

One century after Marian Lydia Shorey, a fleeting star at the inception of the long path to the discovery of Nerve Growth Factor

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Abstract. This article, the third of a series dedicated to Rita Levi-Montalcini's and her discovery of the Nerve Growth Factor (NGF), deals with an almost unknown American scientist, Marian Lydia Shorey. In 1909, in her dissertation thesis at the University of Chicago, Shorey reported the results of experiments made on the chick embryo that set the stage for further research leading to the discovery in the 1950s of NGF. Thereafter, this discovery path was marked first by the work first of Viktor Hamburger, afterwards by Rita Levi-Montalcini and Giuseppe Levi, and eventually by the research of Levi-Montalcini and Stanley Cohen in Hamburger's lab in St. Louis. As we will see, despite the importance of Shorey's results, she disappeared from the annals of science largely stemming from the personal and social events of a sad life concluded tragically just one century ago, in 1922.

Key words: Marian Lydia Shorey, neuroembryology, Nerve-Growth-Factor, Rita Levi-Montalcini, Viktor Hamburger, Giuseppe Levi.

UN SECOLO DOPO MARIAN LYDIA SHOREY, UNA STELLA FUGACE ALL'INIZIO DEL LUNGO CAMMINO DI SCOPERTA DEL NERVE GROWTH FACTOR

Riassunto. Questo articolo, il terzo di una serie dedicata a Rita Levi-Montalcini e alla sua scoperta del Nerve Growth Factor (NGF), è dedicato alla storia di una scienziata americana quasi sconosciuta, Marian Lydia Shorey. Nel 1909, nella sua tesi di laurea all'Università di Chicago, Shorey riferì i risultati di esperimenti effettuati sull'embrione di pulcino che posero le basi per le successive ricerche che, negli anni '50, portarono alla scoperta dell'NGF. Dopo di lei, questo percorso di scoperta è stato segnato inizialmente dal lavoro di Viktor Hamburger, poi da quello di Rita Levi-Montalcini e Giuseppe Levi, e infine dalle ricerche di Levi-Montalcini e Stanley Cohen nel laboratorio di Hamburger a St. Louis. Come vedremo, nonostante l'importanza dei risultati di Shorey, la sua figura è scomparsa dagli annali della scienza in gran parte a causa delle vicende personali e sociali di una triste vita conclusasi tragicamente proprio un secolo fa, nel 1922.

Parole chiave: Marian Lydia Shorey, neuroembriologia, Nerve-Growth-Factor, Rita Levi-Montalcini, Viktor Hamburger, Giuseppe Levi.

In 1986, Rita Levi-Montalcini was awarded the Nobel Prize for the discovery of Nerve Growth Factor (NGF), a chemical agent released during the embryonic development, by certain peripheral structures capable of controlling the growth and differentiation

of specific groups of nerve cells.¹ In her Nobel lecture, Rita made no mention of the fact that the experimen-

1 - On Rita Levi-Montalcini, besides the two articles already appeared in *Confinia Neurologica et Cephalalgica* (1, 2), see, moreover, a volume edited by Marco Piccolino in 2021 (3).

tal work leading her to that prestigious distinction was a continuation of the experiments carried out many years before by Marian Lydia Shorey, a young woman from Maine. (4) Shorey studied the development of the nervous system in the chicken embryo starting possibly in 1907 and wrote up the results in 1909 (the year of Rita's birth). (5) Her research was carried out at the University of Chicago, under the supervision of Frank Rattray Lillie, a prominent American zoologist, who was well known, particularly for introducing the chicken embryo as a model preparation in experimental embryology. Two years after her 1909 paper, Marian published another article, but thereafter she was forgotten by the scientific community, despite the fact that her experiments stimulated further significant research in the field of neuroembryology. (6)

In her Nobel speech, Rita gave appropriate mention to the role of two mentors in the discovery path of NGF. One was the famous histologist, Giuseppe Levi, her teacher at the University of Turin, who collaborated with her in crucial experiments carried out in a home laboratory, *a la Robinson Crusoe*, she established during the years of the last world war and of racial persecutions. The other was Viktor Hamburger, a prominent embryologist, who was Rita's mentor at the Washington University of St Louis, where she, together with Stanley Cohen, made the final experiments of NGF discovery. (1, 4, 7)

These three scientists, Hamburger, Levi and Levi-Montalcini were all of Jewish ancestry and worked under difficult conditions during the period of racial persecutions in Europe. In the path leading to NGF discovery, Hamburger and Levi represent a kind of intermediate link between Marian Lydia Shorey and Rita Levi-Montalcini.

In 1932, Hamburger took the occasion of a research fellowship from the Rockefeller Foundation to leave his native country then undergoing a massive nazification, and emigrated to America. The laboratory chosen by Hamburger for his research happened to be that of Lillie in Chicago, i.e. the same in which more than twenty years earlier Shorey made her experiments on the development of the nervous system in chick embryo.

In 1983, in a video interview at the Washington University of St Louis, Hamburger narrated to the in-

terviewer, Dale Purves, the way it happened to him to enter the research path opened by Shorey's 1909 experiments and culminated many years later in the discovery of the NGF. After recalling that, in 1931, his mentor at the Freiburg University in Germany, the Nobel Prize winner Hans Spemann, had proposed him as a candidate for a Rockefeller fellowship to work in the Lillie's laboratory in America, Hamburger added:

That was extremely fortunate because Lillie's was the only laboratory in this country that worked with chick embryos, and in 1909, that means twenty-two years before I came here, he had a student who had tried to kill wing buds in the chick embryo to see how the nervous system was reacting. How Lillie ever got that idea, I don't know. Then, Miss Shorey, who did it, disappeared from the literature, so I couldn't ask her either.²

There are two main points of interest in this passage of Hamburger's interview. One is his curiosity about the way Lillie "ever got that idea" to launch the research which was carried out by Shorey as the subject of her PhD dissertation in the Chicago laboratory. The second point concerns how and why "Miss Shorey [...] disappeared from the literature".

With regards to Hamburger's curiosity about the beginning of Shorey's experiments, a remark can be made. In fact, the theme and the plan of Shorey's dissertation experiments were a logical, and predictable, consequence of the embryological conceptions and of the experimental programs that Lillie had been developing in those years, as a research manager at both the Chicago Zoological Institute and at the Woods Hole Marine Biological Laboratory.

As already mentioned, Lillie, a pioneer in the field of developmental biology, had been instrumental in introducing the chicken embryo as a reference preparation. This he did especially with the publication, in 1908, of the volume, *The development of the chick, an introduction to biology*. Besides defining and systematizing the various phases of embryonic growth, in his book the American scholar promoted, against a consolidated tradition based mostly on morphological investigations, a

2 - The interview realized on June 30th 1983, can be found, in both oral form and transcript, at the following webpage: <http://beckerehibits.wustl.edu/oral/interviews/hamburger.html>

dynamic and physiological vision of the study of development, which he defined as “developmental physiology” or “experimental embryology” (8).

Here is what he wrote in the introductory part of the volume:

Development is as truly a physiological process as secretion, and as such is to be studied by similar methods, mainly experimental. The limits of pure observation without experiment are soon reached in the analysis of such a complex subject as the physiology of development; experiment then becomes necessary to push the analysis of the subject farther, and to furnish the true interpretation of the observations. (ref. 8, pp. 7-8).

Summarizing his approach to embryological studies, Lillie considered, among the principles that underlie the growth of the embryo, the influence of extraorganic conditions on the formation of the embryo, and the effects of the intraorganic environment, i.e., of component parts of the embryo on other parts (“correlative differentiation”).

This theme, already at the centre of Lillie’s first studies on the chicken embryo, was based on a non-preformistic conception of embryonic growth. For Lillie – far from being programmed in every detail – the harmonic growth of organs or parts of organs depends on the reciprocal interactions of nearby structures and in their functional relationship, and this integrated, or “correlated” interaction is supposed to occur mainly by means of diffusion through the extracellular environment.

The chicken embryo, Marian Lydia Shorey and the birth of experimental neuro-embryology

The interdependence of the growth of parts of the organism was the theme developed by Shorey in her studies for the doctoral thesis, undertaken on the advice of Lillie, in the Department of Zoology in Chicago, and with the chicken embryo as the preparation of choice.

