Preston Park

A Butler Township Public Park
415 South Eberhart Road, Butler, PA 16001

Description, History, & Significance

Listed in National Register of Historic Places as Preston Laboratories on December 26, 2012

DESCRIPTION

Summary Paragraph

Preston Laboratories is an 87.5-acre property located at 415 South Eberhart Road in Butler Township, Butler County, PA. It was the glass science research facility and later residence of Dr. Frank W. Preston and wife Jane Hupman Preston. Construction of the facility began with the main laboratory in1936 with minor buildings added in the 1950s. Dr. Preston retired in 1959 and sold his business at that time, concluding the period of significance. There are fourteen resources on the property: There are seven contributing buildings, one non-contributing building, two contributing structures, two contributing objects, and two contributing sites. The buildings are located in the southwest corner of the property; the various structures, objects and sites are located across the entire property. Other than maturing vegetation, the Preston Laboratories property has not changed since 1959. Preston died in 1989 and his widow made no notable changes to the time of her death in 2008. Mrs. Preston donated the property to Butler Township. Minor changes in integrity occurred after 1959 with the addition of a non-contributing storage building by the Carnegie Museum of Natural History circa 1967, the erection of two partition walls in one contributing building by Carnegie at the same time, and the removal of machinery after 1959 when Preston sold his business. Otherwise, all elements of the property created by Franks Preston during the period of significance (1936-1959) are intact, maintained

Narrative Description

Overview

The land on which Preston Laboratories is located initially was a combination of small farms and woodland. The area now is primarily residential, with the exception of a large wooded area to the south/southeast and Sawmill Run Park, also a Butler Township facility, which is contiguous to the wooded southern boundary. The entire property has a wooded perimeter and is not visible from any off-site location.

The southwestern area of the property is a slightly undulating terrace. This is the location of the laboratory buildings. The land surface descends in a long, moderate slope to the north and east of the terrace. Sawmill Run crosses the property from the northwest corner and flows east by southeast and then off-site.

When Dr. Frank Preston began planning Preston Laboratories, he wrote in his memoir that, "I wanted to have the best looking place in the industry. I did not expect to have the most palatial buildings; I hoped to make the place attractive by landscaping and by its surroundings." The landscape, indeed the whole property, is a conscious creation of Frank Preston. Born in Leicester, England in 1896, he transferred his Edwardian English aesthetic and attitudes to his laboratory property and created an English-inspired landscape garden uniting culture and environment that defines the property. It is a mixture of utilitarian rectangular scientific buildings set amongst circular and sweeping curved forms, a clear expression of Preston's inter-related scientific and naturalist personality.

The geometric patterns, the textures, the placement of buildings, the circulation system and the physical elements were all designed by Preston and reflect his vision for Preston Laboratories. Preston referred to his property as "The Frith," an archaic English word for woodland or game preserve.

The Preston Laboratories property is accessed from the west from South Eberhart Road. Internal circulation is provided by a system of curving roadways with loops and circles, as well as walking paths, all designed by Preston in the late 1930s. A second entrance to the property was added in 1955 after large decorative iron gates were acquired from a farm in Ohio in 1952 and transported to the Preston property and erected between brick piers (Photo 0001). The gate was intended as the entrance to a proposed Preston residence that was never built, and was thus only used three times.

There are fourteen resources on the property. There are seven contributing buildings (the laboratory, the machine shop, the instrument building, the garage, the maintenance building, the well house, and the Hacienda) one non-contributing building (the Carnegie building), two contributing structures (the electric interurban and the Perkins Bridge), two contributing objects (the gate and the lily pond) and two contributing sites (the entire property including ponds, walking paths, geometric tree plantings, prairie, forest and landscaping, and the Geography Lesson).

The core of the property is a complex of glass research laboratory and support buildings built primarily from 1936 to circa 1947, with some modifications and minor additions circa 1955.

The entrance from South Eberhart Road is a curving, paved, approximately fifteen feet wide 400-foot driveway with a short branch into an unpaved employee parking area. The main drive continues leads to the "U"-shaped interior road. A small (50-foot) diameter traffic circle called the Bowl for its concave center allows for traffic to enter the interior circulation driveway.

The machine shop is visible less than 100 yards to the northwest. The instrument building is visible approximately one hundred yards to the east. In between is a mature circle of Mountain Laurel that masks all but the western end of the main building.

