen collected and deposited in the Herbarium of the Botany Department, Birmingham University. Professor J. G. Hawkes kindly confirmed the determination of this specimen.

Knowle Wood is an area of mixed ash-elm wood (*Fraxinus excelsior-Ulmus glabra*) developed on a carboniferous limestone outcrop on the south facing slopes of Clee Hill at an altitude of ca. 700-900 feet. In the vicinity of the *Pyrola* colony, which covered some 20 square feet of sloping, humus rich soil (pH 6.3), the dense tree canopy resulted in a sparse ground flora, so that the colony was situated in ecologically 'open' conditions. Species noted in the area included *Polypodium interjectum* (on a nearby boulder), and *Neottia nidus-avis* neither of which are recorded for the vicinity (National Grid square number SO/67) in the *Atlas of the British Flora* (F. H. Perring and S. M. Walters, 1962).

The presence of *Pyrola minor* at Knowle Wood is of particular interest, since it appears to be an unrecorded locality of a species which according to the *Atlas* has not been seen in the West Midlands since 1930. It has been reported previously from only six sites,three being in South Shropshire, two in Worcestershire and one in Herefordshire, all these, as far as can be ascertained, lying within six to eight miles of Knowle Wood. Elsewhere in the midlands of England, the species has been reported from two sites in North Staffordshire and one in Leicestershire, all shown in the *Atlas* as unconfirmed since 1930. The nearest region to Knowle Wood where the species has been seen in recent years is in the vicinity of the Vale of Gloucester some 35-40 miles due south.

We are indebted to Miss A. J. Cox for the pH determination.

Midland Mammals Survey (5)

MAMMALS OF WORCESTERSHIRE: ADDITIONS TO LIST

by T. J. Pickvance and F. Fincher

To our earlier annotated list in *Proc. Birm. Nat. Hist. Phil. Soc.*, (1960), **19,** Pt. 1, p. 9, two species may now be added.

Daubenton's bat, *Myotis daubentoni* (Kuhl)

A single specimen picked up dead at Wyre Piddle has been identified as belonging to this species (T.J.P.). Although not a new record for the county, localities have been omitted from previous records.

Muntjac deer, *Muntiacus spp.*

We noted in our earlier article that muntjac deer tracks had been found within a few miles of the Worcestershire border, at the limit of their spread westwards across Warwickshire. No muntjac have been reported to us from the mid-eastern district of the county where the earliest records might have been expected. But the deer have appeared in the far south of the county, on Bredon Hill.

A muntjac was shot in the Snowshill district of north Gloucestershire in December 1960, and others were seen at this time at Dumbleton, five miles to the west. No doubt animals from this area crossed the Worcestershire border. Their presence was suspected in May 1962, and two deer were seen at Westmancote, on the south-west of Bredon Hill, five miles west of Dumbleton, on 20th July 1962. We are indebted to R. J. King, forester on Bredon Hill, for this information.

Coypu, *Myocastor coypu* (Molina)

In a letter in *Countryside*, 19, New Series, No. 8, p. 351, autumn 1962, Miss D. M. Mallett of Redditch reported finding, 'about three years ago,' an unfamiliar animal dead on a box of hay in a garden shed. The animal was 12 in. from root of tail to tip of the guinea-pig-like snout, and with a stout rat-like tail of the same length. The fur was rabbit-like in colour on the back, light and soft on the underside. From the description given, H. N. Southern suggested that the animal was probably a young coypu.

In a letter to one of us (F.F.), Miss Mallett added: ". . . in the hay underneath, which seemed to have been a nest, I found a semi-dried

corpse like a new-born rabbit." We have shown Miss Mallett pictures and the skull of a coypu without being able to confirm the report. In particular, she had no recollection of large orange-coloured incisors. The country in the immediate neighbourhood would have no attractions for feral coypu, and the animal, if a coypu, must have been a local escape from captivity. Such animals have been reported in recent years from several midland counties.

Thelypteris dryopteris (L.) Slosson and *Lycopodium clavatum* L. in Wyre Forest

by M. C. Clark and S. W. Greene

While collecting specimens of bryophytes in the Wyre Forest, in October 1962, two plants which do not appear to have been noted in the vicinity in recent years, were found by one of us (M.C.C.) and confirmed on a subsequent visit.

The first, *Thelypteris dryopteris* (L.) Slosson, the Oak Fern, was reported from Wyre Forest in 1864, according to *The Botany of Worcestershire* (Amphlett and Rea, 1909). This species is shown in the *Atlas of the British Flora* (F. H. Perring and S. M. Walters, 1962) as a 'pre-1930' record, for this and three other localities in Worcestershire. It was rediscovered, in some abundance on a steep north-facing slope above the Dowles Brook, about one mile west of its confluence with the River Severn, on the Worcestershire side. The main colony was growing on a mound, some 30 feet above the river, amongst the Greater Woodrush (*Luzula sylvatica*), under a light canopy of Hazel (*Corylus avellana*) and scattered Oaks (*Quercus petraea*). The extent was approximately 300 square feet, but there was also a few small outlying colonies within a radius of a further 100 feet. Although many similar habitats have been examined along the Dowles Valley, no other colony of this fern has been seen.

