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Agnes Arber, 1879-1960

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Agnes Arber

AGNES ARBER

1879-1960

AGNES ARBER was born in 1879, the eldest child of a cultured family, whose members achieved distinction in different fields. Her father, Henry Robert Robertson, was an artist of Scottish extraction, whose father, a man of considerable botanical interests, also with gifts as an artist, had a private school at Slough. Her mother, Agnes Lucy Turner, was a descendant of Robert Chamberlain, who founded the china works of Chamberlain & Son at Worcester, and her mother's relatives included John Davidson, the African explorer, and George Fownes, both of whom were Fellows of the Royal Society. Her brother, Donald Strain Robertson, M.A., F.B.A., was Regius Professor of Greek in the University of Cambridge and author of various books on classical subjects. Her sister, Janet Robertson, was a portrait painter. At an early age her mother inspired her with an interest in plants and her father gave her regular drawing lessons from the age of three until she went to school. This early training developed her powers of observation, and laid the foundation of the skill and artistry which later formed such a notable feature of her books and papers.

At the age of eight she began lessons at the North London Collegiate School for Girls, where the renowned Miss Buss was headmistress. At that time the equipment and training in science at the school were exceptionally good, and Agnes became a very enthusiastic student of botany. At the age of 13 she read Masee's little book on *Plant life* in which she saw for the first time a picture of the cell and its nucleus. She learned about plant anatomy, and the gymnosperms and cryptogams from Miss Edith Aitken, a former student of Girton College, Cambridge, who taught botany at the school, and this teacher introduced her to the work of Goethe, to whose philosophy she devoted so much time and thought throughout her life. In 1894 her first paper was published in the school magazine. It was an illustrated study of the ivy-leaved toadflax, a little piece of research and original observation, whose recognition thrilled its author. Her botanical ability was at that time confirmed by the Cambridge Local Junior Examination, in which she obtained the first place in botany and was in consequence awarded a scholarship at her school.

While at school two events happened which greatly influenced her future career. She had the opportunity of studying a copy of *Lyte's Herbal* (1578) for a few days. This was an English translation of an earlier work by Dodoens and very finely illustrated. From this rapid schoolgirl study arose an interest which lasted through life and led to her publication in 1912 of a book on the

evolution of printed herbals between 1470 and 1670, which has now become a standard work.

A second event was her meeting with Miss Ethel Sargent, who came to the school to read papers to the Science Club. This lady was a well-known botanist who had specialized for some years on the vascular anatomy of seedlings, working in a private laboratory at her house in Reigate. She invited Miss Robertson to work in her laboratory between school and college, and later during her long vacation from Cambridge. In this way an introduction to the technique and interpretation of serial sections was learnt.

Miss Robertson entered University College London, in 1897 and took her B.Sc. degree two years later. She then proceeded to Newnham College, Cambridge, with an entrance scholarship. At both Universities she obtained first-class honours in every examination taken, and at University College gained several prizes and medals. For Part I of the Natural Sciences Tripos at Cambridge she studied chemistry, physics, botany and geology, and worked at botany and geology for Part II. At University College she was taught by Professor F. W. Oliver and Mr (later Professor Sir Arthur) Tansley, while at Cambridge she went to the lectures of Professor Marshall Ward, A. C. Seward, F. F. Blackman, Francis Darwin and E. A. Newell Arber. She said that the most stimulating teaching at Cambridge was that of William Bateson, later Professor of Genetics, who was then in the full-flood of the rediscovery of Mendel's work. In the course of the teaching on gymnosperms by Professor Seward she studied the anatomy of *Macrozamia* as an exercise in research; the results of this study were published in *Proceedings of the Cambridge Philosophical Society* in 1902, it had not only served for her instruction but also was a great encouragement.