In line with the conception of “experimental embryology”, Shorey conducted a series of experiments investigating the effects of the removal of peripheral structures on the development of the nervous system at the level of the spinal cord. Using fine sewing needles as electrocautery probes, the young scholar (Marian

was 36 years old in 1909) destroyed the buds of one of the two wings in the embryo, leaving the other intact as a control. She found out that this manoeuvre led to a reduction in the number and size of the precursors of nerve cells (neuroblasts), in particular in the motor columns of the spinal cord and in the corresponding sensory ganglia (i.e. those normally assigned to the motor or sensory innervation of the wing). Based on a series of considerations, she interpreted these effects as due to a failure to grow (hypoplasia).

In search of an explanation for these effects (and focusing her attention mainly on motor cells), Shorey then selectively destroyed some segments of the muscle buds (somites), and noticed that – even when the destruction was complete – a substantial percentage of apparently intact cells (about 40 percent) remained in the corresponding spinal nerve segments. She attributed this effect to the action exerted on these nerve segments by the adjacent, undestroyed somites. Since there was no anatomical relationship of innervation between somites and mismatched nerve segments, Shorey concluded that the observed effects were a consequence of the action of a soluble factor that, through the lymph, diffused into the extracellular environment, reaching targets located at a distance from the injured structures.

In her words:

Differentiation of any cell must therefore occur because of a change in the chemical composition or physical properties of the lymph surrounding it. In the case of neuroblasts, the cells outside the medullary tube [that is, the spinal cord] are also differentiating and the products of their metabolism must change, either in kind or amount, and these products must enter the lymph. It is therefore evident that the presence or absence muscles in a given somite must influence the character of the medium surrounding the neuroblasts in its immediate vicinity, and thus a change in the chemical inter-actions may be effected. (ref. 5, p. 53).

Her conclusion was in line with Lillie’s aforementioned conceptions, according to which the integrated growth of the parts of the organism depends on the composition of the so-called “intraorganic environment”. With an *a posteriori* view, Shorey’s explanation can be posited to depend on a specific chemical factor,

or factors, released from the growing muscle and acting as a messenger on the nerve structures responsible for its innervation. It must be noted, however, that the language used by the American scholar betrays the fact that she rather conceived of a possible nutritional-metabolic action of the factor released by the embryonic muscle tissue, rather than of a messenger-type chemical effect.

In her “integrative” and interactive conception of nerve growth (reflecting – as we know – Lillie’s ideas), the American scholar went even further. Shorey denied the possibility that neuroblasts could emit the extensions destined to become nerve fibres, in the absence of the necessary metabolic substances released by growing muscles (or by other structures, for example the skin in the case of sensory nerve cells). She even dared to contest the results obtained two years before by Ross Granville Harrison with his pioneer studies of cell cultures. In his landmark experiments, Harrison had demonstrated that an isolated nerve cell is able to emit the fibre, independently on the action of other cells (Harrison, 1907). In Shorey’s view, the normal growth of isolated nerve cells depended on the fact that the lymph used as culture medium contained factors capable of stimulating the growth of the cell and its processes.

Here’s how she put it:

Harrison’s experiments, described above, in which portions of the medullary tube placed in a drop of lymph developed nerve fibers, are open to the objection that the lymph necessarily contained products of the metabolism of various organs of the body, and it is therefore not certain, indeed it is improbable, that the neuroblasts were removed from the influence of end organs whose physiological activities were similar to those which they normally innervated. (ref. 5, p. 55)

To increase support to her interpretation, in 1911 Shorey published a preliminary report based – as she puts it – on a small selection “from a great numbers of experiments” conducted with in vitro culture methods. With these experiments, she believed to have proven that, in the absence of external chemical factors, nerve fibres do not develop properly. In her opinion, the experiments she carried out on urodele amphibians (*Necturus*) provided important support for her working

hypothesis. She did not see any development of nerve fibres when the culture medium was not supplemented with an extract of ox meat. (6)

The highly critical position adopted by Shorey in relation to Harrison’s conception of the “independent growth” of nerve cells (a conception that in the early decades of the twentieth century was amply supported by scholars), undoubtedly contributed to relegating her into a kind of limbo. Additionally, Shorey’s data were in disagreement with studies on the effects of ablation of limb segments, obtained in the 1920s by the American scholar Samuel Randall Detwiler, a student of Harrison who had used for his studies another type of urodele amphibian, the *Ambystoma* salamander. (9-10)

In conclusion, without any doubt, Shorey’s work contributed fundamentally to the path of discovery of the mysterious factor of neural growth discovered by Rita and her collaborators about fifty years later. Although conceptually still within the limits of the science of her time, the young American scientist had revealed an important (but slow to be fully recognized in subsequent studies) aspect of the factor controlling the embryonic growth of the nervous system, i.e. its chemical nature. As a matter of fact, in their initial studies on the ablation of peripheral structures in chick embryo, both Hamburger and Rita and Levi, had failed to recognize the chemical nature of the peripheral agent potentially capable of controlling the growth of the nervous system.

Hamburger, in his studies in Lillie’s lab in Chicago in the 1930s, confirmed to a large extent Shorey’s experiments, by using a more refined technique to extirpate the peripheral buds of the chick embryo. He proposed, however, a totally different interpretation of the action exerted by the peripheral structures on nervous development. (11) His hypothesis was based on the involvement of central nerve fibres of a particular type that would act as “pathfinders”. These fibres would enter the peripheral tissues and would then somehow transmit to the nerve centres the stimulus responsible for neuroblasts growth. In the case of ablation of peripheral tissues, these pathfinder neuroblasts would fail to transmit the physiological stimulatory message and a reduced nerve growth would ensue.

This is the way Hamburger imagined the action of these fibres:

We must charge the end organs of these first pathfinders with the double task of locating the peripheral field, and, in some way, ‘reporting’ back centripetally to the central organ the approximate size of the field to be innervated. The fibers would communicate the result of their exploration to their own cell bodies which thus would become the first relay station for the stimulus to be transmitted. Under the influence of the stimuli these nerve cells, which are not yet fully differentiated, when they have sent out their axones, would undergo a morphological or physiological change. (ref. 11, p. 475).

As to Rita and Levi, in experiments carried out during the war period in the home laboratory, *a la Robinson Crusoe*, the two Italian scientists came to a conclusion different from Hamburger’s, which – however – also excluded the intervention of a diffusible, chemical agent. They assumed that the degeneration of the embryonal nerve cells, that followed peripheral ablations, was the consequence of the impossibility of the growing nerve fibres to establish proper synaptic contacts with the peripheral structures (see ref. 3).

In Rita’s subsequent studies, carried out after the end of the war, in Hamburger’s laboratory in St Louis, the perspective eventually changed when the chemical nature of the trophic agent involved in these experiments became clear. This occurred following the utilization in these studies of mice carrying a particular type of tumour capable of inducing effects similar to those of the mysterious peripheral agent. The injection of tumour extract into the allantoic cavity of the embryo was able to produce an extraordinary growth of cells and nerve fibres throughout the organism, in the absence of any direct contact between tumour cells and peripheral tissues. Moreover, a similar astonishing growth was produced in isolated nerve cells in culture when the tumour extract was added to the culture medium (the “halo effect”). Finally, the chemical nature of the nerve growth agent was confirmed by “immuno-sympathectomy” experiments, consisting in the suppression of the growth of the sympathetic system induced by the administration of antibodies against the chemical agent whose precise chemical structure was yet to be identified. (see refs 3 and 7)

These results revived, although in a modern and more specific form, Shorey’s conception on the chem-

ical nature of the agent involved in the ablation experiments in chick embryo.

Marian Lydia Shorey: fragments of the life of a woman scientist in the early twentieth century America

An unknown scholar

After the Nobel Prize awarded to Rita and Stanley Cohen for their experiments leading to the discovery of NGF, Shorey’s name re-emerged in scientific literature from which she had disappeared many years before (as remarked by Hamburger in his 1983 interview). However, until very recently, almost nothing was known of the life and career of Marian Lydia Shorey, and the few biographic elements sporadically found in articles and websites are often sources of error.