The other plant, *Lycopodium clavatum* L. (Stag's-Horn Moss) is shown in the *Atlas* as having been recorded before 1930 from two neighbouring areas of Worcestershire, but apparently no previous record exists for Wyre Forest. There is now a colony growing in the shade of bushes of old heather (*Calluna vulgaris*) covering some 25 square feet of the north-facing slope of a railway cutting, a little to the east of the locality for the Oak Fern. No cones were seen, and as far as could be ascertained, the species is confined to this one small area. Unlike the fern which is thriving in a natural habitat, the *Lycopodium* was growing in an artificial situation. It is interesting to speculate whether the present plants are descended from a former colony disrupted during the building of the railway, or if they should be looked upon as recent arrivals.

A specimen of each plant has been deposited in the herbarium of the Botany Department of Birmingham University.

Stuart E. Wace Carlier

An appreciation

Born 1899 – died 3rd December, 1962. These are blunt facts; but what of the man, his work and personality ?

Each one of us sees different facets of another's life, and with regard to Stuart Carlier I can speak only of the man I knew. My contact with him was predominantly as a naturalist, and this word is used purposely, for while many people think of Carlier as a lepidopterist and coleopterist, one had only to be on holiday with him to realize how much wider was his knowledge. Here was a botanist, one who had a knowledge of ornithology and zoology, and had delved into the realms of geology, and one turned to him quite naturally with any query when working in the field.

This knowledge was not static. It is true that from earliest years he had been trained in field observation by his father, Professor E. Wace Carlier, and this early tuition remained an integral part of his outlook on natural history. It did not stop at this level, however, for in the world of nature Carlier had a questing mind, he kept abreast of modern thought and was essentially a young and enthusiastic seeker. This facet of his character was not always apparent to the casual observer as it was often hidden under a brusque manner and he found it difficult to accept people less keen than himself.

As understanding of Carlier grew there was no doubt as to the quality of his brain, and he has probably been one of the most underrated entomologists in the country. It was not only in regard to nature that close association brought revelation; but in the field of literature one found one's own quotations capped, and one discovered that he had a deep love of music.

There were times when Carlier's desire that, entomologically speaking, people should know what they were talking about, led him to speak sharply and even rudely. To be unable to see beyond this, however, was to be narrow oneself, for Carlier, if one allowed him to be, was the best of companions on an outing. Whenever I called at his flat, even at midnight, he was ready to venture forth. The frugal meal was finished, the concert switched off, his equipment hurriedly gathered and away we would go. Cannock Chase or Borth Bog, Wilmcote or Oversley Wood, winter or summer it was all the same to him.

Among many other occasions I well remember a journey to Cannock Chase in December 1961, in an attempt to obtain live coleoptera for a setting demonstration at the Conversazione. It was a bitterly cold day, overcast and sleet threatening. Already he was feeling unwell; but his enthusiasm and desire to help outweighed all other considerations. Never once did I hear him complain on our many combined outings; always he shared in the work to be done and never did he allow his desire for a particular specimen make him selfishly forget the needs of others.

The Society owes much to Stuart Carlier. He was Honorary Secretary from 1937 to 1962; President of the Entomological Section from 1959 to 1961. In these positions he gave of himself unsparingly. With others he worked hard for the rehabilitation of the Society after the war. He was one of the most energetic recorders of the lepidoptera of the Birmingham Plateau, and without him, our knowledge of the micro-lepidoptera would have been nil. This was his life.

Carlier's virtues were not always easily apparent. His sense of failure; his loneliness and his unsuspected shyness made him build a barrier between himself and the world. He could be difficult and offhand and was often suspected of feeling superior; but the loss was with those who never shattered this outward barrier and came to know the man beyond. Once known he had much to give and gave unstintingly.

What better requiem could Stuart Carlier have than that those who knew him were glad to call him a friend. His memory will not be lost, for the knowledge he so willingly imparted to others will enhance the work they do in the realm of nature, and their lives will be the richer.

F. A. NOBLE, F.R.E.S

Society Activities 1962-63

FIELD EXCURSIONS DURING THE 1962 SEASON

Botanical Section

UNDAY, 13TH MAY – PRINCETHORPE. Led by Mrs M. D. G. Jones, visits were made to Bull and Butcher Wood and to Princethorpe Great Wood, and records made for the Warwickshire Flora. In the former wood good colonies were found of *Paris quadrifolia* (Herb Paris) and of the fern, *Dryopteris borreri*. In Princethorpe Great Wood the most attractive find was a patch of *Orchis mascula* (Early Purple Orchis), well situated for photographing.

SATURDAY, 26TH MAY – WYRE FOREST. Two areas were visited, (1) some boggy ground in the valley of a small stream – map ref. SO/753752, and (2) the valley of the Dowles Brook at SO/747765. At the first locality the plants seen included *Equisetum sylvaticum* (Wood Horsetail), *Aquilegia vulgaris* (Columbine), *Serratula tinctoria* (Saw-wort), *Convallaria majalis* (Lily-of-the-Valley), *Listera ovata* (Tway-blade) and *Melica nutans* (Mountain Melick). The liverwort, *Trichocolea tomentella*, was abundant over a wide area. In the Dowles valley plenty of plants of *Geranium sylvaticum* (Wood Cranesbill) were seen, but except on one plant, flowers were still in bud. There were a few plants of *Lithospermum officinale* (Gromwell) and *Scirpus sylvaticus* (Wood Club-rush). Several sedges were noted during the afternoon, including *Carex montana*, which is fairly frequent along the Dowles valley. Mr M. C. Clark was the leader.

TUESDAY (EVENING), 19TH JUNE – CLENT. Some damp meadows and marshy woodland to the north of St. Kenelm's Church were covered, under the guidance of Mr H. E. E. Babb, who is making a comprehensive survey of the natural history of the parish of Clent. One plant of *Genista tinctoria* (Dyer's Greenweed) was seen, together with a number of *Carex* species, *Geum rivale* (Water Avens) and *Triglochin palustris* (Marsh Arrow-grass). A move was made to the old gravel-pits at Sling Common, but little time remained to explore these.