On leaving Newnham in 1902 she became research assistant to Miss Ethel Sargent in her private laboratory, and worked on seedling structures. From this time originated her interest in the seedlings of grasses, and a joint paper with Miss Sargent, on this subject was published. From 1903 to 1908 she held the Quain Studentship in Biology at University College and came once more under the influence of Professor F. W. Oliver, F.R.S. During this period the gymnosperms occupied much of her interest; the morphology and reproduction of *Torreya californica* were studied in 1904; the morphology of *Phyllocladus alpinus* was examined in 1906, and a phylogenetic study of the Taxoideae appeared in 1907. Oliver also encouraged her to study some fossil plants and this led to important papers on the structure of the seed of the palaeozoic gymnosperm *Mitrospermum compressum*, and an anatomical study of the palaeozoic cone genus *Lepidostrabus*.

On 5 August 1909, Miss Robertson married Edward Alexander Newell Arber (1870-1918), University Demonstrator in Palaeobotany at Cambridge. He was the elder son of Professor Edward Arber, D.Litt., F.S.A., famous for his *English Garner* and other studies in ancient English literature. Newell Arber was a member of Trinity College, Cambridge, with wide interests in plants. He was responsible for the collection of fossil plants in the Sedgwick

(Woodwardian) Museum, Cambridge, to which he added some 5000 specimens, and he lectured on both elementary and advanced palaeobotany. He maintained an active interest in the plants of the present day and wrote a book on *Plant life in Alpine Switzerland* (1910). His most widely known work was a joint paper with his friend John Parkin on *The origin of angiosperms*. He was an indefatigable worker on fossil plants, both as a collector in the field, and as a student of the collections made by others. His interests lay mainly in the upper palaeozoic floras, and in the stratigraphical occurrence of fossil plants. By his energy and enthusiasm he collected around him a number of research workers (including the writer) who made many contributions to our knowledge of the plants of the past. He also spent a considerable period arranging the fossils at the Natural History Department of the British Museum and in preparing a catalogue of the specimens of the *Glossopteris* flora.

The marriage was a happy one: they had one child, Muriel Arber, now F.G.S., who helped her mother in many ways. Husband and wife had many interests in common and Mrs Arber records how much she was helped by her husband, especially in the criticism and improvement of her papers and in the technique of research and publication.

The first and probably the most widely read of her books appeared in 1912. It was on *Herbals, their origin and evolution*, giving an account of the principal printed works published between 1470 and 1670, with specimens of the illustrations they contained, and short notices of their authors. She said that the idea of this book was suggested by Sir Albert Seward who was at the time Professor of Botany. There was an exceptional collection of herbals in the library of the Cambridge Botany School, which was available for her study and she produced a very fine book which will long be a standard work on the subject. Retaining an active interest in the subject over the years, she revised and largely rewrote the work for a second edition which appeared in 1938. This edition contained new material, such as a section on the herbals in Spain and Portugal, and a number of figures, in addition to the 134 of the first edition. Her study is an important contribution to the history of botany, and has done much to arouse an interest in the subject. At a later date she made contributions to the history of botany especially on Nehemiah Grew, in essays offered to George Sarton in 1946, and in a similar volume in honour of Charles Singer in 1953. Singer dedicated his *Short history of biology* to her, and to her also J. Hutchinson dedicated his Volume II (Monocotyledons) of the *Families of flowering plants*.

The quality of her work was soon recognized by the award of a Research Fellowship at Newnham College, Cambridge, which she held in 1912-13 and 1918-20. She was a Fellow of University College, London, and held the Keddy Fletcher-Warr Studentship, University of London, 1920-23. From 1936-38 she held a Leverhulme Research Fellowship. Her work was recognized in North America by her election as a Corresponding Member of the Botanical Society of America.

After her marriage and until 1927 she carried on research work at the Balfour Laboratory which at that period belonged to Newnham College. It had earlier been the Congregational Chapel and later was the first home of the University Biochemical Department. After 1927 she worked at her home in a room which was fitted up as a laboratory.

