NPS Form 10-900 OMB No. 1024-0018
(Rev. 8-86)

United States Department of the Interior
National Park Service

NATIONAL REGISTER OF HISTORIC PLACES
REGISTRATION FORM

1. Name of Property

historic name: Petrified Sea Gardens

other name/site number: Ritchie Park

2. Location

street & number: 42 Petrified Gardens Road

not for publication: ____

city/town: Saratoga Springs vicinity: ____

state: NY county: Saratoga code: zip code: 12866

3. Classification

Ownership of Property:

Category of Property: site

Number of Resources within Property:

Contributing	Noncontributing	
____	____	buildings
1	____	sites
____	____	structures
____	____	objects
1	0	Total

Number of contributing resources previously listed in the National Register: 1

Name of related multiple property listing: N/A

6. Function or Use

Historic: other — Sub: Research: Geological Exposure
education — Field trip site
recreation — Tourist attraction
Current: other — Sub: Research: Geological Exposure
education — Field trip site
recreation — Tourist attraction

7. Description

Architectural Classification:

N/A

Other Description: _____

Materials: foundation _____ roof _____
walls _____ other _____
_____

Describe present and historic physical appearance. X See continuation sheet.

8. Statement of Significance

Certifying official has considered the significance of this property in relation to other properties: _____

Applicable National Register Criteria:

Criteria Consideration (Exceptions): _____

Areas of Significance: A, B, D
Science

Period(s) of Significance: 1825-1948

Significant Dates: 1825 1883 1938

Significant Person(s):
Winifred Goldring

Cultural Affiliation: N/A
Architect/Builder: N/A

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.
X See continuation sheet.

9. Major Bibliographical References

_X_ See continuation sheet.

Previous document on file (NPS):

_preliminary determination of individual listing (36 CFR 67) has been requested.
_previously listed in the National Register
_previously determined eligible by the National Register
_designated a National Historic Landmark
_recorded by Historic American Buildings Survey #_____
-recorded by Historic American Engineering Record #_____

Primary Location of Additional Data:

_State historic preservation office
_Other state agency
_Federal agency
_Local government
_University
_Other--Specify Repository: _____

10. Geographical Data

Acreage of Property:
UTM References: Zone Easting Northing Zone Easting Northing

A _____ B _____
C _____ D. _____
___ See continuation sheet.

Verbal Boundary Description: ___ See continuation sheet.

Petrified Sea Gardens is situated on the east side of Petrified Garden Road, approximately one-half mile north of State Highway 29, west of Saratoga Springs, New York. The exposure of ancient stromatolites occupies an elongate area of approximately one acre within the 25-acre Petrified Sea Gardens park. It is located on the eastern edge of the park bordering the Palette Stone Co. quarry. The northern and southern boundaries of the stromatolites are marked by trails and the western edge is bordered by a service road and a heavily wooded area (see sketch maps).

Boundary Justification: ___ See continuation sheet.

The stromatolites are known to exist only in this part of the Petrified Sea Gardens park area.

11. Form Prepared By

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Petrified Sea Gardens, near Saratoga Springs, in the Adirondack region of New York, preserves one of the finest examples in the world of stromatolite fossils, some of the most ancient forms of marine life. The stromatolites at Petrified Sea Gardens lived along the shores of a shallow sea during the Cambrian Period of Earth's history (about 515,000,000 years ago) when most of North America was located south of the equator in a tropical setting. The stromatolite colonies grew crowded together forming reef-like structures, which are now exposed in outcrops of the Hoyt Limestone (proper name for a specific rock unit). These stromatolite-bearing strata are rare because they are restricted to two up-raised fault blocks of limited areal extent, and much of the bedrock through the area is covered by younger glacial deposits.