SATURDAY, 23RD JUNE – WILMCOTE. Wilmcote Common has long been noted as a good Warwickshire locality for calcicole plants. Unfortunately much of the open common has been lost, either by cultivation or by the encroachment of dense scrub. The best remaining area is a steep slope facing west, with much *Genista tinctoria* (Dyer's Greenweed) and *Zerna erecta* (Upright Brome). Other notable finds here, on this excursion led by Mr R. C. Readett, were *Rosa rubiginosa* (Sweet-briar), *Blackstonia perfoliata* (Yellow-wort), *Scabiosa columbaria* (Small Scabious), *Carlina vulgaris* (Carline Thistle), *Cirsium eriophorum*

(Woolly Thistle) and *C. acaule* (Stemless Thistle) and the grasses *Koeleria gracilis* and *Helictotrichon pratense*. In cultivated fields on the hill-top a great deal of the Blue Pimpernel, *Anagallis arvensis* ssp. *foemina* was seen as well as the common scarlet type, and also *Sinapis alba* (White Mustard). Elsewhere, *Ophioglossum vulgatum* (Adder's Tongue), *Iris foetidissima* (Stinking Iris) and *Carex distans* were good finds.

WEEK-END, 6TH-8TH JULY – SOUTHPORT. The annual week-end meetings under the guidance of prominent local botanists have always proved popular. This year's meeting-place was Southport, and the leader, Miss Vera Gordon. It is unnecessary to list the plants seen in the area, as records of the flora have recently been published, but to those members who did not know the Southport dunes as a botanical hunting-ground, the richness of the flora, and in particular the numbers of orchids, was most striking. The Saturday was spent in the area between Ainsdale and Freshfield, and the Sunday between Ainsdale and Hillside. Perfect weather was encountered.

SATURDAY, 28TH JULY – EARLSWOOD. This excursion was arranged specifically to study the Brambles, and was led by Mr J. F. Woolman, who has made a special study of this difficult group. The opportunity was taken to test out a provisional key of the local species and with its aid the following species, mainly from hedgerows, and representing a number of the main sections, were identified : *Rubus adscitus* Genev.; *R. myriacanthus* Focke.; *R. balfourianus* Blox.; *R. sprengellii* Weihe.; *R. sublustris* Lees.; *R. conjungens* (Bab.) W. Wats.; *R. murrayi* Sud.; *R. idaeus* L.; *R. nessensis* W. Hall; *R. vestitus* Weihe.

SUNDAY, 2ND SEPTEMBER – COLESHILL POOL AND BOG. This is an area from which many rarities have been recorded in the past, and the main object of this expedition, led by Prof. J. G. Hawkes, was to see which of these had survived and to note changes. There have been considerable alterations to the original habitats which have caused the loss of many plants. The pools have silted up and become choked with coarse vegetation, the bog has been largely overgrown by rhododendrons and other large shrubs, and much of the heath has been quarried for sand and gravel. The flooded gravel-pits, however, provide some good new habitats, and two uncommon pondweeds, *Potamogeton obtusifolius* and *P. berchtoldii* were found in some abundance. Interesting survivals included *Agrimonia odorata* (Fragrant Agrimony), *Erica cinerea* (Bell-heather), *Scutellaria minor* (Lesser Skull-cap), and *Narthecium ossifragum* (Bog Asphodel).

SUNDAY, 16TH SEPTEMBER – ASTON GROVE, NEAR ASTON CANTLOW. This was another excursion arranged specifically to study one particular genus in the field, this time the Wild Roses. It was led by Prof. J. Heslop-Harrison, who is an authority on the genus. This time of the year was chosen because the fruit characters of the Roses are an aid to identification, and this particular area of Warwickshire, since it is known to be very rich in Rose species. Nine species were found, namely *Rosa arvensis* Huds., the Common Field Rose, *R. pimpinellifolia* L., the Burnet Rose, of which there is an interesting colony, the two Sweet-briars, *R. rubiginosa* L. and *R. micrantha* Sm., and a species of Downy Rose, *R. tomentosa* Sm., together with a number of species of Dog Rose, viz. *R. canina* L.; *R. dumetorum* Thuill.; *R. glauca* Vill. and also *R. stylosa* Desv. This was felt to have been a most useful meeting, giving members an insight into another difficult group.

Entomological Section

SUNDAY, 27TH MAY – SALCEY FOREST. A day of rain and cold made collecting difficult. A few *Nemophora swammerdamella*, the 'micro' with 1 in. antennae

were taken by one small party of members. The others, working independently, took *Ecliptopera silaceata* flying, and larvae of *Oporinia dilutata, Operophtera brumata, Episema caeruleocephala, Trichiura crataegi, Hydrionena furcata, Apeira syringaria, Abraxas grossulariata* and one *Strymonidia pruni* (Black Hairstreak).

SUNDAY, 22ND JULY – DOVEDALE. Bad weather again made entomological collecting difficult, and only five species were noted. However, the walk through the magnificent scenery of the dale was much enjoyed, and Col. Hill's observations on the many kinds of plants seen made the visit well worth while.

OTHER EXCURSIONS. Several other excursions were arranged, but unfortunately had to be cancelled, owing to the persistently poor weather for entomological collecting, and the consequent lack of support.

