AMERICAN WOMEN IN SCIENCE BEFORE THE CIVIL WAR

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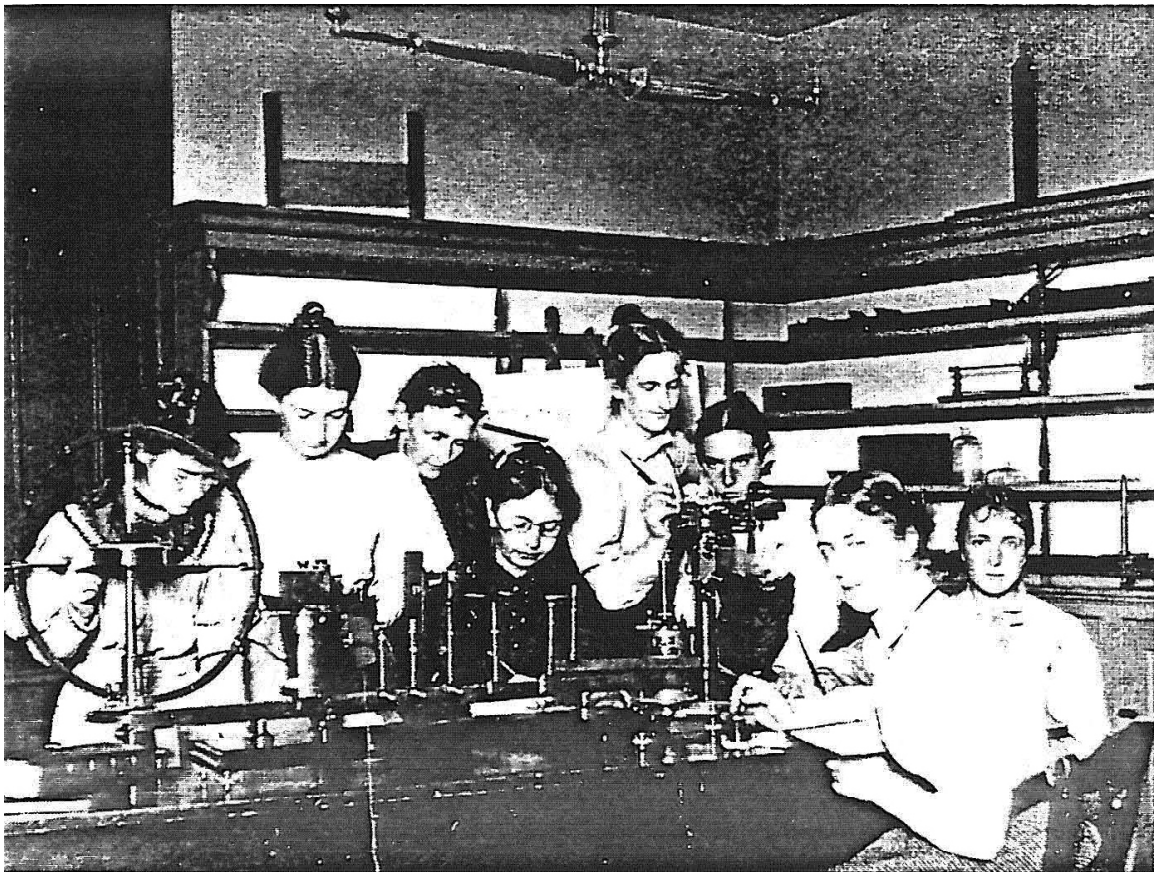
The first physics laboratory in a women's college was established by Professor Sarah Frances Whiting at Wellesley College, 1878. In this photograph, astronomer Annie Jump Cannon is the third student from the left. Her career was largely inspired by Prof. Whiting who, Cannon wrote, wanted her students "to become not only good scholars, but women of influence in their communities." The only other physics lab at an undergraduate college before this was at MIT, where Prof. Whiting visited, finding it "nerveracking to be in places where women were really not expected to be, and to do things which women had not done before."



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Preface

In the last few years there have been quite a few scholarly publications on the roles of women in literature, art, social reform and politics. Many heretofore unknown women finally have been credited with important contributions to society. Missing from this array have been the similarly undocumented but substantial contributions of early American women to science. It is hoped that this review will induce others to undertake further research in this field. Much remains to be learned.

The period chosen for this survey is the time from Colonial America to the onset of the Civil War. There was something of a hiatus during this war, when at least one scientific organization, the American Association for the Advancement of Science stopped meeting. After the war there was a rapid increase in women's participation in science as academic opportunities developed and some professional occupations became available to them.

The term active in science is here used in its broad sense to include any promotion of science. This can come in many forms, experimental data, textbooks, teaching, donations of money, time and collections to institutions, and memberships in scientific societies. The actual designation as scientist is not used. It is an indefinable one at best, varying with the times, and sometimes related to the bias of the writer and the professional status of the individual under consideration. As in any other activity there is a hierarchy of status which this writer does not undertake to evaluate.

Considering the handicaps under which many of these women labored, often denied entry to colleges and unable to attain professional status, one wonders why they continued to pursue this sort of work at all. It is a testimony to the interest that these women had in science that they continued to study, work and participate in science. Perhaps Ellen Tupper, an expert on the physiology and behavior of bees put it most clearly when she wrote in one of her columns on bee keeping that her reason for studying bees was that there was always something to think

about,some experiment to try, something to investigate. In short, she wrote, she had an intellectual as well as a physical employment. Perhaps she speaks for all these women (Part II, Tupper, 1:101).

An incentive to do this work was provided by Mozans' 1913 book, Woman in Science (1), Hanaford's Centennial volume Daughters of America (2) and Meisel's Bibliography of American Natural History (3). The varied activities and range of interests of these early women are well described in Kohlstedt's article in Signs (4). Warner reviews the early educational opportunities for women in her paper in Isis (5) and Woody's two-volume history of women's education in the United States provides a comprehensive view of the subject (6). Rossiter's book describes the academic and social milieu in which these women worked (7).

The contributions of these women before the Civil War range from writers on scientific subjects through volunteer collectors of weather data for the Smithsonian Institution to a girl's botany class which furnished a list of spring flowers for a museum. From this distance in time the contributions of these women are as difficult to measure as the women are to classify, but any contribution can favor an increase in knowledge for subsequent workers in the field.

The following material is divided into two parts. Part I is a report on the activities of women who were engaged in scientific pursuits but left no written records of any work in science. These are the women who were members of and donors to scientific societies, the collectors, the teachers, the artists. Part II includes biographical and bibliographical data on 21 women who had some published writings in science before the Civil War. Some of course continued publishing after that date. Their later work is included. It is important in establishing the credibility of these women's achievements to have as complete a bibliography of their publications as possible and to have an evaluation of these writings from the standpoint of a scientist. The evaluation is included in the write up.

The list of sources searched for the above information is in the appendix.

Acknowledgements

It is impossible to list all the librarians and archivists who helped in searches, answered letters and gave encouragement for the project. Special acknowledgement must be made of the invaluable, personal assistance and helpful advice of Dr. Beatrice Smith, a longtime friend and colleague. The expert and cheerfu1 assistance of Bertha Storts was indispensable to the completion of this project as was also the advice and help of Sally Hogan in preparing the illustrations and help with the bibliography from my daughter, Catherine Reed.

Part 1

MEMBERSHIPS

A survey of the membership lists and secretaries' reports in the transactions, journals, and proceedings of scientific societies shows a substantial amount of participation by women. Two years after the American Association for the Advancement of Science was organized in 1848, Maria Mitchell and Margaretta Morris became members. In 1856 the name of Bernice D. Ames was added and in 1859 Almira Lincoln Phelps joined. This organization did not meet during the years 1861-1866. Women members rapidly increased until by 1875 there were 80 (8). (Membership lists must be taken as approximate since they depend on the accuracy of the secretary's records. Women's names, however, were almost invariably preceded by Miss or Mrs. in the early records so the identification of sex was generally possible.)

Scientific organizations recognized women for their achievements also. The American Academy of Arts and Sciences made Maria Mitchell an associate fellow in 1848, apparently in recognition of her achievement in astronomy, the first discovery of a telescopic comet (Memoirs, Vol. IX pt. 2 p xii 1848, p**.** 52). The Philadelphia Academy of Natural Science elected its first woman member, Lucy Say, in 1841. Mrs. Say illustrated her husband's volume on shells and gave a large collection of his materials including books and the original plates to this organization.

The second member elected to this prestigious group was Margaretta Morris, an internationally known entomologist, in 1859 (See Part II for Morris). By 1875 there were 26 female members a1though only the two named were members before 1861 (9).

A list of members of the Essex Institute showed the names of five women in the first group of 84 members in 1834. This Natural History Society was organized in 1833 to promote the study of natural history in Essex County and to procure a library and a cabinet of specimens (10). In 1847 this organization was joined to the Essex Historical Society and was renamed the Essex Institute. Women were "welcomed" into this society and they continued to become members of

the new group.

While the Naturalist's Directory of the Essex Institute was not published until 1866, it included the names of 25 women who were already known in the field of science by specialty. The editors had obtained the names of naturalists by sending questionnaires to known naturalists asking for the names of persons they would recommend for inclusion. Many of these 25 women must have been known for their work by 1861 to have been recommended by their contemporaries. Some of the specialties listed for these women were marine algae, ferns and medical botany (11).

Rudolph's paper on women in nineteenth-century botany lists 12 names for the years 1800-1860. Whether some of these are the same women in different years is not clear. Twenty years later he found 272. Rudolph reviewed a sample of 1,185 women's names to be found in various journals and reports for the years 1800-1900 (12).

Women were active in state agricultural and horticultural societies where they exhibited plants and animals and won prizes. In the transactions of the New Hampshire State Agricultural Society for the years 1850 to 1860 Mrs. Betsy Whitehouse and Mary Farley received prizes for the animals they exhibited and Mrs. R. L. Robinson received a prize for "transparent window shades" (pp. 127, 155, 136, year 1857).

The records in the History of the New Jersey Agricultural Society for 1781-1940 list awards to two women, Mrs. Henry Van Dyke in 1841 and Miss Margaret R. Shotwell in 1856, both of whom had woven silk fabric from silk worms they had raised themselves.

The Massachusetts Horticultural Society elected its members. For the years 1858-1875 two women's names appear. This organization was founded in 1829 but only the above membership records appear in the History, which was printed in 1880. A report on several early women gardeners is included.

In later years the membership and participation of women in these and other such societies increased rapidly until papers and essays by women were appearing in the records. The numbers of state societies of this sort also increased rapidly as the country expanded. (Eliza Lucas is known for her development of indigo as a cash crop but no good records of her methods has been found.)

DONORS

Some record keepers went into considerable detail about donors, such as Mr. S. B. Buttrick at the Essex Institute, who wrote on page 233 of the second volume of the Proceedings in 1858 that a list of 81 plants was reported by Miss Ann L. Page, "a member of a class engaged in the study of botany in North Danvers, which I had not previously seen or had reported by members of the Institute....to Miss A. L. Page and her associates. I feel much indebted for their contributions." In many cases there was no reliable way of finding out which donations were made from collections which the women made themselves and which may have come from someone else's collection. However the fact is that donations to museums, whatever their source, are important for their use in teaching and research, especially now when the study of ecological changes in the distribution of plants and animals has become more important than ever for the study of environmental changes.

Museum collections were enriched by donations from women which ranged from one or two specimens to large valuable collections. Some museums connected to institutions such as the

Boston Society of Natural History and the Philadelphia Academy published detailed lists of donors and their contributions. Sometimes these were dated by day, month and year, as in the records of the Boston Society, but other reports did not supply exact dates. From the records of seven museums for the years before 1861, one, the Boston Society of Natural History reported 23 women donors, including Dorothea Dix (111:144), and "a lady" who made the very first donation in February 3, 1841 of "two beautiful specimens of Cypraea aurantia" (the rare golden cowrie). (13, 1:5).

The somewhat incomplete records of the California Academy of Natural Sciences Vols. I - IV, 1854-1875 lists 15 or 16 women donors for the period, not dated (14).

There are 22 women donors listed for the years 1834-1836 in the Journal of the Essex County Natural History Society. Many of these donations were shells. In the Essex Institute Proceedings for 1848-1868, 122 women donors were listed, some of course being before 1861 (15). Two women donated specimens as recorded in the Transactions of the Illinois Natural History Society in Vol. 1 ser. 1 for 1861.

The Annual Reports of the New York Museum of Natural History for 1845-1876 lists the names of 9 women donors by year to 1861. One, Mrs. Ann Redfield, gave 25 specimens of Unias and Anodons (shells) from the Ottawa River. Records of the State Cabinet of New York report 2 women donors for 1847-1851 (16).

Women donors to the Museum of the Philadelphia Academy of Natural Sciences as listed in the Proceedings for 1841-1876 include 51 donors, of whom an unknown number contributed before 1861. One donor was the before mentioned Lucy Say, who can be dated before 1861. Her contribution of shells, copper plates of her drawings and the text of her husband's Conchology together with volumes on foreign shells was reported as being by far the largest and most valuable donation to the museum and library (17, Vol V.).

Many women donated books and papers to the libraries of scientific academies.

A list of women donors to the Smithsonian Institution in the Annual Reports for the years

1845-1876 lists 59 women, including Dorothea Dix who contributed a "box of minerals" (18, Vol. V:41).

The preceding list of women donors to museums is of necessity quite incomplete. Some organizations published detailed lists, some apparently none. The Smithsonian listed only "Principal Donations" (18, 7:38). Some of these donations appear to be those of persons collecting specifically for the Smithsonian, as "prepared algae" from Miss Brewer (7: 66) and two collections of reptiles, fish and mamma1s from Mississippi from Miss Teunison (Vol. 11:67; Vol. 13:6).

In addition to donors of museum materials women gave money for scientific projects. In 1851 Mrs. Blandine Dudley contributed $10,000 for a telescope in Albany, N. Y. She later added two installments of $14,000 and $50,000 for the Dudley Observatory as a memorial to her husband (19:41, 43).

The Boston Society of Natural History thanked Mrs. Binney and her daughters Mary and Emeline for their "liberal donation" in aid of the fund for the purchase and adaption [sic] of the new building. Mrs. Binney, her daughters and one other woman were listed as patrons and seven donors were listed in the next volume. Patrons were those who gave fifty dollars or more. Mrs. Binney also gave a large collection of shel1s and fossils to the museum, and books to the library. Her late husband had been president of the society (13:11, III).

By 1873 more than $125,000 had been given to Harvard University by various women and women's groups for such projects as building funds, scientific expeditions and memorials (20). A woman gave the very first donation to the young Harvard University. She was Ann Radc1iffe, Lady Mowlson, who gave 100 pounds "for the maintenance of some poor schollar" [sic], as reported in Harvard Today, Spring 1976. Many years later the "women's annex" of Harvard was named for her. The development of Radcliffe College was largely promoted by Elizabeth Agassiz (see Part II).

COLLECTORS

Many women made their own natural history collections for personal study and for exchange with other collectors. Some of these collections were later donated to museums. In the annual reports of the curators of some museums some persons credited the donor with the contribution. If the donor had given a hitherto unknown species the person was credited with finding and supplying the specimen, and in some cases was honored by having the species given her name. This was especially true of plants contributed to herbaria. Species named for women can be identified by the latinized version of her name as the second name of the Latin binomial. This second name carries the feminine Latin ending ae. Apart from the more or less sporadic records from museums there are records of some important collectors.

One of these women was Hannah Williams, perhaps the first woman collector in America, predating Jane Colden (for Jane Colden see Part II). A recent paper by Dr. Beatrice Smith presents a detailed study of William's life and correspondence. Williams collected both animals

and plants for James Petiver, a London apothecary. Four 1etters of this correspondence covering the years 1701 to 1713 are still extant in the British Museum. For details about the activities of this interesting woman see Smith's article (21).

Abigail Kimber has been referred to in several publications both as a teacher and a collector. Harshberger lists her in his Botanists of Philadelphia, in which he refers to Darlington's book Flora Cestrica for a list of plants Kimber found in her neighborhood. Several are mentioned together with the statement that he is indebted to her for "several rare plants from the vicinity of Kimberton." Some plants are listed as having been collected by her as early as 1829 (22: 167; 23: 124, 399, 424, 426).

Darlington was an important naturalist who carried on an extensive correspondence with collectors. In his book Reliquiae Baldwinianae he reports some correspondence between Dr. Baldwin and Muhlenberg. Baldwin's wife Hannah Webster Baldwin is described here as collecting insects in her "prosecution of the science of Entomology," and Muhlenberg agrees to exchange insects with her. She is also referred to as a "great botanist and entomologist." This correspondence is dated 1811 (24:31, 23).

Maria Owens from Nantucket was a teacher and an important collector of plants. She made a catalogue of the wild plants found on the island in 1882, but it records plant specimens collected before 1852 when she was 25 years old. Her catalogue lists 500 species, an important collection of historical ecological significance. She was also a teacher of botany and astronomy. Dr. Beatrice Smith has made a detailed study of the life of this many-faceted woman (25).

A western collector of the period before the Civil War was Mrs. Jane Carrington. Her collection was made the basis of a sketch of the botany of the Great Salt Lake of Utah by Elias Durand (26). Published in 1860, this article lists 46 species credited to her alone and 17 more credited to her and another collector. In one season, April to July, Carrington collected at 16 sites around the Great Salt Lake, the Wahsateb [sic] Mountains and Yuba Valley among them.

Miss Olivia Dabney in 1861 presented "to the museum a large number of specimens from all classes of the animal kingdom which she has collected on the Islands of Fayal and Picot".... These are of great value." In order to make such large collections she must have been engaged in the work before 1861. Her contributions are listed for the years 1861, 1863, 1865, 1866. Dabney's father was an official on the islands (27, 1861:35, 46, 47; 1863:36, 40, 44, 45; 1865:13; 1866:25). Mary Chase has been cited in Hanaford (2:263) as sending a collection of 300 New York flowers "thoroughly described and classified" to the World's Exhibition in London in 1859. This herbarium is listed in volume III of the official catalogue of the exhibition (28). Otherwise, Chase seems to have been known primarily as a writer. There is a biography of her by Henry Fowler, ed. Mary M. Chase and Her Writings, 1855, Tichnor & Fields.

No doubt there have been other women before the Civil Was who have made contributions to the store of knowledge in science who remain to be discovered.

TEACHERS

Mothers are often the first teachers of children. Some early elementary science books were written in a question and answer style as "conversations." One example is Dorothea Dix's

Conversations on Common Things in which the children ask questions of the mother and she supplies the answer (part II, Dix, 1). These little books were very useful, especially in places where many children did not get much schooling. Indeed, one of the arguments put forth for the better education of women was that thereby they could become better teachers of their own and other people's children.

Teachers of science are indispensable to its progress, both for the production of a new generation of scientists and for the development of an informed laity. Many of these women taught in elementary schools where they were instructors in several subjects. Others taught in the many ephemeral female seminaries and short-lived academies. These institutions often failed because of a lack of financial support but they did serve as an entering wedge of better education for women as Woody points out (6:395).

Woody lists many such institutions including small colleges but does not always indicate the sex of the faculty members or the subjects which they taught. In many sources the names of women teachers are difficult to find, the caliber of their courses is not easy to evaluate and the length of service and their qualifications for science teaching are often not known. Established academic training together with positions in established schools were seldom available for women before the Civil War.

Oberlin College admitted women in 1830 but the only history of women in science teaching in their memorial volume is two "tutors" in mathematics in 1874-75. Ripon College had one woman teacher of science, Clarissa Tucker Tracy who is listed in Who Was Who in America in Volume 1, as being an instructor in Ripon College in 1859. She also compiled a catalogue of plants growing without cultivation around Ripon. Women who taught science courses at Mt. Holyoke in the early years are listed in the History. Anna O. Edwards graduated in 1858 and taught science there the same year. Catherine Fiske taught botany, chemistry and astronomy in a school in Keene, N.H. Mary Lyon, the first president of Mt. Holyoke was well educated in science. She taught science in several schools before coming to the college. Her chief subject was

chemistry. She "became an enthusiastic teacher, performing her own experiments." Mary C. Whitman graduated from the college in 1839 and taught chemistry there from 1839-1850 (30:352; 8;356). Many graduates of Mt. Holyoke went out to other parts of the country to teach including the Cherokee Seminary at Tahlequah, Indian Territory. This school wrote to the college asking for a teacher (31:96, 97).

Some well known women educators organized their own schools. Two of these women were Almira Lincoln Phelps and her sister Emma Willard. Both were innovators of new methods, expert teachers and the writers of best selling textbooks in science. Emma Willard became famous for her Troy Seminary in New York, a school known for excellence nationwide. Willard campaigned for better education for women, and her students, like those at Mr. Holyoke, taught in many places. Phelps organized the Patapasco Seminary along the same lines. Catherine Beecher also established her own schools, traveled widely in the cause of women's education and wrote an arithmetic book. For more details on these three women see Part II under their names.

Also included in more detail in Part II are the accomplishments of six other women. Lydia Folger Fowler was a physician who became the first woman professor of medicine. She 1ectured both in the United States and abroad. Maria Mitchell taught astronomy and mathematics at Vassar College. Elizabeth Agassiz taught natural history to advanced students. Laura Johnson wrote a botanical textbook and taught at the Rensselaer Institute. Mary Swift wrote her two-volume work on natural philosophy for her own use in teaching children. Francis McDougal referred to herself as a teacher of botany and wrote a primary class book to be used in teaching. Eliza Youmans taught, wrote textbooks and published popular articles on science.

There is a great deal more to be found out about early women teachers in science. The data will have to come from much careful research in the archives of libraries and educational institutions. See Woody for an extensive bibliography (6).

ARTISTS

While many scientists illustrated their own works (drawing used to be required as part of

science courses), others employed the help of professional artists. Unfortunately, many of the illustrations in early books and journals were not signed. Illustrators of scientific works had to be knowledgeable in science as well as in art. One of these was Lucy Say who illustrated her husband's articles on shells (32, 20:37).

Maria Martin drew and painted the plants, insects and spiders in Vols. 2 and 4 of Audubon's bird series and later did the same for his book on mammals. She was a gifted professional artist who illustrated works for other scientists as well, including Holbrooks' General Herpetology (33:81-84, 96).

VOLUNTEER DATA COLLECTORS

The Smithsonian Institution, in its project to find out about weather patterns in the United States during the years 1847-1873 recruited volunteer weather observers from many different stations in the country. These observers were supplied with measuring instruments such as thermometers, barometers and rain gauges. The work was not easy, for readings were to be taken three times every day at specified intervals. Data sheets were to be filled out and returned monthly, together with other observations of the sky for clouds, meteors and storms. In 1849 one woman was listed among the observers, Mrs. Lawrence Young of Kentucky. She continued with the project until it ended in 1873. By the cutoff date of 1861 31 women had worked on this project. Other women were recruited in 1856 to help at the headquarters in collating the data. Adding together all the years these 31 observers served, the total years of this volunteer work total 175. Two educational institutions participated in this project before 1861, the Female College of Arkadelphia, Arkansas and the Cooper Female Seminary (34).

From a study of this group of women active in science, it is apparent that they were not only interested in science but that they were well grounded in the subject and competent to teach, write and pursue their own activities in the field. The records on many more of these interesting and versatile women need to be unearthed from old records in archives for women to be given credit for their contributions to science.

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PART II

Part II includes twenty-two women who published in science before the Civil War with brief life histories, an analysis of their writings and a bibliography of their works

Each person is described in a short biographical sketch which incorporates a critique of all her publications in science which would be found in the standard scientific journals, biographical and bibliographical sources and standard reference works such as Poole's Indices and the National Union Catalogue. Older publications such as Hanaford, Willard and Livermore and even Godey's Lady's Book were helpful. Comments by the writer on the contents of the women's writings are made from the perspective of a scientist and only after the original works have been read. Comments from persons contemporary with these women have been included where appropriate.

The one thing they shared was a common interest in science. Who were these women? Some were obscure, some were better known for their social activism than for their work in science, and others were professionals in the field. Some were writers, some experimenters, some teachers, some were all three. They were married or single, childless or not, well known or not, professional writers or researchers in their own back yards. There is Elizabeth Agassiz who wrote on the radiata of Massachusetts Bay and there is Dorothea Dix who published on insects. There is Almira Lincoln Phelps whose botany books sold a half million copies. Margaretta Morris studied the life cycles of insects in her own back yard and had a paper published in the first volume of the Proceedings of the Philadelphia Academy of Science in 1841. There is Mary Swift whose book on natural philosophy for children was translated into Burmese, and there is Eunice Foote, who investigated the effects of the sun's rays on the temperature of carbon dioxide gas, a concern of ecologists today, more than a hundred years later.

There is no doubt that the writings of these women contributed to Science in many ways. Papers in journals contribute to the body of knowledge in science. Textbooks of any level are essential for the development of a new generation of scientists in addition to their vital role in

teaching all students. Popular articles on science educate the non-scientists.

From the viewpoint of a scientist these writings are competent, well done publications given the scientific information available at the time. The papers were published in standard scientific journals and the books were used in school curricula and in homes as well. These women were well versed in their fields. Their writings deserve to be read and recorded in bibliographies. There no doubt is more to be learned about some of these twenty-three women, and there may be more women in this group of Science writers yet to be found. It is hoped that these data will be of use to persons interested in early women in science. It is obvious that women had an interest in scientific pursuits in this early period at a time when educational opportunities were scarce and economic and professional rewards were few.

THIS little book, long out of print, is now offered by us to teachers as one of our "SCIENCE GUIDES," because it fits very appropriately into the series. With admirable clearness and brevity, it gives in narrative form for young children a general history of Hydroids, Corals, and Echinoderms; thus rendering unnecessary a part of the work we had proposed to ourselves in connection with our late lectures on this subject. It will be found, we think, of great service where this kind of teaching is needed, and has saved us much trouble and expense in the preparation of the supplementary guide which is to follow.

For the use of the wood-cuts we are indebted to Mr. Alexander Agassiz. It is one of many favors received at the hands of the family of the late Professor Agassiz, as well as from others; all of which it will be a pleasant duty to acknowledge at some future time.

ALPHEUS HYATT.

Boston Society of Natural History.

GUIDES FOR SCIENCE-TEACHING

No. IV.

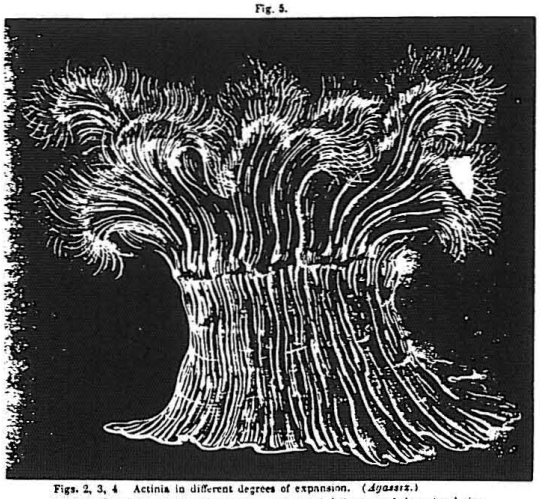
A FIRST LESSON IN NATURAL HISTORY.

BY MRS. AGASSIZ.

NEW EDITION.

BOSTON:
D. C. HEATH & COMPANY.
1886.

Fig. 5.



Figs. 2, 3, 4 Actinia in different degrees of expansion. (*Agassiz.*)
Fig. 5. The same Actinia (Metridium marginatum) fully expanded; natural size.

Elizabeth Cabot Cary Agassiz

1822-1907

Elizabeth Agassiz is much better known for her important contributions to women's education than for her less publicized writings on natural history. Mozans in his book Women in Science writes:

> But much as the women just named deserve recognition for their achievement in the various branches of science to which they have severally devoted themselves, the one who will always be specially remembered, not only for her valuable contributions to diverse branches of natural science, but also for her labor in behalf of higher female education particularly as president of Radcliffe College - is Mrs. Elizabeth Cary Agassiz, the wife of the celebrated Swiss-American naturalist (1:255).

Other contemporary writers recognized her scientific abilities. Willard and Livermore in 1897 wrote about her recounting her writings of a textbook as well as her popular articles and listed her as a "naturalist" (2:10). Meisel in his bibliography of American natural history, lists her two books (3:482-492). And a recent issue of Geology lists her as one of the forerunners of women in geology (4:493).