Five of the contributing buildings (main laboratory, machine shop, instrument building, well house and garage) form a semi-circle around the circular drive. The greatest distance between any two buildings is approximately 250 feet. The buildings are one and two stories in size, with the longest being the main laboratory at 110 feet. Four of the buildings are red. The main laboratory (1936-37) and well house (1939) have brick veneer installed in 1956 to prevent leaking. The machine shop (1939) is a painted red metal structure. The instrument building (completed 1947) is brick with unpainted frame bays at each end. Those unpainted frame bays have visual continuity with the adjacent unpainted garage (circa 1938). Only the Preston's personal vehicles, visitors, and delivery vehicles were allowed in this area.
Preston Laboratories grew from one building in1936 to five buildings by 1947. As the business became more successful, more space was needed. Initially, Preston Laboratories was housed in the main building with operations starting while it was still under construction in 1936. The essential functions were located in separate areas. There were offices for research, a chemistry laboratory where research on glass composition occurred, a physics lab for research on glass strength testing methods, a machine shop for fabrication of testing equipment, a reception area, a library and meeting room, and Dr. Preston's office. A well provided water to the building.

The three-stall garage with storage bay was built in 1937. It is of frame construction, unpainted, and was used as a garage and maintenance building.

The demand for Preston's glass bottle testing equipment, consulting activities for the major glass manufacturers, and on-site testing of bottles surged, requiring expansion of the laboratories. The machine shop was built in 1939 for fabrication of the testing machines Preston invented and patented. That function was moved from the main laboratory. With two buildings, Preston drilled a second well to supply both buildings and housed it in a concrete block building. The well equipment is located below grade and a room the size of the building was built above grade over the well apparatus. A tunnel connects the machine shop and well building. Use of the room prior to the 1950s is unknown. The well apparently tapped into a large aquifer that never drew down and still provides water to the main laboratory.

In 1941, Preston began construction of the instrument building. It was to house the physics laboratory and testing activities. Due to shortages of building materials during World War II, the building was not completed until 1947. Research offices and testing areas occupied the entire building.

The linkage among the buildings was primarily intellectual, with the flow of ideas from each impacting work in the others. Dr. Preston's research and inventions were the unifying factor.

Preston's design created a unique sense of place at a human scale. Upon entering the area, the surrounding vegetation provides quiet and serene passage. The laboratories complex unfolds at a pedestrian pace. Buildings come into view gradually walking along the drive, with another building emerging just as the one in front is displayed. While the buildings are all different in style, the colors and textures tie everything together. The relatively small buildings invite inspection, are neat and tidy with no residue from past activities. It is clearly not a residential area, but the function of a scientific research center is not clear from the visual cues. The entire area can be walked in under five minutes with a feeling of harmony in culture and science. Dr. Preston gave his top-level Ph.D. scientists time every week to go into the setting and contemplate.

The other contributing buildings, the concrete block maintenance building (1954) and the small wood-frame Hacienda (circa 1954) are located outside the main complex. The maintenance building is a utilitarian support building located south and east of the main circular drive on a partially paved service road that provides access to the eastern and northern sides of the property. The Hacienda, a simple wood frame building approximately twenty-five feet square, is located in a secluded wooded setting approximately 125 feet north and east of the main laboratory. It was used by the Prestons as a refuge from the non-air conditioned buildings and from the telephone as well as for a base for Jane Preston to engage in gardening and holistic health practices.

The non-contributing building, is the Carnegie building, an approximately 50x100 single bay metal "Butler building." It was built in the mid-1960s thirty feet east of the instrument building. Built by the Carnegie Museum of Natural History for storage after Preston Laboratories closed, it is not of the same scale, materials, function, and thoughtful setting as the rest of the property. It is a non-contributing resource because it was not part of Preston Laboratories in the period of significance.

An overview of the contributing structures, objects and sites reveals a diversity of resources created by Preston for functional and aesthetic goals. They are all part of his plan to create the "best looking place in the industry."