Geological and Geographical Section

Excursions were made jointly with the Midland Geologists' Association, as follows :

Week-end, 4th to 6th May. Bristol area.

Saturday, 2nd June. Congleton Edge. Leader : Mr Thomas.

Thursday (evening), 7th June. Ellowes Park, Turners Hill, Gornal. Leader : Mr G. R. Coope.

Saturday, 7th July.

Saturday, 15th September. Lickey Hills, south end. Leader : Dr I. Strachan.

Further details are not available. Members also spent the week-end 11th to 13th May at Attingham Park with the Geographical Association (Birmingham Branch) to study 'Human Geography of the Anglo-Welsh Borderland.'

Microscopical Section

MONDAY, 4TH JUNE – VISIT TO MEDICAL SCHOOL. This visit was arranged through the kindness of Dr Smith, Senior Lecturer in the Department of Pathology, and of the authorities of the Medical School. Members were able to see the museum and some of the work going on in several of the Pathology and Cancer Research Laboratories. Equipment was seen and demonstrated; the special techniques used created much interest, particularly those required for producing specimens at great speed, during the course of an operation.

MONDAY, 2ND JULY – VISIT TO YARDLEY SEWAGE DISPOSAL PLANT. This visit was arranged through the courtesy of Mr V. R. Vincent Davies, Engineer to the Birmingham Tame and Rea Drainage Board. The installations were seen and an interesting explanation given of the processes. After mechanical clearance of rags and grit, the sewage is separated into sludge and fluid by sedimentation. Sludge, in the presence of bacteria, is converted into an odourless material, which, when dry, has the consistency of granulated peat, and can be used as a basis for fertilizers. The fluid is trickled over a bacterial bed, composed of stones; these become covered by a slime which would choke the bed but for the fact that various larvae and nematode worms feed on it. Control of the larvae is achieved by the judicious use of insecticides. The most common fly occurring in summer is the small moth-like *Psychoda* and a somewhat larger one is *Anisopas fenestralis*. The latter can become a nuisance if not strictly controlled, unlike another common species, *Achorutes subviaticus*, which is wingless.

Zoological Section

Three evening field meetings, which were highly successful, were held during the summer. On each occasion a large pool within the city was visited, namely :

Wednesday, 16th May. Edgbaston Nature Reserve.
Wednesday, 6th June. Wychall Reservoir, Kings Norton.
Wednesday, 4th July. Moseley Hall Pool.

The main object of the visit to Wychall Reservoir was to seek further examples of *Anodonta anatina,* exhibiting the feature of 'striata' of P. T. Deakin, recorded in specimens from there. This hope was not realized, but *Lymnaea stagnalis* was seen in profusion, crawling upside-down on the surface film of the water. Roach were plentiful, swimming near the surface.

The visit in July to Moseley Pool yielded living examples of the two pond-loving *Anodontas,* viz. *A. cygnea* and *A. anatina* in the shallows beneath the trees. Numerous dense clumps of the Sweet Flag, *Acorus calamus* were found, with inflorescences, at the Moseley Village end of the pool.

THE SOCIAL EVENING AND EXHIBITION

9th October 1962

The first event of this type in recent years, held a year ago, proved very successful. It brought together members of diverse interests who rarely meet, owing to the division of the Society into more or less self-contained sections. It was, therefore, repeated this year, and should become an annual occasion. A wide variety of different interests was again represented, and members who normally take part only in the activities of one of the sections were able to see what others were doing. Although the exhibition was an informal one, it seems worth while to record a few details, as a reflection of the interests and activities of members at the present time. A note of the exhibitors and brief particulars of their exhibits follows :

MR L. W. PINKESS showed 32 colour slides in home-processed Ferraniacolor of British orchids, in an illuminated display cabinet.

MR H. R. MUNRO, who is an expert on trees, and was formerly head forester at the Lickey Hills, showed a number of herbarium sheets of foliage of native and introduced trees, to illustrate autumn colour. He also had some specimens of mosses and lichens, dried and beautifully mounted in special display boxes, and, lastly, a number of photographs on two subjects, (1) good and bad tree pruning, and (2) Sirex Woodwasps and their parasites.

MR W. PEARSE CHOPE exhibited living amoebae under microscopes, using a special technique, involving the suspension of a drop of water on a slide in liquid paraffin, which enables the specimens to be kept alive for weeks. He also showed some large living specimens of fresh-water mussel.

MR F. A. NOBLE showed specimens of *Lepidoptera,* and also of mosses, collected on a Scottish holiday in the Aviemore area, and the Findhorn Valley. He also exhibited six bred specimens of *Nonagria typhae* (Bulrush

Wainscot Moth) from Cannock Chase, and three from Edgbaston Nature Reserve. The Birmingham specimens were duller and darker than the Cannock specimens, the probable result of industrial melanism.

MR CARTWRIGHT TIMMS showed a number of *Diptera* from Cannon Hill Park, mostly common species, but including *Rhagio lineola* Fab., *Thereva nobilitata* Fab., and *Conops flavipes* L. which are not frequent Midland insects.

MR L. J. EVANS showed a collection of Spanish *Lepidoptera*, with English specimens for comparison wherever possible.

MR D. J. R. HAIGH had living specimens of Common and Natterjack Toads, Common Lizard, Slow-worm and Crested Newt. Some amusement was caused among the visitors by the sight of the toads feeding on flies. His other exhibit was of herbarium sheets of Orchids, mainly from Wales and the Midlands.