The main events of Elizabeth Agassiz's life are well documented. The details given below are primarily from her official biographer, Paton (5). The commentaries on her scientific writings are my own.

Elizabeth Cary Agassiz was born December 5, 1825, in Boston, Massachusetts, the daughter of Thomas Graves Cary and Mary Ann Cushing Perkins. Her childhood was spent largely at her grandfather's home, an elegant house in Boston. Because of her "delicate health" she was educated at home by a governess, but had ample opportunity to take part in the social and

intellectual pursuits of her family and friends.

She met Louis Agassiz at the home of her sister, Mary Felton, the wife of a Harvard professor. Louis was on leave from the University of Neuchatel in Switzerland to deliver a course of lectures at the Lowell Institute. During his stay he was offered the chair of natural history at the Lawrence Science School at Harvard, which he accepted. Also during this time his wife in Switzerland died, leaving three young children, Alexander, Ida and Pauline. The Agassiz's were married April 25, 1850 and Louis' three children came to join the household. Childless herself, Elizabeth mothered her three stepchildren, who became devoted to her, especially Alexander with whom she collaborated in later years.

Louis Agassiz, accompanied by Elizabeth, undertook a lecture tour to augment his Harvard salary of $1500 per year, but soon found this too much of a task for his uncertain health. As an alternative Elizabeth proposed starting a school for girls in their home. Sixty to seventy girls enrolled and paid for lectures by Louis and other professors, and Elizabeth, aided by her stepchildren took charge of the business end of the project, which ran from 1855 to 1863. Both the Agassizs were interested in the education of women and this early project was something of a precursor of things to come. One important result of these home classes was that Elizabeth became very well versed in natural history. She attended all the lectures, took copious notes and eventually developed into her husband's assistant. Louis has been quoted as saying, "Without her I could not exist."

Elizabeth's first book, A first lesson in natural history, by "Actaea" was published in 1859 (6). There were six more editions of this work, all under her own name and designated "new edition." The later ones were published as part of a series of guides for science teaching. There was also an Italian translation. The text, about sea animals and written in clear and simple language, has illustrations by her stepson Alexander, and is addressed to her niece and nephew, Lisa and Connie Felton with an acknowledgement of the "guidance" of Louis Agassiz. Perhaps the best evaluation of this book comes from Professor Alpheus Hyatt in his introduction to the

1886 edition, where he states:

> This little book... is now offered by us to teachers as one of our "Science Guides" because it fits very appropriately into the series. With admirable clearness and brevity, it gives in narrative form for young children a general history of Hydroids, Corals, and Echinoderms; thus rendering unnecessary a part of the work we had prepared to do ourselves. It will be found, we think, of great service where this kind of teacher is needed.

In 1865 the Agassizs took a trip to Brazil, primarily for Louis' health. He had been corresponding with the emperor of Brazil, Don Pedro II, with whom he shared a mutual interest in natural history. Nathaniel Thayer financed the trip and Elizabeth became the self-appointed clerk of the expedition. She kept a careful daily journal, parts of which were later published in the book, A Journey in Brazil (7). She included the text of Louis' shipboard lectures, some of his letters and descriptive footnotes, and an appendix written by him. It is a very interesting account of their travels, including a lot of the natural history of the area. Louis wrote in his appendix that, "I cannot close this book, written for the most part by another hand, without a few words as to my general impression of Brazil," thus giving his wife credit for most of the writing (7:495). This book is cited with two different publication dates, 1867 and 1869. In 1938 a Portuguese translation was published, a tribute to the continuing interest in Elizabeth's reporting of this trip.

One excerpt from this book was published in the Atlantic Monthly for March, 1866, under the title, "An Amazonian Picnic," (8). This is a rather misleading title, since the "picnic" was a three-day trip up the Amazon with overnight stays at an Indian village. It was a collecting trip for Louis and an exploring trip for the Brazilian officials who accompanied them. This article is an interesting detailed report of the trip in all its aspects, biological, political and anthropological.

During 1865 Elizabeth's book on seaside studies in natural history was published. A second edition was published in 1871, a third in 1881, and a fourth in 1893 (9). This book was dedicated to Louis and written in collaboration with her stepson Alexander; he supplied the drawings, and

she the text. It is a well written and beautifully illustrated book on the Radiata of Massachusetts Bay. This book appeared in three more editions.

According to the preface of the 1865 edition, the book was intended to be a "Manual of Natural History." It is an interesting and informative book about the appearance, behavior and 1ife cycles of the radiates, which are invertebrates such as the jellyfishes, starfishes, and crinoids. Here is an example of Elizabeth's beautiful writing style which combines aesthetics with science. She writes about a collecting trip in the bay:

> Look down, - how clear the water is and how lovely the seaweeds, above which we are floating, dark brown and purple fronds of the Ulvae, and the long blades of the Laminaria, with mossy green tufts between (9:85).
>
> She then recounts the capture of the specimens, and continues:
>
> ---we turn and row homeward. The buckets look very pretty as they stand in the bottom of the boat with the sunshine lighting up their living contents. The Idyia glitters and sparkles with ever changing hues. The Pleurobranchiae dart about, trailing their long graceful tentacles after them, the golden Melicerta are kept in constant motion by their quick sudden contractions, and the delicate Tima floats among them all (9:87).

Here is a writer whose knowledge and observational powers are conveyed in an appealing literary style. Her book ends with information about the distribution of radiates along both coasts of North America and along the Gulf of Mexico. Even today this is a work of scientific value for anyone interested in the lives of radiates or in natural history in general.

Four years later Elizabeth accompanied her husband on a dredging expedition off the coasts of Florida and Cuba. These experiences were reported in two articles in the Atlantic Monthly for October and November 1869 (10). The first one includes a report on political conditions in Cuba and a description of the activities on board the Coast Survey vessel Bibb. The mechanisms of the collection of sea specimens are explained and the organisms found are named and described. The trip was not without incident, for a severe storm came up and the Bibb went to the rescue of a schooner in trouble. Elizabeth concludes with her own thoughts on the formation of reefs and quotes from Darwin on the subject.

In this same volume of the Atlantic Monthly we find a well-written report on the topography, geology, history and plant and animal life of the Florida Keys. Her notes indicate that far from being just an observer, Elizabeth was an active participant in the exploring and collecting expeditions. A traveler to the Keys today could read this report with pleasure and profit.

A second and much longer trip was undertaken by the Agassils in 1871. This was the Hassler voyage in which the surveying vessel traveled all the way to Patagonia. On this trip the captain's wife, Mrs. Johnson, accompanied them and is mentioned in the reports made by Elizabeth from her journal records. The exploration of the Hassler glacier in the Straits of Magellan is reported in the Atlantic Monthly for October 1882 (11).

Elizabeth begins her report on the Hassler glacier by recounting where she has been on this expedition - from the West Indies to the southernmost limits of the continent, examining glaciers and plains. She describes the area around the Straits of Magellan, comparing it to the Alps. As an indication of her participation in these expeditions, here is a description of the trip to investigate the glacier:

> We climbed over and under great fallen trees, fell into holes and clambered out of them, and often took to the bed of the stream, wading through it where we could do no better. Where the river was too deep for us and very swift, we crossed on a fallen trunk, which was wet, slippery and moss-grown [sic] (11:473).

She and the others climbed up onto the smooth icy glacier on steps cut with an ice ax. One gets the picture of a very adventurous and hardy woman when reading this account. Her description of the mechanics of glaciation and the formation of moraines could be read with profit by any beginning geology student today.

Two more articles, in volume 31 of the Atlantic Monthly, are reports of this same trip, one in the January 1873 issue, on the Straits of Mage11an, and a second in the May issue on a cruise through the Galapagos Islands (l2). The first article begins with a detailed description of the Straits and a report on the appearance, behavior and activities of a group of Fuegians. A description of the fauna and flora of the beaches follows, including the details of a "picnic" of "mussels roasted on the shell, salt pork cooked on a stick and hardtack" which they shared with a second group of Fuegians (12:94). This time the ship was almost lost in a sudden storm (12:91).

The second report in this volume deals with the Galapagos. It contains beautiful descriptions of the underwater life. "---there is as gay, as tumultuous, as enjoyable a life for animals in the sea as on the land. Among the purple and green flexible coral fans, as they stirred gently with the movement of the water, were swimming bright colored fishes, sometimes singly, sometimes following each other in zigzags, as if they played a game of hide and seek between the branches...Starfishes without number and brilliant ophurians, all arms and no disks, crimson, purple and yellow, crawled over the large masses of coral" (12:579).

Elizabeth's literary style enables the reader really to picture the landscapes and the aquatic areas with their strange plant and animal life. Most of the time she accompanied the group on their land excursions, however rugged the terrain might be, and duly reported all the findings.

This article ends with a speculation about Darwin's theories about these islands.

Upon their return to Cambridge in the fall of 1872 Louis began a long desired project, a summer school of natural history on Penekese Island. In this endeavor Elizabeth took an important part in its establishment. This Anderson School of Natural History was designed primarily for teachers, many of whom were women.

Louis' health was deteriorating, and he died in December 1873. This event brought about a complete change in his wife's life. Since Alexander's wife also died at this time, Elizabeth took care of her stepson and his three young children for several years, aiding Alexander in his scientific pursuits and writing a biography of her husband. Two volumes with the title Louis Agassiz, His Life and Correspondence were eventually published (13). There were many editions of this work, including translations into French and German. For this publication she is listed as editor.

From this time on Elizabeth turned her ta1ents and energy toward the establishment of Radcliffe College for women and served as its president from its inception as the Harvard Annex in 1879 through the early years of Radcliffe College until 1899, eight years before her death at 85 on June 27, 1907. In addition to detailed information about Elizabeth Agassiz's later years, an interesting addendum has been published in the Radcliffe Quarterly for December 1978 (14).

Elizabeth Agassiz's own achievements in both science and education are exceptional. Her contributions to her husband's career are not as measurable, but none the less valuable for that. As Arthur Gilman writes in her obituary, "Mrs. Agassiz shone by no borrowed light," (15:37).

In her later years Elizabeth turned her talents and energies toward the establishment of a separate college for women. Aware of the lack of advanced training for women who were excluded from Harvard, and conscious of her advantageous position as the wife of Harvard professor Louis Agassiz, she undertook a project to improve the status of women. In the beginning she opened her home for the first school which functioned from 1855 to 1863. Classes were taught by professors from Harvard, including Louis Agassiz himself.

As the number of students increased, Elizabeth set out to raise funds for professors' salaries and four rented classrooms. This money she obtained largely from her son-in-law, Quincy A. Shaw, and her stepson, Alexander Agassiz, both of whom had made fortunes in the copper industry. Full time students paid 200 dollars tuition while part time students paid less. This institution, known as "the Annex" held its first commencement in 1883.

Elizabeth knew that in order for the "Annex" to achieve academic status it had to be put under the aegis of the Harvard Board of overseers. Her new group was not welcome for Harvard had not given a degree to women in the 257 years of its existence. Mr. E. W. Harper, the treasurer of Harvard, wrote to Mrs. Agassiz that he had no prejudice in the matter of the education of women "and am quite willing to see Yale or Columbia take any risks they like, but I feel bound to protect Harvard College from what seems to me a risky experiment. If Yale or Columbia make a success of their experiments we shall have something to guide us to a wise course in future years" (14).

Upon this refusal a Harvard law professor's wife, Mrs. John C. Gray, persuaded her husband to ask the Massachusetts' legislature to institute a separate college while at the same time Harvard would countersign and place their seal on their diplomas. Real estate and endowments would be retained by the new college and Harvard would control faculty appointments. In this way "the Annex" would become a bona fide college named for the first donor to Harvard, Lady Ann Radcliffe Mowlson.

The women students of Radcliffe College remained segregated from Harvard for many years. In time they were allowed to use the library facilities. Graduate students became integrated before undergraduates, as recently as the nineteen forties Harvard professors taught the "Cliffies" in separate classrooms on the Harvard campus. Finally reason prevailed and both sexes were taught together. However, the medical school did not accept women students until 1947.

Radcliffe College today retains its own housing for women on its campus, and keeps its own identity. In 1978 it celebrated its centennial. A quotation from the Radcliffe Quarterly for

December 1978 states "from no access to equal access." The success story of "the Annex" is a tribute to the way women working together can bring about lasting changes in the status of their sex.

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Temperance J. Burk

ARITHMETIC SIMPLIFIED,

PREPARED FOR THE USE OF

PRIMARY SCHOOLS, FEMALE SEMINARIES,

AND

HIGH SCHOOLS,

IN THREE PARTS;

ADAPTED TO CLASSES OF DIFFERENT AGES, AND OF DIFFERENT DEGREES OF ADVANCEMENT.

BY CATHARINE E. BEECHER,

LATE PRINCIPAL OF THE HARTFORD FEMALE SEMINARY.

HARTFORD:

PUBLISHED BY D. F. ROBINSON & CO.

1832.

Catharine Esther Beecher

1800 – 1878

> Professor Olmstead of Yale wrote to Catharine Beecher, "Your Arithmetic I have put into the hands of my children, giving it a decided preference over those in common use. Reflecting how I might best serve you, it has occurred to me that when your revised edition is out, I may write a notice of it ..." (quoted in 1:120).

Catharine Beecher is much better known for her work in education than for her arithmetic book, her writings on health and her innovative designs for houses and household equipment. An analysis of her contributions to women's education and her thoughts about it can be found in Woody's History of Women's Education (2). Beecher's life story has been told most effectively in Harveson (3). Beecher's own book on her reminiscences details the most significant facts of her life (4). Sklar cites a large bibliography of her published works (5), as does the National Union Catalogue (6). Beecher's belief was first, that all women should be trained as teachers because all women are teachers of their own or other peoples' children; second, that all women should be proficient in home making, and third, that all women should know how to procure and guard good health (3:183).

Catharine Beecher was born September 6, 1800, in East Hampton, Long Island, and died in Elmira, New York, May 12, 1878. Her father, Lyman Beecher, was an eminent clergyman. Her mother, Roxana Foote, was interested in chemistry, performed experiments, and enjoyed mathematical problems. She also had an Aunt Esther who was greatly interested in medical science and well read in it (4:128). Catharine's early life was one of study at home and attendance at Miss Pierce's School for Young Ladies. She began teaching at age twenty. Two years later, after her fiancé was lost in a shipwreck, she turned her attention toward a lifelong career in education. Her teaching experiences of various subjects, history, chemistry, Latin and the like had

shown her much that was wrong with women's education, including the lack of trained teachers, the need for good textbooks and equipment and the importance of dependable financial support. She devoted her life to efforts to remedy these defects by teaching, writing textbooks and campaigning for better education through lectures and articles. She founded five schools in the Midwest, one of which has survived as Milwaukee-Downer College.

Beecher's Arithmetic Simplified was her first publication, the product of years of teaching and experimentation. First published under her own name in 1832, with a second edition in 1833, both the title and the designation of the author were changed for the 1835 and 1836 editions to Lyceum Arithmetic, by an "experienced teacher" (7, 8). Beecher wrote to her friend Mary Lyon that this change was at the suggestion of her publisher who thought that her book would sell better if it was not known that the author was a woman (3:85). The 1835 copy was seen.

In the preface to her arithmetic book Beecher states that "a small work on this plan was printed some years ago, for the use of the pupils of this writer (8:viii). The book is arranged in three parts, proceeding from "all the fundamentals of the sciences" to the more minute particulars (8:vi). It therefore covers material suited to the comprehension of young children as well as more advanced material for older students. Her approach is to give reasons for particular procedures. She also gives simple definitions, as on page 22 she points out that a "thing" can sometimes be a unit and sometimes a fraction, as a cent can be a unit, one, or one tenth of a dime. These definitions of various arithmetical operations are succinct and clear, and her examples lead quickly from simple to difficult. Multiplication is taught as repeated addition - a concept that is being revived today. Her idea of numeration also is a "modern" one, for example 14 is 10 + 4.

During these years Catharine and her sister Harriet published a geography book for children. It begins simply with the child learning about its own home, town and country with definitions of boundaries, geographical features such as islands, and maps. The children are taught about latitude and longitude and their use in locating places. There is a section on physical geography, after which the remainder of the book takes up the various regions such as Asia and

Europe with simple descriptions of the customs, the flora and fauna. Interesting bits are interpolated at appropriate spots, such as storms and historical happenings with dates. The tone is conversational. Review questions appear in footnotes. There are numerous pictures plus eleven full-page maps (9).

In 1841 Beecher's book on domestic economy was pub1ished. This book proved so popular that it was published at least 17 times in various editions and revisions until 1856. The author's thesis is stated in her preface to the third edition, 1848. It holds that young girls should be taught "their profession," i.e., home making, as a branch of study similar to any other branch of study in order to give it dignity and importance as well as to make their lot easier and more agreeable. She had a great concern for women's health, both mental and physical. She realized that inefficient housekeeping contributed to health problems. Her remedy was to elevate housekeeping to a science because, as she writes, "it embraces knowledge, which will be needed by all young women at all times and in all places" (10: preface, 5, 6).

This large 382-page book with 42 engravings covers all aspects of homemaking, even including the care of yards and gardens, the cultivating of fruits including grafting, and the care of animals. The first four chapters are an overview of the subject, chapters 5 through 9 concern health, stressing the importance of good food, proper clothing and exercise. These chapters are illustrated with labeled anatomical drawings and include a description of the various bodily processes. Chapter 12 is on domestic manners, chapter 13 on "preservation of good temper in a housekeeper;" and succeeding chapters on system and order, on finances and care of domestics, and even on the "health of the mind" (ch. 17). Beecher then moves into chapters on the care of infants, children, the sick, with a last part on care of the house and a glossary (10).

Beecher's domestic receipt book, first published in 1846, was designed as a supplement for her book on domestic economy. Seventeen printings of this book are listed in the National Union Catalogue, of which some were revisions. These printings cover the period from 1846 to 1872. The facsimile reprint of the 1848 "Treatise" includes her receipt book for that year. In her preface

she states that these are well tested recipes "simply stated." This is much more than a cookbook. It contains detailed directions not only for cooking but on preserving food, diagrams of meat cuts, and an illustrated chapter on table settings, table service and the efficient use of kitchen equipment and design. In chapter 22 on the care of the sick there is a picture and description of a "water bed," in which the patient is floated on a rubber sheet over warm water in a zinc-lined tub. She proposes that this contrivance be available to be rented out to patients (11:613). She also has designs for an "invalid couch" with a movable back rest and a rocking chair on wheels (11:214, 216).

Chapter 24 in the "treatise" book is about the construction of houses. It is illustrated with drawings of house plans for several kinds of houses. It includes designs for a water system, an "earth closet" and other "domestic conveniences." Her design for a model kitchen is mentioned in a Newsweek article "Designing Women" for March 7, 1977:79. A picture of one of her houses and its floor plans can be found on p. 62 of Ms. Magazine for March, 1977. A combination of Beecher's books on domestic economy and her receipt book was published under the title Miss Beecher's Housekeeper in 1873, 1874 and 1876 (12).

Beecher wrote a similar book with her sister, Harriet Beecher Stowe. The 1869 edition did not contain recipes. It was titled The American Women's Home (13) dedicated to the women of America. Another joint book with approximately the same content called Principles of Domestic Science was published in 1870, 1871 and 1873 (14). These books were followed by a much larger edition, the housekeeper's manual which included the receipt book in 1873 and 1874 (15).

The scientific interest of Beecher is shown in her statistical study of the health of women which is included in her Letters to the People on Health and Happiness (16). These "letters" or chapters include descriptions of organs of the body with labeled illustrations, a section each on the laws of health, abuses of the body with their "resulting evils," remedies for these evils, and a section on "statistics" of female health" in the eighteenth letter, p. 121-133.

Beecher was concerned with the poor health of the female population, so she instituted a

study of the proportion of healthy women to sick ones (she found a much greater proportion of sick ones). To achieve this she collected data on hundreds of women whom she met as she traveled about visiting health spas and investigating medical treatments. Her own family and friends supplied data also. Her sister Harriet had spent nearly a year at a "water cure" spa. (For a study of hydropathic institutions which includes Harriet's and Catharine's reports see Sklar, K. K., American Heritage Vol. 26 (1):64-69; 100-101, December 1974.

This rather primitive statistical study, the defects of which Beecher herself was cognizant, was organized by her into most reliable, not as reliable and less reliable information (124-129). This study does indicate the low number of really healthy women and the problems of the less healthy, many of which were pelvic disorders, perhaps related to frequent childbearing, tuberculosis, and "weakness" or "invalidism." Many had disorders which the writer ascribed to bad diet, lack of exercise, and improper clothing. In subsequent chapters she describes these causes of poor health and her own recommendations for treatment. This book was published in 1855 and 1856.

An additional publication on health was Beecher's book on physiology and calisthenics, which combined her calisthenics books pub1ished in 1860 and 1862 with a section on physiology. This combined edition was published in 1856, 1862 and 1867 (17). The 1856 edition was seen. This book is quite similar to the first part of the "Letters" with the addition of material on the sense organs. Following this there is a 58-page portion on exercises for the chest and lungs, the muscles of the arms and hands, for the trunk and the feet and legs. There is also a section on calisthenics for a hall, including a design for the hall, and exercises to cure deformities. Boys and girls are shown together in the illustrations.

Catharine Beecher had wide interests, ranging over the entire field of women’s activities both as professiona1 teachers and as housewives and mothers. She brought a scientific approach to health with her recognition that statistical data were important. She educated her readers in physiology, not neglecting to include mental health as a necessary condition. She criticized

current practices and proposed her own remedies. Her laws of health, proper diet, exercise, cleanliness, rest, recreation and variance in routine are valid today. All her points are made with the scientific facts available to her, including observations from her own experiences. Her arithmetic book was advanced for her time. Her writings proved popular with a large group of readers because they were well written and illustrated as well as valid in their content. That her talent for architectural designs has been brought to light today indicates their interest and value for us.

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FLORA NOV.-EBORACENSIS

by

Jane Colden

A manuscript which was written and illustrated by Jane Colden during the years 1755 to 1758, it is a report on the flora of New York state at the time that this region was still a part of the British colonies. It is still in existence in the British museum in London.

JANE COLDEN

(1724 - 1766)

"The first woman in the New World to be distinguished as a botanist" is the description of Colden in the Dictionary of American Biography (1).

Jane Colden was born March 26, 1724 in New York and died there March 10, 1766. In 1759 she married Dr. William Farquhar, a Scottish physician. Seven years later, in 1766 Jane died and her only child died in that year also. Her parents were Cadwallader and Alice Christy Colden who were well educated Scottish emigrants to the New World. Cadwallader Colden had been trained as a physician in Edinburgh. Upon arriving in New York he acquired 3000 acres of wilderness west of Newburgh. Here he built an estate and became a very important figure in the colonies, eventually becoming the lieutenant governor or New York He was a man of many interests, one of which was botany. He had a fine library and conducted a wide correspondence with many people abroad.

Jane was educated by both her parents but her father instructed her in Latin, botany and the new Linnaean system of plant classification. As a result of this training and encouragement, Jane compiled a volume of drawings and descriptions of nearly 400 plant species indigenous to New York State. She investigated this heretofore unknown flora in scientific detail. She included not only the morphological details of the specimens but in addition added notes about the domestic and medicinal uses of some of the plants. She acquired tis latter information from the persons who lived in the area, including the Indians.

Colden's father sent specimens of her work to important scientists abroad, many of whom he knew and some of whom had been his guests. Thus her work became known and appreciated so much that she herse1f had personal correspondence with some of them, something quite unusual for the times (2). There is evidence from correspondence that at least one of Co1den's descriptions of species was incorporated into Linnaeus' Species P1antarum (3), an important

compendium of plant species from Europe and the New World.

There is one other printed description of a species discovered by her in 1753 which was found the next year by Alexander Garden. This description was published in the Scottish Essays and Observations (4). It may well be the first published work in science by an American woman who lived and died before the Revolutionary War. In that early time there were almost no "American" journals to which one might send a· paper.

Colden's original manuscript on the flora of New York is now in the British Museum after a journey via a Prussian forester who served in the Revo1ution to Professor Ba1dinger of the University of Gottingen, from there to the library of Sir Joseph Banks, and at last to the British Museum (5). This manuscript has been reprinted in part together with a description of her life and work by Rickett and Hall (6). This work of Colden gives evidence of her scientific talent for observing and describing plants. It also indicates her inherent interest in research which was nurtured and encouraged by her father.

Several people have written about this botanist of Colonial America. One British writer in 1895, James Britton, wrote about "Jane Colden and the Flora of New York." In this country Vail brought Colden's work to the attention of American scientists in 1907. For more details of Colden's life see her paper (7). For details about the long travels of Colden's manuscript see Smith (8). It is one of the serendipitous events of history that this original work has survived to the present day.

The renewed interest in Jane Colden is an example of the necessity of further research into the lives and achievements of other early women in science.

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EUNICE POWERS CUTTER

Fig. 36.

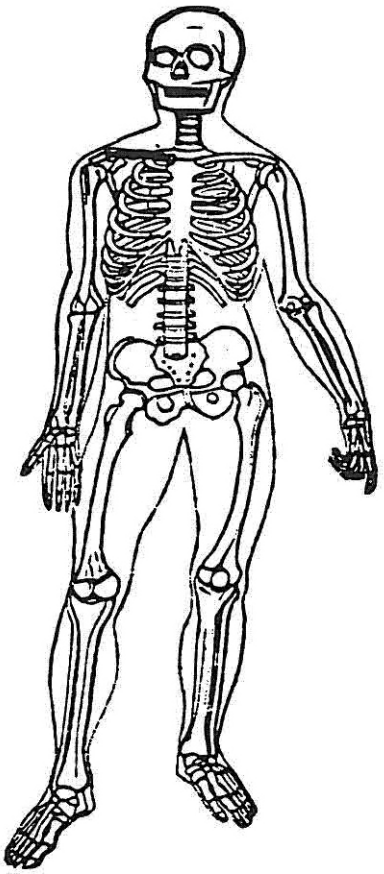

Fig. 36. Gives a fine view of a perfect skeleton, with the outlines of the soft tissues surrounding the bones, and shows the relations of each.

Let the pupil with the plate before him, point out the situation of the bones in this engraving; give their names, also a general description of each

Eunice Powers Cutter

1819 - 1892

John Nietz in his book on old textbooks cites Cutter's book in his description of early textbooks on physiology as follows:

> In 1894 a small text, entitled Human and Comparative Anatomy, Physiology and Hygiene, by Mrs. Eunice P. Cutter appeared…It was an attractive and simple one with 100 engravings. It definitely was an elementary physiology. Evidently it had considerable circulation (1:306).

Little was found about Eunice Cutter's life except that she was the wife of Dr. Calvin Cutter, a physician and a professor of physiology in "several universities." Dr. Cutter wrote 14 different books under 6 titles from the years 1846-1888, all apparently dealing with some aspect of physiology at about the college level. His wife's books on the same subject were more elementary in nature (1:306).

Eunice Cutter's first book is undated in the National Union Catalogue, but Nietz ascribes the date of 1854 to it. However, the book dated ca. 1854 in the National Union Catalogue is a revised and stereotyped school edition and follows the first citation (2,3). A third printing from the same publishers came out in 1855 (4).

The 1854 copy of her book was seen. Cutter's purpose is clearly stated in her preface:

> Its object is twofold: To teach the child something of the general structure of man and animals, with the use of the different parts, and to suggest practical hints relative to the preservation of health. 2. To indicate a method of instruction. Instruction includes reading, study, and teaching. Since profitable reading and study require the same analysis and method as clear and efficient teaching, therefore text books should be so arranged as to afford readers, pupils, and teachers an index to the

> unfolding and the necessary aid to the understanding of the subject (italics by author) (3:5).

After the introduction and analysis the book is divided into three main parts. Part I describes the nutritive apparatus and covers the digestive, respiratory, circulatory and vocal systems. Part II, The Nervous Apparatus takes up the cerebrospinal [sic] system and the sentient system. Then Part III, the Protective Apparatus, includes the osseous system, the muscular and cutaneous systems, and is followed by a review in Chapter IV. Review questions are provided after each lesson. The material is presented in straightforward statements with a question following each statement. Eight pages in the back of the book present explanations of the anatomical plates and suggestions for the teacher on how to present the material.