These stromatolite fossils were created by cyanobacteria, trapped sediment particles, and precipitation of minerals to form a hardened structure. They grew into club-like, columnar, or domal structures composed of concentrically-arranged, alternating, thin layers of microcrystalline calcite and coarsely crystalline dolomite. The layers seen in cross-section are wavy and irregular, causing the stromatolites to resemble the leaves of a head of cabbage that has been cut crosswise. When alive, the stromatolites probably stood 1-2 feet above the surrounding seafloor in a shallow marine, intertidal setting where they were subjected to a lot of wave and current energy. The upper surface of the stromatolites was subsequently eroded and later planed by glaciers during the last Ice Age, revealing their concentric structure.

The stromatolites are known to exist in an area of about 1-1.5 acres within Petrified Sea Gardens, preserved in 25 acres of wooded park setting originally established by Robert Ritchie in 1924. It is located on the east side of Petrified Gardens Road approximately 0.5 mile north State Highway 29, west of Saratoga Springs, New York. The stromatolites can be reached via a footpath from the parking lot.

Summary

Petrified Sea Gardens is significant in the history of geology under Criteria A, B, and D. This is the area where stromatolites were first recognized, described, and interpreted in North America, resolving questions about the origin of these organisms that puzzled geologists for more than a century. First found in 1825 by John Steele, stromatolite fossils from the Petrified Sea Gardens area were the first stromatolites discovered in North America. Following more than a half-century of debate over the origin of these concentrically-laminated structures, in 1883, the eminent American paleontologist James Hall determined that they were organic. Placed in the new genus *Cryptozoön*, meaning "hidden life", specimens from this area were the first stromatolites to be described scientifically. The stromatolites from this site remained the focus of research to determine which organism created them. To this end, Winifred Goldring, the first woman to be elected president of the Paleontological Society and the first named as State Paleontologist of New York, conducted the most exhaustive study of the site. Although Hall proposed that the stromatolites were organic, Goldring, based on her careful research, was able to identify the kind of organism that created the stromatolites. In addition, she was able to interpret the ecology and environmental setting of these important, once-widespread ancient life forms. Goldring's interpretations have helped geologists understand significant environmental and ecological changes that have taken place on Earth through the ensuing half-billion years since the stromatolites of the Petrified Sea Gardens were alive. Moreover, her work brought the stromatolites back to 'life,' enabling their reconstruction in a museum diorama of Petrified Sea Gardens, which allowed the general public to learn about these important ancient organisms. In 1961, the fossil stromatolites at Petrified Sea Gardens were used to analyze the newly-discovered living stromatolites from Australia. Study of these living stromatolites confirmed Goldring's environmental interpretations, underscoring the importance and accuracy of her work. Displaying some of the best examples of fossil stromatolites anywhere in ancient rocks, Petrified Sea Gardens remains one of the classic stromatolite localities in the world. It will continue to yield important scientific information and remain useful in the geological education of students, professionals, and the general public—a use that was promoted by Goldring sixty years ago.

History

In 1825, when Dr. John H. Steele described the first ooids in North America in *The American Journal of Science & Arts*,[1] which is one of the earliest references to oolite in Paleozoic rocks,[2] he also described these stromatolites from the Petrified Sea Gardens and illustrated them for the first time:

> "In and near the road, which leads from Greenfield to Ballston-spa, by the way of Rowland's mills, on the farm of Deacon Wood, there is a bank composed of a series of horizontal strata where the peculiar characteristic features of this formation are well defined and may be readily examined.
>
> "One of the strata, which compose the series at this place, presents a very singular appearance, and one which, if it occurs elsewhere, has never been noticed, so far as I am able to learn, by any writer. The surface of this stratum is fairly exposed for a number of rods both to the north and south of the bank beneath which it evidently passes, it is about two feet in thickness and has imbedded, throughout its substance, great quantities of calcareous concretions of a most singular structure; they are mostly hemispherical but many of them are globular and vary in size from half an inch to that of two feet in diameter; they are obviously composed of a series of successive layers, nearly parallel and perfectly concentric; these layers have a compact texture, are of a dark blue or nearly black colour, and are united by intervening layers of a lighter-coloured calcareous substance, either stalactical or granular, they are very thin and I have counted more than a hundred in one series. By breaking the matrix in which they are imbedded, they drop out entire, and may be readily reduced to any smaller size, by merely throwing them upon the rock—the concentric layers easily separate, leaving the form exactly the same."
>
> "These interesting concretions appear to be confined solely to one stratum of the series, and this stratum evidently accompanies the Oolite in its whole extent, and is undoubtedly a variety of the same series, the best characterized Oolites lying beneath, while those of a less definite character are regularly piled above it.
>
> "I have endeavored to represent the appearance of this singular stratum in the small sketch which accompanies this communication; it comprises a section of the rock as it presents itself in the road, near the bank above mentioned, and is intended to display a view of its edge and surface together with the superincumbent strata." (p. 17-18).