PROF. J. G. HAWKES and MR R. C. READETT, the official recorders for the new Flora of Warwickshire, showed a number of herbarium sheets of specimens collected by workers in the present survey, illustrating 'New finds and old records.' These included about 10 new county records, and about the same number of species which had been thought probably extinct, but which have been refound in the present survey. Other rare species shown have persisted in localities known to early botanists for a century or more.

PROF. J. G. HAWKES also showed some fine photographs of Mexican scenery and plants including some potato species, on which group he is a recognized authority.

MR M. C. CLARK showed living material of 45 species of mosses and liverworts from Wyre Forest, illustrating the paper by S. W. Greene and himself in the last issue of the *Proceedings*. He also showed specimens of *Lycopodium clavatum* (Stag's Horn Moss), *Thelypteris dryopteris* (Oak Fern) and *Juncus tenuis*, recently discovered by him in Wyre Forest.

MR E. A. B. STANTON showed a complete collection of *Lepidoptera* collected during 1962 in Arley Wood, Warwickshire, as part of the survey of the *Lepidoptera* of the Midland Plateau on which the Entomological Section is engaged, comprising 165 species of *Macro-lepidoptera* and 45 of *Micro-lepidoptera*.

MR H. H. FOWKES showed by means of a projector, colour slides taken by himself and Prof. Hawkes during the 1961 expedition to the Pyrenees, organised by the Department of Extra-mural Studies of Birmingham University, attended by several members of the Botanical Section of the Society.

The number of members and visitors attending the Social Evening and Exhibition was estimated at 70.

LECTURES 1962-63 AND SECTION REPORTS

General Meetings

2nd October 1962 : *S. W. Greene* – '*Biological Exploration in S. Georgia.*' The speaker, a Lecturer in Botany at Birmingham University was fortunate enough to take part in an expedition which spent some months in the island of South Georgia. He explained the climatic relationship of the island to the Antarctic continent and described its striking geographical features. Though only 20 miles wide it contains mountains of up to 10,000 feet; fine photographs of the mountains and glaciers were shown. Although he was particularly interested in the bryophytes, the lecturer's very fine photographs were of a wide variety of subjects, including the seals, the penguins, and the catching of whales and the treatment of the carcasses. In regard to the rather limited flora he gave some interesting ecological details and described the finding of a good colony of *Sphagnum* which was previously believed not to occur in these regions.

4th December 1962 : *Dr Moore* – '*Agriculture and Conservation.*' The speaker was deputizing for Dr Mellanby, who was prevented from fulfilling the engagement by illness. The theme of his talk was the effect of reclamation, modern agricultural methods, insecticides and herbicides on the natural life of the countryside, and the part played by the Nature Conservancy. Changes in agriculture had meant the disappearance of heathlands, in favour of pasture and forests, drying up of ponds, and destruction of hedgrows by deliberate uprooting, by fire due to the burning of stubble and through damage by herbicides. The pros and cons of the use of pesticides and herbicides were discussed. Whether these or other reasons accounted for the decrease of certain species, e.g. kestrels, was a subject of speculation. Not enough research had been done into the effects of toxic chemicals and more was being encouraged by the Conservancy.

26th February 1963 : *D. H. Christ* – '*Modern views of the Universe.*' This lecture, which was rather outside the field normally covered by the Society, created a great deal of interest, and many questions were put and comments made, at the end. The lecturer, who is President of the Birmingham Astronomical Society, traced briefly the history of astronomy up to the development of the telescope in the fifteenth and sixteenth centuries. This new tool enabled details of the planets to be studied for the first time, but the stars remained mere points of light. With the aid of illustrations he explained modern ideas of how the universe is made up, and touched on the theory of the expanding universe, and the grounds for doubts about this. One illustration was of the Crab Nebula, which is considered to be the result of the explosion of a star. He showed how the date of the explosion had been computed and agreed with a date in 1054, when a phenomenon which could have been the event in question, was recorded by Chinese astronomers.

7th May 1963 : *Peter Tyrer* – '*An account of the Cambridge Central African Expedition*, 1962.' This was an interesting account of the planning, organization and achievements of an expedition by students from Cambridge, given by their leader and chief botanist, a former very active member of our Society. The areas covered were the seasonal lake, Mweru-wa-ntipa, the Nyika Plateau and the Mafinga Hills in the north of Northern Rhodesia and of Nyasaland. Although much publicity was given to one of the objects of the expedition, namely the collection of plant products used by the local witch-doctors in the treatment of chronic diseases, in the hope of finding some of real medical value, the principal object was to collect specimens and study the vegetation and geology of areas little visited previously. Specimens of about 1,000 species of plants,

including some 300 grasses and sedges, were collected and distributed to various scientific institutions, as well as some zoological specimens for the British Museum. A few species of plants are thought to be new. Part of the lake area is known to be a breeding ground for the locust and the observations of vegetation and soils which were made, may prove of value in combating this pest. News was received a few days before the lecture that one of the local remedies sent back seemed most efficacious in reducing blood pressure. It is felt that the expedition may provide more of a permanent value than most student expeditions. A large number of slides was shown of scenery and plants, including an orchid 15 feet in height and a beautiful tree-fern in danger of extinction. There were also two films dealing with the everyday work of the expedition and with activities of the native population.

NOTE. In addition to the General Meetings recorded above, two General meetings were arranged by sections, and are reported later as meetings of the respective sections, namely, the lecture on 15th January 1963, on 'Conservation of Nature in the Midlands', arranged by the Botanical Section and that on 30th April, 1963 on 'The Canary Islands,' arranged by the Entomological Section.