One can speculate that Mrs. Cutter perhaps was a teacher herself since she evinced such concern for the appropriate teaching methods, but no records were found confirming this. She writes in her preface that the book is designed for "pupils of that maturity of mind at which they can profitably pursue the study of primary arithmetic, geography, or grammar. Indeed, it can be used before geography or grammar, as it is the simpler and more interesting study" (3:5). Her book does provide considerable information about the subject and no doubt achieved its purpose in introducing children to this "more interesting study."

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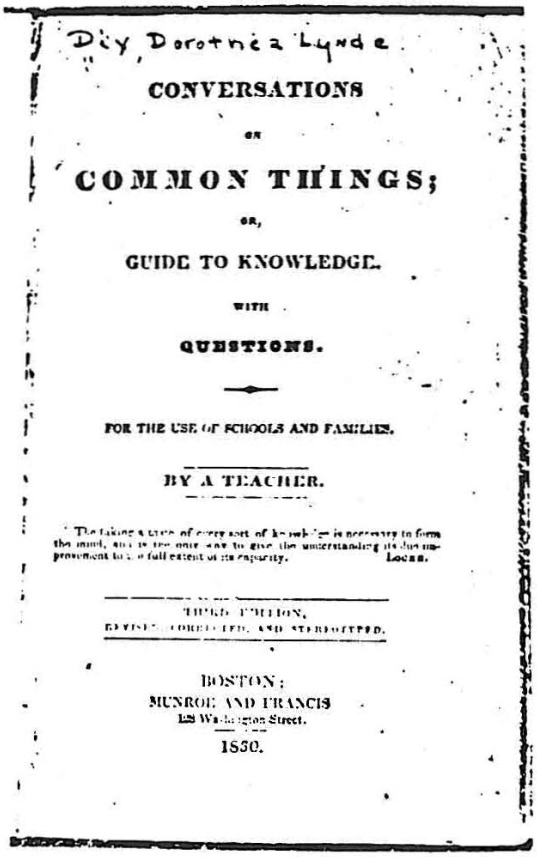


Dby Dorothea Lynde

CONVERSATIONS

ON

COMMON THINGS;

OR,

GUIDE TO KNOWLEDGE.

WITH

QUESTIONS.

FOR THE USE OF SCHOOLS AND FAMILIES.

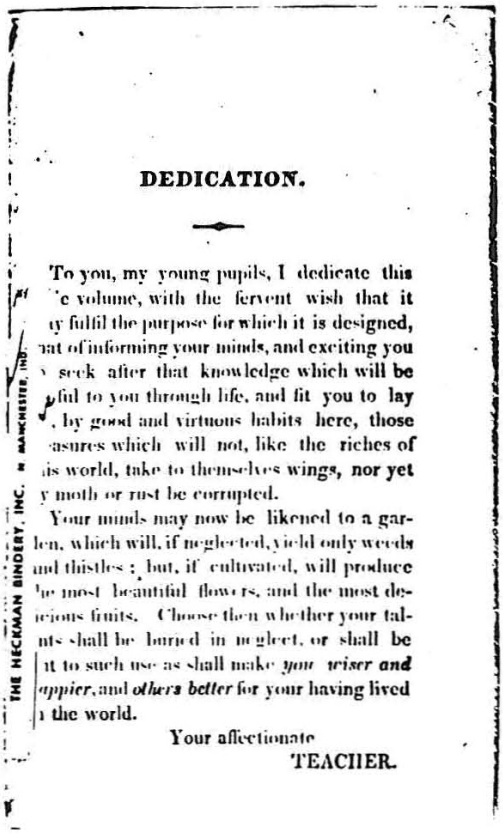
BY A TEACHER.

"To take a view of every sort of knowledge is necessary to form the mind, and is the only way to give the understanding its due improvement to the full extent of its capacity. Locke.

THIRD EDITION,
REVISED, CORRECTED, AND STEREOTYPED.

BOSTON:
MUNROE AND FRANCIS
128 Washington Street.

1830.



DEDICATION.

To you, my young pupils, I dedicate this ...le volume, with the fervent wish that it ...y fulfil the purpose for which it is designed, ...at of informing your minds, and exciting you ... seek after that knowledge which will be ...ful to you through life, and fit you to lay ... by good and virtuous habits here, those ...asures which will not, like the riches of ...is world, take to themselves wings, nor yet ... moth or rust be corrupted.

Your minds may now be likened to a gar-...len, which will, if neglected, yield only weeds ...d thistles; but, if cultivated, will produce ...e most beautiful flowers, and the most de-...cious fruits. Choose then whether your tal-...nts shall be buried in neglect, or shall be ...t to such use as shall make *you wiser and ...ppier*, and *others better* for your having lived ... the world.

Your affectionate
TEACHER.

Dorothea Lynde Dix

1802 - 1887

> "The taking a taste of every sort of knowledge is necessary to form the mind, and is the only way to give the understanding its due improvement to the full extent of its capacity."

So Dix quotes Locke on the title page of her book (1, title page). Dix dedicates this "little volume" to her young pupils, whose minds she likens to "a garden, which will, if neglected, yield only weeds and thistles; but, if cultivated, will produce the most beautiful flowers, and the most delicious fruits" (1, dedication). Such are the words of a teacher who has been most widely known for her humanitarian efforts on behalf of the mentally ill and the war wounded. But her text book on science for children, Conversations on Common Things went into 60 editions during the years 1829-1869 (2: footnote 21). Not all these editions are listed in the National Union Catalogue.

Tiffany published his Life of Dorothea Dix in 1891, only four years after her death. He had access to much original material about her, including letters and reports of friends. He described her interest in science as follows:

> "All through life, the prospect of snatching an hour from passing cares for the criminal and the insane, to devote to studying in its native habitat a new plant, new seaweed, or new shellfish, or for observing anything before unseen in a Bay of Fundy tide, or a remarkable geological formation, excited in her an enthusiasm nothing could call her off from but the cry of human misery" (2:28).

Tiffany was correct in his view for Dix wrote three papers on entomology, corresponded in scientific journals and continued to collect specimens all her life, all this in addition to her books Garland of Flora and Conversations about Common Things. Unfortunately, her journals and notebooks on natural science which are mentioned in Tiffany, (2:33), were not found in the Houghton Library at Harvard or in the American Antiquarian Society files at Worcester despite the kind he1p of the 1ibrarians William H. Bond and Frederick E. Baum, Jr., respectively.

The biographical material cited here has been derived from Tiffany who used many primary sources, and Marshall, who wrote a definitive biography of her (2,3). Dix was born April 4, 1802 in Hampden, Maine, and died July 18, 1887 in Trenton, New Jersey. Her parents were Joseph Dix, an unsuccessful business man, and Mary Bigelow, a semi-invalid. Dix's grandparents encouraged her to study, and despite a rather chaotic childhood she educated herself enough to open a dame school in Boston. In 1824 she published her elementary science book Conversations on Common Things which became a great success. In 1829 she published a three-part paper in the American Journal of Science and Arts, and in 1830 her Garland of Flora. Neither of the books carried her name as author.

Summers spent as a governess to Ellery Channing's children at Narraganset Bay and in the Virgin Islands gave her an opportunity to expand her interest in natural history. She collected plants for herbaria to be presented to her scientist friends Benjamin Silliman, John James Audubon and William Harris, a cousin (3:42). Dix taught for five years until illness finally forced her into a period of inactivity until 1841 when the cause of improving the care of the mentally ill, and later the organization of a nursing corps in the Civil War engaged most of her time and energy. However, she retained a life-long interest in natural history.

In 1824 Dix published the first edition of her Conversations. The third edition of this book was seen. Its form is that of a mother-daughter dialogue in which the daughter asks the questions and the mother replies. It fulfills its title since the subject matter is indeed about common things,

books and writing, metals, ores and coins, glass and lenses, salt, china, foods, fabrics, and many other items in its twenty-five "conversations." Review questions appear at the end of each conversation. The next to last chapter has a patriotic theme in its discussion of government, laws and liberty. The last chapter is about the history of religions with a final theme on the importance of prayer. Appropriate poems are included here and there. On page 200 the mother refers to her microscope, certainly not a common possession at the time. There is an index but no illustrations. In a list of her works at the beginning of the book there is mention of a proposed sequel to this book but none has been found (1).

This book demonstrates the wide range of information possessed by Dix. She incorporates a wealth of facts into the mother's replies to questions, much of which is scientific in nature and still valid today. For example, a question about honey leads to an answer about bee life; on ivory, to a description of elephants; on coral, to more facts about sea life; the life cycle of silk worms is included in the conversation on textiles; a question about fruits leads to a description of fruit trees, native and foreign. Dix herself taught science in her school, the Dix Mansion school, while at the same time attending lectures by Harvard professors, including Mr. Chickering's lectures on astronomy (3:28). Dix did not hesitate to use scientific terms when appropriate.

Her Garland of Flora, published in 1829 is a different kind of book. In the preface the author says, "The present work is the result of an attempt to exhibit a list of the most interesting flowers, with striking passages from the ancient and modern poets referring to them, and also, some of the more curious rites and ceremonies of which they are, or have been, either the subjects or the signs." This collection of "floral poetry" is hardly to be considered a scientific work and yet we find scattered throughout its pages informative botanical comments, such as the following:

> Many species are admirable barometers. - - The African Marygold indicates rain, if the corolla is closed after seven or eight in the morning. The common bindweed closes its flowers on the approach of rain; the Anagalis [sic] areaenses, scarlet pimpernel [sic] called in England the

> poor man's weather glass…The capsules of the geranium furnish admirable barometers. Fasten the beard, when fully ripe, upon a stand, and it will twist itself or untwist, according as the air is moist or dry (22).

In a more scientific vein Dix published a three part article in the American Journal of Science and Arts in 1830. The first part is about the appearance and behavior of Aranea aculeata, a spider; the second part of the article is about Phalaena antigua, the white spot tussock moth, which she described in detail, noting that she has not found anything resembling it "in any work on Entomology." The third section of this paper is a report on how she "reared from the egg" forty or fifty specimens through the larval form to the adult Papilio danaus. She makes a comparison of this species with that of Papilip hirundo. This paper shows her interest in and capacity for scientific investigation. In this paper she includes the personal note, "My love of natural history and constant search after objects of curiosity and interest, had enlisted in my service the gardener, and his subordinate, who never failed of bringing forthwith to my hand…[anything] that was likely to become a subject of study" (5:62).

No other scientific papers by her have been found. However, notes about her appear from time to time in scientific journals. In 1849 a report to the Boston Society of Natural History lists her as donor of larvae of Prionus unicolor and pupae of Buprestis fulvo-gutta, both from white pine trees in North Carolina (6:144). In 1850 Dix sent a "box of minerals" from North Carolina to the Smithsonian Institution (7:41). There are three notes from her in the American Entomologist for 1869. One answers a question on horse-hair worms. "Horse-hair worms are often found attached to aquatic plants in brooks or ponds in the northern and middle states, and probably also in all the states." A second note on the same page, "This remarkable caterpillar, figured in no. 12, page 27 of your first volume, was found this season, and has been found heretofore, in the District of Columbia; while the perfect insect has been secured by Dr. Eastman - the Physician of the Government Hospital for the Army and Navy" (8, Vol. 1:147). The third note is an inquiry about the proper identification of a butterfly she found in Washington, D. C. (8, Vol. 2:52). These notes

indicate that even while Dix was working in Washington after the Civil War, she was reading scientific journals and studying natural history.

The reports of the Peabody Academy of Science for 1871 and 1873 record additions to the museum by Miss Dix of a "specimen of Lipura from a Wardian case, aquatic plants from Taunton River at Taunton, Massachusetts," and "silk spun by insects infecting figs" (9, p. 95, 17). Dix's address at this time was given as Washington, D. C. Asa Gray reported the receipt of a tiny species of Mimulus leptalus from Miss Dix from "gravelly soil, in the Sierra Nevada, California, at 5,000 feet and upwards" (10:96). This collection was also reported in the Geological Survey of California Vol. 11, Botany, 1880,:564. If this last refers to Dorothea, she would have been 73 years old at the time. However, she had always been a great traveler, both abroad and at home. Considering her active life with its great interest in natural history, this is not an impossibility.

Dorothea Dix is an example of a woman whose primary work lay in other fields still retained her interest in natural history. The continuing sales of her science textbook show its continued utility for schools. The fragmentary notices of her activity which appear in different scientific journals make one wonder how much was contained in her own journals that were not found. With all her success in her humanitarian endeavors it is obvious that Dix also had an abiding interest in natural history, was well versed in it, contributed to it in her early teaching and writing, evinced an understanding of research procedures, and continued her connection with science all her life. As Tiffany says, "What she could have achieved had her indominable energy been permanently turned in the direction of natural science, it is impossible to say" (1:29).

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From: The American Journal of Science
Second Series, Volume 22, Number
66. November 1856

(first page of paper only)

ART. XXXI.—*Circumstances affecting the Heat of the Sun's Rays* by EUNICE FOOTE.

(Read before the American Association, August 22d, 1856.)

MY investigations have had for their object to determine the different circumstances that affect the thermal action of the rays of light that proceed from the sun.

Several results have been obtained.

First. The action increases with the density of the air, and is diminished as it becomes more rarified.

The experiments were made with an air-pump and two cylindrical receivers of the same size, about four inches in diameter and thirty in length. In each were placed two thermometers, and the air was exhausted from one and condensed in the other. After both had acquired the same temperature they were placed in the sun, side by side, and while the action of the sun's rays rose to 110° in the condensed tube, it attained only 88° in the other. I had no means at hand of measuring the degree of condensation or rarefaction.

The observations taken once in two or three minutes, were as follows:

Exhausted Tube		Condensed Tube.	
In shade	In sun.	In shade.	In sun.
75	80	76	80
76	82	78	95
80	82	80	100
83	86	82	105
84	88	85	110

This circumstance must affect the power of the sun's rays in different places, and contribute to produce their feeble action on the summits of lofty mountains.

Secondly. The action of the sun's rays was found to be greater in moist than in dry air.

In one of the receivers the air was saturated with moisture—in the other it was dried by the use of chlorid of calcium.

Both were placed in the sun as before and the result was as follows:

Dry Air.		Damp Air.	
In shade.	In sun.	In shade.	In sun.
75	75	76	75
78	88	78	90
82	102	82	106
82	104	82	110
82	105	82	114
88	108	92	120

Eunice Newton Foote

1819-1888

An anonymous reviewer in the Scientific American for September 13, 1856, in describing Mrs. Foote's first research paper, concludes with the statement:

> The columns of the Scientific American have been oftentimes graced with articles on scientific subjects, by ladies, which would do honor to men of the highest scientific reputation; and the experiments of Mrs. Foot [sic] afford abundant evidence of the ability of woman to investigate any subject with originality and precision (1:5).

Eunice Newton Foote was born July 17, 1819, the daughter of Isaac Newton, Jr. of East Bloomfield, N. Y., mother's name not given. She married Judge Elisha Foote, a lawyer and mathematician on August 12, 1841. She died September 30, 1888, place unknown. She had two children. The older, Mary Newton Henderson, born July 21, 1842, was an artist and writer, and a wealthy and influential woman, the wife of a U. S. senator from Missouri. Her second child, Augusta Newton Arnold, born in October 1844, was a writer, one of whose books was The Sea at Ebb Tide. Each daughter had three children (2:352-353; 3:339-340).

Foote's first paper, "Circumstances affecting the heat of the sun's rays" was published in the November 1856 issue of the American Journal of Science. A parenthetical insert states that this paper was read before the American Association for the Advancement of Science on August 23 of the same year, and a reference to this presentation was also made in the editorial review in the Scientific American. [For some reason the report of these meetings does not include this title.]

In this paper Foote describes the experiments she devised, the apparatus she used and the results she obtained. Her apparatus consisted of an air pump, two glass cylinders and four thermometers. With this equipment she could test the gases hydrogen, oxygen and "carbonic acid gas" [carbon dioxide] for temperature differences between cylinders in shade and sunlight. She

could also test "common" air in the cylinders under different conditions of pressure and humidity, and use the air sample to contrast with the other gases in the comparison tube. She tabulated her results and found that air under pressure or with a high water content became warmer in sunlight than air under less pressure or when "desiccated" by calcium chloride. When both samples were in the shade there was very little difference between them. From this she deduced that air is colder at high altitudes because it is rarer and drier. She also found the result that the cylinder containing carbon dioxide became much warmer in sunlight than the one containing air, thereby demonstrating what we call the greenhouse effect today and is a phenomenon which is of concern to us even now (4).

The writer in the Scientific American article reviews this paper in great detail, remarking that Foote's data did much to resolve a dispute then current among the correspondents of that journal, none of whom, he reports, supported their opinions with "practical experiments," and observes that "this, we are happy to say, has been done by a 1ady" (1:5).

Foote's paper on a new source of e1ectrical excitation was published in the Physics and Chemistry Section of the Proceedings of the American Association for the Advancement of Science for August 1857. [The first half of it was also published in the American Journal of Science for August 1857.] The second half failed to appear later (5: 6).

In this paper she reported experiments with a glass tube filled with different gases and attached to a gold leaf electrometer with which to measure electrical charges. These experiments were conducted over a period of eight months, and consisted of evacuating the tube and replacing the air with oxygen, hydrogen or carbon dioxide. She noted the effects of changing pressures [by the use of an air pump] and also the effects of heat and humidity upon electrical charges as indicated by the action of the gold leaves. She then hypothesized that these small-scale variations of electrical charges may be repeated on a large scale in the fluctuations of pressure and temperature in our atmosphere. Her discussion of this theory includes references to the works and theories of Becquerel, Gay-Lussac, Biot and Humboldt, indicating her familiarity with the

literature. She implies that she devised her experiments to test these theories and concludes from her results that magnetic phenomena, which are related to electrical phenomena must be connected with cyclic atmospheric changes, "aerial tides" (5).

No more papers by Foote have been found in the records, a1though she lived until 1888. Nothing was found about her early life or education. The work she did publish reveals her interest in scientific problems of large dimensions, the global atmosphere and the geologic history of the earth. It also shows that she had the attributes of a good research scientist. She proposed the problem, devised experiments, manipulated apparatus and reported all her results together with their implications. She indeed had a real understanding of the correct procedures for scientific research and the ability to use it. Whatever the reasons, her abandonment of scientific investigation resulted in a real loss to science of a gifted research mind.

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An attempt to find out something about Elisha Foote in the hope of learning more about his wife led to an inquiry about an Elisha or A. E. Foote who had been recorded as having been a chemistry professor at the University of Iowa. Our request was kindly answered by Miss Toby Fishbein, the University archivist, who found there had been no professor of chemistry at Iowa with the name Elisha or the initials A. E.

FAMILIAR LESSONS

ON

ASTRONOMY;

DESIGNED FOR THE USE OF

CHILDREN AND YOUTH

IN

SCHOOLS AND FAMILIES.

BY MRS. L. N. FOWLER.

AUTHOR OF "FAMILIAR LESSONS ON PHYSIOLOGY AND PHRENOLOGY."

ILLUSTRATED BY WILLIAM HOWLAND.

"The Heavens declare the glory of God, and the Firmament showeth his handiwork."

STEREOTYPE EDITION.

NEW YORK:

PHRENOLOGICAL CABINET, 131 NASSAU STREET.

SOLD BY BOOKSELLERS GENERALLY.

1848.

Lydia Folger Fowler

1822 - 1879

An article on the history of women in medicine in reference to Fowler concludes:

> We, therefore, must recognize the broad-mindedness and industry of Lydia Folger Fowler, and admit that the second pioneer woman to obtain a medical degree in the nineteenth century was worthy of the honor (1:44).

Lydia Fowler led a many-faceted career in medical practice, lecturing and writing. Despite her medical achievements she is better known for her association with phrenology, a pursuit in which her husband Lorenzo, his brother Orson and his sister Charlotte Wells were very active. Lydia's only child Jessie was also an important figure in the movement. While phrenology has lost its status today, at one time it was accepted by such persons as Ralph Waldo Emerson and Professor Silliman at Yale. It was taught at medical schools at Harvard, Bowdoin and Transylvania and perhaps others. Some now credit phrenology with being the forerunner of current ideas about the brain, the fact that indeed certain parts of the brain are associated with specific functions, and that it is possible to modify behaviors. For a well-documented book on the subject, including the activities of the Fowlers, see Davies (2). For a detailed popular article see Carmer (3).

Fowler was born May 5, 1822, on Nantucket Island, the daughter of Gideon Folger and Eunice Macy, and died in England in 1879. During her early years she developed an interest in mathematics and astronomy from an association with Maria Mitchell's father and her own uncle, Walter Folger, who was an astronomer and inventor. She married Lorenzo Fowler in 1844 and had one child, Jessie, born in 1856. Lorenzo Fowler was a publisher and an exponent of phrenology, then a very popular and lucrative subject. Lydia published three books before she entered medical school, one on phrenology, one on physiology and one on astronomy. Already a

lecturer and author, she entered Central Medical College in 1849 and became the first American born woman to receive the M. D. degree in her native country. (Elizabeth Blackwell was born in England.) She then became the first woman professor in medicine, teaching midwifery and diseases of women and children at her Alma Mater. Later she was a demonstrator in anatomy, and became a lecturer at the Metropolitan Medical College in New York, where she also established a medical practice. She traveled extensively and studied and lectured in Europe. The family moved to England in 1863, where she died in 1879. For a detailed description of her medical career see Waite (4).

Fowler published her first two books, Familiar Lectures in physiology and phrenology in 1847. These two books sometimes appeared separately and at other times as bound together in one volume. The physiology book was pub1ished as one volume in 1850, 1851, 1854 and 1860. The 1860 edition was bound with the phrenology text, as were the 1847 and 1848 editions. One issue was published in England but had no date in the National Union Catalogue (5:489, 490).

The 1860 edition of Fowler's physiology book was seen - this book is written in dialogue form with review questions in footnotes. The "conversations" cover the topics of digestion, bones and muscles, the skin, heart and lungs, secretion and "instinct." This last section is illustrated by comparison with these same items. There are appropriate illustrations with each chapter. The dialogue is rather sparse, most of the material being given in lecture form. The author states in her preface that it is important for children to know themselves mentally and physically and that "a correct knowledge of the laws and principles of Physiology and Phrenology is undoubtedly the most effectual medium through which this light can be obtained." The phrenology section fills the purposes of the then current "science" but of course is outmoded today (6).

Fowler's astronomy book was published in 1848 and 1850 in New York and in about 1877 in England. This book was not released to Interlibrary loan but a copy of the title page and table of contents was obtained. The table of contents lists fourteen chapters covering many aspects of astronomy. Chapter one deals with the history of astronomy and the properties of the sun. Chapter

two describes the planets. The earth is the subject of Chapter three. The moon, eclipses and tides are next, then the fifth chapter describes Mars and the asteroids. Jupiter and Saturn are the topics of Chapter six, and Neptune and its discovery the topic of Chapter seven. Comets, fixed stars and constellations are the topics of the next three chapters. The following three chapters include the subjects of nebulae, meteors, gravity, centrifugal and centripetal forces. The last chapter describes the accomplishments of such astronomers as Copernicus and Newton. There are thirty-four illustrations. Details in the table of contents indicate that this is a comprehensive text on the subject (7).

All three of Fowler's bocks were advertised in the American Journal of Insanity as follows:

> "We thank Mrs. Fowler for having prepared and published these works. Few will study them without becoming wiser and better. The first two [i.e. on physiology and phrenology] treat of subjects that are very important, though but little understood, or perhaps we should say, much misunderstood. The work on astronomy is one of the most interesting and instructive of its size that we have ever seen on this important science. We strongly commend them all (8:280)."

Waite reports that Fowler had three articles "Medical Progression," "Female Medical Education," and "Suggestions to Female Medical Students," which were published in the journal of Metropolitan College. These were not found nor were the twelve pamphlets he mentions which were composed of some of her lectures. In addition she assembled her lectures on the diseases and care of children into a book entitled, The Pet of the Household and How to Save It." This book could not be found in standard reference works. Fowler wrote on other subjects as well; "woman and her destiny," and "Nora, the lost and redeemed," on temperance. Her book Heart Melodies was a collection of poems. Waite also believes that she helped her husband with his writings. For an account of Folger's background and the times see Chapter II in E. P. Lovejoy, Woman Doctors of the World, 1957.

Lydia Folger Fowler was a person of wide interests, very closely related to the social

movements of her time. Her activities in phrenology, temperance and women's rights tend to overshadow her very considerable achievements as the first American-born woman to receive a medical degree and teach in a medical school. Waite reports that by Fowler's own estimate she had lectured on medical topics to more than 200,000 women in America over a period of more than thirty years, and he considers this work to have been her major service (4:296, 297).

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THE

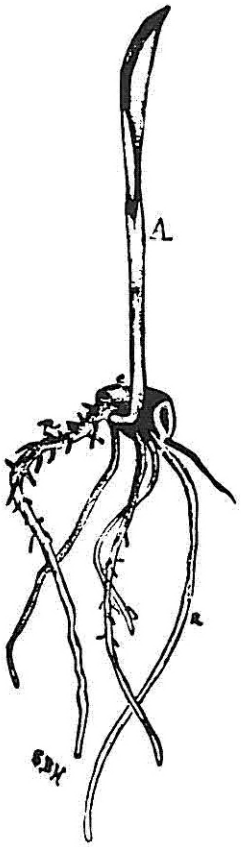
WONDERS OF PLANT LIFE

UNDER THE MICROSCOPE

BY

SOPHIE BLEDSOE HERRICK

G. P. PUTNAM'S SONS
NEW YORK 27 WEST TWENTY-THIRD STREET
LONDON 24 BEDFORD STREET, STRAND
The Knickerbocker Press
1896



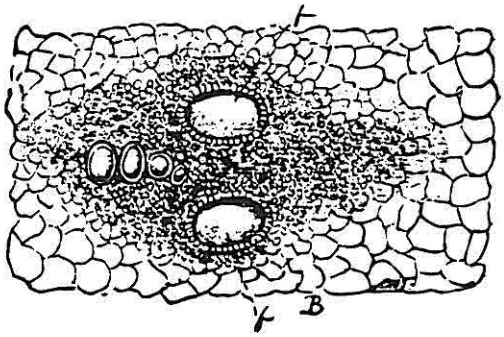


FIG. 41.
A, Vertical, and B, cross-section of fibro vascular bundle of corn.
[From Nature.]

Sophie McIlvaine Bledsoe Herrick

1837 - 1919

"Mrs. Herrick is known as a skillful [sic] microscopist, and has described her investigations in numerous articles, illustrated by herself" (1:187).

Apart from Appleton's Who Was Who in America, and a note in her father's biography in the National Cyclopedia, little was found about Herrick's personal life. She was born in Gambier, Ohio on March 26, 1837, the daughter of Dr. Albert Taylor Bledsoe and Harriet Coxe, and died in 1919. Her father was a graduate of West Point, an ordained minister, a lawyer and a teacher of mathematics and astronomy. After the Civil Was he became a journalist and editor, and was joined in this work by his daughter Sophie. No information was found about Sophie's mother, Harriet Coxe, but records show that Sophie attended Miss Coxe's school. Perhaps Miss Coxe was a maternal relative but this was not established (2:272).

Sophie Herrick was educated in Miss Coxe's school and the Cooper Institute in Dayton, Ohio. She married James B. Herrick in 1860. From 1868 to 1872 she was a teacher and principal in Baltimore. In 1875 she became associate editor and business manager of the Southern Review, and for a year after her father's death in 1877 she edited this magazine. The next year she joined the editorial staff of Scribner's Magazine and remained on the staff of its successor, the Century Magazine until 1907 (2:272; 3:555).

Her many articles on nature are well written, professional in style and copiously illustrated with her own drawings, many of which were of microscopic structures "drawn from nature." She also wrote a few articles on other subjects, mostly book reviews. She was a member of the American Association for the Advancement of Science from 1874 and was elected a fellow in 1877. A paper of hers was presented before the membership in 1874 (4, 1874:xxxiii. 4, 1877, xliv.).