Representative structures, objects, and sites (all fully described in the following sections) include the unused iron gate on South Eberhart Road (Photo 0001), a 5-acre pond located at the base of the slope north of the main laboratory, a less than one acre spring-fed pond southeast of the main laboratory along the service road, (Photos 0002, 0003, and 0004), a circle of forty species of mature indigenous and exotic spruce trees enclosing a grassed area of approximately two acres south of the building area and called The Arboretum (Photo 0005), two fields of Wisconsin prairie grass (Photo 0004) along the service road from the small pond to the large pond, and rows of mature evergreens arcing on the east and west of the main laboratory building to the north, to frame the open grassed view from the lab to the large pond. Other geometric patterned stands of evergreens, fruit trees and hardwoods are spread across the property, as well as a concrete lily pond on the north side of the main laboratory, a "Geography Lesson"

and the traffic circle “Bowl” (Photographs 0006, 0007 and 0008, respectively).

The “Geography Lesson” is a circular area located just in front of the main laboratory building that includes fourteen metal signs listing the bearings and distances to locations around the world. At the entrance to the Geography Lesson are two concrete monuments, each with a metal plaque and called “Shooting the Bull.” One is Jane Preston’s Sagittarius (the archer symbol) aimed at the bull, Frank Preston’s Taurus (see Photo 0007).

There is also a relict feature from the former Pittsburgh-Harmony-Butler-New Castle electric interurban line on the property A steel beam trestle supported on concrete wing walls (Photo 0009) is located across the former streambed of Sawmill Run (the stream was relocated during the construction of the large pond) east of the large pond, and the former right-of-way is visible in the woods east of this location. The right-of-way was granted in 1907 by a previous owner and abandoned by 1931, at which time it reverted to the property owner and became part of Preston’s land.

Trails on the property are in the wooded areas of northern hardwood re-growth. The undisturbed woodland contains a network of walking trails Preston established in the first years. He apparently walked the entire property daily at dawn when he was not traveling. His origins in England where nature walks are a great pastime and his deep interest in nature are the reasons for the trails. They are maintained by Butler Township.

Relationships among the buildings within their natural settings, the sense of place and scale of the setting are visible in Photos 0010 through 0013.

Contributing Buildings

Each building is of a different style and material, all utilitarian glass science laboratory buildings. Concrete block construction was most common except for a frame garage, the frame Hacienda, and a metal machine shop. All are set on the slightly undulating upland. They are linked by function, location relative to one another, streetscape, and presence within an encompassing English-inspired landscape that Frank Preston called The Frith. A ten-foot high chain link fence along the property boundaries, erected in the first years of development, encloses the entire 87.5-acre property and defines it clearly.

There are three principal glass research buildings on the property. These are the main laboratory building, the machine shop, and the instrument building (Photos 0014, 0015, 0016). In addition, there are four other contributing buildings that were part of Preston’s research work and personal life. These are the well house, garage, maintenance building and the Hacienda (Photos 0017-0020). All are considered contributing to the district by function and by dates of construction and use.

Main Laboratory Building

Exterior

The main lab building was the heart of Preston Laboratories. It was designed by a local architect and constructed by a local contractor in 1936-1937. The original roof was flat, with parapets. The building was constructed from locally produced and poor quality concrete blocks and there was both roof and exterior wall seepage. In an attempt to address leakage, in 1939 the building was covered in stucco and painted tan with medium brown trim. Roof leakage remained an intermittent problem. Circa 1956, the entire first floor of the lab building was clad in 16-inch Roman bricks, the upper level was sided, and the roofs were raised from flat to a low-pitched gable (Photo 0014). The roof, which leaked, is now rubber roofing material. The main laboratory building is 120'x30'.

As part of the mid-century remodeling, the laboratory windows were replaced. However, the openings and their three-part configuration with a large fixed center pane with flanking casement windows remained. The windows are constructed of wood and contain either glass or plexiglass. Glass was used as a decorative element on the laboratory as well. A column of glass blocks forms the centerline of the rear façade (Photo 0023). The canopy over the front entrance is wire glass construction.

Entrance is under the glass canopy into two doors. The west or left-side door provides entrance to the main laboratory building. The east or right-side door accesses the stairwell to the second floor as well as the main laboratory reception area. Other than a double loading door at the southwest corner there are no other entrances.

At the time of construction, a small four-room apartment was built above the laboratory as a residence for a caretaker. Caretakers resided here from 1937 to 1947. The Prestons moved into the apartment in 1947 and remained there, expanding their residence to use space on the ground floor after Preston sold his business in 1959. The second story apartment is approximately twenty feet by thirty feet. There is one casement window on the south elevation, three each on the east and west, and none on the north. There are three lights in three rows for a total of nine in each window. The windows are original construction, 1936-37.