Botanical Section

18*th September* 1962: *Prof. J. G. Hawkes – 'Warwickshire Yellow-flowered Composites.'* The lecturer restricted his talk to those plants which he referred to as the *Liguliflorae* (or *Cichorioidae*) all but a few of which are yellow. He produced a key for identifying those plants of this group which are known to occur in Warwickshire, and explained that such keys are to form an essential part of the new County Flora. He illustrated by herbarium specimens the characters used in the key, particularly the arrangement of the involucral bracts, and other characters such as the type of scape and leaf arrangement, the fruit, leaf shape, hairiness, etc. Some fresh material was provided for members to identify with the aid of the key.

16*th October* 1962: *J. Harvey – 'Violas.'* The talk was in fact confined to the violets (i.e. excluding the pansy section of the genus), and in particular dealt with the dog violets. Useful pointers on identifying the various species in the field were given, supported by close-up slides in colour. Mr Harvey described current research on the taxonomy and cytology of violets, showing how the evolution of certain species can be attributed to polyploidy, not only in this country but also in Eurasia and N. America.

20*th November* 1962: *Dr F. H. Perring – 'Mapping the Critical Groups.'* Dr Perring, Director of the Botanical Society of the British Isles Maps Scheme, outlined the methods used in the collection and handling of the material for the 'Atlas of the British Flora.' He showed slides of the punched-card machines and their operators, which played such a large part in coping with the enormous mass of details, and explained the ingenious method by which the tabulating machines were used to insert the dots on the maps. He acknowledged the assistance received from our own local survey, both as regards the ideas evolved, and, as far as Warwickshire is concerned, from the records collected by our own workers. He then dealt with a few of the problems remaining in connection with the critical groups – e.g. *Polypodium* (Polypody Ferns), which have now been recognised to comprise three distinct species, *Ranunculus ficaria* (Lesser Celandine) and its sub-species, the *Arctium* species (Burdock) and others.

15*th January* 1963: *Dr Tom Pritchard – 'Conservation of Nature in the Midlands.'* Dr Pritchard, Regional Officer of the Nature Conservancy, outlined the history of nature conservation in this country from its inception in 1889 with the founding of the R.S.P.B. until 1947 when the Nature Conservancy received

the Royal Charter. He described the organisation of the Nature Conservancy and its work in the acquisition and maintenance of nature reserves, and in watching over sites of special scientific interest. The talk was illustrated by fine slides of areas of contrasting ecology, with special emphasis on sites in the Midlands, e.g. Shropshire meres, Alvecote, Earlswood and Dudley.

19*th February* 1963 : *Dr C. D. Cook – 'Water Buttercups.'* Dr Cook, Lecturer in Botany at Liverpool University, gave a most interesting account of his researches into the taxonomy of the Water Buttercups. There are probably only about 14 species, although upwards of 200 names have been used from time to time. The phenomenon of the two distinct types of leaves, with an abrupt change at a certain point on the plant from one type to the other, which occurs in certain species, is almost unique in the plant kingdom. Some mistaken ideas have arisen about this feature, but Dr Cook put forward a theory as to how it originated by selection, after hybridization. He gave some valuable assistance during his visit, to the Warwickshire Flora work, by going through a large mass of specimens of this difficult group which had accumulated, and naming them, according to the latest views.

19*th March* 1963 : *Dr C. E. Harrold – 'Mycorrhiza.'* Dr Harrold, Lecturer in Mycology at Birmingham University, explained that, owing to the great technical difficulties of investigation and experiment in this field, there is much that is still unknown regarding the association of root and fungus; this applies particularly in the case of endotropic mycorrhiza. For this reason his talk dealt with ectotropic mycorrhiza, about which a lot has been discovered, mainly within the last 25 years or so. This form of association is found mainly in the trees, and in many cases quite common kinds of toadstool, e.g. *Amanita, Russula* and *Boletus* species are the fungi concerned. Typically stout, blunt root-branches are formed, these being encased in fungus hyphae. It has been found, using modern techniques of following the course of radio-active molecules, that substances taken up from the soil by the fungus, such as phosphates and potassium. eventually reach the plant tissues, and, on the other hand, carbon absorbed from the atmosphere by the tree can pass into the fungus, but the mechanism, and other aspects are not fully explained yet. There seem to be distinct advantages to the tree in the association, but the advantages to the fungus plant are less obvious.

11*th April* 1963 : *M. C. Clark – 'The Genus Carex in Warwickshire; a survey for field botanists.'* This was another talk centred round a key to a difficult group, this time a key to the Warwickshire species of *Carex*, produced by Mr Clark. He explained the points used in the key by demonstrating the features concerned in a series of specimens and then worked right through, showing a specimen of each species in turn. The known Warwickshire species of this very large and fascinating genus comprise about half of the 75 or so species in the British list. A lively discussion followed.

23*rd April* 1963 : – *'At home' at the University Botany Department.* The winter season ended with a pleasant social meeting at the Botany Department, by invitation of Prof. J. G. Hawkes, attended by a large number of members and friends. The main object was to report on the progress of the Warwickshire Flora and in connection with this, specimens, maps and other material were on view. Prof. Hawkes and Mr Readett gave details of the progress made and plans for the remainder of the work and Mr Clark gave some advice on submission of specimens. In addition Mr Dermott of the National Agricultural Advisory Service provided a practical demonstration of soil-testing; a short account of the soils and underlying rocks of Warwickshire followed, from his colleague Mr Macney.