Herrick was versatile enough to write on natural history at both the juvenile and adult

levels. Her paper with the charming title "Children of the Queen," written when she was nineteen, is a description of the life, anatomy and behavior of bees. Her writing style is shown in this comment on bee behavior:

> Bees have a constitutional monarchy with an elective queen, a hereditary peerage...exempt from all labor. They lord it, for a time, over a poor oppressed people, whose whole care is given to the raising and feeding the children of the monarch and the nobles (5:269).

Anthropomorphic as this is, it is an excellent description of the social organization of bees (5:268-281). This unsigned article and several other unsigned articles have been ascribed to her in Poole's Index (6:203; 107). Another article on bees, which was similar to the preceding one, was published in 1861. It, too, is written in anthropomorphic terms but the facts are there, including references to her own research on page 75 (7:73-75).

Two more articles on bees were published in 1864. The first one describes the three classes of bees, queens, drones and workers, and goes on to explain their functions in the hive. The second paper in the same issue concerns itself more with the social behavior of bees. The author recounts experiments with swarms which were performed by "bee masters." She also includes information on how bees make honey cells and how they interact with queens (8:133-135; 222-226).

A third article on bees published in 1865 in Once a Week was on the history of bee keeping in England. Included in this article is a report on her own experiences in observing bee behavior as it is related to weather changes (9:187-191).

Herrick's own experiments with bees are related in a paper "My Bees." It is primarily a description of how to raise bees, the kinds of hives, how to deal with swarms, how to transfer and winter bees. On page 629 she writes, "I am not a bee-master but a bee-scholar" (10:629-633). In all her writings on bees Herrick evinces a wide knowledge of the literature as well as an experimental approach in her own observations. (Two papers on bees which were credited to her

by Pooles were not found. One of these was listed as being in volume 15 of Every Saturday but no volume number as high as fifteen was found. In the second case, two papers listed for her in the Journal of the Franklin Institute were found by page and title but could not have been hers since they appeared in the volume of 1829, eight years before her birth.)

During this time Herrick was also writing book reviews for the Southern Review. Among these was a review of Romola by George Eliot in vo1ume 3, 1868; one on La Grande Mademoiselle for the same year; a series of four reviews in 1873 in volume 13, one on George Eliot's book Middlemarch, one on the Land of the Veda, a review of three books on India; and one on the book Corals and Coral Islands. These are lengthy well written analytical reviews. The next year she reviewed for the same journal, volume 14, four books on bees. These writings were essentially a review of the biology of bees with short references to the authors of the books. There followed reviews of the Life of Sir David Brewster, a designer of lenses, and of a biography of Mary Somerville by Somerville's daughter. In volume 15 there is a review of two books about Alexandria. These articles are unsigned also but are listed for her in Poole's. Herrick was an editor of the Southern Review at the time.

Her paper "On the organic change produced in the bee by different conditions to which it is subjected in the larval state" was presented before the American Association for the Advancement of Science at their August 1874 annual meeting. It was printed by title only in the Proceedings, either for the reason that a copy was not sent or that the committee decided not to publish the text. No report of this paper was found in the American Chemist which carried reviews of some papers presented at this scientific meeting. The title indicates that it might have included a report of her own experiments (11:149).

In 1875 Herrick wrote two papers for the Popular Science Monthly. The first was a sketch of the life of Francis Huber, a blind man of the eighteenth century who experimented on bees, especially the fertilization of queens and the "massacre" of drones. His wife was his "reader, his secretary, his observer" (12:486-495). Her second paper in this journal was on hydroids with

references to the forms found during the laying of the Atlantic cable. She describes the history of the study of the Ctnidae, their anatomy, physiology and life cycles. The work is illustrated with beautiful scratch board drawings of different species. Scientific names are used throughout (13:17-33).

An article in Scribners on another group of sea organisms, the glass sponges, appeared in this same year. This paper is similar to the one on hydroids in the extent of information presented about this group and is also well illustrated (14:42-50). (One paper on hydroids of the Gulf Stream was assigned to her by Poole's but was found to have been signed by another name.)

Herrick now began her series of papers on botany and biology which she would later incorporate into two books, Chapters on Plant Life and Wonders of Plant Life Under the Microscope. The first one of these papers, on the beginnings of 1ife, emphasizes the unity of nature, the structure of cells and tissues, and the importance of photosynthesis.

The second, on single-celled plants and algae describes their reproduction, the alternation of generations, and the structures in algae. The third article covers the structures and life cycles of ferns and liverworts. She then turns to evolutionary development in the plant kingdom, ending with the reproductive structure in flowering plants. An idea of her feeling about living organisms can be gained from her writing in volume 13, page 539. "This whole subject is, in fact, full of beauty that is indescribable. There is nothing more exquisite in all microscopy than flowers, - especially the pistillate and staminate portions of them."

Her next two articles are about the morphology and behavior of insectivorous plants, the pitcher plants and sundews. These articles are followed by one on pond life, the infusoria and other microorganisms in pond water. She reports her observations on their activities such as locomotion, food ingestion and cell division. A similar article follows on the organisms found in the globigerina ooze which was collected during the Cyclops expedition of 1867. Her continuing interest in aquatic organisms is demonstrated in her next paper on corals which she calls "toilers of the sea" and "nature's stone makers." Her report indicates firsthand observations of these

organisms, perhaps those in aquaria. She continues this study with another paper on the polyzoa with illustrations of their gross and microscopic structure together with descriptions of their complex life cycles. Two papers on insects complete this series in Scribner's, one on bees and one on ants, with special emphasis on their communal behavior (15).

Herrick's book The Wonders of Plant Life Under the Microscope was published in 1882 and again in 1896. It was composed mainly of her Scribner's articles with some additions. A mixed review of it appeared in the American Naturalist, in which the reviewer wrote "Putnam's has brought out one of the tastiest little volumes which it has been our good fortune to examine for many a day." He then goes on to criticize some of the drawings and terminology but hopes that "the publisher will authorize an early revision in which the errors will be eliminated" (17:186). The 1896 copy of this book was seen. In her preface Herrick states that in addition to her papers in Scribner's which are incorporated into this book she has added chapters on fungi and lichens, mosses, corn and its cogeners, and orchids. There are ten chapters with many illustrations of the microscopic structures in algae, leaves, stems, sections through the reproductive parts of liverworts, mosses, and ferns, pictures of pollen grains and the structures in leaves of insectivorous plants. Her chapter on plant physiology is brief but the material on transpiration, photosynthesis, growth and cyclosis is correct for the period. The book reflects Herrick's interest in microscopic structures as well as her expert use of the microscope for viewing and drawing the structures seen. It is not particularly well organized for a textbook, but it does contain a lot of useful well illustrated material for those who are interested in botany (16).

In the preface to (16), dated 1883, Herrick refers to some material in her chapter on fungi as having come from a paper "published some years ago in the Southern Review." She was the associate editor of this journal during the years 1875-1877. In these volumes there were four unsigned papers which were on her subject of biology and in her writing style. One, "The Republic of Ants," in volume 17, April 1875, pages 391-434, was a detailed review of three books on entomology. In volume 22 for July 1877 an article "The Mission of the Microscope,"

pages 61-90, was a review of two books, one on the microscope and one on fermentation. In this article there is a lot about fungi, especially yeasts, and this may well be the paper she refers to in her preface. One more paper was found, in volume 23 for October 1877, which was a review of a book, a pamphlet, and a collection of essays on biology, in pages 219-242, "The microscope in common Life." Since the articles were unsigned and the index did not 1ist authors it may be that these articles, except the one to which she refers in her preface may not be hers, although it seems very likely that they are. Poole's Index does not list them. No similar papers were found after she was no longer connected with the Southern Review.

About this same time Herrick published an elementary botany book Chapters on Plant Life which the American Book Company published. It is listed as "Botany - juvenile literature." The 1885 edition was seen. This is a children's book written in conversational style and well illustrated with 84 drawings. The sixteen chapters bear intriguing titles such as "The fairy fungi," "Flowers in fancy dress" (orchids), and "Some queer traps." She begins her book with a chapter on yeast and its growth. On page 22 a footnote describes a simple dissecting set with a magnifier with which the child can examine his or her flowerless flower garden which is the fungal growth on bread and flour paste. In her next chapter she describes Pasteur's work. In chapter four she has the children collect pond water and examine it. One chapter is about water transport. "The Thirsty Flowers;" and so this book continues, involving the children in study, albeit at an elementary level (18).

A beautifully illustrated paper on orchids was published in the Century Magazine in 1885. It includes the distribution, anatomy, physiology· and processes of fertilization in many orchid species. She visited "orchid houses," dissecting and experimenting ·with the flowers. Her article includes quotations from the works of other experimenters including Darwin (19:230-240).

A book of essays and reviews about George Eliot had an introductory essay on her "genius" by Mrs. S. B. Herrick. This book was published by Aldine in 1887. In this same year her article on Mt. Vernon appeared in volume thirteen of the Century Magazine. This paper was followed by

one in volume fourteen in 1888 on Richard Malcolm Johnson, a southern lawyer and college professor.

Turning to science again, Herrick published a book on geology in 1888. It is about the history of the earth written in a conversational style that takes the reader into the period of "Fire and water," "The Ice King at work," the "Reign of the reptiles," "The coming of man" as the chapter headings state. Herrick does not hesitate to write about the age of the earth, evolution, or "cave men." This book is a well-illustrated overview of the subject with an emphasis on the processes of geological change over a long period of time. The 1915 edition was seen (20).

The next year Herrick published a paper on pitcher plants which was a detailed study of four species, their structure, physiology and behavior (21:244-247). A critical review of a paper on pitcher plants written by her but cited as published in The Great Divide was printed in the Bulletin of the Torrey Botanical Club volume 17 no. 9:245, citing errors in labeling but also stating that there is "little information that is deceptive." Whether this paper is the same as the one cited above was not determined. Volume 3 of "The Great Divide" was not found.

In 1890 Herrick reported on a new interest, experiments with films. Her paper on her work covers the results she obtained with experiments with soap bubbles, the geometry of their surfaces and angles. She takes up the question of iridescence in films and old glass which she attributes to interference in light waves. She reports she examined the old glass under the microscope and found "a series of films of the most exquisite delicacy." It is a very interesting well researched project. In the same journal she reviews a biography of A. F. J. Plateau who himself experimented on films (22:620-632; 693-698).

Another paper along the same line but dealing with sound instead of 1ight appeared in the Century Magazine in 1891. In her comments on an article by Margaret Hughes on "visible sound," she reports Hughes experiments with lycopodium powder on liquids and gels and on vibrations produced by strings. Her comments include reports of her own experiments (23:40-44).

Herrick also compiled a book of sonnets in 1902 and wrote a book on public school

physiology with the notation that it was "persuasion of truth and science in the name of temperance in 1908." This book was not seen.

Sophie Herrick was a woman of great versatility and wide interests. She was an editor and professional writer, an artist, a microscopist and experimenter. While her topics ranged over many fields, her primary contributions lie in the fields of botany and biology. Her talents as a microscopist and artist were crucial to her achievements in writing her informative papers and books. She wrote in a fluent interesting style while at the same time she maintained the scientific content of her current work in her fields both at home and abroad. Her many publications conveyed a wealth of information about many aspects of science on both young and adult readers.

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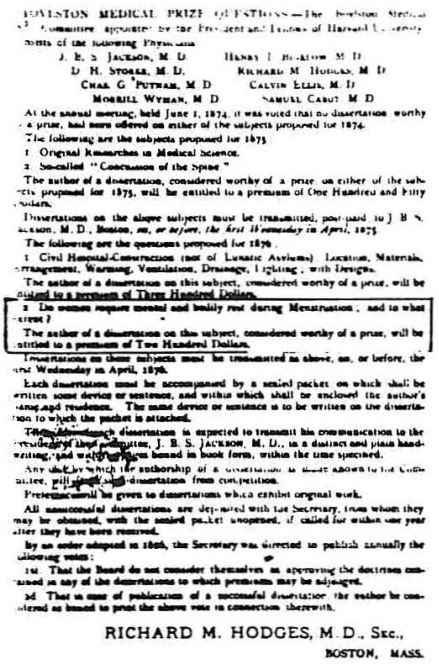

BOYLSTON MEDICAL PRIZE QUESTIONS.—The Boylston Medical Committee appointed by the President and Fellows of Harvard University consists of the following Physicians

J. B. S. JACKSON, M. D. HENRY I. BOWDITCH, M. D.
D. H. STOKES, M. D. RICHARD M. HODGES, M. D.
CHAS. G. PUTNAM, M. D. CALVIN ELLIS, M. D.
MORRILL WYMAN, M. D. SAMUEL CABOT, M. D.

At the annual meeting, held June 1, 1874, it was voted that no dissertation worthy of a prize, had been offered on either of the subjects proposed for 1874.

The following are the subjects proposed for 1875.

1. Original Researches in Medical Science.
2. So-called "Concussion of the Spine."

The author of a dissertation, considered worthy of a prize, on either of the subjects proposed for 1875, will be entitled to a premium of One Hundred and Fifty Dollars.

Dissertations on the above subjects must be transmitted, post-paid, to J. B. S. Jackson, M. D., Boston, *on, or before, the first Wednesday in April, 1875.*

The following are the questions proposed for 1876.

1. Civil Hospital-Construction (not of Lunatic Asylums). Location, Materials, Arrangement, Warming, Ventilation, Drainage, Lighting; with Designs.

The author of a dissertation on this subject, considered worthy of a prize, will be entitled to a premium of Three Hundred Dollars.

2. Do women require mental and bodily rest during Menstruation; and to what extent?

The author of a dissertation on this subject, considered worthy of a prize, will be entitled to a premium of Two Hundred Dollars.

Dissertations on these subjects must be transmitted as above, on, or before, the first Wednesday in April, 1876.

Each dissertation must be accompanied by a sealed packet on which shall be written some device or sentence, and within which shall be enclosed the author's name and residence. The same device or sentence is to be written on the dissertation to which the packet is attached.

The successful dissertation is expected to transmit his communication to the President of the Committee, J. B. S. JACKSON, M. D., in a distinct and plain hand-writing, and will be required to have it bound in book form, within the time specified.

Any disclosure by which the authorship of a dissertation is made known to the Committee, will exclude such dissertation from competition.

Preference will be given to dissertations which exhibit original work.

All unsuccessful dissertations are deposited with the Secretary, from whom they may be obtained, with the sealed packet unopened, if called for within one year after they have been received.

By an order adopted in 1865, the Secretary was directed to publish annually the following votes:

1st. That the Board do not consider themselves as approving the doctrines contained in any of the dissertations to which premiums may be adjudged.

2d. That in case of publication of a successful dissertation, the author be considered as bound to print the above vote in connection therewith.

RICHARD M. HODGES, M. D., Sec.,
BOSTON, MASS.

WITH THE
COMPLIMENTS OF THE AUTHOR

FOR

WOMEN DURING MENSTRUATION

BY

MARY PUTNAM JACOBI, M.D.
PROFESSOR OF MATERIA MEDICA IN THE WOMAN'S MEDICAL COLLEGE, NEW YORK

THE BOYLSTON PRIZE ESSAY OF HARVARD UNIVERSITY
FOR 1876.

ILLUSTRATED

NEW YORK
G. P. PUTNAM'S SONS
182 FIFTH AVENUE
1877.

Mary Corinna Putnam Jacobi, M.D.

1842-1506

Dr. Jacobi in her article on the practice of medicine by women quotes those opposed to women doctors in these words:

> These ask not, "Is she capable?", but, "Is this fearfully capable person nice?" Will she upset our ideal of womanhood, and maidenhood, and the social relations of the sexes? Can a woman physician be likable? Can she marry; can she have children; will she take care of them? If she cannot, what is she? "Qu'est ce qu'une femme," said a French journalist in this connection "qui n'est ni èpouse ni mère?" (1:5252).

As a matter of fact Mary Putnam Jacobi was not only a capable physician in the widest sense of the word but was also "qualified" in being both a wife and a mother. The facts about both her professional career and her other activities are documented in two very different biographies. One of these, edited by Ruth Putnam, portrays her varied interests and experiences chiefly in her youth and during her life as a medical student in Paris, with many excerpts from family 1etters. The second biography, edited by the Woman's Medical Association of New York City, is almost exclusively concerned with her professional career in medicine. Twenty-three of her articles on medical subjects are reprinted in this volume together with an outline of her activities and memberships, and an extensive bibliography of her well over a hundred publications. These two books taken together give a well-rounded picture of this important pioneer in medicine. The biographical data presented below are compiled from these sources (2,3). The research aspects of her professional life will be emphasized here including reviews of some of her primary research papers.

Mary Corinna Putnam was born August 31, 1842, in London while her American parents were abroad on a business trip. Her father, George Palmer Putnam was the founder of the

publishing firm of G. P. Putnam's Sons. Her mother was Victoria Haven, who was Mary's first teacher and mother of eleven children. In 1873 Mary Putnam married Dr. Abraham Jacobi, a refugee physician from Germany and a leading physician in New York. They had three children, only one of whom, a daughter, Marjorie, later Mrs. George McAneny, survived to adulthood. Putnam died in 1906 of a brain tumor.

In 1863 after attending a girl's school and having some private tutoring in Greek, she completed two courses at the New York College of Pharmacy and a course of lessons in science. She then went south to nurse her brother who was a soldier in the Union Army. While there she sent a series of letters on Army life and the south to the New Orleans Times and the New York Evening Post. In 1864 she returned to receive her medical degree from the Woman's Medical College of Pennsylvania. There followed an interlude when she again left home to nurse a sister ill of typhoid and to do some tutoring. At this time she wrote a series of articles for the New Orleans Times under the name of Mary Israel (2:83).

In 1866 at the age of 24 Mary Putnam sailed for Paris for advanced medical training. She was the first woman to be admitted to the Ecole Medecin where she passed her examinations with "Très satisfait, vous avez fait très bien," and wrote her thesis entitled "De la Graisse Neutre et de les Acides" (2:184; 3:551). This medical training was interrupted for a time because of the involvement of Paris in the Franco-Prussian war. An insight into Mary's adventurous spirit can be seen in her reply to a letter urging her to return home. "I confess that the siege of Paris and the interests of the Republic presented a paramount attraction to me - I would not have missed the occasion for anything in the world (2:275). These letters to her friends and relatives give an inside picture of what life was like in the medical community and in the city of Paris itself.

In addition to her letters to her family, Mary Putnam sent back a series of reports on medical events to the Medical Record. These "letters," signed P.C.M. consisted of 19 reports on the medical events and procedures which she witnessed in Paris during the years 1867-1870. Her knowledge, keen observation and her literary ability combine to make these detailed reports

valuable not only at the time, but even today as a historical record of developments in medicine. They cover a period when Pasteur's germ theory was being debated, when surgical procedures were being developed and when experiments with drug treatments were being made.

Upon her return from Paris the well trained Dr. Putnam began her medical practice in New York City where she also began to teach materia medica and therapeutics at the Woman's Medical College. At the same time she continued her writing career with many reports on medical topics to several journals. By the end of her lifetime these amounted to well over a hundred papers, together with other publications as a writer and editor.

A real coup for Mary Putnam Jacobi was her Boylston Prize Award for her essay on menstruation. These essays were submitted anonymously and it is of some historical interest that this award went to a woman from a university which was not to admit women to its medical school until 1945. According to Walsh in her essay "The Quirls of a Woman's Brain," Jacobi was urged to enter the competition by friends because one of the topics was to be on menstruation (4:118). At this time many objections were raised to the entrance of women into advanced study and professional life because of the popular notion that this normal physiological process was at least debilitating and at most quite incapacitating, not to mention adversely affected by strenuous mental effort.

In this essay, which is really a book, Jacobi covers the historical attitudes toward menstruation and then goes on to report the results of her own research and the theories which she derived from her data. From 1,000 Questionnaires she sent out she received 268 replies. Her respondents were asked their age, marital and reproductive status, occupation and amount of education, and their evaluation of their own menstrual discomfort. Fifty-three percent of these women had no problems, 46 percent reported varying amounts. Her data revealed that there were more menstrual difficulties associated with women who took little exercise and who had received little education.

In a second part of her research she made a series of studies on a group of women for 31

months, making daily measurements of pulse rate, temperature, urea in urine, sphygmographic tracings of the radical artery and strength tests with weights and a dynamometer. Her data were summarized in many tables and graphs. She realized that there were changes associated with the menstrual cycle which she categorized as "pregnancy in miniature." She felt that appropriate diet and exercise could be helpful and came to her final conclusion that "There is nothing in the nature of menstruation to imply the necessity, or even the desirability, of rest, for women where nutrition is really normal," (p. 5, 227), and on the next page she refuted the commonly held ideas of needed "mental rest" and the "temporary insanity." This publication shows the results of a well thought out study with research documentation of a basically normal physiological process in women, which had been popularly and professionally thought to be incapacitating for nearly, if not all women.

Jacobi's interest in research in medicine continued all her 1ife, keeping pace with the changing focus of medicine, from drugs and surgery to the use of electricity and mental therapy. Examples of her papers are described below. She was well versed in the literature and conducted her own research.

Some of her research involved the use of animals. In a two-part paper on atropine she first recounts the current theories, and then goes on to report her own experiments on rabbits (6:249-254; 273-278). Another paper which includes this kind of research was on the action of nitrate of silver which she tested on the excised mucous membranes of rabbits and humans and on the stomachs of rabbits and dogs after ingestion (7:251-264). Her reports of such experiments brought criticism from antivivisectionists which she answered in a letter to Century Magazine (8:157-158).

The use of the sphygmometer to make tracings enabled her to study other actions of the body. When a ten-year-old boy was brought in with a portion of his brain exposed after a fall, she used the opportunity to use the instrument to measure pulsations of the brain under various conditions of treatment, making a control trace and then making tracings after the administration

of atropine, coffee, brandy, tartar emetic, potassium bromide, quinine, and belladonna, and after exercise and a full meal. She used these data to draw conclusions about intracranial pressure and its source, as related to blood pressure, pulse rate and condition of the blood vessel walls (9:103-112).

In a second paper using the same technique she investigated the effect of pain on the pulse trace. She used a human subject undergoing dental treatment and found that pain slackens the pulse rate by inhibiting the action of the cardiac ganglia (10:51-62). Two papers of a psychological nature appeared, one on hysterical fever, an account of a patient who had no discernible cause for the fever and became well during "months at the seashore" (11:373-388). A second paper along this line was on hypnotism in which she theorizes that events are recorded in the brain and never last. She takes up the uses of hypnosis to make pain disappear, even in childbirth (12:485-489).

Jacobi's interest in woman's physiology led her to a series of articles on endometritis. After a preliminary paper on the subject in the Boston Medical and Surgical Journal, Volume 110, she wrote a series "Studies in Endometritis" which was published in the American Journal of Obstetrics, in which she goes into the subject in great detail starting with a comprehensive review of the theories and practices and continuing with the anatomy, physiology and cytology of this disorder. She then moves on to the physiology of menstruation and of the parturient cycle. The final article is on ovarian disease. These papers have many illustrations, mostly of microscopic preparations (13).

Dr. Jacobi continued her long active career of writing, lecturing and practicing medicine until she succumbed to a meningeal tumor and died at age 64. It is doubtful that all of her published papers have been listed in bibliographies because of the wide range of her interests and the various journals in which she published.

Mary Putnam Jacobi was a woman of wide interests which embraced not only the practice, teaching and research in medicine but included women's rights, the advancement of women in

medicine and even the proper education of children, on which topic she engaged in a written dialogue with Eliza Youmans on the use of botany in the teaching of children in the pages of Popular Science Monthly (14:342-352). In 1889 she published a small book on the education of children (l5). The Torrey Botanical Club listed her in their Botanical Directory for 1873. Many of her early newspaper articles and some of her later writings have not been documented as far as this writer could determine. There are even discrepancies among the published bibliographies of her many medical papers, which ranged from letters, reports of speeches, and short case histories to long reports on specific medical topics.

Dr. Jacobi was a gifted energetic woman who brought her abilities to full use in her chosen field. Much better educated than many of her contemporaries in medicine, she campaigned for higher standards, particularly in defining the roles of young women students. She was outspoken in her opinions as seen from the dedication of her thesis to the "one man" who permitted her to enter the Ecole Medicin to her comments in a letter to Dr. E. T. Edes that the female invalidism seen "in the present century" was due to "a swarm of nervous disorders "due to the increased attention paid to women, and especially in their new function as lucrative patients" (16:175).

It is well that her many contributions to medical practice and to her advancement of women physicians as teacher and mentor have been so well documented in medical literature. At the end of her life she documented her own fatal illness. Under the title "Description of the early symptoms of the meningeal tumor compressing the cerebellum," (the disease from which the author died), written by herself" (3:501-504). The article was written in 1903 and she died three years later.

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L A U R A H . J O H N S O N

21

Laura H. Johnson

ca 1798 - ca 1870

A tribute to Laura Johnson's teaching ability came from a former pupil, the Hon. Norman Stratton, who referred to her in an address at the celebration of the centennial of the Rensselaer Institute where she had been a teacher.

> I studied botany at this institute under the teachings of a lady professor. I refer to Miss Johnson, whose love of that science enabled her to clothe her teachings with a beauty of expression which the lapse of time has been unable to efface (5:90).

Laura Johnson was the daughter of Benjamin and Alice (Smith) Johnson of Middletown, Connecticut. No specific birth or death dates were found for her. However, in McAllister' s bock on Amos Eaton, a letter of Eaton's written in 1833 is quoted as referring to her as "an old maid school mistress of 35 years" (1:233). This would give her an approximate birth date of 1798. She was a sister of Eaton's wife and lived with them for some years (1:57). Part of this time she was a student at Troy Female Seminary.

Johnson was something of a protégée of Eaton's. He encouraged her to teach and to write her book "Botanical Teacher" to accompany his own manual on botany, and described it to the publisher, writing "I declare it the best book for common School exercises in botany as has appeared in any language· and assured the publisher that "It is perfectly sure in ready sales" (1: 234). He a1so defended it from a derogatory review by Asa Gray which appeared in the American Journal of Science and Arts. Gray's review ends with the statement ... "but when young ladies write, and learned professors supervise such books as that before us, we are reminded of the title of a chapter, we believe in Fielding, "showing that an author writes all the better for having some knowledge of the subject of which he treats" (2:185). This blast brought a rather moderate reply from Eaton in the same volume defending the organization and contents of the

book (2:377, 378).

Johnson's book, "Botanical Teacher" appeared in two editions, the first in 1834 and the second in 1840 (3, 4). In her preface the author acknowledges the help of Professor Eaton as follows: "In regard to the preparation of this treatise it is proper for me to make several acknowledgements. Though the labor is my own, the plan of the work was suggested by Professor Eaton. He supervised it also at every step of its progress; and directed me in the selection and use of authors. Most of the proof-sheets were revised by him, and some important additions and corrections were thus introduced."

The book itself was dedicated to the Hon. Stephen Van Rensselaer, L. L. D. March 10, 1834. The dedication explains her reason for writing the book. "I could not resist the desire to enter as an under actor in the fascinating exhibitions of the natural sciences. I have therefore labored intensely, more than a year, in preparing this auxiliary treatise. I have endeavoured to adapt it to the economical character of American parents and guardians; and to facilitate the progress of the young in one of the departments of knowledge, to which you have devoted much wealth and paternal care" (2: preface).

Johnson states that the purpose of the book is to identify plants that have been collected and prepared for herbarium specimens. This is to be done by observing the parts, and the nature of them, and of the plant as a whole, and then finding it in the descriptive list of genera (4:4). She includes helpful directions for teachers on how to proceed, even supplying a detailed introductory "lesson" for them. She emphasizes the importance of starting with fresh specimens and stated her own feeling about the subject of botany as follows: "There can be no such thing as a lazy botanist; and an unhealthy botanist or a botanist of feeble health, is almost a paradoxical expression. The daily exercise in collecting plants, and the mental exercise in studying them, seems, by experience, to secure health and cheerfulness, until we arrive at that stage in our existence when life must downward tend; should omnipotence offer me one wish, it would be - let every individual of our race study his works; particularly the vegetable kingdom. Society

would then be almost perfect" (4:15).

The material covered in the second edition is quite extensive. In addition to directions for teachers it covers plant structures (with illustrations), something of plant physiology, and lists descriptions of the classes, orders and genera of plants. There is also a glossary of technical terms and an index.