Interior

The interior layout was designed to accommodate Frank Preston's needs for his glass research, including space for chemistry, physics, testing, research offices and administration. As business grew, activities were moved from room to room and eventually to other buildings. Because the building structure is concrete block, the basic floor plan never changed, only the functions of the rooms. The location of walls and openings for the laboratory has been the same since 1936.

There is a four-room basement of concrete block, under the mid-point, containing heat

and water utilities and some artifacts of glass bending research. The remainder of the building is on a concrete slab. Access to the small basement is through an interior door adjacent to the reception area. The building is heated by a two-year old boiler, and water is available in the first floor bathrooms.

Entrance is into the reception area (Photo 0024). Three secretaries and a switchboard occupied the area originally. Two storage closets and two bathrooms are on the north side. The vault is a totally concrete block room with concrete ceiling and a steel door for secure document storage. A door connecting to the upstairs apartment is in the southeast corner.

On the lower level, the floor is concrete, all walls are exposed or industrial fiberboard covered concrete block, and the ceiling is concrete. Except for the former testing room and storage area with exposed concrete floor in the northwest corner and the chemistry lab in the southeast with painted wood flooring, the floors were covered with asphalt tiles at an unknown time, most likely in 1956 when renovations took place. The tiles are in excellent condition and do no pose an asbestos problem. All interior walls are light blue, last painted in 1976, encapsulating any potential lead paint.

East from the reception area along the north wall are Dr. Preston's office (Photo 0025), a research office, and the drafting and map room. Along the south wall is the "Old Library" which became a conference room and finally the Preston's living room, and the chemistry lab.

West from the reception area on the north wall is another research office followed by the original physics department. Along the south wall is the "New Library," originally the machine shop (Photo 0026), and a storage area.

Both the "old" and the "new" library walls are lined with bookshelves painted in an industrial gray. Several hundred books are shelved and cataloged by the Dewey Decimal system in the new library. A card catalog including these books and several thousand donated to various institutions by Preston late in life is present.

Most rooms are empty or have stray pieces of furniture. Dr. Preston's office is intact with desk, chair, bookcases, research materials, publications and other reminders of his productive life.

The second floor is a small apartment built in 1936-37 as a caretaker's apartment. Photos 0027 and 0028 show the simple character. The Preston's lived in this apartment beginning in 1947 and expanded their living area to the lower level after 1959. The underlying structure is concrete block.

This level contains four rooms. It has a distinct 1959s appearance in wallpaper, kitchen appliances, linoleum, doors, and bathroom fixtures, The date is coincident with the other changes such as the siding and the ground floor windows in the building. It is heated by radiators.

The stairway, accessed by a separate entrance door and from the reception area, is located on the east side. It receives light from a casement window At the top, an approximately 22-foot hallway with a casement window on the east end is oriented east-west. Directly across from the stairs is a small kitchen containing a stove, sink and cabinets. At the opposite end is the bathroom.. The living room is located in the southwest corner, and the bedroom is located in the northwest corner. The north elevation has no windows.

The kitchen is approximately eight feet wide and 10 feet deep. It has a linoleum floor and what appears to be plaster or plasterboard walls over the concrete blocks. It is in good condition except for one large crack on the north wall. A nine-pane casement window provides light and ventilation over the sink, on the east wall. The ceiling is similar to the walls; the underlying structural material is not known in any of the rooms.

The bathroom is smaller than the kitchen, approximately six feet by eight feet. The walls have green tiles from the tile floor to the mid-point of the walls. There is a sink, commode and bathtub without shower. There is a casement window above the tub.

The living room is the largest and airiest of the spaces. It is approximately eighteen by eighteen feet with bookcases, radiator, tile floor and a large closet on the east wall. There is one window on the south wall and one on the west wall. The walls are covered with tan wallpaper.

The bedroom is approximately ten feet by twelve feet. It has the same flooring and wall covering as the living room. It is from a covered radiator. Illumination comes from a casement window on the west wall. On the north facing wall immediately adjacent to the east bedroom wall is a ceiling to floor column of glass blocks. This is part of the building's structure from ground level to the gable of the second level (Photo 0023). It is a decorative element as well as source of natural light from the north.