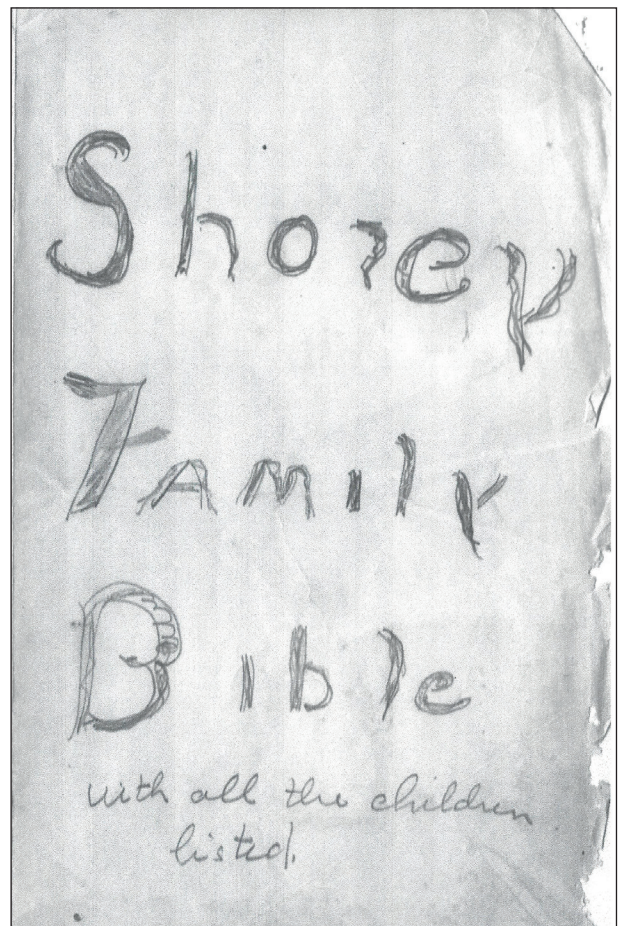


Figure 1. The title page of the manuscript “Shorey Family Bible”, containing information on the Shorey family since the end of the eighteenth century.

The name is frequently misspelt (Marion, Mariam), or frankly wrongly written (Elizabeth)³. Sometimes, she is even assumed to be a male researcher by people who quote “his” work, probably without reading “her” papers.⁴

Things have changed in a substantial way with the research on Shorey’s life that one of us (M.P.) started three years ago in collaboration with Germana Pareti of the University of Turin. This article, written one century after Shorey’s death, is an attempt to draw her figure out from the darkness of the times and, in some way, to beget her a posthumous historical justice.⁵

Our research on Shorey has involved a search of all possible places and institutions that might provide information on her life and career, encompassing the consultation of books, journals, local reports, directories of scientific societies, “College Yearbooks”, newspapers, census registers, lists of passengers of transoceanic ships and genealogical sites. In the end, it was not unfruitful, thanks to the competence and kindness of many persons around the world, from North America to South Africa. Among them Lisa Simpson Lutts, Debra Morehouse, Carolyn M. Picciano, Erin K. Dix, Cornelis Plug, Raymond Butti, Joseph Doore and many others who have actively collaborated in the attempt to add fragments to an incompletely documented biographical portrait.

Marian’s life has emerged as a kind of painful counterpoint to the “luminous” story of Rita, who – as

already mentioned – was born precisely in 1909, the year of publication of Shorey’s thesis work.

Settlers in the Northeastern regions of the U.S.A.

Unlike Rita Levi-Montalcini, Marian Lydia Shorey was of a modest social background. She belonged to a large family of farmers and lumberjacks of Albion, (Maine), in the Northeastern United States), and had managed to embark on a research career through a complex and difficult educational background.

Marian’s ancestors had settled in Albion in the early 19th century. The first Shoreys to arrive in this region, very rich of forests and water, were Daniel, Edmund and Phineas Shorey (21, 19 and 17 respectively), three out of the ten children of Samuel Shorey

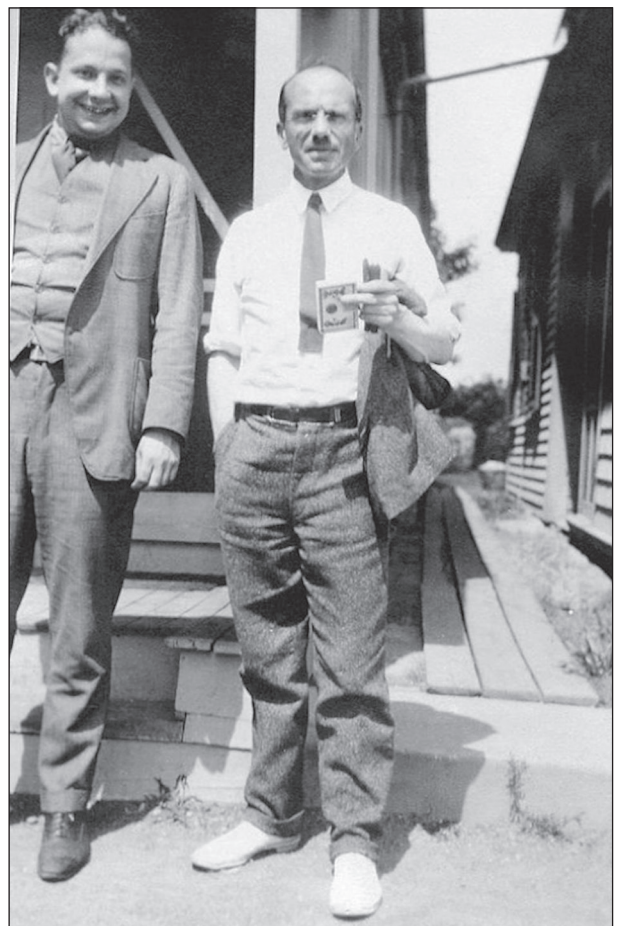


Figure 2. Frank Rattray Lillie, 1870-1947, (on the right) together with a colleague in a picture from the Archives of the American Philosophical Society ©.

3 - See for instance Lijing Jiang in the “*Embryo Project Encyclopedia*” web-site: <https://embryo.asu.edu/pages/viktor-hamburgers-study-central-peripheral-relations-development-nervous-system>

4 - In the 1909 paper (ref. 5), the one alluded to by Hamburger in his interview (and the first of the two articles authored by her), the names of Marian Lydia Shorey are indicated in full. However, in the index of the volume VII of *Journal of Experimental Zoology*, she is indicated as M. Louise Shorey. In the second paper the second name (Lydia) is indicated only by the initial. The error of alluding to Shorey as a male author occurs for instance in a book on the scientific and social aspects of biology published in 2001 by Garland E. Allen and Jeffrey Baker (ref. 12). The error is repeated by Allen, a student of Viktor Hamburger, in a historical paper on his teacher’s life and work published in 2004, (ref. 13).

5 - Trying to put in the light of history a personage almost entirely “disappeared” (except for two scientific articles she left) has been as making a work somewhat similar to that done by Patrick Modiano for another lost female personage, Dora Bruder. Dora was a Jewish teen-ager disappeared in the 1941 Paris under the Nazi occupation, and eventually reappeared, just to be deported to Auschwitz in 1942 and vanish in the tragedy of the Shoah. (14)

and Elizabeth (Betsey) Woodsum.⁶ They had left their home and their parents in Berwick Maine, about 130 miles south, and were proceeding north, looking possibly for a land grant on which to build a farm and thus settle (Crosby Wiggin, 1963). (15)

After having being informed that there was a property of about 600 acres in the southwest of Albion that could be obtained without money, Daniel and Phineas decided to settle there. They engaged to fulfil the legal and residential requirements needed to obtain it (which included, among others, “[to] build a sawmill and erect a house”). Edmund decided to go farther north, while Daniel and Phineas eventually built the required house and the mill near a waterway and forest. Daniel married Betsey Howe in 1810, and the two they had many children (13) as often was the case for settlers in strong need of prospective labourers for their farm.

The ninth child was Gustavus Benson Shorey, Marian’s father, born in 1827. Gustavus married Julia Howe in 1852, from whom he had six children. At some point, Gustavus was obliged to build a second mill, after the first one was destroyed by a flood. Julia died in 1864, and, in the next year, Gustavus married Mary Ellen Gilman (20 years old at the time of the wedding). Marian Lydia was the third of at least nine children of Gustavus and Mary Ellen. In the 1880 census of Albion, eight children were listed as living with their parents (four daughters and four sons, these last ones all termed “labourers”).