The illustration that accompanies Steele's report shows a tree stump adjacent to the rock outcrop, which provides a size comparison for the stromatolites depicted. Even though the stromatolite specimens are much larger than true ooids, Steele apparently believed that they were another type of ooid, which are also composed of concentric layers. Consequently, he thought that the stromatolites were also of inorganic origin.

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[1]Steele, J.H. 1825. A description of the oolite formation lately discovered in the County of Saratoga, and state of New York. American Journal of Science 9:16-19 and Plate II.

[2]Wieland, G.R. 1914. Further notes on Ozarkian seaweeds and oolites. American Museum of Natural History Bulletin 33:237-266.

Writing in his 1843 report on the geology of the First Geological District of New York, William Mather appears to have been the first to consider that these structures were organic, stating: "Some of the rounded masses described as concretions analogous to Oolite [by Steele] are organic..."(p. 416), but he provided no evidence.

In 1883, the eminent nineteenth-century American paleontologist James Hall, who was the first State Paleontologist of New York, described this area in general, as follows:[3]

> "In the town of Greenfield, Saratoga county, there occurs a bed of limestone which presents a very remarkable appearance, the surface being nearly covered by closely-arranged circular or semi-circular discs which are made up of concentric laminae, closely resembling in general aspect the structure of Stromatopora. It very often happens within these larger discs there occur two or more smaller ones, each with its own concentric structure and exterior limitation, and appearing as if budding from the parent mass. A farther examination shows that the entire form of these masses is hemispheric or turbinate, with the broadest face exposed upon the upper surface of the limestone layer; that their growth has begun from a point below and rapidly expanding upwards, has often extended one or two feet in diameter, as now shown upon the exposed surface of the limestone bed. At a single exposure on the farm of Mr. Hoyt, the surface of the limestone is covered by these hemispheric bodies for many rods in extent. The entire area of the cellar beneath the house of Mr. Hoyt is upon this bed of limestone closely covered by these hemispheric masses with concentric structure. For a distance of one or two miles to the southward the outcrop of this limestone can be traced, and everywhere presenting the same characters in the presence of these masses. Large numbers of specimens of various sizes have been weathered out and lie scattered over the surface."

Hall observed that these fossils

> "have long been known under the name of Stromatopora, from their general resemblance in form and structure to that fossil; but their position in reference to the bedding of the rock is uniformly the reverse of that of Stromatoporae, which occur in the higher limestones, growing from a broad base which is covered by epitheca, while these bodies under consideration grown upward and expand from a point below, while the convex surface is on the lower side. A careful examination of the nature of these bodies proves that while having the concentric structure common to Stromatopora they have not the regular succession of layers of tubuli characteristic of the species of that genus and cannot properly be included under that term." Consequently, Hall proposed "the term Cryptozoön as a designation for this peculiar form and mode of growth..."

As a result, Hall gave them a new scientific name, *Cryptozoön proliferum*, placing them in both a new genus and species, which , translated from the Greek, means "prolific hidden life." He described this new genus and species, as follows:

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[3]Hall, J. 1883. 36th Annual Report of the New York State Museum of Natural History. Regents of the State University of the State of New York, Albany:

> "These bodies are made up of irregular, concentric laminae of greater or less density and very unequal thickness. The substance between the concentric lines, in well-preserved specimens, is traversed by numerous, minute, irregular canaliculi which branch and anastomose without regularity."