GENERAL REPORT ON BOTANICAL SECTION ACTIVITIES

The main field work of the section has continued to be the collecting of records for the revision of the Flora of Warwickshire. Most excursions were arranged to

further this work, but have also, it is hoped, been of interest to members not working on the Flora, and to beginners. Many members have been engaged individually in recording for the Flora, particularly in checking doubtful records and filling in gaps. The field excursions were mostly well-supported, the average attendance being 15. The number attending the 1962 week-end meeting, 11, was, however, considerably less than on previous occasions. The winter programme of lectures was well-attended. A popular feature of the winter season was again the presentation of their latest slides by a number of members interested in colour photography of flowers; this followed the Annual General Meeting.

Entomological Section

27*th November* 1962 : *L. J. Evans* – *'A Week in Spain.'* This was a record of a holiday tour, illustrated by slides of places and buildings of interest seen on the way and in Spain, as well as of insects. The speaker described the good collecting ground he found at his destination, his adventures there and the captures he made (some of which were shown in the exhibition at the Social Evening).

29*th January* 1963 : *P. Walker* – *'Social Behaviour in Insects.'* The lecturer defined a social species as one where a female insect constructs a brood chamber for an egg to be laid by another female. This occurs only in the Orthoptera and Hymenoptera. He dealt first with the wasps as primitive social insects, providing the link between solitary and social habits. He then dealt with the bees, and pointed out that, although they have been kept by man for some 4,000 years, a great deal about them is still unexplained. He mentioned some interesting facts which are known concerning the production of different castes, division of labour, collection of food and communication of information by means of dance-like movements. The ants are the most completely social of the Hymenoptera, and it is known that they have existed for 30 million years. Like man they have passed through hunting and agricultural phases. The lecturer gave examples of different species and their social habits. He pointed out that experiments had shown that they completely lacked reasoning power. Termites were the oldest of the social insects, having existed for at least 200 million years. They are really social cockroaches; they produce both kings and queens and have a very complex social life.

3*rd March* 1963 : *Dr M. P. Osborne* – *'Life Histories of Aquatic Insects.'* Dr Osborne began by explaining that the many insects which spend all or part of their lives in water originated from terrestial ancestors and that the majority continue to use atmospheric air. However, a few are completely aquatic and can absorb dissolved air from the water. He showed the methods of obtaining air, and the many special adaptations in the various orders of insects. The lecture was admirably illustrated by slides.

30*th April* 1963 : *Baron C. G. M. de Worms* – *'The Canary Islands.'* In his introduction, the speaker described the geography of the Canary Islands, and went on to give an interesting talk on their natural history, during which he showed colour slides. These included slides of the Milkweed Butterfly and he suggested that this butterfly, when found in this country, had probably come from the Canary Islands. Questions were put by the large audience and a general discussion followed.

GENERAL REPORT ON ENTOMOLOGICAL SECTION ACTIVITIES

Attendances at meetings were much better than in the previous year. It will be seen that some interesting lectures were given to the section, but most meetings were of an informal character. At all meetings a number of exhibits was produced by members and these gave rise to lively discussions. Outings during the

summer were not of the usual standard owing to the weather and other causes, but, given more favourable conditions, it is hoped that the 1963 season will provide a better programme.

Several groups of members continue to work new areas of the Midland Plateau, adding to existing records; much, however, remains to be done and it is hoped that the section will concentrate on this work until it is completed.

The loss of Mr Carlier has been keenly felt by members of the section to whom he was always a great help. It is gratifying to know that his lists of microlepidoptera will be published, as many are unique.

Geological and Geographical Section

19*th October* 1962 : *S. Harper – 'Gemstones – Origin and use.'* The lecturer, a Fellow of the Gemmology Association and a practising jeweller, dealt exhaustively with his subject. He explained the origin of gemstones as products of igneous activity and metamorphosis, and described the crystal systems to which they belong. He detailed the characteristics which are used for identification. Specimens of the more common varieties of gems and colour slides of the processes of diamond cutting were shown. A large collection of specimens of gems was also exhibited by Mr Beresford, of Pineapple School, a friend of the lecturer.

16*th November* 1962 : *H. Sanders – 'What Future has Geology ?'* In this unique and stimulating lecture Mr Sanders referred to recent discoveries and changes of ideas in astronomy, with reference to the origin of the earth and to the latest work on meteorites. He also discussed the repercussions on geology of the study of seismology, igneous activity, oceanography, electricity, earth magnetism, glaciology, nuclear science and bacteriology, which in time will have a profound effect on geology as we now know it.

14*th December* 1962 : *E. Kestle – 'Black Country Craftsmen in Glass and Chains.'* The lecturer (the Hon. Sec. of the section) showed how the growth of the Black Country was to a large extent connected with the development of the South Staffordshire coalfield, with its associated iron ores, fireclays and limestone. Water power in the Stour Valley was also of significance. The development was very different in character from that of Birmingham, being very often based on enlarged villages specializing in particular trades. The history and background of two typical trades, those of glass and chains were sketched and illustrated by slides taken on visits to a glass firm at Brierley Hill and to chain-makers at Cradley and Netherton.

25*th January* 1963 : *Dr R. J. Adie – 'Some aspects of the Geology of Antarctica.* This was a well-illustrated lecture by one who has taken an active part in recent geological surveys of several areas of Antarctica. Reference was made to the visits paid by Birmingham University students under the auspices of the Falkland Islands' Dependency Survey and to the comparison of rock formations and parallel occurrence on the South Orkneys, South Shetlands, South Georgia and Deception Island. Mapping in surprising detail has been carried out on the Coronation Island of the South Orkneys. Graham Land, equal in size to the British Isles and 1,200 miles in length, has been fairly well mapped, showing the fiord-like coastline, as in Norway. Modern methods, including the use of helicopters, enabled the work to proceed at a pace and in detail impossible a few years ago; mountain rock faces are now accessible by winches. Some substantiation was found for theories of continental drift etc. The study of Deception Island and its complex volcanic origin was of particular interest. It had originated from four cones and had been built up in successive stages, the fourth stage being reached in 1834, but hot springs still give evidence of volcanic activity.