Marian was born in Albion on 6 February 1873. This date is certified by two passport applications signed by Marian herself. In various genealogical repertoires, accessible online, the year is incorrectly indicated as 1872, although the day and month generally are correct. In the register of Brown University, the institution where Marian graduated and taught at the beginning of the twentieth century, the year is indicated as 1873 in the “Graduate Records” (i.e. the correct one), but as 1874, in other documents (which also have a wrong date of birth, 4th instead than 6th February)

6 - If Daniel (Shapleigh) Shorey was really 21 years old, this foundational event should have occurred around 1819, because we know that he was born on 20th August 1788,

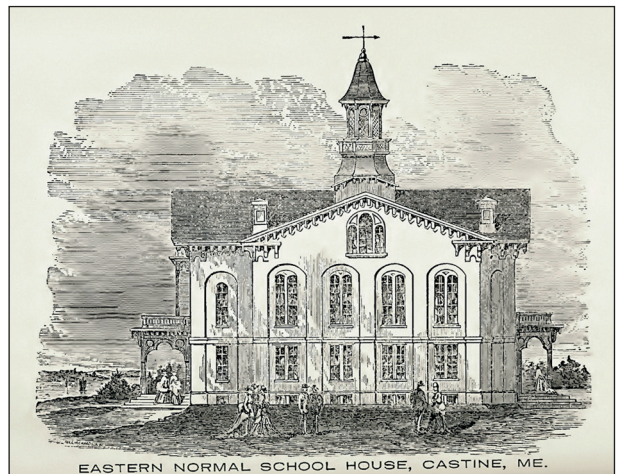


Figure 3. An old print featuring the State Normal School building in Castine, Maine, where Marian Shorey studied to get her teaching degree and to prepare for her admission to Brown University. The school has been active from 1867 to 1942.

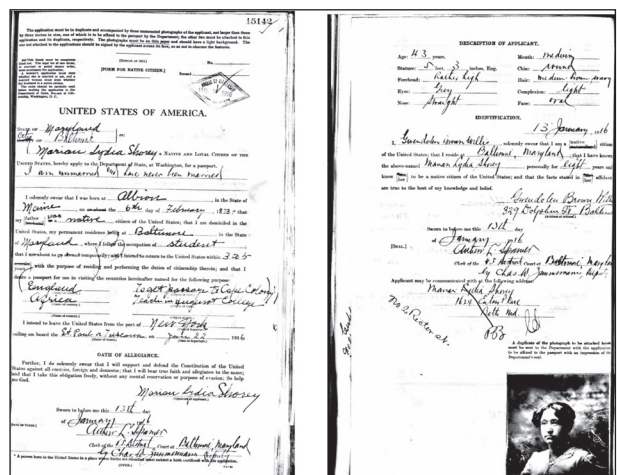


Figure 4. One of the two available passport applications in which Marian Lydia Shorey “solemnly swear[s]” to have been “born at Albion, in the State of Maine, on 6th day of February 1873. The application was made on 16th January 1916 and concerns Shorey’s plan to emigrate to South Africa in order to teach at the Huguenot College of Wellington (see below).

Marian and her sister: studying and teaching, and studying again

Nothing is known of Marian’s initial education, but we can assume that in her youth she attended one of the local rural schools. From the outset, she was probably interested in culture and perhaps science, and was proficient in her studies, which accounts for the fact that her life did not take the ordinary direction of

marrying at an early age, and producing and educating a flock of children.

In 1889, at less than seventeen years, and soon after finishing High schools, Marian began her profession as a teacher, almost certainly as a substitute teacher, in a primary school “of District n. 10” of her native village. The experience lasted a few months, but it must have been satisfactory. In the *Annual Report of the Municipal Officers and Supervisor of Schools, of the Town of Albion, for the Year Ending March 7th, 1890*, the inspector in charge of the control of that district, a certain T. Sanborn, evaluates the activity of the very young teacher this way:

Summer term, Miss Marion L Shorey, teacher. This was her first term. Though young in years, she came to her school possessing natural and acquired qualifications for her work, and I believe the school accomplished as much as though it had been placed in experienced hands. Miss Shorey will rank with our best teachers. (ref. 16, p. 12)

In 1890, at the end of this first work experience, Marian enrolled in the “Eastern State Normal School” of Castine, a small town on the Atlantic coast, in the Penobscot Bay, about a hundred kilometres from Albion. The “Normal schools” had been established, on the French model, to train teachers to be assigned to

middle-grade educational institutions. Marian’s choice is likely due to the fact that – as for other young women of her time in America (including her elder sister, Bina May) – the girl envisioned that, as a teacher, she could engage in an intellectual profession widely open to women. It offered her the opportunity to escape the status of wife and mother to which she, by birth, was destined as a peasant or worker.

It should be noted *en passant* that, although literary teaching prevailed in Normal schools, in the particular case of Castine there was a significant curricular addition dedicated to scientific culture. This was due particularly to the presence of a cultured teacher, Edward Everett Philbrook. A physician, graduated at the Boston School of Medicine, Philbrook was an eminent personage of the local community of Castine (as well as exponent of the Mason Grand Lodge of the Maine). He also had administrative duties in the Castine School, and he acted as a chairperson of the local committee of the Maine State Board of Health. He was a brilliant teacher, and – as reported, in 1934, in his Obituary in the *Bangor Daily News* – he was “beloved by hundreds of students all over the New England”. In addition to scientific disciplines, he also taught music, being an expert musician and acting as director of choir in the local Congregational Church.



Figure 5. Marian Lydia Shorey (left) and her older sister Bina May Shorey (right) in their official portraits of graduation at the Castine Normal School. Marian and Bina were 21 and 26, respectively, at the time of these photos. As indicated below the portraits, the photos were taken in Belfast, a small town in Maine, about 40 km from Albion, in the studio of W [illiam] C [ain] Tuttle. At that time the studio was run by Adrian Cain, William’s son who died in 1901.



Figure 6. Edward Everett Philbrook, a natural science teacher at the Eastern State Normal School in Castine at the time of Marian.

The table in Fig. 7 enumerates the courses of the Castine School which ranged over a great variety of disciplines both in the humanistic and scientific fields, with a rather evident predominance of the latter. Out of 33 courses, 17 had a clear scientific character, and only 12 could be assigned to the field of human sciences, with two courses in the arts (Music and Drawing). As was usual in normal schools of the time, there were also courses of a practical nature (“School Economy”, Bookkeeping, Didactics of Education). In the last year of school, before graduating, the students had to carry out a period of “practical teaching” in the “model class” attached to the institute, an experience which, according to the school regulations, constituted a “good preparation for the work there” (*ibid.*, p. 16). From the *Catalogue and Circular of the State Normal School at Castine, Maine, for the Year Ending June 7, 1894*, it is clear that a model school was created *inside* the buildings of the Eastern State Normal School of Castine. Its purpose was such that “during their last year in the school, the pupil teachers find here an opportunity to do the actual work of the schoolroom, under kind and careful criticism” (ref. 17, p. 45).

Having graduated from Castine in 1894, Marian began her career as a teacher, which most likely took her to various places in the Northeast, including the town of Southborough in Massachusetts. Her name appears in the 1896 Census, with the qualification of “teacher”. In the same year, Marian was listed among the residents of Southborough Mass. as a teacher, “boarding in the house of Fontinelle Carpenter”. In addition, her sister, Bina May had moved southwards, since in the 1900 Census she was listed as living in Northampton Mass. the county seat of Hampshire County, as “teacher” boarding in the house of Charles Howard.

After a few years, however, Marian left teaching and decided to continue her studies at the university level (Bina May took the same decision). In 1900, Marian was admitted to Pembroke College, the women’s division of the prestigious Brown University in Providence, where she attended natural science courses. During her university studies (which led her to obtain a Bachelor’s degree in 1904, and – in 1906 – a Master degree “in Physiology, Bacteriology and Organic Chemistry”), Marian was active in the student organizations of the College, and, during the period 1904-1906, participated in teaching activity as an “instructor in physiology and household economics”.

The subject taught by Marian, which was then also denominated by the more qualifying term “Euthenics”, corresponded to a type of discipline placed at the intersection of various sciences: biology, medicine, chemistry, public hygiene, economics and even architecture. It was flourishing at the time, as part of a movement to promote the role and self-awareness of women in American society. As a matter of fact, it represented a compromise that allowed women access to scientific studies, within the limits of classic female roles, revolving around the house and the family, albeit in an apparently more modern form.

Marian’s commitment to this type of teaching explains her participation, in June 1906, in the *Seventh Annual Conference of Home Economics* in Lake Placid, a tourist village in the State of New York. In her speech at this conference, Marian focused in particular on the issues of nutrition, public and personal hygiene, disciplines to be considered by the women attending the Conference as “guiding principles [that], as intelligent women, they may apply in conducting a home” (p. 81).