Hall's description is accompanied by a fine lithograph of numerous specimens of *Cryptozoön* as they appeared in the outcrop (Plate VI).

James Hall was born in Hingham, Massachusetts, on September 12, 1811, and died in Albany, New York, on August 7, 1898.[4] Less than 10 years after his graduation from Rensselaer, Hall had become the most eminent geologist and paleontologist in North America. Throughout much of his life, Hall was a leader in many of the most prominent scientific societies in nineteenth century America, serving as a founder of the Association of American Geologists and the American Association for the Advancement of Science, and as a charter member of the National Academy of Sciences, still the most prestigious scientific society in the nation.

Over the ensuing years, stromatolites were found in Precambrian, Cambrian, and Ordovician age rocks at a number of other localities in the northeastern and midwestern portions of the United States (Pennsylvania, Maryland, Vermont, Minnesota, Wisconsin) as well as in other countries (Canada, Sweden, China, Russia). Nonetheless, the stromatolites of the Petrified Sea Gardens area were considered the best preserved. In 1906, H. M. Seely[5] published several photographs of *Cryptozoön* stromatolite specimens as well as photographs of their internal structure in thin section. He presented several arguments to establish the organic origin of these fossils, classifying them incorrectly with the sponges. G. R. Wieland[2] presented evidence in 1914 "that *Cryptozoön* belongs to a group of algae, which formed vast reefs in the ancient oceans."

In 1922, Robert F. Ritchie, who was a stone mason and amateur geologist, uncovered the stromatolites at his summer home.[6] After clearing nearly 2 acres of the stromatolite outcrop, Ritchie opened Petrified Sea Gardens park to the public in 1924.

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[4] Biographical information on James Hall as taken from the following sources:

Fenton, Carroll Land, and Mildred Adams Fenton. *Giants of Geology.* (New York: Doubleday & Company, 1952).

Clarke, John M. *James Hall of Albany, geologist and paleontologist 1811-1898.* (Albany, New York: Arno Press Reprint, 1978).

[5] H.M. Seely. 1906. Cryptozoa of the Early Champlain sea. Report of the Vermont State Geologist 5: 156-173.

[6] Fisher, Donald W. 1991. Algae from antiquity. The Conservationist/NYSDEC, p. 42-47.

In 1937, Winifred Goldring, who was the fourth State Paleontologist of New York and the first woman to hold that position, wrote the most exhaustive study on these ancient stromatolites. She provided many photographs and the best description of the site, noting that Ritchie park exposed the finest specimens:[7]