Eaton directed the botanical work at the Institute and taught at both Emma Willard's school in Troy and at the Institute. McAllister (p. 487) reports an announcement by him "Ladies of all ages, who are well taught in common English studies, will be instructed in Practical Botany, in a room near the Institute, by the authoress of the Botanical Teacher. Her pupils will have the advantage of that experience and precision in the science, for which the Institute has long been distinguished. Call on Miss L. Johnson, at Professor Eatons' house." A year later Eaton announced that Laura would continue her work. "Miss Johnson will continue to have charge of this department; but the course of instructions will be under the supervision of Professors Eaton and Hall" 1: 487)

A tribute was paid to Laura Johnson by a former student, the Hon. Norman Stratton of the class of 1838 in an address printed for the semi-centennial celebration of the Rensselaer Polytechnic Institute (5: 89, 90). He makes a plea for the extension of such schools and for the inclusion of women; and hopes that "the time is not far distant when every school, every profession, every enterprise, will have all gates and bars removed, and access thereto be open to all, without restriction to sex. I know of no harm that could come to this institute by admitting ladies as students. I studied botany at this institute under the teachings of a lady professor. I refer to Miss Johnson, whose love of that science enabled her to clothe her teachings with a beauty of expression which the lapse of time has been unable to efface."

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ANALYTICAL

CLASS-BOOK OF BOTANY.

Designed for Academics and Private Students.

IN TWO PARTS.

PART I.

ELEMENTS OF VEGETABLE STRUCTURE AND PHYSIOLOGY.

BY

FRANCES H. GREEN.

Frances Harriet (Green) Greene (McDougall

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Illustrated by a Compendious Flora of the Northern States.

BY JOSEPH W. CONGDON.

Science is only the interpreter of Nature

NEW YORK:
D. APPLETON AND COMPANY, 346 & 348 BROADWAY
LONDON: 16 LITTLE BRITAIN.
1855.

Frances Harriet (Whipple) Greene McDougall

1805 - 1878

> Having been for several years a teacher of botany, I have had considerable opportunity of experimenting on the happiest means of imparting this delightful science. The Primary Class-Book of Botany (one of the present series), is intended to supply this great want of a Common-School book, which shall be at once clear, simple, and thorough in its details, so as to render the science attractive without diluting it.

So wrote Frances Greene McDougall about her book which was published in 1854 (l:iii).

Few biographical details about the 1ife of this author could be found. Even the spelling of her name is sometimes changed from Greene to Green. Her own preface describes her as a teacher of botany, but she was a prolific writer on various subjects. In addition to her botany book and editorial work she is credited with 31 other listings in the National Union Catalogue. These titles show biographical works, poems and stories (2, vol. 350:276-278).

Her first botany book, published in 1854 was under the name of Green. This book was published again in 1855, 1856, 1857, and 1859. The 1854 edition was seen. There are 33 chapters which cover all aspects of plant anatomy from cells through the structures of roots, stems, leaves and flowers, with the two final chapters on the geographical distribution of plants and their economic value. There are 29 full-page plates inserted at appropriate places in the text. Part II, by Joseph Congdon, is a flora with a glossary and two indices to classes, orders, and genera, one for Latin names and one for common names (1).

Apparently her own "Part I" was also issued separately, since two listings for 1855 and 1856 do not include the name of Congdon and have a slightly different title (3).

McDougall is also listed as an editor of the "Young People's Journal of Science, Literature

and Art" on the title page of volume 1 no. 1 for November 1848. In the foreword to this issue she is described as "Mrs. Green is one of the most brilliant writers in this country and is pre-eminently qualified, by her scientific attainments…for the position she is to occupy." In the preface to this journal it is stated that its purpose is to "combine the gems of Science with the flowers of Literature and Curiosities of Art [sic]. " The editor proposes three departments, the first being physical science, the second or literary department including papers on archeology and political economy, sketches of travel and biographies of eminent persons, history, short orations and poems. The third department will have papers on the fine and useful arts, inventions and great discoveries, and in addition, a synopsis of the history of the world. The first object was to institute it as a reading book in school (4, title page and foreword). No later issues were listed in the Union List of Serials, so this enterprise apparently did not continue. A copy of the first issue can be found in the Worcester Antiquarian Society Library (5, vol. 5:4582). The fate of the journal of which she became a joint editor is unknown. It certainly was an ambitious project.

This writer's book on botany was comprehensive, clearly written and seemed to fulfill her requirements as she stated them in her preface. It was quite successful, going into several printings and one revised version.

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Wm. Mitchell

Eclipse of 2 mo 1831

Time by clock Beginning	11..58.14
Formation of ring	1.29.35
Rupture of ring	1.31.17
End of the Eclipse	2.55.42
Duration of ring	1.42
Duration	— — —

Clock too fast 3′.7″

Mean Time corrected

	h ′ ″
Beginning	11.55.07
Formation of ring	1.26.28
Rupture of ring	1.28.10
End of eclipse	2.52.35
Duration of ring	1.42
Duration of Eclipse	2..57.28

12
11.55.07
.04.53
2.52.35
2.57..28

This time was noted by me; I was $12\frac{1}{2}$ years old. M. M.

Maria Mitchell

1818 - 1889

One of the best known of the early women in science was Maria Mitchell, astronomer and mathematician, Vassar professor and activist for women's rights. Professor Everett of Harvard, in writing of her discovery of an unknown comet at age 29, describes her as "A lady, industrious, vigilant, a good astronomer and mathematician" (1:385). Her successful professional career shows a woman who seems to have been born the right person in the right time in the right place.

Several biographies of her have been written including one by her sister, Phebe Kendall. The one written by Phebe Kendall, Maria Mitchell, Life, Letters and Journal, includes the correspondence about the Danish award in the appendix. Another book, Sweeper in the Sky by Helen Wright has a list of her honors and awards on page 240. For a chronological outline of her career see the 63 Annual Report (1964) of the Nantucket Marie Mitchell Association. A scholarly paper by Kohlstad on Mitchell's activities on behalf of women in science can be found in the New England Quarterly Vol. 51 no.1: 39-63. The information about her career which is presented here has been derived from Professor Mary Whitney's memorial paper and from Henry Mitchell's obituary. Whitney's paper was written from the standpoint of a professional contemporary and long time associate. Henry Mitchell, Maria's brother, wrote her obituary for the American Academy of Arts and Sciences. Both these papers contain more details about her scientific life than do some of the longer biographies (2,3).

Maria Mitchell was born August 1, 1818 in Nantucket, Massachusetts, the third child in a Quaker family of nine children. She died June 28, 1889 in Lynn, Massachusetts. Her mother was Lydia Coleman "a woman of fine intelligence and literary tastes" (2:13). Her father, William Mitchell was first a teacher and later a bank clerk, but his primary interest was in astronomy. He was employed by the U. S. Coast Survey to survey the island of Nantucket. Later he became the rater of chronometers for the 92 whaling ships that put into the harbor there. This work

necessitated the making of astronomical observations for which he had several instruments, including a telescope. Maria grew up in this environment both at home and at school. Navigation was studied by both boys and girls and Henry reports that in this town even small children learned to "box the compass in the Monthly Meeting School in place of the catechism" (3:331).

Early in life Maria began assisting her father in his observations, including that of an annular eclipse of the sun. Her facsimile record at age 12 is reproduced in Henry's obituary of her on page 332. She showed great mathematical ability and pursued her studies first with her father, then with Cyrus Peirce and finally by herself after she became the librarian for the Nantucket Athenaeum at the age of 18. This library had an unusual collection of important books on mathematics and astronomy.

At this time Maria's father had a telescope on the roof of an adjacent bank where the two of them could continue their observations. This spot became a well equipped observatory with a second telescope and several other instruments, some of which were loaned to them by the Coast Guard for use in supplying data for government surveys. Thus their observatory became designated as one end of a great arc used to determine the figure of the earth. In addition to their routine observations the father and daughter moved into systematic studies of double stars and nebulae in 1854.

Maria had found several comets in the course of her observations and had calculated their orbits. While these were unknown to her, they had been observed before and reported by other astronomers. However, in 1847 she found a comet which turned out to have been a previously unknown one. This qualified her for the gold medal which had been offered by the King of Denmark to the first discoverer of an unknown comet. Maria Mitchell became a celebrity at age 29 and her feat brought about her election to the prestigious American Academy of Arts and Sciences in 1848.

Other awards and memberships followed. An interesting description of "Miss Mitchell's

comet" can be found in Section V of Elias Loomis' book of 1856, Recent Progress in Astronomy. In 1847 a notice about Mitchell's comet appeared in the Monthly Notices of the Royal Astronomical Society, and in it her own calculations of its orbit were published a year later (4).

In 1849 Maria was asked by the superintendent of the U. S. Coast Survey, Professor Bache, to join the astronomical party in Maine to take part in a survey of the coast. In this same year she was appointed a computer for American Ephemeris and Nautical Almanac. Her assignment was to compute the positions of the planet Venus for the astronomical ephemeris for the meridian of Washington. This office she held for 19 years. Her calculations were incorporated into nautical tables and do not appear as separate publications under her name.

Mitchell went to Europe in 1853 as a companion to a banker's daughter. She was received with honor by foreign astronomers including the Herschels, Sir John Airy, (the Astronomer Royal), Leverrier in France, Humboldt in Germany, and was even given access to the ecclesiastical observatory in Rome, the first woman to be so permitted. Upon her return Maria received a gift of an equatorial telescope from Elizabeth Peabody "representing the women of America" (3:339). She made a second trip abroad in 1873.

After her mother's death she moved with her father to Lynn, Massachusetts where they set up a new observatory to continue their work. However, in 1865 Mitchell was offered the position of professor of astronomy at the newly founded Vassar College, which had a well-equipped observatory, so Maria moved there with her father. She proved to be an innovative teacher who required high standards of academic excellence from her students while at the same time involving them in her own research projects. Her interest in education is reflected in a pamphlet she published in 1881 on the collegiate education of women. For other work of hers in the field of education see Kohlstedt's paper mentioned above.

A whole new career opened for her at Vassar. Her first project was to establish the exact latitude and longitude of her observatory. This had to be achieved before accurate astronomical

observations cou1d be made from that spot. She then taught her advanced students how to calculate the monthly positions of the planets. These data were sent in to the Scientific American as a monthly column for several years. At times observations on sunspots and other phenomena were included in these reports (5). Mitchell was interested in sunspots and later introduced photography as an aid to their study. (She was a pioneer in the use of photography for sun spots.) Her students were encouraged to observe all kinds of astronomical events, meteor showers, transits of heavenly bodies and eclipses. In 1869 and 1878 she tock several students to observe eclipses of the sun.

Mitchell's report on the "Elements of the Comet" was published in 1848 (4). A long report on the U. S. Coast Survey was written by her and published in 1852. This is a well written detailed paper on the history of the Coast Survey, the measurements needed and the instruments and procedures used in the one she took part in to determine the coastline from Maine to Rhode Island. Anyone interested in the problems involved in surveys of a coast line would find this paper informative (6:77-96) .

A letter to the editor of the Astronomical Journal in 1856 reported her observations on the minima of Algol for the years December 1853 October 1856. (Algol is an eclipsing variable star of considerable interest to astronomers.) Short reports like this give no indication of the actual time consuming work that is involved (7:7).

In 1860 Mitchell published an article on Mary Somerville, the eminent 8ritish mathematician, in the Atlantic Monthly. It is a good description of Mrs. Somerville, her personality and her accomplishments (8:568-571).

Her paper on double stars appeared in the American Journal of Science and Arts in 1863. In it she describes her instruments and her procedures in determining the location and colors of 36 double stars which she had observed over a period of from November 1859 to May 1863. Her data are presented in large tables which make up the body of this paper (9:36-40).

The total eclipse of the sun in 1869 was described by Mitchell in an article in Hours at

Home. She begins with a description of earlier eclipses and goes on to describe the 1869 eclipse where she was a member of a party of observers which included some of her students. Her vivid description of the event covers the procedures of observations together with the appearance of the eclipsed sun and the surrounding environment (10:555-560). [This unsigned article is attributed to her in the index of the magazine.] As an example of her writing style, here is her description of totality:

> The Mississippi assumed a leaden hue; a sickly green spread over the landscape; Venus shone brightly on one side of the sun, Mercury on the other; Arcturus was gleaming overhead, Saturn was rising in the east; the neighboring cattle began to low; the birds uttered a painful cry; fireflies twinkled in the foliage, and when the last ray of light was extinguished, a wave of sound came up from the villages below, the mingling of the subdued voices of the multitude. Instantly the corona burst forth, a glory indeed! (10:559).

A comment on p. 560 of this article expresses her feminist views:

> Piazzi Smyth says 'The effect of a total eclipse on the minds of men is so overpowering, that if they had never seen it before they forget their appointed tasks, and will look around during the few seconds of obscuration, to witness the scene'…my assistants, a party of young students, would not have turned from the narrow line of observation assigned to them if the earth had quaked beneath them …was it because they were women?

Mitchell's article on Jupiter and its satellites was published in 1871 in the American Journal of Science and Arts. Here she describes the changing appearance of the planet itself and the times of passages of its satellites over a period of three months (11:393-395). A second article in the same journal appeared in 1873. This was another paper on Jupiter which reported the results of

her observations from January to April of 1872 (12:454-456).

Also in 1873 a book by Amedee Guillemin, Wonders of the Moon, a translation from the French was described as "edited, with additions by Maria Mitchell." This citation was printed in the National Union Catalog but a copy of the book was not found (13:604).

Mitchell was much concerned with the need for improved opportunities for women. In 1875 she became president of the Association for the Advancement of Women, an organization which she helped found. In 1876 she read a paper before it which was published under the title, "The need of women in science." In this paper she stresses the need for women in science to do research, write and teach. Also she points out the need of women to have the opportunity to learn about science so they can pursue a subject of great interest to them.

To emphasize her thesis she contrasts the opportunities afforded Tycho Brahe, who was supplied with every need for his research by the King of Denmark with the situation of Caroline Herschel, another gifted astronomer, who wrote in her diary that she was "employed in doing the drudgery of the scullery" and who "knit cotton stockings" for her brother. Mitchell ends her paper with the statement "And until able women have given their lives to investigation, it is idle to discuss the question of their capacity for original work" (14:9-11).

Two other papers by her were published by this organization, one in 1882, a study of the planet Saturn, its appearance, its rings and its satellites. The other paper, in 1884, concerned astronomical phenomena. Here Mitchell recounts events of the past fifty years, the auroras, the comets seen, the new information on the planets, even the sky colors related to great fires and volcanic eruptions. She poses a question for her readers as to whether or not space is empty and what constitutes the "dwelling spaces of the stars" (l6:37-40).

Another paper on Jupiter and its satellites appeared in 1878. This was a summary of her observations of the planet from May 1874 to June 1877, with notes on the changes in the appearance of Jupiter and the times of transit of its several moons (17:38-41). This paper was followed by one in 1879 on the satellites of Saturn. It is similar to the one in Jupiter with a

description of her observations of this planet, its rings and the passages of its four moons. These records were made from October 1877 to December 1878 (18:430-432).

In 1878 Mitchell took some of her students to Denver to observe an eclipse of the sun. She counted the time for them, thereby permitting them to witness the eclipse itself while she watched the face of the chronometer and they recorded the changes in the sun's appearance. Whitney reports that her advanced classes were always small because of the stringent requirements in mathematics, but these students became her assistants and friends. As Mitchell wrote in a poem for her annual observatory party for students, she wanted them to "take the starlight into their lives" (2:22, 24).

Maria Mitchell continued to teach and do research until she retired in 1888, a year before her death. Whitney reports that she published some articles of a "more popular character in "the leading periodicals" but these were not found and were not listed in Poole's Index or other standard bibliographies which were consulted. A posthumous paper of hers, compiled by her sister Phebe Kendall was published in 1894 in Poet-Lore. It was comprised of notes made by Maria in about 1857 on the astronomy of Milton as found in "Paradise Lost." Mitchell reports that Milton visited Galileo during the time Galileo was making his telescopic studies. She found references to Galileo and to his telescope in the poem, together with other references to various heavenly bodies. Her conclusion on page 323 was that "Milton's epic reflects through a poet's lens, but with considerable learning, the state of astronomical knowledge in his time" (19:313-323).

Maria Mitchell was one of the few early women in science who achieved professional status in her chosen field. Her honors, both at home and abroad were many, including honorary degrees and memberships in important scientific societies. She was an expert astronomer and mathematician, a clear and lucid writer, and an innovative teacher. She contributed greatly to the status of Vassar College by her personal prestige together with her insistence upon high standards of excellence for her students, several of whom went on to professional careers themselves.

Among all these successes it is pleasant to think that together with her other honors, including her comet that is named for her, there is now also a crater on the moon which bears her name (20:173).

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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF PHILADELPHIA.

VOL. I. AUGUST, 1841. No. 5.

STATED MEETING, AUGUST 3, 1841.

VICE PRESIDENT MORTON in the Chair.

WRITTEN COMMUNICATIONS.—Miss M. A. Morris, of Germantown, Pennsylvania, through Dr. B. H. Coates, submitted the following "Observations on the development of the Hessian Fly," dated August 6, 1841.

"Having completed a series of observations on an insect that has for years destroyed the wheat in the neighbourhood of Philadelphia, I now beg leave to lay them before the Academy of Natural Sciences, with specimens of the insect in all its forms, from the egg to the perfect fly. To those familiar with Mr. Say's description, accompanied by Mr. Le Sueur's accurate drawings, given in the first volume of the Journal of the Academy, no doubt can arise as to the identity of the male insect now presented with the Cecidomyia destructor of Mr. Say; but the female differs materially in colour, her body being entirely black or blackish-brown; and the wings are destitute of the hairy fringe so conspicuous in the male.

In the months of March, April and May, I have frequently found the larvæ feeding in the centre of the straw, from the root up to above the last joint. They were then of a pale greenish white colour, translucent, with an internal visceral green line; mandibles of a dark brown colour. At this early period the larvæ have frequently been so small that a magnifying glass has been necessary to detect them.

In the present year, 1841, my observations were unavoidably delayed until the first of June; when I found that the larvæ near the root had left the inside of the straw, and become pupæ on the outside, under the sheath. On the 20th of June, most of the puparia were empty; and on agitating the wheat, swarms of flies rose from off the grain, where they had been resting. I was fortunate in obtaining one of these while in the act of depositing her egg on the grain. Thus interrupted, she placed six on my finger. Three of these I have glued to the paper near her. When deposited they were of a pale straw colour, and inconspicuous to the naked eye, unless collected in numbers. . . .

Margaretta Hare Morris

1797 - 1867

Victor de Motschulsky in a report of his trip to the United States in 1856 writes:

> Je ne voulais pas quitter Philadelphie, sans avoir fait la connaissance d'une entomologiste distinguée, Miss Morris connue par ses observations sur la Cicada septemdecim [sic] le Baridius tripunctatus des pommes de terre, le Hylesinus du pecher etc. Ce fut M. le Dr. Elwyn, qui eut la complaisance de m'introduire chez cette dame, oú je passai une matinée fort interessante (1:17,18).

Motschulsky was the editor of Etudes Entomologiques. He was a well known and well traveled Russian entomologist who visited many important entomologists in the course of his travels. His inclusion of Margaretta Morris indicates that she herself was well known in entomological circles. Her research was published in well-known journals and her correspondence indicates that she was in touch with other workers in the field including collectors (2:38).

Margaretta Hare Morris was born December 3, 1797 and died unmarried May 20, 1867. She lived her adult life in Germantown, Pennsylvania with her sister, Elizabeth. Her parents were Luke and Ann Willing Morris, who came from prominent families in the area. Contemporary reports describe both sisters as prominent workers in natural science. The only journal record found of Elizabeth's work was her listing as a weather observer for the Smithsonian for the years 1866 to 1872. In the genealogy of the Morris family Elizabeth is described as "a truly scientific botanist and an intimate friend and correspondent of Dr. Gray" (a famous botanist at Harvard). Margaretta herself is described as an entomologist who pursued her research in her own home and garden, and is credited with being the first to publish the life cycles of the Hessian fly and the seventeen year locust (3:404). Another report from an acquaintance of Margaretta Morris also

credits her with the first discovery of the life cycle of the Hessian fly, and a feasible suggestion for its control (4:98, 99).

At that time the Hessian fly was a serious pest of wheat, as its species name destructor indicates. It was thought to have been introduced in the straw brought in by Hessian troops. At one time, 1788, American wheat was banned from English ports and it was reported that it "ravaged the wheat crops of the middle states region" (5:364-365).

Morris' first paper, published in 1841, was read by Dr. Coates, who himself had investigated the research reports on the life cycle of the insect in a review paper (6), in which he refers to her work in several places. Morris' paper dealt with the life history of the Hessian fly. She reported on her experiments in observing the insects both in the field and by rearing them through their life cycle under a bell jar on straw. In this way she reconciled the differing reports of other observers by discovering that two different species were involved (7:66, 67).

Her next paper, also on the Hessian fly, was first submitted to a committee of the American Philosophical Society for evaluation. This committee commented that "... should the observations of Miss Morris be ultimately proved correct, they will eventuate in considerable benefit to the agricultural community, and through it, to the public" (8: 381). The paper was subsequently published in the transactions of the society. Here she reports in a more detailed and formal fashion her observations dating from 1836 to 1843. By following the insect's life cycle closely she discovered that eggs were laid in the grain, thereby correcting the reports of Mr. Say (a well known naturalist) that the eggs were laid in the stalk. Hence, she points out that any method used to destroy the eggs in the grain will also kill the plant embryo, and so the only solution is to procure uninfested seed (9:49-51).

In 1846 Morris wrote four articles for the "Ladies Department" of the American Agriculturist, three under the pseudonym of "Old Lady" and one unsigned. These papers are credited to her by the bibliographers Horn and Schenkling (10: 840). She writes that they are written for farmers' wives and purport to come from "an unpublished journal of an old Lady." The

first one is on the apple moth, the second on the clothes moth, the third "to the girls" about natural history, and the fourth about fleas (11:65-66; 12:97-98; 13:161-162; 14:353). These little articles are informative and interesting.

A report on the discovery of the larvae of the seventeen-year locust, Cicada septendecim was given to the Philadelphia Academy in 1846 through the agency of Prof. Johnson, and was published in the Proceedings. Morris attributes the failure of fruit trees over twenty years old to the ravages of the larvae of the seventeen-year locust on the roots rather than as the result of injury to young twigs by the egg 1aying of adults. She was led to this belief by a report that young trees could be saved by digging around the roots and replacing the soil. She experimented on her own pear tree, digging around its roots, where she found many larvae fastened on the young roots. (Her early observations on the life cycle of this insect began in 1817 when a brood emerged, and were repeated in 1834, seventeen years later.) She includes a reference to her brother Thomas' investigations (15:132-134). This paper, the ones on the Hessian fly and a later one on the plum curculio were reported in Weiss (16:136-137; 175).

Morris had five papers in the American Agriculturist for 1847, one unsigned, two signed "M" and one "M. H. Morris." One was a report on experiments on the cotton moth, a destructive insect whose larvae eat the leaves of the cotton plant. She recommends that the larvae and cocoons should be destroyed on the plant, a procedure persons in parts of Europe are required to do for insect control in their gardens. The next paper described the chinche, or bed bug with directions for its elimination. There followed one on the army worm and its life cycle, one on the shrew mole and cutworm and one on the seventeen year locust (17:22; 18:33; 19:50; 20:223-224; 21:86,87) These are all short conversational papers with a lot of good scientific information about insects in them.

In the same year there is a report from her on the source of some specimens of the Cicada which were sent to the Academy of Natural Sciences in Philadelphia (22:238). This was followed several months later by a letter about specimens of the Hessian fly and an insect which attacked

raspberry plants (23: 238). About the same time she sent a paper about the controversy respecting the Hessian fly to the American Agriculturist. A note from the editor states that the question of the Hessian fly is "one of the greatest importance to farmers of western New-York (sic) state and elsewhere." Morris' article defends her identification of the insect and her reports of its life history against published criticism of her findings by one Dr. Fitch. It is especially interesting because it reveals her working methods. She visited wheat fields, collected sheaves, collected and identified the insects and reared some on growing wheat in a bell jar (24:206-208).

A paper on the destruction of fruit trees by the seventeen year locust appeared in the September 1848 issue of the American Agriculturist. This is a report on her further investigations of root damage by this insect and is partly a reply to an article whose author states incorrect information about the damage caused by the Cicada (25:279).

The next year Morris wrote a letter concerning the nomenclature of the Hessian fly and her investigations on its mode of transport (26:194).

A short article on the curculio attacking the potato appeared in the Transactions of the New York State Agricultural Society and a longer one on the same subject in the American Agriculturist, both in 1850 (27:736; 28:113-114). A new subject for research is reported in this same year on the cause of yellows in the peach tree, in two articles, one in the Horticulturist and one in the American Agriculturist. In both of these papers Morris describes work which brings her close to the discovery of an insect vector for a plant disease, something which was not understood for many years until the discovery of bacteria and viruses as agents of disease transmitted by insect hosts (29: 502-503; 30, p. 144-145). Her theory stimulated a reply from "Agricola" who thought she was wrong but wrote that he could not drop the subject without expressing a hope that "we shall often hear from Miss Morris" (31:219).

A report on the seventeen year locust from Morris was communicated by Professor Agassiz to the members of the American Association for the Advancement of Science. It was discussed, but was never received for publication. (This was in 1850, the same year that Morris and Maria

Mitchell became the first women members of the Association, [32: 354]. The same subject was covered in a letter to the Boston Society of Natural History in which Morris reports her finding that the larvae of the seventeen year locust feed on the roots of the trees upon whose branches the eggs have been deposited. Consequently, the removal of trees from some areas has eliminated the insects and distinct tribes then arise from other areas (33:110). She sent a letter on the subject of a luminous larva she had found in the Delaware Water Gap to be read at the 1859 meeting of the Philadelphia Academy, promising to send more information if she could rear the larva to maturity (34:193-194).

An official or lead paper, illustrated with a full page colored picture of affected fruit, on the life cycle of the curculio on plums, cherries and peaches appeared in the Horticulturist for Nov. 1859. She raised the insects she had collected on twigs in bell jars. From these studies of their life cycles she recommended that all infected twigs and fruits be burned (35:506-509). A followup to her work is reported in these pages in which a microscopist confirms her findings. This paper was reviewed by Weiss (16:175).

Two papers on the peach tree appeared in 1860, one in the Horticulturist (36: 118-120) dealing with peach yellows, and one in the Gardener's Monthly on several insect enemies of the peach (37:130-131). An editor's note at the end of this article reports on her election to the Philadelphia Academy. (Morris was the second woman to be so honored. Lucy Say was the first in 1841-see Proceedings for that year.) This is the last paper found for her.

Margaretta Hare Morris was certainly a gifted research worker and an indefatigable student of entomology. Using bell jars and other paraphernalia for raising insects, and utilizing her own back yard and surrounding areas, she was able to make important contributions to fundamental problems in entomology, especially the life cycles of economically important insects. Her papers are models of succinctness and she did not hesitate to defend her findings when the occasion arose. She had a wide acquaintance with workers in her field together with a comprehension of the economic importance of crop destroying insects. Thus from her experiments she could make

recommendations as to their control. All this she accomplished without the benefits of an official position or formal academic training. It is pleasant to report that she did achieve personal recognition at home and abroad.

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- - - -

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With the warmest filial affection, this Volume is dedicated to the

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The Author

Hannah Mary Bouvier Peterson

1811 - 1870

In the preface to her popular astronomy book, the author states that her book is intended

> to be a complete treatise on Astronomy conducting the pupil step by step, from the base to the summit of the structure; explaining as far as practicable, by figures and diagrams, all the celestial phenomena, and the laws by which they are governed, without entering into those mathematical details which properly belong to treatises designed for those who propose to make astronomy their chief study. (l: preface).

Few biographical data have been found about Hannah Bouvier Peterson. She was born in Philadelphia in 1811, the daughter of John Bouvier, a prominent jurist and author to whom she dedicated her astronomy book "with the warmest filial affection" (l: title page). She was the wife of Robert Evans Peterson, a physician and author, and the mother of at 1east one child, a daughter, Mrs. George W. Childs. She died in Long Branch, New Jersey, in 1870. It is reported that she was highly educated and that astronomy was one of her favorite subjects. These meager facts are included in an article about her husband in the National Cyclopedia of American Biography (2).