Under these conditions a continuous series of original observations was produced which formed the bases of over 50 papers, mainly published in the *Annals of Botany* and in *The Botanical Gazette*. These researches were chiefly concerned with the anatomy and morphology of monocotyledonous plants, which were studied from every point of view, and whose structure was depicted in many interesting figures. This work which occupied about 50 years of her life may be divided into four parts, in each of which a number of separate investigations were made which were later combined in a book, giving the main results in an abbreviated form, and with particular reference to the general principles derived from them. The first of these was a study of the structure and life history of aquatic plants published in 1920 with the title of *Water plants: a study of aquatic angiosperms*.

This described a variety of forms illustrating certain life histories and went on to consider the general anatomical and reproductive characters of the chief types. After reviewing the physiological and ecological condition of plant life in water, there was a series of chapters devoted to the study of water plants from the phylogenetic and evolutionary standpoints. The view put forward by Miss Sargent on the origin of the monocotyledons probably had considerable influence in leading Mrs Arber to investigate water plants. It was suggested that this group was a decadent race, of which some branches had been driven to an aquatic habitat to escape the severer competition on land. But the conclusion reached by further study was that no sound evidence could be found to support Miss Sargent's theory.

Much of the work which occupied Mrs Arber was concerned with monocot plants to which she was originally introduced by Miss Ethel Sargent. That skilled and eminent anatomist had accepted about 1910 an invitation from the Editors of the *Cambridge Botanical Handbooks* to write a book on *The Monocotyledons* for this series. Ill-health and advancing years made this impossible and shortly before her death in 1918 she suggested that Agnes Arber should take over the task. This led to the publication in 1925 of an admirable book devoted to a general survey of the group with numerous figures, one hundred and forty of which are original drawings by the author. The book opens with a valuable chapter on the principles of morphology and with an analysis of the philosophy of plant form; the two concluding chapters were designed to show how the monocotyledons appear to illustrate the principles discussed in chapter one.

This examination of the methods and object of morphological study was of great importance because, during the first quarter of this century, there was much confusion of thought about the philosophical principles underlying this type of work. Many English botanists believed that morphology

was only useful in so far as it led to the discovery of phylogenetic lines. On the other hand continental botanists, especially those from France and Germany, following the traditions which had become established before the appearance of *The origin of species*, were interested in the study of form and structure for its own sake. If phylogeny was considered, it was based on the old views of plant structure handed on by tradition, rather than based on careful examination of objective facts bearing on the problem, and on the employment of logical reasoning. A completely new examination of the philosophy of morphology was needed, and this was commenced in the first chapter of *The Monocotyledons* and followed up in the remainder of her works.

Mrs Arber attempted to resolve the philosophical difficulty by drawing a distinction between the study of pure and applied morphology. The work on monocotyledons, like the later work on the Gramineae, was mainly concerned with the more general aspects of morphology especially as shown by anatomical studies. Most of the leading morphologists of the Continent had paid little attention to comparative anatomy, believing it to have little significance in morphological interpretation, but occasionally making use of it when it suited the writer's views. In England, however, much work had been done about the turn of the century on the comparative anatomy of pteridophytes and gymnosperms, both living and fossil, and this gave a quite different view of the significance of comparative anatomy. The preparation of this survey of the monocotyledons involved a considerable amount of original research much of which was published in some 20 preliminary papers, mainly concerned with the development and internal anatomy of monocotyledonous leaves and vegetative organs. All these were illustrated by many excellent figures.

After describing roots and axes, the foliage leaf received a further treatment. Although remarkably uniform in external features there is great diversity in its anatomical character, and in many cases genera and even species can be determined on structural grounds without any help from the reproductive organs, though this is not invariably true. The peculiarities of leaf form and structure seen in the group lead to attempts at its interpretation and Mrs Arber assembled the more important evidence bearing on the view that the original stock from which the monocots arose had leaves which were petiolar phyllodes. The comparative anatomy of the prophylls of the monocotyledons presents a number of difficult problems leading to the nature of the phylloclades of the Rusceae and the 'frond' of the Lemnaceae. These were elucidated by a careful study of the development and mature anatomy of the various forms, which cleared up many of the difficulties in the interpretation of these structures.