> "...the Hoyt limestone...carr[ies] reefs built by three species of calcareous algae, *Cryptozoön proliferum* Hall, *C. ruedemanni* Rothpletz and *C. rundulatum* Bassler...The three algal reefs and their relations are best studied in the Saratoga Springs area and particularly in Ritchie park [Petrified Sea Gardens], which comprises over 20 acres. Ritchie and Lester parks are located respectively two and a quarter and two and a half miles west of Saratoga Springs on the east side of the road running north from the State highway (route 29) to Greenfield Center. Ritchie park ("Petrified Gardens") is three-quarters of a mile north of the state road; Lester park a little over a mile and a quarter. The same reefs continue through both parks and northward. The Ritchie house stands on a ledge composed of dipping S.28°W. at an angle of 7°. The top of the ledge is formed by a four-foot reef of *C. undulatum*, beneath which are 40 inches of gray, sandy dolomite and below again to the base of the top being eight feet below the base of the *undulatum* reef. The *proliferum* reef outcrops about 400 feet east of the house and the top of the reef is 16 feet below the base of the *undulatum* reef. The *ruedemanni reef* as shown in the ledge east of the house has a thickness of about 28 inches below which is exposed about one foot of coarse sandy dolomite and above three feet of sandy dolomite. The *proliferum* beds here have a dip of 7° to 8° in a direction S.33°W. Between 500 and 600 feet southeast of the Ritchie house in Ritchie park is a ledge of *ruedemanni*, 40 feet below the top of the *ruedemanni* ledge on which the house rests. About 150 feet northeast in the woods is a quarry showing well the *ruedemanni* reef at practically the same elevation as the occurrence at the ledge above...The top of the ledge here as in the locality just mentioned shows specimens of *ruedemanni* smaller and more scattered than in the exposures near the house. Some of the individuals are drawn out in stringers as though they grew in rill channels. These stringers run roughly N.10°E. The shore line must have been at right angles to these rill channels, that is, running roughly close to an east-west direction.
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> "Between 200 and 300 feet southeast of the quarry in Ritchie park is found the finest exposure of *C. proliferum* known. Between this spot and the outcrop east of the house, this reef is gradually being uncovered through the efforts of Robert Ritchie, the owner, so that soon there will be a continuous exposure. There are between five and eight feet from the base of the *ruedemanni* reef in the quarry to the top of this *proliferum* reef....The *proliferum* heads or stocks are concentric growths, somewhat resembling a cabbage in structure, which in general have had their tops sheared off by the glacier that passed over the region. The stocks are very large in this southern exposure in Ritchie park. They are usually composed of a number of budded individuals growing together into specimens reaching two to three feet and over in diameter. Sometimes ones individual may attain this size. Evidently in this part of the reef the conditions were most favorable to growth, because individuals and stocks are also very closely crowded together. There is coarse sand filling between

[7] Goldring, Winifred. 1938. Algal barrier reefs in the lower Ozarkian of New York with a chapter on the importance of coralline algae as reef builders through the age. New York State Museum Bulletin No. 315: 5-75.

the separate heads or stocks of *proliferum* which through weathering stands out in places as conspicuous ridges. This condition would seem to favor organic origin rather than inorganic origin for these structures...Many individuals show well the dichotomous budding which is characteristic of plants, another fact in favor not only of organic but of plant origin.

"In Lester park a little over a half a mile to the north and along the same road is an exposure of the same reef. Here, although there are some fair-sized specimens, the preponderance of the stocks and individual heads are fairly small and considerably less crowded together...

"The character of the *proliferum* reef as shown in the outcrops discussed above indicates to the writer that the specimens exposed in the southern end of Ritchie park are on the outer side of the reef toward the open ocean where the waters were purer and conditions more favorable to growth...Lester park would then be on the shore side, as would be expected from the more sandy character of the rock, the smaller more scattered specimens, and the stringers of *proliferum* found in the rill channels just to the north...

"The three species of *Cryptozoön*...are so very distinct in their habit of growth that they may be readily recognized in the field. *C. proliferum* grows in heads or budded stocks up to considerable size, three feet and over in the case of the largest stocks and sometimes individuals, which roughly resemble cabbage heads and also have a very striking irregularly concentric structure. The concentric structure is brought out beautifully by the planing off of the upper parts of the heads during the continental glaciation. In *ruedemanni* the concentric layers are more regularly distributed and one finds instead of the compound, budded stocks as in *proliferum* simple individuals up to about four feet in diameter. *C. undulatum* differs strikingly from the other two species. This form is composed of thin laminae, the basal ones practically horizontal to the bedding plane. Soon a strong wavy character is developed with frequent narrow or broad undulations with narrower or sharper down-bedding of the laminae.

"...In these calcareous algae, the remains are not those of the plant itself, simply secretions of calcium carbonate upon the tissue of the plant, the form of the plant, however, being well preserved in the limestone secretions.

"...The largest and best developed stocks [of *C. proliferum*]...are found in Ritchie park, particularly in the southern area which has been interpreted as the seaward side of the reef. Here the stocks are so crowded together that they touch and the spaces between are filled with coarse sand carrying fragments of trilobites and macerated *Cryptozoön*...Approaching the shore, that is northward in this area, the stocks become smaller and more scattered in the rocks until, as north of Lester park, in the rill channels the individuals lose their characteristic shape and have grown out into long stringers."