The laboratory building functioned as Preston Laboratories, a glass research center employing from 20 to 25 Ph.D. scientists and workers, from 1936 to Preston's retirement in1959. In 1959 he sold the business to four men who would form American Glass Research, now an international glass research operation. The business was moved away from Preston Laboratories, removing most equipment and machinery from the property. That was the last use of the property for large-scale glass research projects. The building remained Preston's headquarters for consulting to the glass industry, ornithology research and publishing, geological and ecological research, and community involvement. Following his death in 1989, Jane Preston continued to live in the building and remained active on the grounds until her death in 2008.

Machine Shop.

Exterior

The machine shop is a two-story steel building constructed from panels of galvanized, corrugated steel painted red. No rust or decay in the metal is apparent. It was illuminate by large industrial windows on both floors (refer to Photo 0015). The first floor has four windows with ten lights in three rows on the east side, a double loading door and three identical windows on the west, a double loading door on the north end and no windows, and a door flanked by identical windows on the south elevation. The same windows are present on the north, east and west elevations. The south elevation has the same constructed window with twenty lights in three rows. It is on a concrete slab.

The building was constructed circa 1939. It is located approximately 250 feet southwest of the main laboratory building, set back slightly from the loop road in order to accommodate large trucks. Double loading doors are located on the west and north walls. A gas-fired boiler provided heat. Water came from the well house. Construction of the roof could not be determined. The footprint is 80 by 40 feet. The building has not been modified since its construction.

Interior

The interior consists of one open bay encompassing the entire first floor (Photo 0029). The north end of the first floor is two-stories. The second floor also is an open bay, half the size of the first floor. There is a small office in the southwest corner of the second floor, and a bathroom under the stairs on the first floor. Floors are concrete. The roof is metal.

The building was used initially as a pilot plant, producing scale models of glass handling and testing equipment designed by Preston. Later, full-scale fabrication of machinery and equipment took place here to fill orders for the equipment designed by Preston and sold to the glass industry. There were individual workstations where production of machine parts and fabrication of completed machines took place. It was not organized on a mass production model. The first floor was where the heaviest materials were handled. The smaller second floor was used for lighter production and equipment such as lathes.

In the 1960s and 1970s, the Carnegie Museum located its taxidermy department in this building, preserving everything from large mammals such as a giraffe to tiny insects. This operation did not alter the building during or after its presence.

Instrument Building

Exterior

The Instrument Building was built from circa 1940 to circa 1947. The construction was interrupted by materials shortages during World War II. The core is a two-and-one-half story brick building with gable roof, with no distinctive style, with one frame section and a frame garage on the north end and a frame section on the south end (Photo 0016). The brick is recycled from a street in Butler. The brick portion is approximately 50 by 30 feet, the two-story frame additions are each 16 by 30 feet, and the one-stall garage on the north end is 11 by 30 feet. All the framed areas are sheathed with clapboards. There is no basement. There is a low crawl-space that was not used for any aspect of the business.

The building is on a slab. There are three entrances, one is centered and is under a small portico. This was the original entrance to both floors. There is an entrance door and stairwell in each of the frame ends. They lead to the second floor. Heat is supplied from the hot water boiler in the main laboratory. Windows are 3 over 3 and original. The roof is composite roofing of an unknown age.

The building was sometimes referred to as the Physics Building. Testing of glass quickly outgrew the space available in the main lab building. Areas with concrete floors to withstand the vibrations of testing equipment were required.

Initially, the frame ends were open on the ground floor with stairs visible to the second floor. These open areas contained some storage and were used to house various animal and bird pens prior to being enclosed circa 1950.

Interior

The first floor has a reception area, five offices, a testing room, a small room with sink and counters, and a bathroom. Initially the area north and east of the reception area was an open testing area. Small offices (Photo 0030) were created in the late1960s when the Carnegie Museum re-located its archaeology department to the Preston Laboratories property. In need of separate spaces for cleaning, identifying and curating artifacts, museum staff erected two partitions in the north end of the first floor to create these spaces. When the department moved back to Pittsburgh, these rooms were left, slightly affecting the interior integrity of the building.