The study of seedlings has given rise to several hypotheses regarding the phylogeny of the monocotyledons and since Mrs Arber had been associated with Miss Sargent and seedling anatomy from her student days, the chapter on the monocot seedlings and their significance is of especial interest. She

was highly critical of the view put forward by Miss Sargent and other authors, and discarded the theories based on the idea that cotyledons are organs *sui-generis* or anything but the first leaves of the plant. The anatomical and comparative study of monocotyledonous flowers and of the vegetative reproductive structures adds a further contribution of interest especially in the information which the author collected about the periodicity of flowering and the rhythmic alternation of vegetative and sexual phases of reproduction. The last two chapters, on taxonomy and its interpretation, survey some of the general conclusions which the author had reached during the course of this work.

During the course of this general study, which not only gave an account of a numerous and important group of plants, but was also an admirable introduction to plant morphology, Mrs Arber felt that it might be possible to get a clearer view of the questions arising out of this study if it were combined with more intensive work upon one of the great monocotyledonous orders. With this in view she returned to the *Gramineae* and she once said that during the next ten years these plants were seldom far from her thoughts. The plants available for study were very numerous, including the cereals, the bamboos and the many other grass forms, the problems presented are so inextricably interwoven with the history of man that the subject is much broader than a purely morphological study. It was preceded by a series of ten papers in *The Annals of Botany*, which, with their admirable illustrations, demonstrated many of the more complicated and less familiar topics. Seventy-nine of the blocks from this series of papers were used in the book together with many other original drawings. Many of the structures which are considered are explained by a series of drawings showing the same structure at different stages of growth or at different levels, rather than by verbal description. This forms a unique but very successful method of imparting information.

The works previously published on the grasses are extremely numerous and the bibliography with the references to works mentioned in the text occupied 43 pages. Beginning with an account of the cereals and fodder grass from the earliest times, the early chapters contain a most interesting collection of information both from the standpoint of world history from the earliest times and of economic botany. These chapters are written in such a clear and easy style and are so delightful to read that they formed a unique beginning to a book packed with technical information yet always interesting. When the structure of the vegetative and reproductive parts were described they were made clear and intelligible by the numerous line drawings in the author's inimitable style. While dealing with almost all of the main types of structure, both vegetative and reproductive, facts and views were interspersed among the purely structural information, giving it a great deal of general interest, with information about the ecology of the species, and their economic importance in various parts of the world.

Nearly twenty years of continuous investigation and thought about a

group of plants with considerable variation in form, but at the same time with many characters in common, led Mrs Arber to a philosophical view of plant morphology rather than to a speculative phylogeny. This aspect of thought can be seen to be gradually developing in her work. She concluded her great work on the grasses in the following way. 'This slight sketch of the trends revealed in the grasses, opens up the idea that this group is a microcosm in which are displayed in little, all those tendencies of the corresponding macrocosm—the Monocotyledons—which can be developed within the definite, though elastic, framework of the ordinary type. . . . What is the meaning of the differences that separate the Gramineae so delicately, yet so definitely, from any other order, and that so prevail that a grass remains a grass however freely the type may vary? To attribute these differences to genic constitution is an "explanation" of a merely descriptive kind; it enables us, indeed, to assign a place to them in the mental framework which we impose upon reality, but in so doing we have shelved, not solved, the problem.'

About 1930 Mrs Arber began a series of studies on flower structure in which she investigated the vascular structure of a considerable number of forms and used the results as guides to the morphology of other parts. In 1937 she summarized the morphological views which had been expressed about floral structure, and their relation to the anatomical structure, an important critical survey. Several years before this she had examined the views put forward by Miss E. R. Saunders on the morphology of the angiosperm carpel, based on vascular anatomy: Mrs Arber found that this revolutionary theory of the carpel was not justified by the vascular structure actually present.