Goldring provided detailed evidence that the structures at Lester park and Petrified Sea Gardens are of organic origin, which she related to calcareous algae. Stromatolites were a ubiquitous life form in the earliest oceans, although few of their fossils are as well preserved as those at Petrified Sea Gardens. Because they played such a major role in the distant past, but only a very minor part in modern oceans, it is important for geologists to know what organisms created these structures so that they can interpret the environmental

changes that caused their decline. By understanding the vicissitudes of life on Earth through time, scientists are better able to understand the modern world and to predict future trends. Therefore, Goldring's work on the Petrified Sea Gardens stromatolites has had an impact far beyond the rocks and boundaries of New York State.

Noting that these stromatolites were of interest to the tourist, Goldring[7] added a supplementary note to her scientific paper "for the benefit of the Capitol District [Albany], and more particularly for tourists unfamiliar with the area, to give more definite directions for reaching Lester and Ritchie parks..." She went on to give a few more details about the site and expressed its importance:

> "The Lester Park area, besides the *Cryptozoön proliferum* reef, has...other features of interest such as the *C. ruedemanni* reef in Hoyt quarry and the stringers of *C. proliferum*, developed in rill channels, which are located in the field along the east-west road to the north. The 'Petrified Sea Gardens' or Ritchie park, where reefs belonging to three species of *Cryptozoön* are displayed...is privately owned by Robert R. Ritchie, of Saratoga Springs, and is in a much better state of preservation. The 'Gardens" area, comprising some 20 acres of land entirely underlain by these reefs of calcareous seaweeds, constitutes one of the most remarkable displays in the State, even in the country and perhaps the world. The remarkable nature of this exposure, particularly as regards the *C. proliferum* reef, is to considerable extent due to the fact that the ice sheet which covered this part of the country during the Glacial Period sheared off tops of the concentric seaweed growths. The wide crevices that are found everywhere cutting through the limestone and the reef, in which vertical sections of the seaweeds are displayed, are due to solution along the joint cracks that occur in the rocks; and in places pot-holes have been developed. Mr. Ritchie is continuing the work of clearing away the veneer of soil that still covers parts of the 'Gardens' and has laid out well-kept paths designed to give the best views of the reefs. The place, as a whole, particularly the northwest corner where his summer home is located, is attractively landscaped. In addition Mr. Ritchie maintains an adequate and well-instructed guide service and has for sale, at a small price, a popular pamphlet on the area written by Professor Harold O. Whitnall, of Colgate University, and a short article by the writer [Goldring]. Near the entrance gate Mr. Ritchie maintains a picnic grounds and a small museum in which an interesting fireplace built of *Cryptozoön* heads or stocks. In this museum are displayed local fossils and minerals, some of which are for sale, as well as specimens acquired from various parts of the country, either through exchange or gift. So popular have the 'Petrified Sea Gardens' become, and so widely know, that in the past season (1936) there were more than 15,000 visitors from 44 states and several foreign countries. many prominent scientists of this country and from abroad have visited the place.
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> "Lester park may be viewed free of charge. A small entrance fee is asked for 'Petrified Sea Gardens' and special rates have been made for schools. This fee entitles the visitor to the tour of the grounds, including the museum, and he may stay as long as he pleases..."

Lester Park, which is owned by the New York State Museum, is located approximately 1.2 miles north of State Highway 29 on the east and west sides of Petrified Gardens Road. This site does not expose stromatolites of the same high quality as Petrified Sea Gardens, and the exposures are not maintained. Lester Park is actually consists two small rock outcrops immediately adjacent to the highway, one of which is at road level and routinely driven on by motorists.