Bouvier's Familiar Astronomy was published at least three times in its original format, in 1855, 1856 and 1857, and in two other editions in 1858. One of these was a "cheap" but equally large edition published "at the solicitation of teachers and others," and it was followed by a "cheap" edition which was considerably shorter "adapted to the wants of common schools" (1). Notice of this book was also given in French and German works (3, 4) and in the Annual of Scientific Discovery (5). Obviously it was a popular and well known work. Allibone's Dictionary of Authors, Vol. 1:224 prints laudatory statements about this book from George Airy, (the Astronomer Royal,) Sir John Herschel, Rear-Admiral W. H. Smyth and Dr. Dick (6).

The 1857 edition of this large and comprehensive text book is written in a succinct readable style in the form of questions and answers. The subject matter is divided into five parts: the first, physical astronomy, deals with "the laws which govern the heavenly bodies;" the second, descriptive astronomy, with "the components of the solar system;" the third, "the sidereal heavens, embracing the fixed stars, clusters and nebulae;" the fourth, practical astronomy, with "the principal instruments used in the observatory;" and the fifth on the use of globes (1, table of contents). There are two maps of the heavens, a 58-page astronomical dictionary, 14 astronomical tables, a 23-page history of astronomy, some study problems to solve and a good index. An extensive section of explanatory notes supports and gives further clarification of the text.

The organization of this large amount of material into a comprehensive and yet readable textbook indicates the author's wide knowledge of her subject and her skill in writing. She gives picture credits for some of her illustrations, so it appears that she herself may have prepared most of the diagrams and other illustrations. Quotations from other astronomers, such as Mary Somerville of Great Britain are included in the text, indicating that the author was widely read in her field. Hannah Bouvier's book is altogether an impressive accomplishment. As far as is known, this book in its different editions was her only published work related to science.

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CHEMISTRY,

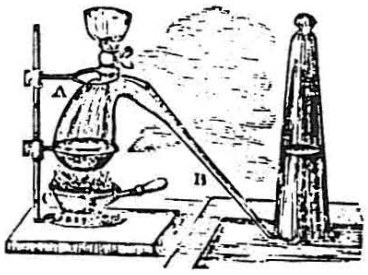
FOR SCHOOLS, FAMILIES, AND PRIVATE STUDENTS.

BY A. H. LINCOLN PHELPS.

PRINCIPAL OF THE PATAPSCO FEMALE INSTITUTE, MARYLAND.

AUTHOR OF THE FIRESIDE FRIEND &c. WITH A SERIES OF WORKS ON BOTANY, NATURAL PHILOSOPHY AND CHEMISTRY, DESIGNED FOR BEGINNERS AND MORE ADVANCED STUDENTS.

Fig. 62.



NEW EDITION, REVISED AND CORRECTED.

NEW YORK:
GEORGE SAVAGE, 22 JOHN-STREET,
(LATE HUNTINGTON & SAVAGE,)
AND
MASON AND LAW, 23 PARK ROW.
1852.

Almira Hart Lincoln Phelps

1793 - 1884

Sara Josepha Hale in her "Women's Record" of 1873 describes Phelps' achievements in the following passage:

> No woman in America, nor any in Europe, excepting Mrs. Marcet and Mrs. Somerville, has made such useful and numerous contributions to the stock of available scientific knowledge as Mrs. Phelps (1:771).

The above statement may seem an exaggeration but in fact Phelps' publishers claimed that her botany books alone sold in the region of 645,000 copies. She was the author of chemistry and physics texts as well which proved popular also. For a complete listing of her published works see the National Union Catalogue (2). There is also an extensive listing of her many publications in Bolzau (3).

The facts of Phelps' life and works are well documented in several accounts. The summary presented here is derived from Hale (l) and Bolzau (3). Bolzau's book is a comprehensive and well written account of Phelps' life and times. Much of her material has been derived from primary sources, especially from letters and interviews with Phelps' descendants and others who had been associated with her friends and students. There is a large bibliography divided into primary and secondary sources. Phelps had many interests in addition to her scientific pursuits. Some of her publications deal with slavery, the women's movement, aid to Greeks, Bulgarians and Cubans, and the Zoar settlement in Ohio. She also wrote essays, "letters" and a novel.

Almira Lincoln Phelps was born in Berlin, Connecticut, July 15, 1793 and died July 15, 1884 in Baltimore, Maryland. She was the seventeenth and last child born to Samuel Hart, a businessman, and former officer in the Revolutionary War. Her mother, Lydia Hinsdale, was Hart's second wife, "a woman of great energy and sound judgement" (l:170), who had ten stepchildren from Hart's first marriage and seven of her own. Almira's older sister, Emma Hart

Willard, was her early teacher and mentor.

After some instruction at the Berlin Academy and the school of her cousin, Nancy Hinsdale, Phelps became a teacher herself until her marriage in 1817 to Simeon Lincoln, a printer and publisher. Six years later she was left a widow with two small children, Emma and Jane, and the insolvent estate of her husband. This situation forced her to return to teaching. She became an assistant to her sister, Emma Willard, at the Troy Seminary where she spent the next seven years studying Latin, Greek, natural science and drawing while at the same time teaching botany, chemistry and geology. At this time she wrote her first book, Familiar Lectures in Botany (1829). A laudatory review of this book was printed in the American Journal of Science and Arts, Vol. 17:414-415, Jan.1830.

In 1831 Almira Lincoln married the Hon. John Phelps, a Vermont lawyer and politician. He was a widower with six children, one of whom was a student at the Troy seminary at the time. Almira had two children by this marriage. Charles and Almira. Phelps continued to write textbooks in her home in Vermont. In 1841 she and her husband took charge of the Patapasco Female Institute in Endicott's Mills, Maryland. Almira served as principal and teacher; her husband acted as business manager until his death in 1849.

Many of Phelps' books were prepared for her seminary students, some of whom became teachers. The Patapasco Seminary under her direction became well known for its high standards, especially in science. At age sixty-three Phelps retired but she continued to pursue a very active career in writing. One evidence of her lifelong interest in science is shown in the fact that she became the fourth woman to join the American Association for the Advancement of Science, the other three being Maria Mitchell and Margaretta Morris in 1850 and Bernice D. Ames in 1856.

Phelps joined in 1859 and remained a member until 1874. Four papers by her were presented to this group at their annual meetings in 1866, 1868, 1870 and 1874. (See the Proceedings of the American Association for the Advancement of Science for the years 1850, 1856 and 1859 - 1874 membership lists and 16).

Phelps was also one of the few women members of the Maryland Academy of Sciences. Her essay on the progress of science in Maryland accompanied the presentation of her herbarium to that organization in 1874. This collection consisted of 600 plants, her lifetime collection of forty years. For a detailed review of her activities in scientific organizations see Bolzau:445-452.

Phelps' botany books were so successful that a tally made from the National Union Catalogue yielded a total of 65 entries of various sorts from 1829 - 1891. Two of these entries specify the number sold to date. Her Botany for Beginners sold 270,000 copies or more, her Familiar Lectures an additional 375,000, making an impressive total of 645,000 copies or over half a million (2:566). Bolzau reports that Phelps' grandson was still receiving royalties in 1900 (3:264).

Phelps' Familiar Lectures on Botany, first published in 1829, was designed for advanced students in higher schools, seminaries and academies. This book went through many revisions and editions from 1829 - 1871. The 1831 edition included "practical and elementary botany, with generic and specific descriptions of the most common native and foreign plants and a vocabulary of botanical terms (4:title page). This book is divided into "Lectures," including two on the history of botany. On page 291 a footnote records, "Females who have interested themselves in the study of botany." Those are listed as Josephine, Napoleon's wife; Mrs. Wakefield, Mrs. Marcet and Mrs. Somerville.

The 1835 edition is a longer book (5). Her 1846 edition is of interest because of a footnote which led a colleague to the discovery of Jane Kilby Welsh. Phelps, writing on the need of books, cites "a small work entitled Catechism of Botany, by Miss Jane Welsh, was the first attempt by an American lady to illustrate the science" (6:254).

The 1852 edition of this book carries a statement by Phelps in her preface as "the Author of this work, in its preparation more than twenty years since, availed herself of the most valuable foreign works, consulting English books less than those of the French and German School [sic] of

Botany" (7, preface: 3). She continues in her preface "This work professes to be of itself a botanical library, sufficiently full in each department for all purposes of a class book, or for the private student" This book does indeed fulfill her object for her times and it is still consulted by botanists today (personal communication to writer).

In this book Phelps includes helpful directions for the students to dissect, study and classify. Her chapters on plant anatomy are illustrated with many simple labeled drawings. Following the anatomy she continues with plant physiology, ecology and taxonomy, with notes on the history of botany. There is an additional section of 187 pages called "The Flora, or Practical Botanists' Companion," which describes plant species, and includes a glossary and an index of plant names, both common and scientific. One unique item is a frontispiece consisting of a diagram of a mountain with superimposed labels and drawings of the types of plants which would be found from elevations of sea level to 21,000 feet and from latitudes from the equator to 90°. The title is "Progress of vegetation at different elevations, corresponding with its progress at different latitudes."

Phelps' Botany for Beginners was designed "For the use of common schools and the younger pupils of higher schools and academies" and is "an introduction to Mrs. Lincoln's Lectures on Botany" (8). The 1849 stereotype edition was seen. This is a small book of 216 pages which appears to have been intended as an introductory textbook for her more advanced Familiar Lectures, although the latter book appeared first in print, preceding the beginner's book by four years. This beginner's book became so popular that the publisher claimed that a new edition "… was the 270th thousand [copies] by 1867" (2: 568). The publisher' s statement on page 6 states that the first edition was sold in less than six months and is now in its "present amended form." There is a note to teachers, an introduction, 15 chapters on plant structures with many illustrations, eight chapters on classification with brief descriptions of genera and species, a "vocabulary" or glossary of 28 pages and three pages on the "language of flowers," ending with a poem (8).

In 1830 Phelps was asked by Amos Eaton of the Renssalaer Institute to translate a chemical dictionary from the French, which she did, adding some notes of her own (9). Eaton approved her work and the book was used both in his school and in the Troy Seminary (10: 352-353). Eaton was an important influence on at least four women writers in science, Willard, Phelps, Laura Johnson and Jane Welsh. He taught them the natural sciences while at the same time encouraging them to undertake teaching and writing in the field. For a detailed biography of Eaton see McAllister (10).

In 1837 Phelps wrote her first textbook on physics, Familiar Lectures on Natural Philosophy. Subsequent editions of this book, of which there were nine, were divided into one book for beginners and another longer book for more advanced students. The 1838 edition of Natural Philosophy for Beginners was seen. The author divides her subject into seven parts: the mechanical properties of solids [inertia, motion, gravity]; mechanics [simple machines]; hydrostatics; pneumatics; acoustics; optics; animal mechanics, which includes material on human bones, tendons and muscles. There is an 11 page "vocabulary" or glossary. The subject is well illustrated with pictures and labeled diagrams. The material is presented in short numbered paragraphs with review questions as footnotes. In her preface Phelps states her philosophy that

> The attention of the young should be directed to natural operations; that thus the powers of observation and comparison may be developed and strengthened (11:preface iii).

She also points out on the same page that the teacher

> endeavors to give variety and interest to his instruction; and is ever inventing methods to arouse and arrest the attention.

And on the next page of the preface

> The author of this little book after having spent many years of her life in teaching, and many in writing for the young, is more than ever impressed with a sense of the importance of interesting them in their scholastic

pursuits.

One way in which Phelps achieves this objective is to use common experiences as examples, as, for instance on page 52, a horseback rider is being thrown forward at a sudden stop of her horse to illustrate momentum, and the rising of a soap bubble illustrates the effect of heat on air (11: 106). All the diagrams are fully explained in the text. The chapter on sound has a diagram of the ear, the one on light has one of the eye. She includes the optics of the microscope and telescope. This little book contains a wealth of information about the physical world presented in an interesting, well illustrated manner. A notation in the National Union Catalogue lists one copy of this book as "Inscribed on fly-leaf "Ezra Haynes'es Book captured at Savannah, January 1865" (2:568).

Phelps also made a contribution to geology, partly by teaching it and partly by revising and editing Goodrich's geology text which was issued by three publishers (12). In an article condensed from a paper presented at the annual meeting of the Geological Society of America, Arnold, in a paper entitled "American Women in Geology" is quoted as follows:

> Virtually unknown, however, is the name of Almira Lincoln Phelps, also a student and scientific associate of Eaton's, at the nearby Troy Female Seminary. She wrote several Science texts, including one on geology. Phelps popularized the study of science for women through these texts and through her teaching at Troy Seminary and later at the Patapasco Female Institute in Maryland. She was a key figure in the emergence of women as geoscientists in the 1890's (13:493).

This book was reviewed in the American Annals of Education for 1833, Vol. 3:19I, with a long statement beginning "we are pleased with this as an introduction to geology." The writer goes on to imply that the book is too advanced to be called a "child's" geology.

Concurrently with these writings Phelps was publishing her chemistry books in which she followed the same pattern of writing an elementary text to lead up to one for more advanced

students. Her Chemistry for Beginners was first published in 1834. The last publication date found was in 1867, with 14 printings in all. The 1852 printing of the 1834 edition of her Chemistry for Beginners was seen. The title page states that it is designed for "common schools and the younger pupils of higher schools and academies" (14).

In her preface Phelps writes that the beginner must learn the language as well as the principles and that she hopes "to give such a taste for chemical pursuits (without expecting in this little volume to make them chemists) has been the author's aim." Her engravings are in many cases from "original design" (14, preface:34). After an introductory part to teachers, and one beginning with the 1aws of attraction, heat, radiation, electricity, and continuing with the "alphabet of chemistry," a description of the commoner chemical elements, chemical compounds, metalloids, metallic oxides and salts, with a final part on organic chemistry including the chemistry of plants and animals.

This is a well-written elementary chemistry book with many pictures and drawings. Basic facts are stated in small numbered paragraphs, experiments are illustrated and explained. The student is introduced to the processes of chemistry, its uses and its "alphabet," which at that time consisted of only fifty elements. Phelps' more advanced chemistry book was published seven times from 1838 to 1866 under two different titles, Familiar Lectures and Chemistry. The 1852 edition was seen. The book's text takes the form of 890 numbered paragraphs, with summary titles in footnotes below. It serves also as a sort of laboratory manual with many illustrations of apparatus with descriptions of the experiments performed using them. These laboratory procedures are included at appropriate places in the text. The thirty-six chapters are separated with three divisions. Part I covers chemical processes in general such as the results of heat, light and chemical affinity. Part II covers the chemical and physical characteristics of the elements, their compounds and properties. The last part concerns organic chemistry, the properties of alcohol, sugar and similar complex carbon compounds. Historical allusions are included where appropriate. This is a well written very informative text for more advanced students and their

teachers (15).

Phelps also wrote papers which were read before the annual meetings of the American Association for the Advancement of Science of which she was a member. Only the titles of these papers were published in the Proceedings but they were all read before the membership of the society and reviewed or printed elsewhere (16). The first paper, in 1866, was on the "Scientific and Religious Character of Edward Hitchcock." The second, in 1869, was titled, "Popular Science." The third, given at the 1870 meeting of the Association which was held in Troy, New York, was a presentation of her sister Emma Willard's "Theory of Circulation by Respiration." This paper was published separately (l7). A paper presented in 1874 was on "Progress of Science in Maryland." None of these papers were strictly scientific except for the one on her sister's theory of respiration. For a review of Willard's theory see the description under Willard's own history. For an analysis of the other papers see Bolzau, (3:447-54). Phelps was troubled by a conflict between science and her religion.

The Patapasco Institute declined in the years following Phelps' retirement in 1856. This was partly due to the onset of the Civil War, for many of its students came from southern states, and perhaps also partly due to the loss of Phelps' leadership. Phelps' books retained their popularity for many years. It is easy to see why these books were so popular. They are well organized, well illustrated and interesting to read. Her notes to teachers were very helpful. Furthermore, because of their clear presentation of the subject they could be used in home circles as well as in classrooms. For a detailed study of textbooks of the period, see Bolzau, chapter VII. For a recent paper on Phelps and her special contribution to the spread of botany see Rudolph, American Journal of Botany 71:1161-1167, 1984.

Phelps was a well informed experienced teacher who wrote popular textbooks on science. Their scientific content was accurate and well presented. She was progressive in her approach to education as is illustrated in her comments on arousing the student's interest in the subject. Another indication of her interest is the fact that she, together with her sister Emma Willard,

translated Madame Necker's book on progressive education (18). Phelps was a woman of wide interests, a collector of plants, an active member of scientific societies and a participant in social causes. It is of interest to note that these two sisters, Almira Phelps and Emma Willard both became so influential in women's education and yet neither of them had had the opportunity for a college education.

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second one in Volume 9:135-136 for August 1884 which is a brief obituary of Phelps.

FIRST LESSONS

ON

NATURAL PHILOSOPHY,

FOR CHILDREN.

In Two Parts.

PART FIRST.

BY MARY A. SWIFT.

NEW EDITION, ENLARGED AND IMPROVED.

HARTFORD:
WILLIAM JAMES HAMERSLEY, PUBLISHER.
PHILADELPHIA: J. B. LIPPINCOTT & CO.
1859.

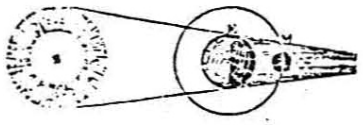
Lesson Sixth.

CAN you tell me what caused the Moon to be eclipsed?

The Earth on which we live came between the Sun and Moon.

Could we not see the Moon?

We could see it, but it did not shine on us.



Why did it not shine; is it not a bright object?

It is not; it is dark like the earth.

Mary A. Swift

Dates of birth and death not found

Very little information about the life of Mary Swift was found. She is listed in Allibone's Dictionary as the daughter of Zephaniah Swift, L. L. D., 1759-1823. He was a Yale graduate, a lawyer, and at one time, Chief Justice of Connecticut. No dates are given for the daughter, although her book on natural philosophy is listed. Her mother is not mentioned in the short note about her nor in the longer one about her father (1:2318).

Swift is listed on the title page of the 1842 edition of her book as the principal of the Litchfield Seminary, Litchfield, Connecticut. This school was a prestigious one according to contemporary accounts. It was a pioneer institution, established in 1792 and did attract young women from other states (2:603, 604).

Mary Swift's two-volume work on natural philosophy became so popular that 34 printings are listed in the National Union Catalogue, covering the years from 1833 to 1884. In some years one volume or "Part" was printed, in other years both were issued. There were three printings of a Burmese translation which was published by tile American Baptist Mission Press. The 1835 edition is listed as the fourth edition and the 1836 one as the fifth edition, although the first publication date is 1833. According to the 1842 edition, the book was entered "according to an Act of Congress in the year 1833" (4:title page). A new enlarged and improved edition of both volumes was published in 1859 and continued being published until 1884. A complete list of these printings is appended to the reference list (3, 579:250-251).

In her 1842 stereotype edition Swift writes in her preface:

> At the time this little work was commenced, the author was teaching a few children; and no book on Natural Philosophy suited to their capacity was to be found. It was written for them and taught to them as it progressed. The form of question and answer was used in the manuscript,

> and is retained as the simplest method of teaching children. It has been used in this form in several schools, and the satisfaction expressed by the children has induced the author to allow its publication (4: preface).

Her book defines natural philosophy in the last chapter as explaining the reasons of things and "tells us about the properties of bodies." The subject matter is a combination of astronomy and the properties of solids, liquids, and gases. Some chapters have illustrations at the end. There is often a poem, usually with a religious context. The chapter on winds and storms ends with Psalm 107 and the one on the sun and telescopes with the words of the hymn, "The Spacious Firmament on High". This book, Part 1, is elementary but does present, in the first part, material about the earth, planets, eclipses, the seasons, sun, rain and wind.

The later chapters of Part 1 cover the forces that act on orbits, centrifugal, centripetal and gravity, with mention of Newton, and goes on to take up cohesive forces, inertia, and the shapes of bodies. It ends with the principle, arrived at by experiment, that no two bodies can occupy the same space. There are diagrams of eclipses, planetary orbits and the relative sizes of the planets. Swift uses simple activities to demonstrate basic principles, for example illustrating centrifugal force by a boy whirling an apple on a string.

Swift's second volume on the same subject was registered with Congress in 1836 by the publishers (5, title page). The edition described here is the stereotype edition of 1844. In her preface the author comments on the "favorable reception" which was given to her first book and offers this one to "parents and teachers of primary schools" (5, preface), This book is a sort of elementary physics text, with 25 chapters on such topics as motion, gravitation, friction, simple machines, air, water, capillarity, air pressure, sound, light (reflected, refracted and absorbed) and prisms. There are illustrations and her examples are always related to common experiences, as for instance, a picture of a seesaw to illustrate levers and fulcrums. Interesting facts about desert winds and boiling springs are included at appropriate spots. Nearly all the religious tone is gone (5). Both volumes are in dialogue form with the important words italicized. The second volume

has much more advanced material in it.

In the appendix of Part Second in the 1844 edition there is a quotation from an undated unsigned review in the "Hartford Watchman" which states that the author has "unusual skill in writing a child's book of natural science … Children are better pleased with ideas than words … It is beautifully concise and simple."

The only facts which have been found about Mary A. Swift are that she was a teacher and at one time a principal of the Litchfield Seminary in Litchfield, Connecticut. Her texts on natural philosophy were issued 34 times, including three translations into Burmese. It is apparent that her books filled a need of the times. It is obvious that she had to acquire a considerable store of information about astronomy and elementary physics to be able to present the material in such a useful and attractive form. From her own words it appears that her two-volume work must have been one of the first to provide instruction in this field, since she was constrained to write her own texts for lack of any suitable ones already in print.

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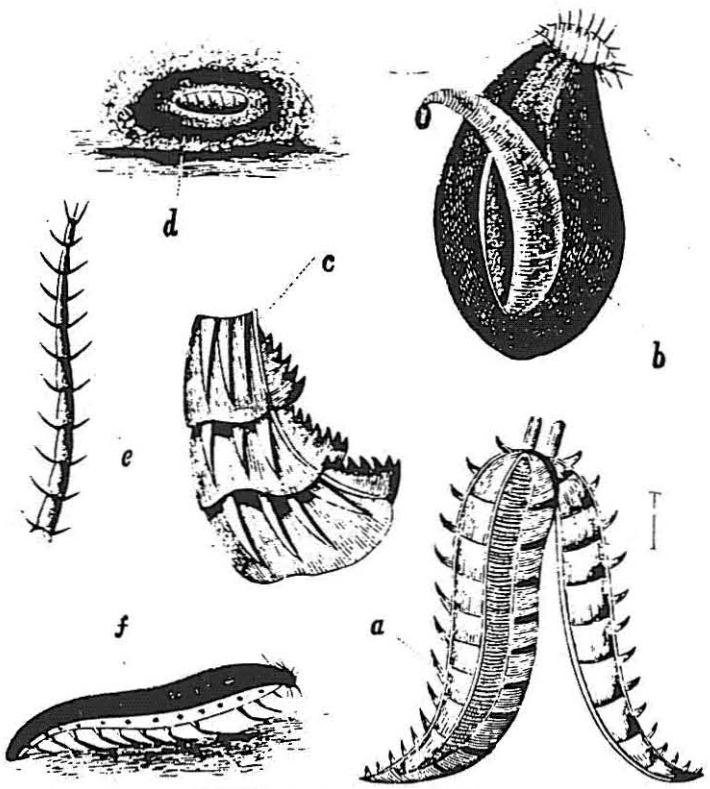

FIGURE 19.—PARTS OF GOOSEBERRY SAW-FLY.

a. Saw open for Use.—b. Saw used as Ovipositor and Egg.—c. Section of Saw.—d. Pupa-Case.—e. Antenna.—f. Larva magnified.

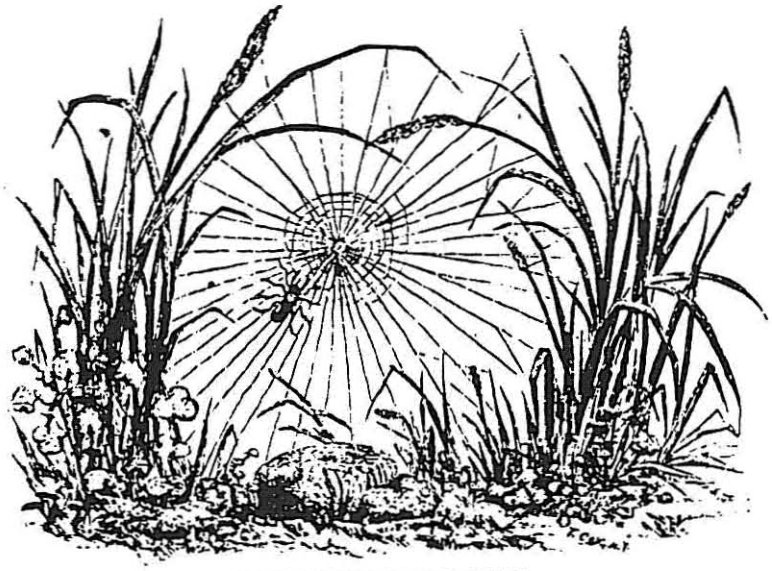

FIGURE 9.—WEB OF LATHODECTA CHRUSOS.

Charlotte de Bernier Scarbrough Taylor

1806-1861

The editor of the American Agriculturist introduced a series of articles by Charlotte Taylor as follows:

> We are happy to present to the readers of the Agriculturist the first of a proposed series of original articles, giving a description of the habits and characteristics of various insects, with suggestions for their extermination etc; together with new illustrations taken directly from the insects themselves and prepared expressly for this journal (1: 80).

Charlotte Taylor did not begin writing her many articles on insects until she was in her fifties, although her study of them encompassed many years before her writing career started. She was born August 4, 1806, in Savannah, Georgia, the daughter of William Scarbrough, a "merchant prince" and planter, and Julia Bernard. She died in 1861 on the Isle of Man. She was educated in Madame Binze's school in New York and in 1829 she married James Taylor, a businessman. They had five children.

Charlotte grew up in a prosperous setting but later underwent serious financial reverses when her father's business enterprises failed. She was a largely self-educated student of entomology in which field she became expert in the rearing of insects, their taxonomy, behavior and anatomy. She made many drawings and paintings of her specimens both as seen by the naked eye and as under magnification where she dissected their often minute structures. In this work she was assisted by her daughters, Virginia and Agnes. For the definitive study of Charlotte and her family see Davis (2) and Ice (3). A few facts are given about her in the National Cyclopedia of American Biography 11:164, and in the Dictionary of American Biography, Vol. 9:319-320. She is mentioned in L. O. Howard's History of Applied Entomology, vol. 84 of the Smithsonian

Miscellaneous Collection and in May Meisel's Biography of American Natural History, vol. 1.

Poole's Index was relied upon for citations of most of Taylor's works, because they did not appear in the indexes to the standard scientific journals of the time. It is possible that some have been overlooked since a few were not signed and some references were not found. One record stating that she had an article in School Fellows in 1854 proved to be inaccurate as none was found in that volume. However, a short unsigned article on insects attributed to her was found in The Homestead, vol. 4-5:894, 1858 (4).

Three early papers which appear to have been written by her were found in Harper's New Monthly Magazine for June, 1857 and June and December, 1858. No mention of the author has been found but these articles are in her field, in the magazine which published many of them and written and illustrated in her style. The first one, monads, is a paper on infusoria including the phosphorescent species and illustrated with ten drawings. The second one in this group, on the microscope, contains an explanation of the action of lenses in magnification and the problems of chromatic aberration and distortion. Three diagrams explaining the process of magnification and several drawings complete this paper. The third article, on Croton water, is a report of her studies on the infusoria she found in the Croton reservoir. Here she describes her own microscope and how she uses it, thus providing evidence that she was a microscopist in her own right. (Doubts were voiced by some critics that she only used magnifying glasses.) One additional piece of evidence that the above papers were hers is that she included a drawing of a life-sized organism for comparison with the magnified one, a technique which she continued to use (5). These papers were brought to my attention by Reverend Davis. The following articles were all cited in Poole's Index (6).