By 1942 Mrs Arber's publications were more than 70 in number and covered a very wide field, they gave valuable accounts of anatomical structure and critical discussions of the interpretation of the facts recorded. Her position in the study of botany was recognized by her election as a Corresponding Member of the Botanical Society of America and in 1946 she was elected to the Fellowship of the Royal Society: only two other women had previously received this honour. She had been a Fellow of the Linnean Society of London since 1908, and had served on the council of that Society from 1915 to 1919. She was awarded the Linnean Gold Medal in 1948.

During the second world war Mrs Arber found it impossible to maintain the small laboratory in her house and her active mind turned more and more to philosophy and to the quiet contemplation of the facts which she had observed during the work of the previous twenty-five years. *The natural philosophy of plant form* (1950) was the outcome of this study and is perhaps her most important book. When one examines a plant structure or compares it with that of another species we cannot make use of mathematical logic as in the physical sciences. What mental processes are employed in forming a unified conception and what is the history of these modes of thought?

The average student is ignorant of the mental processes employed and of

the history of these modes of thought. It is easy to imagine a phylogenetic tree as suggested by the theory of evolution, in which the relationships of organisms are objective and the validity of an actual historic tree is assumed. But morphology long antedated the Darwinian theory and in fact Darwin placed considerable confidence in the theory put forward by Goethe on quite different grounds. Even today many of the ideas of morphology of the flowering plants are based on the doctrines of Aristotle as gradually developed during the centuries, and most of the continental work on plant morphology has been the direct outcome of Goethe's thoughts. At the present there is a hopeless state of confusion between the views whose basis is a series of mental concepts, with no objective basis, and those which are based on objective facts.

Mrs Arber, using the type concept, reviewed the structure of the flowering plants and put forward a series of suggestions based on an examination of the facts of comparative structure. Her book is a very interesting survey of the essentials of structure of the flowering plants, collected from published papers and from original observation. It is concise, well illustrated, and it supplies at last an account of the form of the flowering plants which is philosophically sound, being based on typology, but agreeing with the conclusions reached by research on palaeobotany.

Another small but important work appeared in 1954, *The mind and the eye, a study of the biologist's standpoint*. This short study gives in outline an account of the nature of biological research and of the thinking which a specialist uses when he considers the meaning of what he has observed. The work is a summary of the stages which a biologist like Mrs Arber has passed through on the road towards reality, but actually the work and thought described are very similar in those employed in pursuit of other branches of natural knowledge. The work of the biologist, if it is to lead men to any permanent result, must be continued to the stage of unearthing his basic assumptions and subjecting them to unprejudiced criticism.

Her last book *The manifold and the one*, published in 1957 by John Murray, was a philosophical essay, the outcome of the quiet contemplation which occupied her last years.

She died on 22 March 1960 in the Hope Nursing Home in Cambridge and was interred in the churchyard of the little church at Girton, ~~close to the spot where her teacher and friend, Ethel Sargant, was buried.~~
E. Sargant is, in fact, buried at Sidmon & R.

I think it may be said that the passing of Agnes Arber ended a distinct period in the development of botany in England, a period in which comparative anatomy and morphology were regarded as the centre points of investigation. Later came the influence of physiological discoveries and the impact of ecological and cytological studies, but the careful investigation of plant structure by Mrs Arber and her contemporaries made a lasting contribution to botanical knowledge which is not likely to be superseded. Her writings on the philosophy of biological study, and her distinction

between the phylogenetic speculation reached by typological arguments, and by the examination of plant form in the light of historical evidence, have still to become fully effective.

H. HAMSHAW THOMAS

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[Additional references supplied by Dr M.A. Arber, Professor Agnes Arber's daughter. 9 April 1962]