The second floor is dominated by a large open space (Photo 0031). Sometimes called the lunchroom, it housed fiberglass-testing facilities. Under contract to Owens-Corning, various adhesives were tested for their ability to bind fiberglass in rolls. A small kitchen and two bathrooms on the south end, and an office on the north end of the building complete the interior. The floors are tile throughout.

Well House

The well house is located adjacent to the Machine Shop (Photo 0017). It is a two-story concrete block building that was altered in 1956, veneered with the same Roman brick that encases the main laboratory building. The lower story is one open space below grade and houses all the equipment required for providing water. The above-grade floor is one open room and currently is vacant. At one time it housed an electric components shop, primarily for the winding of wire for motors used in the machinery fabricated in the machine shop. The well is tapped into a major aquifer that has never suffered a draw down and water is distributed to other buildings.

Frame Garage

This three-stall garage and storage building was one of the first auxiliary buildings on the property, dating to circa 1938. It is post and beam construction with vertical wood siding (Photo 0018). The interior is one open space, suitable for three vehicles and equipment storage. The building is adjacent to one frame end of the Instrument Building. The two buildings are connected visually as the only large wood-clad buildings on the loop road.

Maintenance Building

This is a utilitarian concrete block building built in the mid-1950s. It has one open garage-like bay and two storage rooms (Photo 0019). It was constructed as a maintenance and repair building to augment and partly replace the smaller frame garage. It continues to be used for equipment storage, repair and upkeep as well as storage of materials necessary to maintain the grounds. It is built on a slab with no heat or water.

Hacienda

This is a one-room frame cabin approximately 25 feet by 25 feet, built circa 1954 in plywood in a clearing northeast of the main lab building (Photo 0020). The name was derived from the Preston's interest in and ownership of land in Arizona. Also referred to as Jane's Cabin, it served as a retreat for Jane Preston where she could garden and pursue other natural interests. It became a place for both Prestons to be away from the telephone and a retreat from the non-air conditioned laboratory building.
It is a gable roof building built on a concrete slab. The entrance is a 1950s aluminum storm door with side windows. The north and south ends have openings where aluminum glass panes and/or screens can be installed. Two larger opening are on the west side. Each opening has a plywood panel that can be raised and secured to the rafters with an eye hook. Windows or screens can be installed in whatever openings allow for the best ventilation or the opening can be closed against rain. It has no electricity or water.

Contributing Structures

There are two contributing structures on the property. These are the electric interurban trestle and Perkins Bridge.

Interurban Trestle

In 1905, the Pittsburgh, Harmony, Butler and New Castle Street Railway Company, an electric interurban company began building lines connecting those communities. In 1907, Henry and William Miller, local farmers anticipating a land development windfall, granted a 30-foot right-of-way across their property to the company. The grant specified that upon abandonment the right-of-way would revert to the property owners. The southern fifteen feet of the right-of-way was cleared and tracks laid. A steel truss trestle on concrete wing walls was constructed across Sawmill Run on what became the Preston property (Photo 0009).

The Millers went bankrupt in a development scheme and the property passed to the Troutman family. When the interurban company finally ceased all operations in 1931, the easement reverted to Troutman. The Troutmans were a prominent family for whom Preston had worked at Standard Plate Glass in Butler, and when they became aware that Preston was looking for a new site, offered the land for free. Preston demurred.

All tracks, electric line poles and other element of the interurban had been removed, but the trestle remained. In 1949, Preston completed the dam for the large pond on Sawmill Run. The outflow from the dam created a new channel for Sawmill Run, and the trestle now spans an area of backwater. At some time, Preston had a bird sanctuary built on the structure. The steel and the concrete appear to be in good condition.

Perkins Bridge

This is a footbridge over Sawmill Creek near the eastern property line (Photo 0021. Once, and sometimes twice daily, Preston walked his property observing nature, birds and wildlife in his enclosed Frith. It was a habit stemming from his deep interest in nature and typical of the English hiking-in-nature tradition. At certain times when Sawmill Creek was running high, Preston encountered problems crossing and staying dry.

Preston, the professional engineer, used scrap iron available in the machine shop as the basis for his design rather than design first and possibly need to purchase materials. The result is an unusual-appearing structure with a lateral support or buttress. Built in the early 1950s, it is solid and functional. The bridge has iron trellis sides, but at the time of the photograph, they were being restored by local Boy Scouts.