15*th February* 1963 : *Dr G. M. Bennison* – '*A Geologist looks at Soils.*' Dr Bennison, of the Geology Department, Birmingham University, first discussed the composition and formation of soils, outlining the effect of weather in different climates and the influence of plants. Dissolved carbon dioxide plays an important part in regions with a reasonably high rainfall. Shale breaks down to a clayey soil, sandstone a sandy one, and a mixture of the two, a loam. The lecturer dealt with various types of soil of great geographical importance – the Central Asian chernozen, a black earth of great age; podsol of temperate forest lands, dark at the top with a lighter layer below; lateritic soils of monsoon climates, bright red in colour. Reference was made to the soils of the United Kingdom most of which are relatively young, following the ice age.

15*th March* 1963 : *P. J. M. Bailey* – '*Aspects of the Geography of Russia.*' The lecturer, who is head of the Geography Department at Saltley College, visited Russia in 1957 and his lecture dealt with his impressions of a number of towns which he saw, including Moscow, Stalingrad, Rostov, Kiev and Leningrad, and the Black Sea and Caucasus region. His lecture was illustrated by colour slides. Those of the University building in Moscow, designed to take 30,000 students, chiefly in science and technology, were most impressive.

26*th April* 1963 : *J. Morris Jones* – '*The Avon Navigation and Stratford Canal.*' This interesting local topic was ably discussed by the lecturer who has been carrying out a considerable amount of research. It was well illustrated by slides of maps and photographs specially prepared by the lecturer. Mr Jones summarized the history of the Avon Navigation from its beginning in 1638, and of the canal's building between 1793 and 1816. He dealt with the problem of using a river impeded by mill weirs and of bringing a canal 332 feet down from Birmingham to Stratford and supplying it with water. Traffic and trade on the waterways, their decline and the recent work of restoration, by voluntary bodies and individuals, were described and illustrated. All aspects were dealt with – social, historical, technical and economic.

GENERAL REPORT ON GEOLOGICAL AND GEOGRAPHICAL SECTION ACTIVITIES

'The section, after passing through a period which caused concern to its officers, now seems to be in a better position, with attendances much improved. The audiences have usually been close to thirty in recent months. Particularly gratifying has been the interest shown in meetings by students from local selective schools, who have found the talks useful to their studies in geography. This has to some extent affected the lectures, with a greater emphasis on the geographical content.

It has been recent policy to organize few field meetings. Rather than indulge in competition, it has been considered better to take advantage of the invitations and co-operation of the Geologists Association – Midlands Group – and the Birmingham branch of the Geographical Association. This enables our members, some of whom are also members of these societies, to be provided with a good choice of excursions.

Microscopical Section

Regular meetings for practical work have continued to be supported by a small group of enthusiasts. Other activities have consisted mainly of informal talks and discussions. Members of the section are always prepared to assist others with microscopical work in connection with their particular interests, or to demonstrate the apparatus which the Society has available.

Zoological Section

11*th September* 1962 : *Lt-Col. H. A. Hill* – '*Natural History and Philately combined.*' This talk, being to the Zoological section, naturally dealt mainly with the animal kingdom. Virtually every animal group is represented on stamps, French colonials being particularly fruitful in this respect. A fine display of specimens illustrated the talk, but the lecturer pointed out that as regards classification, philatelic principles had had to take precedence over zoological.

13*th November* 1962 : *E. Cartwright Timms* – '*The Homeward Way.*' This lecture dealt with various aspects of the homing instinct, starting with familiar and well-authenticated cases of long journeys by domestic pets, passing on to the honey bee, with its journeys to and from the hive, and finally the migration of birds and certain mammals, e.g. lemmings.

12*th February* 1963 : *F. R. Woodward* – '*Rare and Beautiful Shells.*' The lecturer referred to the fascination of shell collecting and to the high prices which have been paid in the past and are still being paid, for certain rare specimens, particularly the Cone shells and Cowries. The Cone shells, many of which are very beautiful both in shape and colouration, are difficult and dangerous to collect from the crevices of coral reefs which they inhabit, for the animals which form them can cause nasty wounds into which they inject poison. As much as 100 guineas was paid for a specimen of the Glory of the Seas Cone (*Conus gloria-maris*) of which only about 25 specimens are known, seven being in the British Isles. A number of other beautiful and much sought-after groups were described and all the kinds dealt with were shown, either as actual specimens, or by means of slides.

9*th April* 1963 : *M. J. Griffin* – '*Mites and Ticks.*' The higher classification of the *Acari* on an anatomical basis was outlined. The group was discussed on an ecological basis, with special reference to economic importance. *Ixodes ricinos* and *Argas persicus* were described, as examples of ticks. The Eriophid Mites were cited as examples of gall mites of plants. *Sarcoptes scabiei* (Scabics Mite) and *Acarapis woodi* (Isle of Wight Disease of bees) were dealt with under the heading of animal parasites. Mites as vectors of virus and spirochaete diseases were considered. Amongst the free-living *Acari*, special attention was devoted to mites damaging stored foods and furniture.

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