F Class	E Class	D Class	C Class	B Class	A Class
Arithmetic	Arithmetic, methods	Algebra	Geometry	Psychology	Didactics of Education
Grammar	Grammar	Geometry	General History	Chemistry	History of Education
Geography	Geography	Physics	Physics	U.S. History	Practice Teaching
School Economy	Algebra	Physical Geography	Rhetoric	Civil Government	English Literature
Reading	Physiology	Drawing	Botany	Moral Philosophy	Astronomy
Writing			Bookkeeping	Practice Teaching	Geology
Elementary Music					

Figure 7. A table with the courses assigned to the different classes of the Eastern State Normal School of Castine, in the years in which Marian Lydia Shorey attended the school.

These themes give us the measure of the limits to which this young woman (she was 33 years old at the time), educated and intelligent and interested in science, felt constrained in the minor role of Euthenics instructor. They permit us to understand the circumstances that underpinned the decision to change the direction of her life, by opting to continue her university studies. In 1906, she enrolled in a doctoral program at the University of Chicago, one of the most prestigious centres of biological research in the United States, where she obtained the PhD in 1909, under Lillie's tutelage.

The PhD in Chicago and the dream of a scientific career

The attainment of a doctorate in a prestigious institution, with the academic honour of publication of one's thesis, and the high-level research activity that she conducted in both Chicago and Woods Hole under the Lillie's aegis, certainly constituted a success for this farmer's daughter. Almost certainly this gave Marian a glimpse of the possibility of a scientific career in the academic field, an event that was then extremely rare for a woman, and – in particular – for a person emerging from disadvantageous socio-economic con-

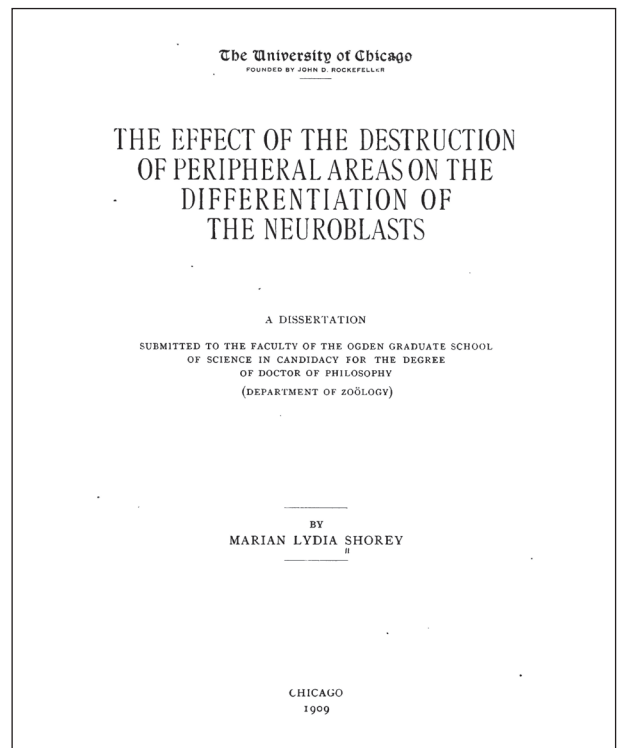


Figure 8. The title page of the doctoral thesis discussed in 1909 by Marian Lydia Shorey at the University of Chicago.

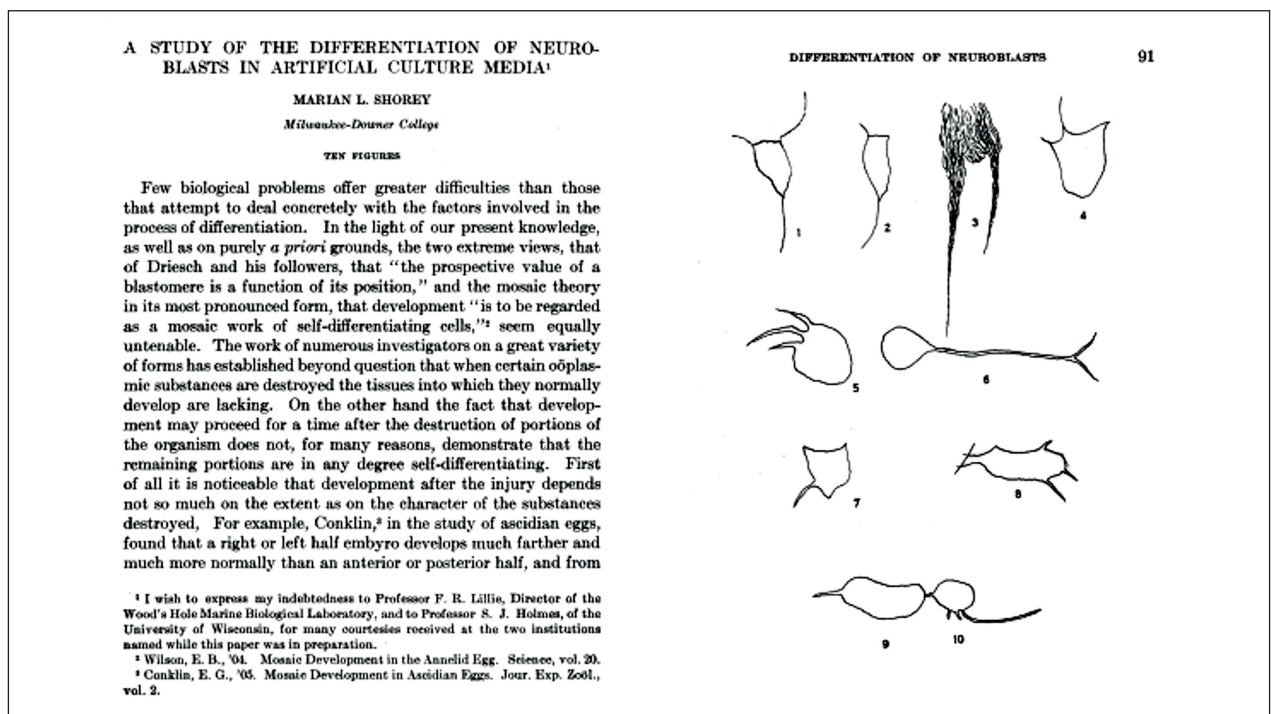


Figure 9. On the left, the initial page, and on the right, a table with the figures from the article published by Marian in 1911, on the *in vitro* cultivation in different culture media of spinal cord explants obtained from the urodele amphibian *Necturus*.

ditions. Unfortunately, this possibility failed to materialize. In fact, the second article that Marian published in 1911 (6) represented her last scientific work, and afterwards, to use Hamburger's words, "Miss Shorey [...] disappeared from literature").

Marian left Lillie's laboratory rather soon, perhaps due to financial difficulties or a lack of career prospects. Her research activity apparently continued for a while with research stages in Wood Hole (where – according to the records of the Marine Biological Center – she occupied a post in 1910), but, as early as 1908, she began a teaching career as a professor of biology and zoology in Milwaukee-Downer College, Milwaukee, Wisconsin. This institution had boasted a long tradition education that focused on the objectives that constituted the preferential tasks in the professions or roles intended for women: teaching, nursing, childcare and housekeeping. It was certainly not a place in which to continue high-level experimental research, such as the program Marian had been able to undertake during the Chicago years.



Figure 10. Portrait of Mary Lyon (1797-1849), the energetic and intelligent founder of the Mount Holyoke Seminar for the education of young women.

What happened next is somewhat mysterious, and marks the beginning of a descending parable bound to have a sad conclusion one hundred years ago, in 1922. In 1915, a short note in the *College Bulletin* (Milwaukee-Downer College) informs us of the fact that Shorey resigned her teaching post: "Marion (sic) Shorey (prof. of Zoology) has resigned" (this is despite the fact that her name still appears as secretary of the Club of Milwaukee until July 1916). In this same year, a brief note in the same *Bulletin* says: "Dr. Shorey, formerly connected with the Faculty of Milwaukee-Downer College, is in Baltimore studying and resting". The allusion to the "resting" condition could suggest that Marian was suffering from some disease, and thus needed to leave her research activity for a period.

Very likely, however, this was not the case.