Preston often named features after friends and colleagues. In this case, he honored Hayes Perkins, a friend from the 1920s. Perkins was a world-traveling knock-about. Preston asked Hayes to become his first caretaker and built the second floor apartment on the main building for him. Perkins was working as a landscaper and zookeeper for

the Hearst estate at San Simeon in California at that time. He accepted the position with Preston and during his stay from 1936-1938 was responsible for the laying out of the plantings that characterize the property. Preston acknowledged that Perkins was the one responsible for the fundamental landscape and honored him with this bridge.

This structure is contributing as a representation of Preston's engineering skills and as a symbol of the early creation of the landscape.

Contributing Objects

There are two contributing objects. These are the iron gate on South Eberhart Road and the lily pond on the north side of the main laboratory building.

Iron Gate

Frank Preston always admired iron gates of the type seen at great estates when he was growing up in Leicester, England. He drove several times a year to Toledo, Ohio to consult with Owens glass. Each trip he noticed this gate on a farm in Ohio. In 1952, Preston noticed that farm looked abandoned and discovered land had been condemned for the Ohio Turnpike. He located the gate owner and purchased the gate. He had it shipped to Preston Laboratories and put on the ground near the machine shop.

Preston had wanted to build a grand house a few miles away or on the property in the area north of the machine shop and well house. In 1956, the year of renovations, the gates were erected along South Eberhart Road under three hundred feet north of the regular drive. Columns and sweeping buttresses of concrete are covered with the Roman brick facing. The forms resemble many of his plantings on the property.

Jane Preston was content with a simple life in the small apartment and the grand house was never built. There was one grand procession through the gates when they were completed and they were opened only one or two more times. They are well-maintained, kept painted, and are in working condition.

Lily Pond

The lily pond is located north of the main laboratory just before the land surface dips to the north and to the large pond. It was built in 1936-37 when the laboratory building was constructed. The view from Dr. Preston's office overlooks the lily pond and down the grassed slope to the pond below. The pond is constructed in concrete, with a concrete apron and is 20 feet by 30 feet and three feet deep. Both tropical and regular lilies were cultivated in the pond and many plants are still producing flowers. Goldfish were stocked and their descendants still occupy the pond. The water connection is in the laboratory; an overflow drain discharges water to an unknown location.

Contributing Sites

Two contributing sites are on the Preston Laboratories property. One is the geography lesson and the other is the entire property with all of Preston's created setting, his vernacular English Garden.

Geography Lesson

The "Geography Lesson" is a circular area located just in front of the main laboratory building that includes fourteen metal signs listing the bearings and distances to locations around the world. At the entrance to the Geography Lesson are two concrete monuments, each with a metal plaque and called "Shooting the Bull." One is Jane Preston's Sagittarius (the archer symbol) aimed at the bull symbol, Frank Preston's Taurus (see Photo 0007). It is within a larger circle around which the driveway system runs, lined with labeled geological specimens and surrounded by shrubs

Preston wrote that he was an indifferent student in his early years except for geography. He spent hours examining the large world maps hanging in the classrooms. In 1936 Preston was in the Butler hospital for minor surgery and to pass time conceived the Geography Lesson. His personal papers contain a large file of places with bearings and distances. Why he selected the ones on the signs is unknown. There has been conjecture they represent places he visited or sold equipment but one sign includes the South Pole. The signs remain in excellent condition.

English Garden

Preston's determination to have the most attractive place in the business through its landscape and setting is best expressed in the landscape that represents a form of the English Garden that most likely was familiar to him in his formative years in England.

In 1949, Preston constructed a dam on Sawmill Run and impounded water for the large pond. The pond is five-acres and when excavated was 22-feet deep. He designed the dam and oversaw construction. A concrete spillway sends water back into Sawmill Run. Recent dam inspection revealed that the dam is sound and poses no downstream threat. Three small islands were left as nesting places for ducks. In the natural cycle, the pond now is estimated to be 15 feet deep as a result of sixty years of siltation, and a large lily pad population covers much of the surface. A variety of fish species such as carp and other suckers, trout and bass have been caught recently.

The pond is located at the base of a continuous grassed slope and is visible from the main laboratory (Photos 0003, 0004) in a classic English Garden tradition of the "manor house" (lab) sitting on the high point with a view of the "lake."