In 1858 Taylor published an article in Harper's on the Musquito [sic] in which she set the pattern for the rest of her papers on insects. Each one begins with an introduction to the history and taxonomy of the insect, then continues with an account of her own experiments and

observations and concludes with a final evaluation of the uses of the insect and sometimes recommendations for its control. Many drawings illustrate most of the papers. These include pictures of structures she dissected under magnification in addition to the gross anatomy and often there is added a helpful picture of the insect drawn to 1ife size for comparison. The mosquito article has 23 drawings of the external and internal anatomy of this insect (7:32-43).

In 1859 Taylor published four papers on Harper's, one in May on flies, their anatomy, life cycles and behavior, chiefly on the house fly, Musca domestica. The second article, "The Flea," includes myths about fleas, the varieties of fleas and her account of the rearing of fleas, together with her apology for them. "They have their mission." The third article, "The Musicians of Our Woods" deals with her observations of katydids, cicadas and grasshoppers. She reared some cicadas and grasshoppers, taking pains to observe and describe their process of sound production. On page 333 of this paper she states, "I never present that of which I have not had ocular demonstration." Her last article for this year is on insects destructive to wheat, in which she describes nine species of these insects and suggests some forms of control which are related to the different life cycles of these organisms (8). All the papers have many illustrations.

The next year the American Agriculturist published four of her papers. The editor wrote a lengthy introduction to her first paper on "Microscopic Views of the Insect World," in which he states that she will show her readers "some of the wonders with which, by the aid of her artificial eyes - her microscope - she is daily conversant" (9:80). Her first paper is on the life cycles of several species of aphids. She reports rearing more than thirty generations of Aphis rosae, during which time she discovered the changes in the male-female ratios and the female changes from viviparous to oviparous reproduction. Her next paper, Part II, is also about aphids, those on apples, poplars, bananas, oaks, currants and grapes. She remarks on the increase in their numbers, since "twenty years ago I searched many orchards throughout the Eastern States, and found with difficulty a single specimen" (9, p. 108). The difficult species are described in relationship as to how they affect the host plant. Her article in the June issue concerns the lacewing. She describes

watching the female's deposition of her eggs, which are attached upright on slender stalks or leaves, remarking that the process had been a puzzle for a long time. In September the article was about Chrysopa eriosoma, the golden-eyed fly of the apple blight. These she studied in situ during the course of their life cycles. Her last paper in this journal was on the pigeon tremex, Tremex columba, which had been on the increase and attacked fruit trees. She not only describes its life cycle but also that of its parasite, a small ichneumon fly (9).

In this same year of 1860 Taylor had four papers in Harper's. The first one, on the silkworm begins with an interesting historical sketch of silk production. She then gives directions on how to rear silkworms and recommends this occupation to "my countrywomen advancing in years" (10:764). In June there was a paper on insects belonging to the cotton plant. In it she refers to "the results of many years close and accurate observations of these important insects" (10:39). There follows a description of nine species and recommendations for their control. The third paper concerns spiders. She describes thirteen species and reports her experiments in rearing them. In the December issue there appeared an article on "Unwelcome guests;" i.e., cockroaches, clothes moths, bedbugs, (feeding the latter on her own hands), and experimenting with ants, rearing them and observing their behavior. The only remedy she suggests is good housekeeping, and she reminds us that "All are created by God and are marvels of creation" (10). All these papers have many illustrations.

The year 1861 saw five papers by her in Harper's, the first being a second article on spiders, in which she compares their behavior with the more stereotyped behavior of ants, wasps and butterflies, and describes six species. In one instance at least she watched "one battle" all night (10:323-335). In April there was a paper on mites in which nine species are described. A third article included descriptions of ten insect pests of maize, some of which she reared and painted. One of these specimens had been sent to her from the Patent Office. The next paper, entitled, "Pets," differs in that it expresses her philosophy about nature.. "I have a very particular interest in every thing [sic] that runs or flies, or swims, or walks, or creeps ..." (10:519). It is her first

paper that is not illustrated. The last paper of this year, "Night Revelers," is chiefly about fireflies, on which she performed feeding experiments and tests for sulfur on specimens which she reared under glass. A few other beetles are mentioned. This paper also has no illustrations (10:771-776).

It is during the year 1861 that Charlotte Taylor is thought to have died on the Isle of Man, although the exact date has not been established, according to a personal communication from her biographer, Reverend Davis. It follows that her later papers must have been prepared earlier and published posthumously, with the last one appearing in 1864.

Two papers appeared in 1862, one on the praying mantis, a specimen of which she kept as a pet, "Queen Bess." She tethered her under mosquito netting to catch mosquitoes. She also describes related species. A second paper, "A Notable congress," is about thirteen species of flies - horseflies, blow flies, gallinippers and sow flies among others with data on their life cycles and habits. This paper was illustrated with nineteen drawings but the preceding one was not illustrated (10).

In 1863 three papers came out, the first, "Musicians of the field and wood" has detailed descriptions of how insects produce sounds. Her ability for keen observation and clear description is shown in this passage on crickets. The sound is produced as:

> One thigh at a time, with its horny protuberances, is moved quickly over and under the wing, the wing covers cross each other rapidly: the head, like a mandarin's, is shaking and scraping to and fro; the antennae beat time; the thorax is elevated to give free egress to the music; the abdomen moves rapidly up and down to allow the free action of the muscles and nerves …" (10:24:497).

Her second paper is a description of nine species of insects which are injurious to fruit, including scale insects, curculio, borers and fruit moths. The third paper is a similar one on eight insects injurious to grapes, inclduing borers, chafers, hoppers and beetles. There are no

illustrations (10). In 1864 the last paper found for her was "Soundings," a study of material brought up from the sea by the depth-sounding lead. She examined magnified specimens, attempted to identify them and provided 28 illustrations (10).

Charlotte Taylor's papers reveal a great detailed knowledge of many insects, much of which she derived from collecting, rearing and dissecting them. Her keen observations together with her experimental approach gives these reports scientific validity. Coupled with this is her appreciation of the insects' variety, their place in nature and their beauty. Her drawings are preserved in her papers but apparently many of her paintings have not been preserved. One book of them exists in the Punta Gorda Library (Taylors specimen book for 1859), in Punta Gorda, Florida. Many of these unlabelled paintings were good enough to be identifiable as to species (11). Here is a woman who studied insects for many years, wrote clearly and lucidly about them, kept some of them as pets. The details in her papers, all of which were written in later life, indicate her many years of earlier work in the studies of insects, her detailed experiments, studies and records as well as her wide reading of many writers on the subject. She was, indeed, an entomologist of the first rank.

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12. Description of the book of Taylor's paintings and its restoration in a report by Mrs. Glen Guthrie of the Punta Gorda Garden Club forwarded to the writer by the Rev. Raymond E. Davis, Jr. of Savannah, GA.

YOUTH. *Of what use is the study of Human Physiology?*

OLD AGE. It teaches us how to preserve our health; what kinds of food, air, and habits of living, will make us sickly; what practices will be likely to shorten our lives; and how, on the other hand, we shall most likely attain, with the blessing of God, a healthy and cheerful old age.

ENTITLED,

Wouldst

KNOW THYSELF!

OR

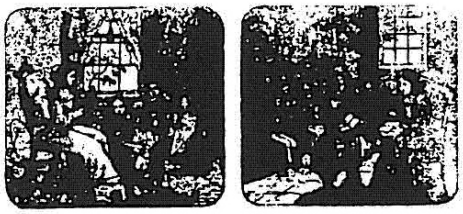
THE OUTLINES OF

HUMAN PHYSIOLOGY;

BY MRS. JANE TAYLOR.

DESIGNED FOR THE USE OF

FAMILIES AND SCHOOLS.



TO PARENTS AND TEACHERS.

THIS book may be used with great interest as a reading class book in families and in schools. The parent or teacher reading the questions and the children or pupils reading the answers; and thus reading the book through and through until the important lessons it contains shall be fully impressed upon their youthful minds.

NEW YORK:
PUBLISHED BY GEORGE F. COOLEDGE,
323 PEARL STREET, FRANKLIN SQUARE.
And also published and for sale by all the principal Booksellers throughout the United States of America, and its Territories.

Jane Taylor

Dates of birth and death not found

Very little information about the life of Jane Taylor could be found, despite the fact that her children's book on physiology was published in 10 editions during the years 1839 to 1860. A note in the 1847 edition states that the book was "entered, according to an Act of Congress, in the year 1839 by J. Orville Taylor." It could not be established what the relationship was between J. Orville and Jane, since his name was not found in such standard encyclopedias, as Appleton's, National Cyclopedia of American Biography or Who Was Who.

The first edition listed in the National Union Catalogue in 1839 was published by the American Common School Society, apparently as a textbook (1). In 1844 a revised and corrected edition was issued by Saxton and Miles of New York. An 1845 edition was published by the same firm, Saxton and Miles. In 1846 the publisher became Saxton & Huntington in Boston (2, 3, 4).

The 1847 edition was seen. It is a small book with illustrations of the bones, teeth, jaw, heart, and proper posture. The text includes not only the basic facts about physiology, but also health hints about exercise. It is in the form of questions and answers (5).

In 1848 a new edition with a changed title and increased size was brought out by the same publisher (6). A note in the 1855 edition states that the book was "entered according to an Act of Congress in the year 1839 and re-entered in the year 1848 by George F. Cooledge and Brother." The 1855 edition published by Phinney & Co. was seen. It has the familiar dialogue form in 25 short chapters, is illustrated and has a four-page vocabulary at the end. The material covers body structures, the senses, exercise and health. In the preface Taylor states as her objective:

> This little book is devoted to human physiology, and explains in an intelligible and interesting manner, the structure of the human frame, the form and uses of its several parts, the means to be employed for their

> preservation and perfection, and the sources from which danger is to be apprehended (7: preface).

The book was again published in 1856, 1858 and 1860. The 1858 book had a different title, "Wouldst know thyself!" and was "designed for the use of families and schools." It was apparently an abridged edition since it had only 64 pages.

Taylor's books apparently were very popular and must have filled a need for this sort of information. The material in the two issues which were seen is adequate to convey elementary information about the physiology known at the time. The illustrations contribute to the text. These books must have made a lot of children aware of the structure and functioning of their bodies. The details of the life of the author and her sources of information remain unknown at this time. It is to be hoped that further research will reveal more facts about Jane Taylor's 1ife.

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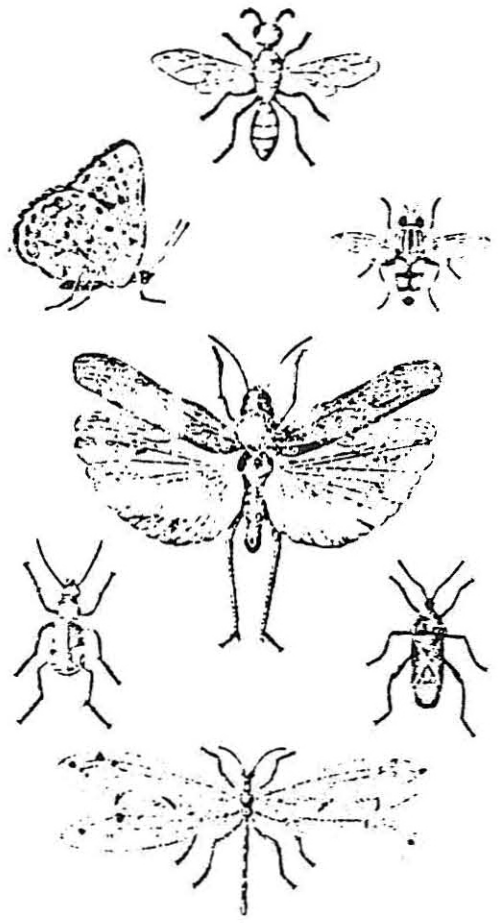
MARY TOWNSEND

ILLUSTRATIONS OF THE SEVEN PRINCIPAL ORDERS OF INSECTS.



Wood-boring Wasp, Order I.

Butterfly, Order III. Syrphus fly, Order IV.

Locust, Order VI.

Beetle, Order II. Bug, Order V.

Ant-Lion, Order VII.

Mary Townsend

b. ?, d. 1851

"Treat them with kindness, for they are innocent and helpless; treat them with respect, for they are the work of God."

[So wrote Mary Townsend about insects as quoted by Warner] (1:25). Few details were found about the life of Mary Townsend. Her name does not appear in standard biographical sources and even her book on insects is unsigned. However, Hanaford in an article on Graceanna Lewis cites a letter from Lewis establishing the fact of her authorship (2:260). Some details of her life are given in Warner's book on Graceanna Lewis (1) and some facts can be derived from the preface to Townsend's own book.

Mary Townsend came from a prominent well-educated Quaker family in Philadelphia. Apparently she was subject to a recurring illness when she became bed ridden and unable to see, but it was during one of these episodes that she wrote her book (3:vii). She had a lifelong interest in insects and their behavior.

Townsend's book was published anonymously in 1844. Her material came from her personal observations and experiments as well as from the works of other naturalists. She chose to deal with a few common insects in detail in 20 chapters which were titled "Evenings," during which an aunt talks about insects to her nieces and their friends. She takes up, in succession, the characteristics of insects, the ants, termites, butterflies, silkworms, beetles, crickets, locusts, fleas, musquitoes [sic] bees, wasps, spiders, katydids and fireflies. She not only describes the insects' structures and behavior but includes items and anecdotes of general interest, such as the uses of termites and locusts as food, wasps as the first paper makers, the habits and social structure of ants, and the life cycle of the butterfly.

There are several illustrations including one of a flea seen through the microscope (3, opp.:125). The text indicates that she was familiar with the use of the microscope. An examp1e of

her clear and succinct writing style is seen in her description of leaf rollers:

> The eggs of these caterpillars are often laid on the fence or wall above the bush, instead of on the bush itself. They hatch about the time that the young leaves make their appearance, and the little caterpillars fall down upon them, and immediately begin to draw them together, to make a covering to conceal themselves from observation. I have watched them at this …(3:61).

Despite her physical problems, Townsend was a keen observer of insect life, and also an experimenter, as her references to experiments in feeding ants and in testing the sound production of locusts show. In regard to locusts, she writes that she "found that by pressing my fingers upon the upper part of the wings, I could produce the sound made by the insect" (3, p. 29). A testimonial to her influence comes from a letter of Graceanna Lewis cited in Hanaford. Lewis writes of her friend that "Eighteen years ago she bade farewell to earth: and, after a long period, I wished for a study kindred to hers." (Lewis became an ornithologist. (2, p. 260).

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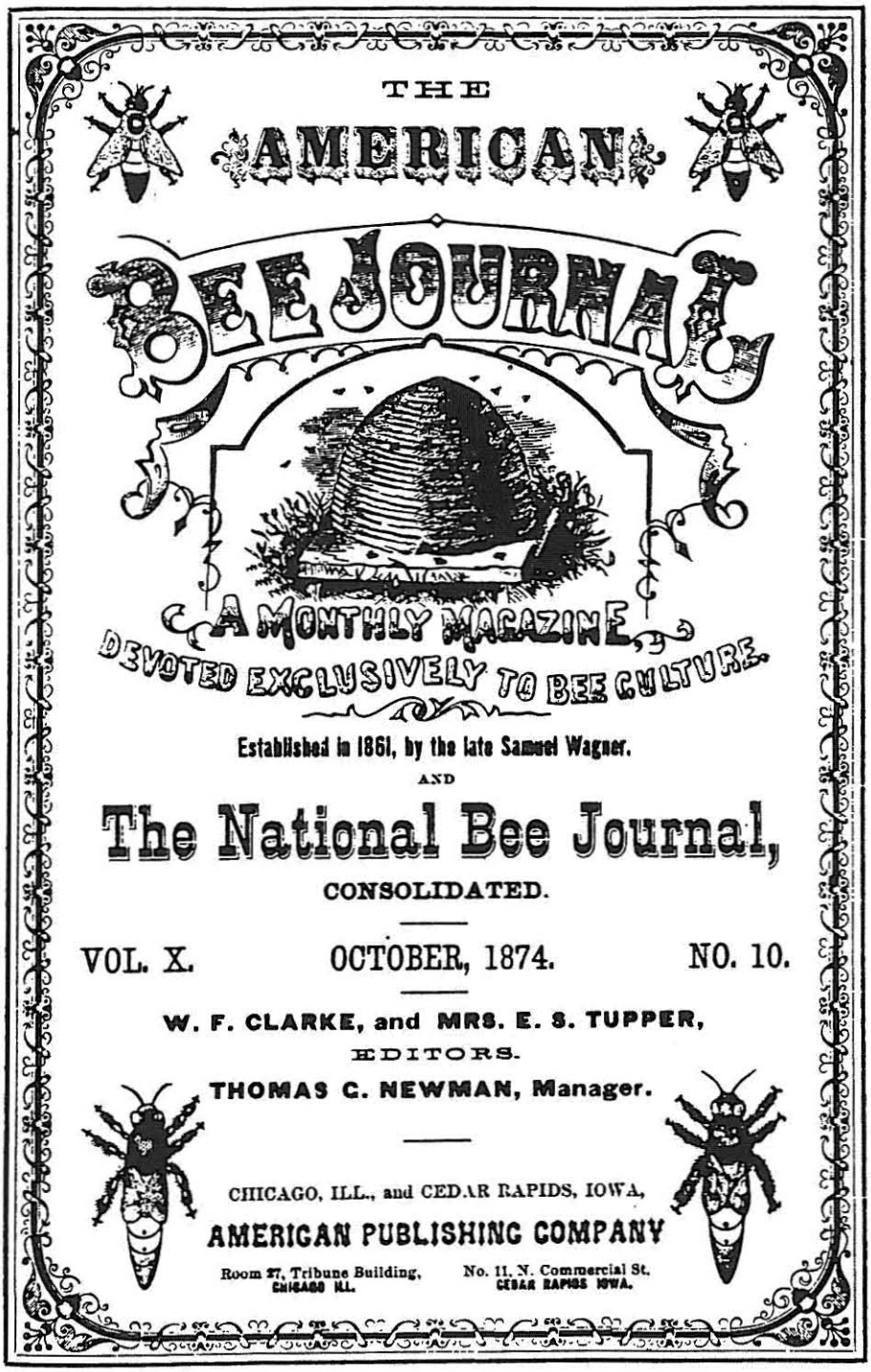

Established in 1861, by the late Samuel Wagner.

AND

The National Bee Journal,

CONSOLIDATED.

VOL. X. OCTOBER, 1874. NO. 10.

W. F. CLARKE, and MRS. E. S. TUPPER,

EDITORS.

THOMAS C. NEWMAN, Manager.

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Ellen Smith Tupper

1822 - 1888

Mrs. Tupper, in her letter to the Prairie Farmer in 1867, explains why she became a bee keeper. After recounting her early health problems and family tragedies, she reports her find of a book on bee keeping. This aroused her interest and she began raising bees in 1860. She found "great pecuniary profit" but continues:

> This, however, has been the very least part of it to me. There is always something to think about, some experiment to try, something to investigate. In short, I find an intellectual as well as physical employment (1:101).

Willard and Livermore describe Tupper's work as raising bees, writing and lecturing about them and editing a journal on the subject. In fact they state "Mrs. Tupper was for many years known as the "Queen Bee" because of her prominence as an authority on the culture of bees." She was for several years a "non-resident lecturer on bee culture before the State Agricultural College of Iowa" (2:726).

The biographical data about Tupper's life are derived from her letter cited above and from two sources contemporary with her, Willard and Livermore, and Hanaford (2, 3). Ellen Tupper is listed among eminent women by Willard and Livermore, together with three of her children, Mila Tupper, Eliza Tupper Wilkes (both of whom were ministers) and Kate Tupper Gilpin, a college professor (2:726, 744, 411).

Ellen Tupper was born April 9, 1822 in Providence, Rhode Island and died in 1888 in El Paso, Texas, at the home of her daughter, Margaret True who was the wife of a wealthy Texas businessman. Tupper's father was Noah Smith, a political figure; her mother's maiden name was Wheaton. She was well educated in a wealthy family, following the course of study at Brown University where her brother was a student. In 1843 she married a prosperous Maine lumberman,

Allen Tupper. Her health deteriorated until, as she writes, she was "under the sentence of death from one of Boston's best physicians," so the family moved to Iowa in 1851 in search of better health for her (1:100).

Tupper's letter describes the hardships of farm life which included the deaths of two children from cholera. This left her with a family of four daughters and one son. For a time she taught school to support them, but once she became interested in bee keeping she developed into an expert on all aspects of bee culture. (The raising of bees requires a great deal of knowledge about their complex behavior and biological requirements.) Her professional contributions to scientific agriculture lie primarily in her editorial writings, essays, government reports and lectures. Much of her information was derived from her own experiences in raising and selling bees and honey, and she was also well informed about current practices both at home and abroad. Her approach to bee culture was experimental and her writings reflect this. Kathy Fisher reports that she was a very good lecturer, speaking at Farmer's Institutes and, by invitation from Horace Greeley, lecturing at the New York State Fair in 1871 (4:343).

In 1863 Tupper had a long first premium "Essay on Bees" in the Iowa State Agricultural Report. This is an interesting well written article on bee keeping (which she recommends for women). This essay relates the facts about the life history and behavior of bees, their management and the equipment needed to raise them, together with a report on honey production and the profit to be gained from this enterprise (5:212-234).

The next year Tupper had another article in the same journal on bee keeping. This 1864 report deals primarily with the economics of bee keeping derived from her own experiences, including the amount of honey her own bees produced (1754 pounds), (6:143-153).

In 1865 her essay on "The Italian Bee" was published. It gives detailed directions on how to raise Italian queen bees. (Since all the bees in the hive are descended from the queen she shows the way to produce colonies of Italian bees, which she found to be better honey producers.) In this same year she had an article on bee keeping in the Report of the U. S. Commissioner of

Agriculture. It is a general article on all aspects of bee keeping including how to replace "common" bees with the offspring of Italian queens. The concluding section "Adaptation of the business to women" stresses the health and profit women can gain from bee keeping (8:458-475).

There followed a report to the Commissioner of Agriculture in 1867 on winter bee keeping. This article describes how to keep a bee colony viable through the winter in a cold climate. As in her other papers she explains the principles and problems together with data from her own experiences (9:209-211).

Tupper sent a report to the Iowa State Agricultural Society on the status of bees in the state for the winter of 1871-72, stating that nearly half of the bees in Iowa had "perished." She investigated the causes for this and decided that the losses were the result of the weakened condition of the bees because of an early cold spell and not the result of diseases (10, p. 497-499). She has now become so well known that she is referred to in the Kings' textbook as "a noted Western writer on bee culture" (11:73).

Late in 1871 the Tuppers moved to Des Moines, Iowa from Tipton. Here Ellen and a Mrs. Savery set up a partnership as the "Iowa Italian Bee Co." This enterprise failed but they did publish a joint pamphlet on bee management, in part as an advertisement for their business but it also contained considerable information about bee management (12). In this year Tupper was made an honorary member of the American Beekeepers Association. This event and her subsequent participation in meetings together with her election as a vice president are reported in several issues of the American Bee Journal (13). She was put in charge of the bee exhibit for the 1876 Centennial Celebration in Philadelphia (21).

During all these years Tupper was also writing for two professional journals, The American Bee Journal and The Prairie Farmer. The National Union Catalogue credits her with being an editor of the American Bee Journal from its beginning in 1861, but the masthead of this journal does not list her name until 1874 although a letter introducing her as editor appears in the October 1873 issue (Vol. 10 (8):241). In 1867 her first article appeared (14). From that time on Tupper

had articles and answers to letters until 1876. At times she wrote under a column titled, "Seasonable Hints" or "Notes and Queries." Some issues also recounted her activities in connection with the American Bee Keepers Association. See reference list for her articles (14).

Tupper's articles for The Prairie Farmer began in 1865 when she had a column "The Apiary" in which she wrote "Chapters on the honey bee." These appeared usually every two weeks and continued at least through 1867. Unfortunately, the manufacturer of the microfilms recorded that the volumes from 1868 to 1872 could not be found in the Library of Congress, the National Agricultural Library or the libraries in Iowa and Minnesota. Tupper had no articles in the 1872 issues, but it is not known whether or not she wrote for this journal during the years 1868-1872 (15).

Mrs. Tupper experimented with controlled fertilization of queen bees by selected drones. (This is difficult to accomplish because queens are usually fertilized during mating flights.) There has been a dispute about whether or not her method was successful. King in his textbook states that "It was Mrs. Tupper who first announced success in artificial fertilization of queens. Though pronounced impossible her statement is verified by recent experiments" (16:226). Her method is described by Pellet who reviews Tupper's article in the illustrated Bee Journal (17:99). (Tupper's original article was not available for review.) Dilley's article in the National Bee Journal states that her method "communicated to him as early as 1868 was not used successfully by him" (18: 170-171).

In 1873 Tupper had an editorial in the National Bee Journal and Magazine stating that she had become an editor. Until she became editor Tupper had had some short communications from time to time in the journal. After she became the editor there were some unsigned papers presumably by her in volumes 4, 11, and 12. [The National Bee Journal later consolidated with the American Bee Journal, hence the discrepancies in some volume numbers [19, 20, 21].

Tupper also had articles in the Iowa Homestead, a small newspaper. The early volumes have not been accessible for review except for Vol. 10 for 1865. In Vol. 10 no. 24 for January

1865 Tupper had an article on the Italian Bee. There may be more of her writings which were not found.

Tupper's official function as the person in charge of the bee exhibit at the Philadelphia Centennial apparently was never accomplished, for in 1876 she suffered a mental breakdown which ended her professional career, although King states that she recovered enough to resume her bee keeping (16: 226) . Some details of her illness are recorded in the American Bee Journal Vol. XII no. 3 (for March 1876:53, 54). She finally retired to her daughter's home where she died in 1888.

During her active years Tupper clearly justified her reputation as an expert apiarist. She was an experimenter, a clear and lucid writer and speaker and an important contributor to apiculture. Willard and Livermore summarized her career as "Mrs. Tupper was a scientist, a business woman, a lecturer, teacher and neighborhood nurse, citizen and mother … (2:726).

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FAMILIAR LESSONS

IN

MINERALOGY AND GEOLOGY,

DESIGNED FOR THE USE OF

YOUNG PERSONS AND LYCEUMS.

IN TWO VOLUMES.

BY JANE KILBY WELSH,

AUTHOR OF 'THE PASTIME OF LEARNING, WITH LESSONS IN BOTANY.'

Rocks, plains, and mountains,
'Founded on the seas, establish'd on the floods,'
Proclaim an Architect Divine.

VOL. II.

INCLUDING LESSONS IN GEOLOGY.

BOSTON:
CLAPP AND HULL, 184 WASHINGTON STREET.
M DCCC XXXIII.

Jane Kilby Welsh

ca. 1790 - 1850

A footnote in Mrs. Lincoln's Botany of 1838 refers to

> a small work entitled, "Catechism of Botany" by Miss Jane Welsh, which was the first attempt by an American lady to illustrate the science (1:234 footnote).

There is little to be found out about the details of Welsh's life. Even her birth and death dates are unknown. Since her first book was published in Northampton in 1819, it is reasonable to assume that she was born sometime in the last part of the eighteenth century and probably in New England. Even the authorship of two unsigned works was difficult to establish. With the aid of references from writers of the times and the invaluable assistance of librarians and antiquarians it has been possible to establish her authorship and a few facts about her life. See the end of this article for acknowledgements.

Welsh was fortunate in being a pupil of Amos Eaton, an early educator who encouraged women to study and to write about natural history. In his biography by McAllister a letter of his is quoted as saying "I should not omit to mention a very meritorious little work, entitled a Botanical Catechism, published in Northampton, 1819. It contains 34 pages, written in the manner of question and answer, and embraces all the essential principles of practical Botany. It is the best book for very young students, particularly for ladies' schools which has appeared. It was written by Miss Jane K. Welch (sic), of Northampton, Mass." (2: 258-259).

In her turn Welsh writes to Eaton in a letter cited in McAllister on the same pages, thanking him for his help and encouragement. The preface to her book contains a statement from the author that it might be useful as preparatory to the use of Eaton's manual of botany. There is a great deal of information in this small book, for it includes facts about plant structures and the classification of plants according to a modified Linnaen system. She advises the use of living

plant materials or of "specimens dried with care" for use in winter (3:preface).