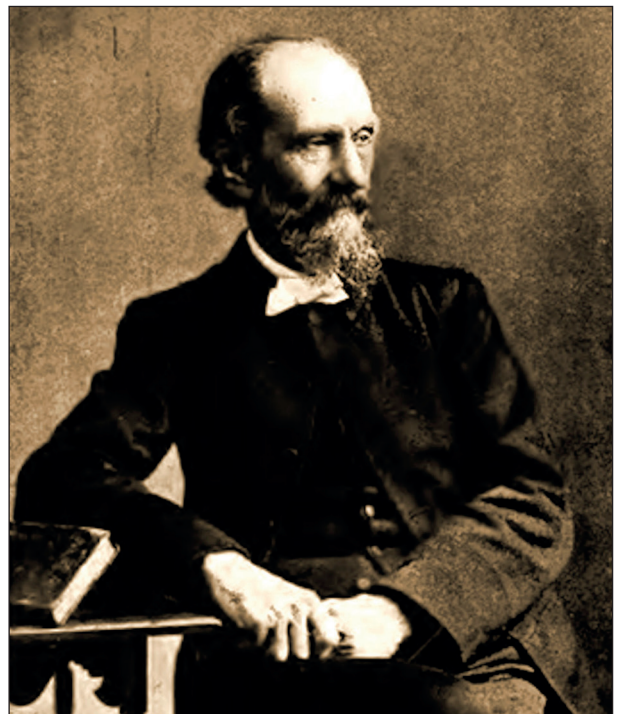


Figure 11. Andrew Murray (1828-1917), the "Moderator" of the Dutch Reformed Church of South Africa, who played a pivotal role in the creation of Huguenot Seminary, South Africa's first higher education institution for women, which later became Huguenot University College (is the relevant name in Shorey's time).

Since the name changed numerous times and the alongside/apart from the 'college' long after the College was added, I think it more accurate to – for this article and time frame – stick to the actual name of the institution where Shorey taught..

Emigration to the southern regions of the world

The reasons for this unexpected move by Marian can be understood on the basis of the decisions that matured during her stay in Baltimore. This period evidently represented for her a necessary pause for reflection at the moment of an important choice in her life, that of leaving America for a few years in order to go and teach in another and distant continent. On January 13, 1916, Marian applied to obtain a passport, specifying in the application that she intended to travel to South Africa to teach at the “Huguenot University College” in the Cape Colony. The fact that she declared Baltimore as her permanent residence at the time of the application, and as her occupation that of a “student”, suggests that during her stay in this city Marian attended university courses to prepare herself adequately for the teaching that she would subsequently have to carry out in the South African college.

Although surprising, Marian’s choice is quite understandable if one takes into account, on a general level, the great mobility that already characterized the world of Anglo-American university teaching at the time. More specifically, we need to consider the strong links that existed between the college where she went to teach (Huguenot University College or Hugenote Universiteitskollege in Afrikaans – in Wellington in the Cape region) and an important American institution for high-grade women education, Mount Holyoke College of South Hadley, Massachusetts, to which Marian was probably connected.⁷ Mount Holyoke was an institution of female education, which – both in intention and in facts – went well beyond the limits of the classic training programs needed to prepare “good women and good mothers”.

The Mount Holyoke institution was founded in 1837 by Mary Lyon, a young woman (like Marian, from a family of farmers) with a strong interest in teaching and promoting women’s rights, and with an intense religious motivation in the context of progressive Protestantism. A characteristic of the Mount Holyoke education was a great emphasis on scientific

teaching and experimental demonstrations, and, moreover, the importance given to manual work and physical exercise in the open air. (19-20) According to some of her biographers, one of Mary’s favourite mottos was “First the kingdom of God, but after that—and after that most certainly—all science and knowledge”⁸.

Around 1870, when the need to create university-level female teaching institutions began to be felt in South Africa too, Mount Holyoke was chosen as a reference model by Andrew Murray, the “Moderator” of the Dutch Reformed Church. (21) The first school he founded, the Huguenot Seminary, began its activity with the arrival in Wellington in 1873 of two teachers sent by Mount Holyoke, Abbie Park Ferguson and Anna Elvira Bliss. Abbie and Anna were the first of about 30 young American women to join the teaching staff of Huguenot Seminary and College in the following years. (21-24) Among these, in 1916, there was also our Marian. It is no coincidence that there were recruiters in America specially appointed by the leaders of the Dutch Reformed Church to identify potential teaching staff for Huguenot College. Almost certainly, the person who contacted Marian was one of these recruiters, Sarah Landfear. It is possible that one of the reasons convincing Marian to leave the Milwaukee-Downer College and go to South Africa was the concrete possibility to establish a research laboratory at Huguenot College. Indeed, there was a great deal of excitement in those years to equip a modern Department of Zoology in the College of Wellington, which was also to include experimental laboratories.

Although there is no indication of possible philanthropic reasons behind Marian’s decision to go to South Africa, it must be taken into account that – starting from the beginning of the twentieth century – an element that pushed young women with humanitarian impulses to reach the African country was the situation of extreme life conditions of Boer women. Following the Anglo-Boer wars, many of them were interned in concentration camps, after the destruction

7 - This possibility is supported by the fact that, in a newspaper article on the death of Marian’s sister, Bina May, appeared on *The Greenfield Recorder* of 22 November 1916 (see later), it is said that Bina May “Shorey was a graduate of Mount Holyoke College”. As a matter of fact, Bina May and Marian had parallel paths in their education.

8 - The strong interrelations between progressive forms of religion or spiritual philosophy and the social and women rights movements (typical of many initiatives of the nineteenth-century America) are attested, among others, by the success of the novels of Louisa May Alcott, that were widely read in her native country (and elsewhere). Alcott’s writings and personal life contributed to lay the cultural grounds, for the young women of the epoch, of a new conscience of their rights and capacities.

of their villages and the massacre of Boer men by the British. Among the prominent personalities who at the time brought South Africa and Boer women to the centre of international attention was in particular Emily Hobhouse, a humanitarian activist from an English aristocratic family, who visited the country and the numerous concentration camps set up by the British government in various territories of South Africa. Nicknamed “the Gandhi of South Africa” for her tireless activity, Emily strove in various ways to improve the conditions of Boer women. In addition to raising money for them, she organized schools to teach young women the art of weaving and spinning, also attracting attention and help to these initiatives from other countries, and in particular from Italy. (see ref. 21)

Similarly, although no clear indication could be found of Marian commitment to religion, it is likely that, at least to a degree, her decision to leave for Africa was in some way influenced by the popular trend amongst religious young North American professionals to “go to Africa to reach and educate the heathen”.

Whatever the case, Marian left America on January 22 by ship from New York to Liverpool, where she arrived eight days later, waiting to embark on her new destination, distant South Africa. However, it is possible that she took advantage of the stop in England to go to London, as a letter from Sarah Landfear in April of that year seems to indicate.



Figure 12. The “American Line” Ocean Liner Saint Paul, the ship with which Maria Shorey sailed from New York on January 22, 1916, and reached Liverpool on January 30. Launched in 1895, it was an elegant and comfortable passenger ship used for transoceanic passages. In October 1917, the Saint Paul was transformed and employed for World War I warfare operations by the US Navy.

We know from Landfear’s correspondence that, when deciding the trip, she also took into account the possible dangers represented by the state of war in which the whole world – and Europe in particular – was at that time. These dangers in fact loomed if one recalls the raids by German submarines (the fearsome *Unterseeboot* or U-boats) which came up to the coastal waters of Brazil and also to the fact that the ship that

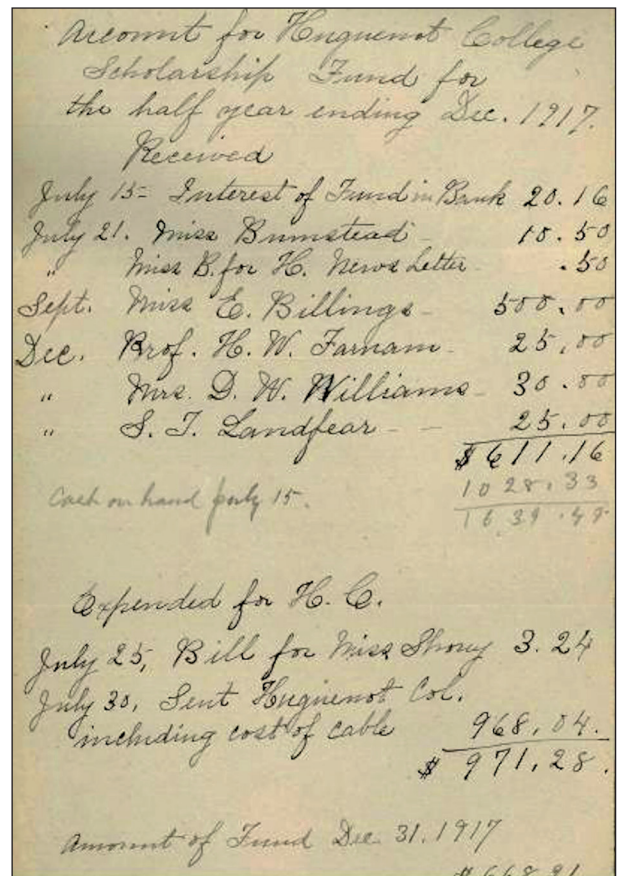


Figure 13. The note of the payments made to Marian for her outward trip to South Africa.