Considered the "grandame of New York State paleontology," Winifred Goldring "devoted her life to New York State paleontology, generally, and to the New York State Museum, specifically."[8] Born on February 1, 1888, in Kenwood, New York, Winifred was one of eight children (seven of them girls) belonging to Frederick Goldring, a horticulturalist, and Mary Grey, a schoolteacher. When she was about two years old, her family moved to Slingerlands, New York, to open a floral business, and Goldring lived in the family home there for the rest of her life. Accompanying the family on hikes into the nearby Helderberg Mountains as a young girl, Winifred was introduced to the natural world, which would continue to fascinate her as an adult. After graduating valedictorian of her high school class at the Milne School, which was associated with the State Normal School for teacher training, in 1905, she went on to college studies at Wellesley College. Here, she first became interested in paleontology, completing a B.A. with honors (1909) and M.A. (1912), while simultaneously studying geography at Harvard University under the tutelage of the famous William Morris Davis. From 1912-1914, she worked as an instructor in geology at Wellesley and as assistant instructor in the Teacher's School of Science in Boston. While teaching, she continued her studies with the prominent geologist Amadeus Grabau at Columbia University. In 1921, she received her doctoral degree from Johns Hopkins University where her research focused on paleobotanical subjects under the guidance of Edward W. Berry. Years later, she received honorary doctorate degrees from Russell Sage (1937) and Smith (1957), both women's colleges.

Goldring's forty-year career at the New York State Museum began in 1914, when she was appointed Scientific Expert in Paleontology. Rising through the ranks at the museum, she was named State Paleontologist in 1939, the first and only woman to follow in the footsteps of James Hall and John M. Clarke. Never married, Goldring held this post at her beloved museum until her retirement in 1954. At one point prior to 1929, however, when she was Associate Paleontologist she discovered to her dismay that her annual salary of $2,300 was less than that made by clerks and stenographers at the museum.[6]

Ever devoted to education, Goldring advised many scientists and students throughout her career. She once remarked that she "always felt that the teacher who turns out enthusiastic students interested in going on in the subject should rate as high as the man who devotes most of his time to research work and may be reaching only a limited audience."[5] Adhering to these principles, Goldring was especially dedicated to public education. In particular, she spent considerable time and energy installing museum displays, including a diorama of the *Cryptozoön* from the Saratoga Springs area, which were useful in providing information to the broadest audience possible in a most interesting and exciting manner. Some of the displays she designed with the famous diorama-makers Henry and George Marchand have appeared in geology textbooks, serving to educate and inspire people who had not even set foot into her museum.

Goldring is considered the first woman to have attained "such high stature in paleontology in North America."[8] She attained high-level positions in prominent professional organizations, especially for a woman of that period. She became a Fellow of the Geological Society of America (the world's largest geological organization) in 1921, and served as its vice-president in 1950. In 1949, she was elected president of the

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[8]Most biographical information on Winifred Goldring is from:
Fisher, D.W. 1974. Memorial to Winifred Goldring 1888-1971. Geological Society of America Memorials 3: 96-102.

Paleontological Society (the largest association of paleontologists in the world)—the first woman to hold that office and one of only two women to attain that position to this day. Because of the overwhelming prejudice against women in the male-dominated geological societies, large numbers of men must have supported her candidacy for Goldring to win.[9] That men would jeopardize their own reputations by supporting a woman underscores her prominence as a nationally-known geologist respected for the quality of her research.

Even though Goldring was able to attain a large degree of success in her chosen career, it "irked her immensely that there were so many outstanding male geologists and paleontologists who were vocally prejudicial to women in science."[8] For example, when she was refused a job at the U. S. Geological Survey, she was told they wanted a "he-man" paleontologist.[9] Goldring died on January 30, 1971. Writing in his memorial for Goldring in 1974, fully 60 years after she began her career, Donald Fisher, a subsequent New York State Paleontologist, remarked that "In the United States, it is with great difficulty that a woman accedes to a high position in science. Had there been a women's liberation movement in science in her day, I am positive that Winifred Goldring would have been in the forefront of such activity."[8]