Welsh's second book was unsigned and her authorship can only be established by a note in the title of her third book, which states that it was written by the author of A pastime of learning, with lessons in botany (5:title page). This is not exactly the same title as in (4) but it is apparently the same book and Welsh is the author. It is a much larger work of 260 pages including 16 pages of glossary, four hand-colored plates and 120 drawings used to illustrate the text.

In her preface the author states "the following pages are designed to impart in a simple manner, and by familiar conversation, some preliminary knowledge upon Botany, a subject regarded by many as beyond the capacity of the youthful mind, or not sufficiently interesting - and unimportant as a branch of female education." The text is in story form of a mother and daughter conversing with each other and with other persons, a device by which much information about plants is conveyed. Not only is the usual botanical material on plant structure, classification and nomenclature included, but also there is the addition of the practical uses of plants in dyes and medicines.

After consulting her "Tutor" (Amos Eaton) as to his opinion about her undertaking a book on mineralogy and geology, Welsh went on to produce a large 2-volume work on the subject which was published in 1832 and 1833 (2:278). These books may well be one of the earliest on the subject in the United States, because, as Goode states, Eaton himself only began to study geology in 1816 (6: 437) . The subject itself was first taught at Columbia University about 1792, and the first mineralogical cabinet was brought to the United States in 1794 (6:422-423; 430).

Welsh's two-volume work on mineralogy and geology has a total of more than 800 pages, some with illustrations, and covers a wide range of these subjects. Volume 1 is primarily on minerals, beginning with an overview of minerals and basic chemistry. The author next takes up the external properties of minerals and introduces the use of the blow pipe and the measurement of crystal angles. Experiments on specific gravity and magnetism are introduced. Following this groups of minerals are described as to their characteristics, properties and occurrence in nature.

The last few chapters deal with metals, ores and "combustibles," including coal, hydrogen, amber, asphalt and diamond. Conchology and fossils are next considered and the book ends with a "vocabulary" and an index.

The above material is presented in a format of a family discussion. Mr. G. does the lecturing and Mrs. G., their five children ranging in age from an eight-year-old to a married daughter, her child and her mother-in-law provide the students. These hearers intercalate questions and comments which serve to illuminate the topic under discussion. This book is a comprehensive and well written volume presented in an interesting family setting (5).

The second volume has this same family investigating the larger aspects of the earth. After a preliminary review of terms and theories, types of fossils and minerals, the classes of rocks are described. Landscape formations such as rivers, lakes, alluvial deposits, volcanoes, coral reefs and tides are all included. This volume ends with a chapter on metals and mines, a "vocabulary" and an index of engravings. The writer is aware of the theoretical aspects of the subject such as evolution and mountain building, and of other writers' theories. Both these volumes could be read with pleasure and profit today by anyone with an interest in the subject.

There is no doubt that Welsh was well informed in the fields of botany and geology. Testimonials from contemporaries indicate that her books were useful contributions to the learning of the day. Welsh herself in a letter to Amos Eaton testifies that the pursuits she learned from him "have subsequently been no less a solace under the privations attending my imperfection of hearing and the loss of dear friends, than uniformily a source of enjoyment to me (2:278-279).

It is unfortunate that she lived and died in such obscurity, but her comment on her pleasure in the work indicates one motivation, at least, for taking on what was indeed a large task - in so doing she helped to increase the readers' knowledge of two important branches of natural science in this early period.

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A TREATISE

ON THE

MOTIVE POWERS

WHICH PRODUCE

THE CIRCULATION OF THE BLOOD.

BY EMMA WILLARD.

NEW YORK & LONDON:
WILEY AND PUTNAM.

1846.

Emma Hart Willard

1787 - 1870

Anticaglia, in her chapter on Emma Willard in her book on twelve American women writes:

> "It was commonly accepted that all the higher mathematics any girl needed to know was how many places to set at table - - - chemistry enough to keep the pot boiling and geography enough to know the location of the different rooms in her house" (1:38).

In contrast, in 1860, Godey's Lady's Book, in a report on Willard's school stated:

> " … one remarkable feature was the ability shown [by the students] to comprehend the mechanical science. - - - In the department of hydrostatics, pneumatics, electricity, and magnetism, the apparatus is full and well assorted, and the illustrations interesting and varied. The mechanical principles and practical working of the steam engine were fully explained from a most delicately constructed model. A member of the class was the engineer, and pointed out very clearly and satisfactorily every law which regulated the movements of the intricate little machine" (2:368).

And Harveson reports in her account that "Mrs. Willard, like Miss Beecher, put her theories into practice, causing quite a flutter of excitement among college professors and professional mathematicians, when it was reported that she was teaching algebra and even geometry" (3:244).

The above quotations indicate the milieu in which Willard functioned and how she related to it. She is chiefly known for her great influence on improved education for women, her innovative teaching methods and her many popular textbooks which were primarily on geography and history, but she wrote also on astronomy and published two long papers on respiration and

the circulation of the blood. These papers caused a stir in the medical community where for a time doctors and others took sides for and against the "Willardian theory," each side conducting their arguments and rebuttals in medical journals. Willard's sister Almira Phelps presented her theory before the American Association for the Advancement of Science as a memorial for Emma. Willard herself had been a member of the organization from 1866 until her death in 1870.

The basic facts of Willard's life and career have been well documented in several biographies. This brief outline of her career is based on information from Lord, who was her contemporary, and Lutz (4,5). Lord is especially useful for its quotations from many of her letters. The home background of this woman was intellectual and liberal. Her father, Samuel Hart, had been a captain in the Revolutionary War. He was a well read businessman and farmer. Her mother, Lydia Hinsdale, was Hart's second wife, a competent stepmother to ten children as well as the biological mother of seven. Emma was born February 23, 1787 in Berlin, Connecticut, the next to last child. The last one, six years younger, was Almira, later to become famous for her own work in education as Almira Lincoln Phelps. Emma died April 15, 1870 in Troy, New York.

Emma was educated by her father and in the local schools as far as she could go. There was no high school for girls and of course no college. Willard began her own teaching career at age seventeen. At twenty three she married Dr. John Willard, a physician and politician, a widower with four children of his own. One child, John, was born to them.

In 1814 Dr. Willard suffered serious financial reverses, so his wife resumed her career. By 1819 she had formulated a plan for the improvement of female education which she had printed. It was addressed primarily to Governor Clinton and the legislature of the state of New York, but she also sent copies to such diverse celebrities as President Monroe and Simon Bolivar. It had become quite apparent to her that not only should the curricula of girls' schools be improved, but that little improvement could come about until there was the same public financial support for girls' schools as there was for boys' schools. This pamphlet outlined the defects of the present

system together with proposals for remedies. Her arguments were put together in a readable and reasoned way (6).

When Willard failed to get public support for her school in Waterford, N. Y., she moved it to Troy, N. Y. in 1821, because this town had raised a fund for her. It became established there where she developed it into a very successful enterprise with a large enrollment of young women, many of whom became teachers.

Layfayette visited her school twice during his American tour, and when she went to France he showed her every honor. Willard made two trips to Europe investigating schools and lecturing. She also made an 8,000 mile trip by stage coach to every state in the Union except Texas, to see schools, to lecture, and to visit former students.

Her many activities included memorials to Congress proposing peaceful solutions to the impending Civil War with recommendations for improving the lot of slaves (she favored their return to an African homeland); she contributed to a school for girls in Greece; she proposed a peace plan to be implemented by a tribunal of the nations to be based in Jerusalem. With her sister, Almira Phelps, she translated a book by Madame Necker de Saussaure on childhood education. Her interest in poetry resulted in the publication of some her poems, one of which was set to music and became the well known song, "Rocked in the Cradle of the Deep."

The National Union Catalogue has 158 listings for her, mostly for various editions of her geography books and Atlases, and for her different history books, some of which were translated into Spanish and German for foreign schools (7, vol. 664: 213-231). Her geography books were written for different levels of students and her history books were revised and updated from time to time over a period of years from 1831 to 1873.

Willard made a unique contribution to the study of history in her "Temple of Time" or "Chronographer of Universal History." This was a chart drawn as a temple with each pillar representing a century and inscribed with the name of the period's outstanding sovereign. On the temple floor the principal nations and battles were written on the right margin and the epochs of

history on the left. The roof bore the names of heroes. This chart was awarded a gold medal at the 1851 World's Fair in London (5: 113) . [The entry was for "maps" according to the official catalogue of the Exhibition.]

Willard's innovative approach to history was that of emphasizing large events rather than requiring the memorization of many small details. She relied on many visual aids, maps, pictures and chronological tables. Her Universal History in Perspective has the Temple of Time as the frontispiece (the history starts with the Creation in 4004 B. C.) and has 18 maps, study questions in footnotes, and dates and important events in the page margins (8).

Willard's Ancient Geography was written as part of Woodridge's Modern Geography. These together comprised a Universal Geography. She wrote in her title that it was "connected with chronology and preparatory to the study of Ancient History" (9, title page). This volume includes maps of the ancient world and its cities such as Pompeii together with instructions on the geometry of map making, explanations of latitude and longitude, and a table of meridians. Her mathematical interests are shown in her construction of charts, atlases and maps.

With respect to Willard's contributions to science, perhaps her primary contribution was to promote the inclusion of mathematics and science into her curriculum for girls. The success of these courses did much to reduce the opposition toward such subjects for women. In fact, Woody reports that Mrs. Willard regarded her introduction of higher mathematics as "epoch making" in the history of women's education in this country (10, p. 345). Since Emma Willard had been denied a higher education, she had to teach herself algebra and geometry before she could teach her students. She also received instruction in the natural sciences from Amos Eaton, who himself wrote a zoological syllabus for her school. Mary Hastings was appointed by Mrs. Willard to teach mathematics, astronomy, physics and chemistry in the Troy school. Hastings introduced laboratory work and used the same textbooks as those in use at Yale University (11:38).

Willard herself published several scientific papers. One in the American Journal of Science and Arts in 1833 was mostly of a philosophical nature on classification from the standpoint of

both the nominalists and the conceptualists. She used examples from the classification of natural objects to make her points (12:18-28).

The problem of the motive power which produces the circulation of the blood concerned Mrs. Willard for many years. She studied anatomy, attended autopsies and experimented with her own models of the circulatory system. In 1846 she published her theory in a pamphlet. In this 170-page paper, which she dedicated to Dr. Robbins, the physician at Troy Seminary, she describes her theory which she developed over a number of years. From her studies and experiments she became convinced that "Respiration, operating by Animal Heat, produces an expansive Power at the Lungs; and thus become the principal efficient cause of the blood's circulation (13:1). There follows a long well-reasoned treatise with dates derived from her experiments with tubing, liquids and heat and cold which served as her model of the circulatory system. She includes answers to objections which were raised by her critics. For a time this paper acquired advocates who did not believe that the heart alone was powerful enough to make the blood circulate. The question was argued at considerate length in medical journals, especially in the Boston Medical and Surgical Journal and the New York Medical Journal (14,15). Correspondence ranged back and forth, with Willard making rebuttals to questions posed by critics, such as what constituted for circulation in the fetus, in fish, in invertebrates and the like.

Then in 1849 her second long paper on the subject appeared. This one had the title "Respiration and it effects; more especially in relation to Asiatic cholera, and other sinking diseases." Here Willard repeats her thesis on the importance of respiration in the circulation of the blood. In her preface she states that her "Essay is the enlargement of an article, originally written for the newspaper press." After she saw some cholera patients suddenly restored to health, she felt compelled to lay these cases before the public (16; preface:3).

In this long paper Willard ascribes the bodily collapse in cholera to the failure of respiration. The cholera cases which she saw recover and her own experience with the disease, convinced her that the institution of deep and proper breathing restored these patients to health.

She herself brought about the recovery of some ill persons in this manner. It must be remembered that it was not until twenty or more years later that Pasteur and Koch established the germ theory of disease. At the time Willard published her papers, no one knew the cause of cholera, which occurred infrequent epidemics. Willard had applied for a grant from the Smithsonian Institution to pursue her experimental work on models, but instead discovered human cases to study (16:48). An account of these individual cases follows in her paper.

A synopsis of her theory of circulation by respiration was written, by request, for the U. S. Journal of Homeopathy and published in 1861 by F. Hart & Co., N. Y. An address on her paper was presented to the American Association for the Advancement of Science after her death by her sister, Almira Lincoln Phelps. This 1870 meeting was held in Troy, N. Y. The paper was not published in the Proceedings of this society, but a report was given of the address in The American Chemist, 1:100, September 1870. The paper was read by the Reverend Dr. Morris, president of the Maryland Academy of Science, and published in Baltimore by W. K. Boyle in 1870.

Willard's last publication was her astronomical geography with the use of globes, printed in 1854, 1856 and 1860. This is a 298 page book with 35 well-drawn figures. Far from just a star-gazing book, it contains quite advanced material on astronomy. Following her notes for teachers, the 26 chapters begin with a study of spheres and their geometrical properties together with the uses of globes. She then takes up the solar system with a table of the planets, their distances, diameters and revolutions. Mapping is described and the concept of the observer on earth in relation to latitude, longitude, the ecliptic and meridians follows. She endeavors to clarify the apparent revolution of the sun with the real motion of the earth by an ingenious experiment which is both illustrated and explained. She asks the student to imagine being in a boat circling a bright light. As long as he circles the light, only looking at it and the landscape, the light (i.e., the sun) will appear to move. He will not notice his motion, which is what is really happening. The writer then turns to measurement on the earth, causes of the seasons, navigation, parallax and the

atmosphere. One chapter describes the moon with clear illustrations of eclipses and phases of the moon. There follow discussions of solar and sidereal time, clocks and calendars, and concludes with 3 chapters on the history of astronomy ancient and modern and a final one on man's place in the universe which has religious overtones. There is a combined index and glossary. There are review questions in footnotes and "exercises" for the student at the ends of the chapters (17, 18).

Willard's contribution to society was threefold. As an administrator she operated a successful school through which she produced a model organization which supplied well educated women, many of whom became teachers. In doing this she laid to rest the objections of many toward training women in science and mathematics. As a teacher she was an innovator in the classroom, introducing laboratory work as part of her science courses. She was also a writer of very successful textbooks, which were so well organized that they could be used either in the classroom or at home. In his list of textbooks used in schools, Woody mentions three of her geography books, seven of her history books, her astronomy book and her essay on the circulation of the blood (10:556, 557, 560). Her attitude toward teaching and textbooks can perhaps be shown by her comment on history quoted by Lord, "History should not weary the mind."

As a scientist she promoted education in science with the inclusion of laboratory work at a time when science was not thought appropriate for females. While her long term study on the subject of respiration and circulation of the blood is no longer valid, her experimental approach still is. In the context of her times it was an appropriate approach to a little understood phenomenon. Not the least of Willard's achievements was her training of her sister Almira, who became an established teacher and writer of textbooks in her own right. Willard was a great traveler, a writer of poems, a firm believer in healthful activities for the body. She had no doubts that young women could be strong, healthy and mentally stable enough to master "even geometry."

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Summary

The foregoing material has been collected in order to provide information about the achievements of women who were active in science in the early days of this country, before the Civil War. While today there are many more opportunities for women in science because graduate schools are open to them, and professional careers can be had, this has not always been so. What of the early women, many of whom were denied entrance into colleges and paying careers despite their interest in science? Did they participate in scientific organizations? Did they produce works of scientific value? The records in the scientific publications of the period show that indeed they were active in many ways, as donors to museums, as members of scientific societies, as experimenters and writers of scientific books and papers. Data on donations, memberships and other activities have been presented in Part 1.

Women have been members of scientific organizations from the time of Lucy Say's election to the Philadelphia Academy of Natural Science in 1841 until, of course, to the present day. Two years after the founding of the American Association for the Advancement of Science in 1848 two women, Maria Mitchell and Margaretta Morris became members. Women became members of state societies of science as soon as these organizations were founded. In general these organizations had no restrictions on women as members written into their constitutions, but naturally women were a small minority in the earlier groups.

Woman donors to societies were of two groups, those who gave collections to museums and those who gave money for scientific pursuits. Donors of collections ranged from those who gave a single item, which was duly recorded by the curator, to givers of large valuable collections of specimens, books and papers. Some of these biological materials had been collected by the women themselves for the purpose of adding to a museum's store of specimens. The earliest known woman collector was Hannah Williams, who sent specimens of animals and plants to an apothecary in London in the early seventeen hundreds. Money given for scientific pursuits ranged

from small sums given by participants in fund raisers to the sum of $74,000 given by Mrs. Binney for an astronomical observatory.

One large group of women collected daily weather data for the Smithsonian Institution, beginning in 1847. They were supplied weather instruments for these measurements by the Smithsonian. The Smithsonian project continued until 1873.

As teachers of science women functioned at every level from elementary schools to college. In addition they wrote many useful textbooks for schools, some of which at the elementary level were written in a dialogue form. These question and answer books could be used for teaching children at home. Usually the child asked a question of the mother, who then responded with the answer. Also many informative articles were published in magazines. The women's own research was published in scientific journals.

In short, women participated in all kinds of scientific pursuits. The fact that many of these women had no academic degrees or professional status did not seem to detract from their acceptance. They could join scientific societies, attend meetings and publish in scientific journals. It is possible that some women may not have succeeded in achieving any of these goals, but in this case they could not be found in reference materials. Only women of whom some written record exists have been described here.

The record does show that women had the interest and the drive to work in science in these pre-Civil War years. The question remains why did they do it? What was in it for them? The answers are as varied as the twenty-two women themselves who published books and papers about science. Some were teachers who wrote textbooks for their own use. Several collaborated with their husbands or other relatives. Some wrote professionally for magazines. Some had primary concerns in some other field, but maintained their interest in science.

In Part II the twenty-two women whose publications have been found are listed, a short biography of each one is given, and an evaluation of her work is provided, together with a bibliography which includes all of her scientific publications which could be found after a careful

search of the available literature. Much more is known about some of the women than about the others, but all fulfill the criterion of having published books or articles on some aspect of science. These works have been evaluated by the writer from the viewpoint of their scientific worth as judged in the context of the times. In the eighteenth and nineteenth centuries no man or woman, Harvard professor or gifted amateur, was writing about the science we know today of nuclear physics or biochemical genetics. However, it will be seen that these women's contributions to education in science, to research and to furthering the progress of science were substantial, and were accurate scientifically.

Two sisters, Emma Willard and Almira Lincoln Phelps became very successful educators and writers of textbooks. They established a school for girls, Troy Female Seminary, in Troy, New York. Here they taught using innovative methods for teaching science. They used many of their own books on geography, chemistry, astronomy and botany. Their school became known nationwide. Mrs. Phelps' book on botany sold over a half a million copies. Neither sister had ever gone to college.

Two of the women had professional careers in medicine, Mary Putnam Jacobi and Lydia Folger Fowler. Both had medical degrees. Both women married men in their own fields and worked with them. Both women published on medical subjects. Jacobi was especially prolific with more than a hundred articles to her credit.

Four of these women were expert research scientists. Three of them experimented on insects, rearing them in their own homes and gardens. Here they studied their life cycles, their behavior and their interactions with the environment. The fourth, Ellen Tupper, became a professional apiculturist. She raised her own bees, corresponded with beekeepers, lectured and wrote about bees. Charlotte Taylor studied many kinds of insects, rearing them through their life cycles and writing popular charming articles for magazines. These articles she illustrated with her own drawings. Margaretta Morris became well known for her research on the Hessian fly, a serious pest of wheat. She published her research in scientific journals. A very different type of

research was pursued by Eunice Foote, who studied the effects of the sun's rays on the temperature of gases. She also did research on electromagnetic phenomena. Nothing was found about where she did this research which must have required access to laboratory equipment.

One woman can be characterized as a popularizer of science, for she wrote for such magazines as Popular Science and Harpers. Sophie Herrick was an educator, editor and publisher of articles on nature which were illustrated by herself.

Four women collaborated with their husbands, Mary Jacobi and Lydia Fowler who were mentioned above, and two others, Elizabeth Agassiz and Eunice Cutter. Agassiz was the wife of Louis Agassiz, a professor of geology at Harvard University. She taught natural history to girls, using her husband's material, and was instrumental in facilitating the establishment of Radcliffe College. She traveled with her husband on his explorations, where she kept journals of the trips. These interesting accounts from a keen observer were later published. She also wrote two small books on sea organisms to be used by teachers. Eunice Cutter adapted her husband's books on physiology for the use of elementary school students.

Both Laura Johnson, a teacher who wrote a botany textbook, and Jane Welsch, who wrote geology and chemistry books, had the encouragement of Amos Eaton, who was an educator at the Rensselaer Institute. Hannah Bouvier dedicated her astronomy book to her father for his "solicitude and parental instruction." Maria Mitchell learned astronomy as a young assistant to her astronomer father. She went on to become a successful professional as a professor of astronomy at Vassar College, although she had never gone to college.

Two women who had absorbing interests in other fields also wrote on science. Catherine Beecher, a reformer who regarded women as important both as teachers and homemakers, wrote both an arithmetic book and books on household management. She was also something of an inventor, as is evidenced by her designs for household equipment such as waterbeds for invalids, for example. Dorothea Dix is best known for her reforms of nursing and of the care of mental patients, but she found time to write small books on natural history, collect rocks and publish

papers on moths and spiders.

Lesser known authors of books on science are Helen Conant who wrote an introductory text for entomology, Jane Taylor who published children's books on physiology, Mary Townsend, an invalid who studied and wrote about insects, and Mary Swift, whose elementary physics book was translated into Burmese.

Twelve of the twenty-two women were married, six were single, and the marital status of the others is unknown. Nine of the married women had a total of 21 children. The family size ranged from one child to two women who had five children each. Three of the women had a total of thirteen stepchildren. It is apparent that the stereotype of "old maid" does not apply here. In fact, several of the most productive women in this group were married with children, including Jacobi, Willard and her sister Phelps, and Ellen Tupper.

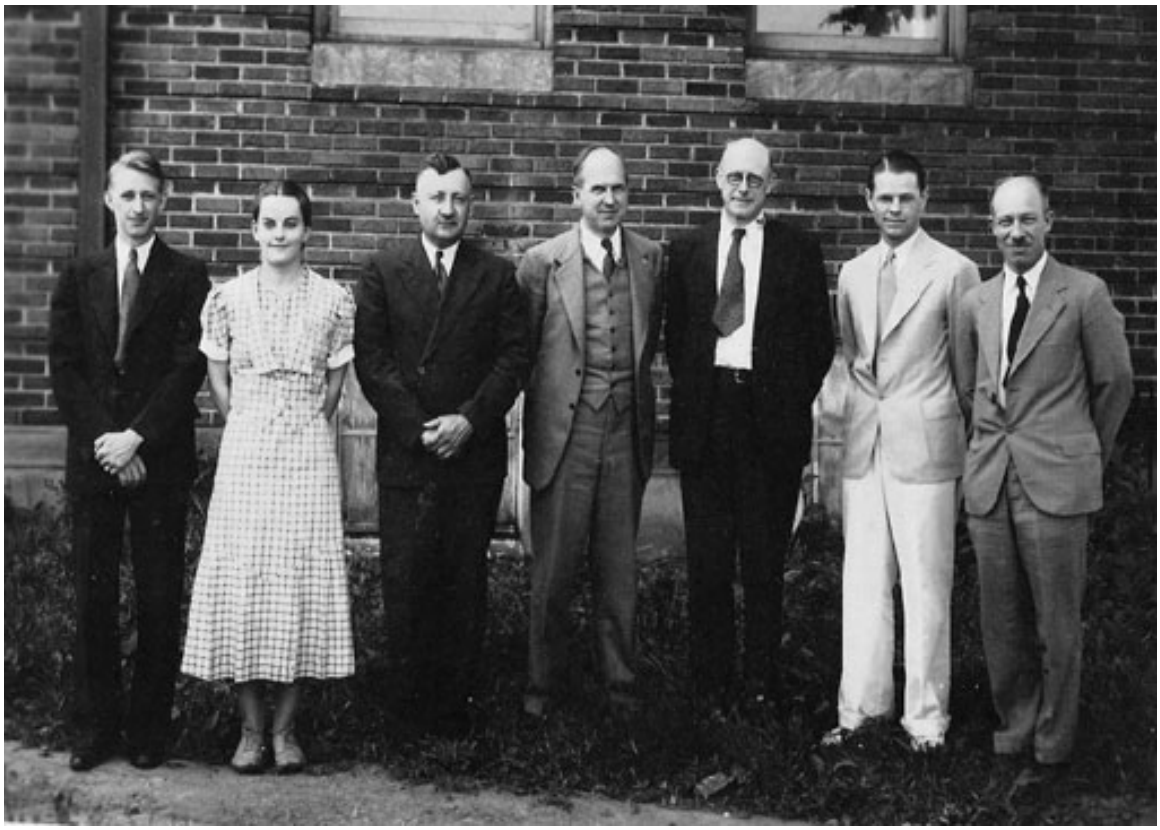
It is obvious that there is much still to be done in learning about these women, especially the lesser known ones such as Mary Swift. There remain archives to be searched and diaries to be found and read. It is to be hoped that records of these women exist which will reveal more of their lives, activities and motivations. The material found in scientific journals and in biographies of the better known women has been presented here, but there may be much more to be found by other research workers in the archives of museums and libraries. It is to be hoped that other workers will want to investigate in greater depth these women of science, from the ones who collected specimens, illustrated books and gave money, to the ones who did leave written records of their scientific pursuits.

Since the material in part two has been restricted to women who have published books and papers, there is still much to be learned, especially about the women who were teachers who did not publish, but who inspired their students to undertake careers in science. These women seldom got credit for their influence. One example of a well deserved tribute to a teacher appeared in the Harvard Magazine in the 1987 May-June issue. The Vita of Walter Bradford Cannon is a summary of his life as was supplied by the authors in a biography of his life and work entitled

Walter B. Cannon, the life and times of a young scientist, by Saul Benison, A. Clifford Bargar and Elin L. Wolfe, Cambridge, Mass. Belknap Press. 1987. Walter B. Cannon, 1871-1945, became a famous professor at Harvard. He was a pioneer in the research and teaching of physiology with a world wide reputation. He was also a social activist, interested especially in helping young students and his tribute to his high school teacher is included in this biography. May (Mary) Newson was his high school teacher in St. Paul, Minnesota. She was the primary influence in advancing his career in science. She saw the academic promise in this boy and encouraged him in every way. She took him into her home, talked to him about books, encouraged him to dream about his future. She even traveled to Harvard so she could supply him with details about the college. She investigated sources of financial help for him, finally procuring enough money for him to enroll.

After he went to Harvard as an undergraduate and later as a medical student (she had advised him to go to medical school) she continued to write to him and to encourage him when he needed help. In turn Cannon helped other Harvard students who came from his home state of Minnesota. He is quoted in this Vita as saying, in reference to Miss Newson, that "he would never be able to repay her." No doubt many other teachers deserve a similar tribute.

Biography of Elizabeth Reed



Elizabeth Wagner Reed, Ph.D. is a retired professor of women's studies at the University of Minnesota, where she taught the biology of women course. Her work for a doctorate in biology included courses in botany, zoology, chemistry, mathematics, physics and astronomy. She has had a career in teaching and research in biology.

Her teaching years were spent at Vassar College, Atlantic Christian College, Ohio Wesleyan, and the University of Minnesota.

She has published more than thirty papers on botany, genetics and the biology of women. She is senior author of a book on mental retardation, together with several workbooks for curricula in elementary school science.

She is the wife of Dr. Sheldon C. Reed and has three children.

[Elizabeth W. Reed died July 14, 1996.]

Afterword

Elizabeth Reed encountered and resisted sex discrimination throughout her career. She researched and wrote this book to refute the claim that there had never been women scientists. The book was to have been published by Pergamon Press as part of their Athena series, but a hostile takeover of the company prevented this, so the author published American Women in Science Before the Civil War privately. The book was reviewed in Science but I have been unable to locate this review.

If you would like to make a donation in support of women scientists please direct it to the Elizabeth Reed Outreach Fund, Sigma Delta Epsilon Xi Chapter, accessible through the SDE website.

Catherine Reed