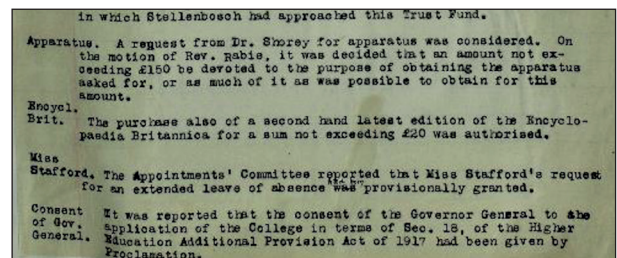


Figure 14. A detail of the November Huguenot Council minutes with a request made by Marian in order to obtain materials for the Zoology laboratory.

transported Marian to England in 1916 was converted the following year into a warship.

We do not know the details of the second passage to the African continent, and we do not even know the exact date of Marian's arrival in Cape Town. However, from correspondence between Miss Landfear and Miss Allen (Huguenot College) dated January and April 1916, it can be inferred that it was only toward the end of April 1916 – even though Marian was officially appointed in January to commence her post of teacher (Lecturer) at the Huguenot College in March 1916.

In the “Staff record” of Huguenot College, Marian's details are given as follows:

Shorey, M.L. PhD (Chicago)
Lecturer in Zoology
Appointed January 1916
(Resigned January 1918)

The first certain mention of Marian's teaching involvement in Wellington is from the Huguenot College Council Meeting report, dated May 1916, and concerns a request she made to obtain funding from the Department of Zoology.

Almost certainly, apart from teaching, the effort to establish a research laboratory at Huguenot College was one of the major commitments that absorbed Marian during her time in Wellington, and is attested by numerous requests for funds recorded in the official records of the College up to her return to America. We

do not know from the records which tools and materials Marian intended to buy for her laboratory, but it is very likely that among these there was a thermostat for the study of chicken embryos. In the *College Yearbook* for 1923, there is an article entitled “A pioneer institution - The Huguenot University College”, we learn that, among the tools kept in the museum of the Department of Zoology there is “an incubator in which the development of the embryo in the egg” could be observed. It is plausible to assume that this incubator was one of the instruments Marian had bought for the embryology experiments that, in all likelihood, she intended to conduct in her laboratory in Wellington.

There is, however, no evidence that Marian was able to carry out any actual research experiments during her time at Huguenot College, and, indeed, no scientific publications appeared to her name in scientific journals during this period. Nonetheless, she maintained her affiliation with the American Zoological Society, a sign to feel she was still a member of the international scientific community.

It is to be assumed that the years spent in South Africa did not correspond to Marian's expectations, neither as regards her scientific activity nor for her academic position. From the documentation preserved in the Dutch Reformed Church of South Africa Archives, it seems that, among the possible reasons for

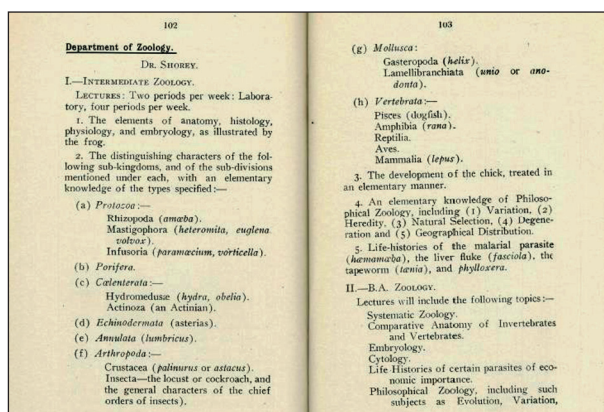


Figure 15. Two pages of the 1917 College Yearbook at the Huguenot in Wellington with the syllabus of the zoology courses taught by Marian.

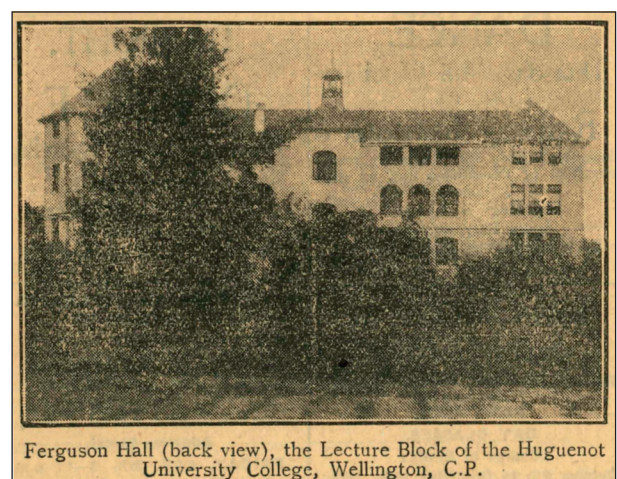


Figure 16. The complex of teaching buildings at Huguenot College in Wellington. This is where Marian taught her zoology courses. The image is from a newspaper clipping from 1923, which speaks of the presence, among the objects in the zoology museum, of an incubator for the study of the embryo.

disappointment, there was the fact that the official role afforded her was that of Lecturer and not the more prestigious one, which she had hoped for, of Professor.

Among the few bits information about Marian's activity as a lecturer at the Huguenot, there is a somewhat private one, indicating her sensibility and kindness. It concerns the fact that during a student excursion, with a picnic (and the possibility of swimming in the river) in Bainskloof, near Wellington, Marian had offered her pupils "a large box of chocolates".

Bina May Shorey: the tragic death of a sister sharing Marian's expectancies

Without doubt a sad event of private nature has contributed to embitter almost from beginning the period spent by Marian in South Africa, leading perhaps to a condition of depression that that might have impacted negatively on her attempts to establish a research lab at the Huguenot. This was the tragic death of Bina May, the elder sister who, as Marian, had decided to depart from the farmer life situation through an education culminating in a teaching profession. The two sisters lived parallel lives until their graduation at Brown University at the beginning of the twentieth century. After that period their lives diverge, and only Marian seems to have been able to further her university education by obtaining a PhD at Chicago University in 1909.

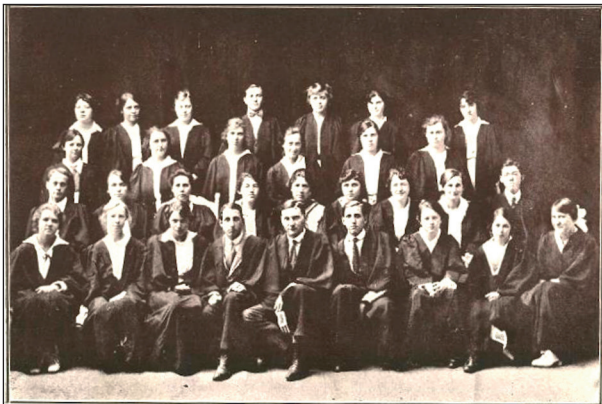


Figure 17. A group photo of the students of the "intermediate class" at the Huguenot College of Wellington, taken in 1917, in which there are almost certainly some of the students of the zoology lessons given by Marian. As one can see, at the time of Marian's tenure, Huguenot College was also attended by male students.

Undoubtedly, after the graduation at Brown, Bina May continued to work as a teacher, but now at a higher level as an advantage of her university degree. Eventually something went very wrong, as we know from a short article of *The Greenfield Recorder* of 22 November 1922 announcing her death by suicide. Bina May had been teaching at the school of Athol, MA., (a High School), but – according to the article – it was "believed that she had been mentally unbalanced for some time". The reasons for that state had to do with a "trouble with the school committee". For this – as Bina May confided to an acquaintance – "she was anticipating discharge". If that event occurred "it would be all up with her". From the article we know also that "several previous positions she had been unable to hold but a short time, and a teacher agency which had secured them for her, wrote Miss Shorey recently that it could do no more for her along this time".