Goldring was employed by a government agency of the State of New York, and, as a result, her research necessarily focused on the geology of that State. However, this does not imply that her work was of a local or provincial nature. On the contrary, Goldring's work, although centered in New York State, dealt with major paleontological discoveries and ideas, which were of interest to a broad audience. Moreover, she is important for her work in popularizing geology among the general public, which had far-reaching implications for science education in America. The dioramas that she commissioned and designed for the New York State Museum were among the first in the nation to reconstruct ancient fossils in life position and depict them as though they were alive again in their natural surroundings. And she was probably the first to base such dioramas on actual research studies, which portrayed these life forms more accurately than ever before. These dioramas set the stage for the modern dinosaur and other fossil dioramas, which still serve as a means to educate the public about scientific concepts and provide the "spark" that encourages young persons to pursue scientific careers. Petrified Sea Gardens was the subject of one of Goldring's ground-breaking dioramas. Unfortunately, the dioramas and the museum building were they were installed are no longer intact.

In 1961, Brian Logan described living stromatolites from Sharks Bay,. Australia, which resemble those in the Cambrian rocks at Petrified Sea Gardens.[10] He was able to confirm Goldring's earlier environmental interpretations of the stromatolites. These stromatolites are now considered to be composed of cyanobacteria (commonly termed blue-green algae).

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[9] Aldrich, M.L. 1990. Women in geology. In G. Kass-Simon & P. Farnes (eds.) Women of Science: Righting the Record. Indiana University Press

[10] Logan, Brian. 1961. Cryptozoön and associate stromatolites from the Recent,. Shark Bay, Western Australia. Journal of Geology 69:517-533.

More than 150 years after their discovery, these fossils from Petrified Sea Gardens are still described as "one of the finest examples of domed stromatolites to be seen anywhere in ancient rocks."[11] Specimens from this site commonly serve as the standard for fossil stromatolites and continue to be illustrated.[12] Consequently, Petrified Sea Gardens will continue to yield important paleontological and geological information. As advocated by Winifred Goldring 60 years ago, Petrified Sea Gardens is an excellent tool for geological education of the general public as well as for students and professionals. More than a century and a half after discovery of the stromatolites, professional geologists and students from elementary through college age continue to visit the site on field trips, and it remains an attraction and learning experience for the general public. A non-profit group, Friends of Petrified Sea Gardens, now operates the site and maintains educational signage at the stromatolite exposure. The site is a National Natural Landmark.

The Petrified Sea Gardens continuing impact on education is shown by a 1990 letter in support of preserving the site written by Stephen J. Gould in which he remarks that these were the first fossils he had ever seen in the field when he was only ten years old. Gould went on to become a professor of geology, biology, and history of science at Harvard University and is, undoubtedly, one of the most famous paleontologists of the twentieth century. Gould's anecdote demonstrates the continuing importance of the ancient stromatolites at Petrified Sea Gardens, which, in their accessibility to the public, have the power to inspire lives in science and wonder for the natural world.

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[11] Friedman, G.M. 1988. Spectacular domed microbial mats (cabbage heads) and oolitic limestone at Lester Park near Saratoga Springs, New York. Northeastern Geology 10:8-12.

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Glossary

calcareous algae: a seaweed that removes carbon dioxide from the shallow water in which it lives and thereby secretes or deposits a solid calcareous structure

cyanobacteria: single-celled organisms related to bacteria, which contain chlorophyll that allows them to produce their own nutrients. These are commonly called blue-green algae, although they are unrelated to algae.

intertidal: the zone along the seashore between low-and high- tide levels

ooid: a spherical to ellipsoidal body with a concentric structure that is 0.25 to 2.00 mm in diameter; it is usually made of calcium carbonate and is precipitated inorganically in agitated conditions, usually in shallow seawater.

oolite: a rock composed of ooids

stromatolite: colony composed of billions of cyanobacteria which secrete calcium carbonate to form a concentrically-layered, calcareous structure.

Stromatopora/stromatoporoids: laminated organic bodies made of calcium carbonate related to sponges