The body of Bina May was found on 18 November 1916 in Lake Ellis, near Athol, after two days of a search involving several persons, including her brother, Leforest Shorey. Leforest had come to Athol from his house in Cliffondale (MA) on the morning of the 18 November (as we know from an article of the *Boston Sunday Globe* written on the same day, before the body was found). He was aware that his sister might be "mentally unbalanced temporarily". From another newspaper *The Republican Journal* of Belfast (ME)

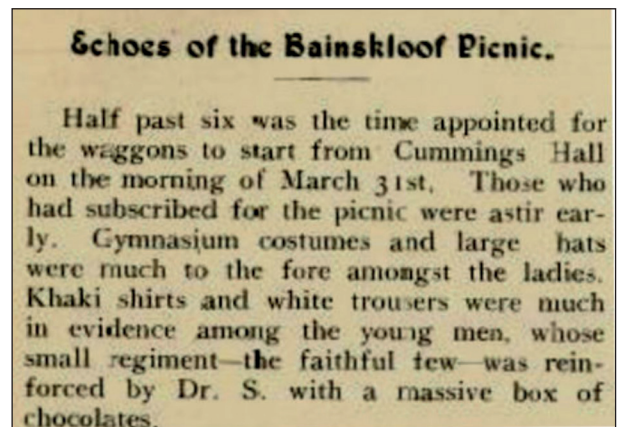


Figure 18. An excerpt from a page in Huguenot *College Yearbook for 1917*, in which, in connection with a students excursion to Bainskloof, a mountain place located not far from Wellington, it hints that Marian (referred to as "Dr. S.") offered the students a "big box of chocolates". A detail that suggests a certain concern of the teacher for her students.

which gives other details. Bina May “had been missing since Tuesday night, Nov. 14th. She had resigned four days before from her position at the Athol High School, in which she was teaching since March, because “of slight friction in the school” with her students

The melancholic return of Marian Lydia Shorey to her homeland.

Although there is not a stringent temporal and causative relation between the tragic death of Bina May and the decision of her sister to leave Wellington, it is logical to imagine that the two events were somewhat connected.

In 1916, in the application for a passport to leave the United States, Marian declared that she wanted to stay in South Africa for a period of 3-5 years. This notwithstanding, as early as June 1918, she requested a new passport for the return journey, and resigned from her role at Huguenot at the end of the academic year, in December 1918. She left South Africa in March of the following year.

The return voyage took place on a very different route than the outbound one, with a passage in Sydney (Australia) on 7 May 1919 and the arrival on the west coast of the United States, in San Francisco, on 26 May 1919 on board the liner Ventura. The



Figure 19. A picture of Bina May Shorey (1867-1916) from the article of *The Boston Sunday Globe* of 19 November 1916.

departure of this ship from Sydney with, among others, a “Miss MB Shorey” [sic] was announced by the *Sydney Morning Herald* on Wednesday 7 May 1919. It is likely that, undertaking this long return voyage, Marian perhaps wanted to take advantage of the opportunity to visit remote countries and enjoy a kind of vacation.

We have little information about Marian’s years in her hometown following the Ventura’s arrival in San Francisco. What we do know is, however, surprising, and also very painful, because it seems to document a progressive decline in a life which, particularly after scientific work in Lillie’s laboratory, appeared to herald a brilliant academic and academic career for the young scientist.

From two brief statements in a Brown University file we learn that – after having been until April 1919 at the “Wellington Huguenot College, Cape Province, So. Africa” in September 1921 Marian worked in a factory in Waterbury in Connecticut, the “Scovill Manufactures” (an industry that is still active, and that, at Marian’s time, produced metal objects of various types, from buttons for clothes, to screws, ammunition and optical equipment). We also know that, in June 1921, Marian resided in Waterbury at the following address “The Cables, 45 Prospect Street”.

Marian’s job at Scovill was that of a clerk, and likely it was unrelated to her scientific skills (particularly in chemistry). With a return to her homeland, an apparently inexorable decline for Marian’s life and career ensued, a decline that had probably started in South Africa, (and perhaps even before). Marian’s life



Figure 20. The Ventura ship on which Marian Lydia Shorey embarked on her return voyage from South Africa in 1919.

prospects changed dramatically with a more or less forced adaptation to that of an ordinary worker, after the years spent as a high-profile researcher in Chicago, in Lillie's laboratory, and of university teaching in the United States and South Africa.

Nonetheless, it was difficult to imagine how Marian's existence would suddenly end on August 26, 1922, about three years after her return from South Africa. In this investigation on Shorey's life, the first clue to the particularly tragic aspect of her death came from a handwritten note affixed to the back of a register sheet with Brown University's "Graduate Records" relating to her. In this note signed by a certain "E. Hines", we read: "I understand from miss Haskell that death was due to suicide".

The proof of the painful act carried out by Marian to put an end to her days then came from two articles that appeared in newspapers of the time and from the report drawn up by the coroner. In the first article (published in the aftermath of her death – on August 27 – in a local newspaper, *The Sunday Republican* of Waterbury, we read that the cause of death was suicide committed "by inhaling of gas". This was confirmed by the report of the coroner, Edward Harry Kirschbaum, stating that death occurred due to "illuminating gas poisoning at her own hands". In the article it is also said that, according to Marian's acquaintances, in recent times the woman (whose name is reported inaccurately "Marion", with the age also incorrect, 40 years – instead of 49) suffered from a "nervous breakdown" and showed strange behaviour over time.

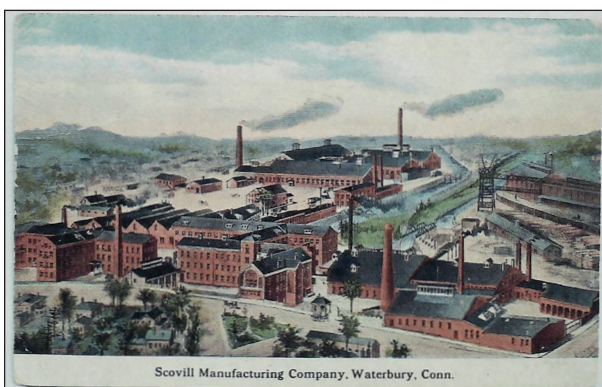


Figure 21. An antique illustration with a view of the Scovill factory in Waterbury, the place where Marian Shorey worked for a while after returning from South Africa in 1919.

Marian had carefully planned her suicide, sealing doors and windows of the house to prevent the gas escaping from her apartment, and putting her personal items in a trunk. She had then left some letters, among which, in addition to the one addressed to a brother, one destined for the newspaper in which she asked "no undue publicity be given her death".

The following day the news of Marian's tragic death (again with an imprecise name and age) appears in another local newspaper, the *Waterbury American*. Here, too, details are given that indicate the careful preparation of the tragic act, and it is suggested that the decision to end her life was the consequence of the loss of a job at the Scovill Manufactures and the difficulties in finding a new job. The importance of this article for us lies in the fact that it reports a larger part of the letter sent by Marian to the newspapers.

Here is the transcript:

If this letter is delivered to you it will be because I was found dead as a result of my own act. The world is always so surprised when a person chooses to leave it that he immediately asks everything about him, even though it might not have paid the slightest attention to him alive. I earnestly ask that I may be allowed to remain as unknown in Waterbury dead as I have been alive.

These words, full of sadness, but also of great dignity, are the main justification for the present writing and of its lingering, at times, on minor biographical details. We aim to avoid losing the track of this in-

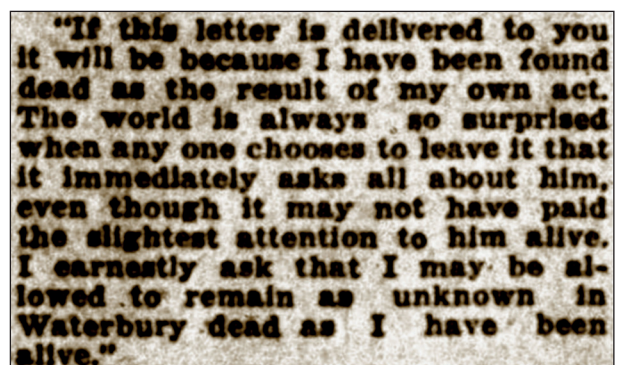


Figure 22. A detail of the clipping from the *Waterbury American* dated 28 August 1922, with the words of the letter in which Maria asked for silence, from the press, on her tragic act. Both Marian and her sister Bina May took their life at the age of 49 years.

telligent and unfortunate woman, who – with her extraordinary experiments in 1909 – set in motion a path of research that would, many years later, lead to one of the greatest discoveries in the biology of Twentieth century.

One final notation; if the reporter of the *Waterbury American* has accurately transcribed the words of Marian's letter, then, in the absence of other personal letters and writings (so far undiscovered after an intense search) the above lines are the only words that remain of an unscientific text written by Marian Lydia Shorey herself. She was like a shooting star that shows itself to us only by disappearing.

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