The second pond was constructed in 1941-42 east of the laboratory buildings complex along the service road adjacent to woodlands. Less than one acre in size, it was excavated to a depth of three feet (Photo 0002). It is fed by a spring that originates near the hacienda and flows in a small channel to the pond location. It is estimated to

be about two feet deep and has no fish. Small ponds are typical in this type of landscape. This is when Frank Preston married Jane Hupman from Toledo, Ohio.

South of the main laboratory is the Arboretum, a concept and term used in England in the garden landscapes. The Arboretum is an oval of spruce trees enclosing approximately two acres of grassed land. It is comprised of 40 species of North American spruce (Photo 0005). The Arboretum adds a balance and harmony to the landscape, a geometric terrestrial counterpoint to the large pond north of the laboratory.

Two fields of Wisconsin prairie grasses (Photo 0004) along the service road from the small pond to the large pond represent Preston's interest in ecology and geologic history. Pockets of the grasses developed naturally after the retreat of the Wisconsin glacier. Because Preston was interested in post-glacial geology and ecology he planted the grass on the property prior to his retirement. Similar to the practices of Native Americans in the prairie lands of the U.S., the grasses are burned annually to fertilize the soil and remove intrusive species.

Geometric tree plantings tie much of the garden together as well as add a decorative element (Photos 0003 and 0006). Rows of mature evergreens arcing on the east and west of the main laboratory building to the north, frame the open grassed view from the lab to the large pond. They lead the eye across the lily pond and to the large pond. Each row ends with a different and smaller species, literally rounding off the tree row. Corridors between the trees are called fairways (Photo 0033). Other geometric patterned stands of evergreens, esplanade trees, an orchard, and hardwoods are spread across the property in lines, star patterns, rectangles and other geometric shapes difficult to observe from the ground.

The existing woodland occupied the property when Preston purchased it. It entirely surrounds the property with the largest area on the east side where steep terrain and the valley of Sawmill Run are located. He cleared and maintained trails for his regular walks around the property (Photo 0032). Preston preferred a woodland with understory that provided habitat, especially for birds and did not cut trees or engage in forest management, leaving a natural setting to encompass his cultivated landscape.

Non-Contributing Building

Carnegie Building

This is a large metal Butler building erected in the mid-1960s as a storage and staging building for the Carnegie Museum (Photo 22). It is approximately 100x75 feet, built on a slab with a loading dock on the south end, and is one open space. The timing of construction coincides with the presence of the Museum's taxidermy and archaeology departments in the machine shop and the instrument building respectively. Dr. Preston had a strong professional relationship with the museum through his work in ornithology, ecology and geology. During the Viet Nam war, protestors were threatening Carnegie

Tech (now Carnegie Mellon), where weapons research was being conducted, and, for unknown reasons, Carnegie Museum as well. Irreplaceable collections and activities associated with them were moved to Preston Laboratories. It is considered non-contributing because it post-dates the 1936-1959 period of significance, is a building built and owned by others, and is related to Preston's other scientific pursuits following his retirement. The Carnegie Museum moved its archaeology and taxidermy departments to Pittsburgh in 1980 and the building has remained unused.

Integrity

Preston Laboratory retains most of its integrity from the period of significance, including all features necessary to convey its significant association with the productive life of Dr. Frank Preston. The location of the property and its features has not changed, nor has its setting. The property has been maintained as it was when Jane Preston donated it to the Butler Township in 2008 for use as a community park, and she maintained it very much as it had been throughout the life of Dr. Preston.

The greatest change was the addition of the Carnegie Building circa 1967. It is out of scale and character with the earlier buildings. It clearly defines a change in Preston's glass scientist life, a defining symbol of the end of the period of significance. The leasing of space in the instrument building to Carnegie to house the "Department of Man" resulted in the building of two interior partitions to re-use existing space on the first floor. Since the partitions were never removed, a loss of interior integrity in a portion of the instrument building first floor occurred.

When Preston sold his business in 1959, the successor company AGR (American Glass Research) removed all working research equipment to their facility in Butler Township.

The design, materials, and workmanship of the property's features are intact from the period of significance, 1936-1959. The main laboratory building was modified by Frank Preston circa 1956 to address design flaws associated with the flat roof and poor quality concrete blocks, and to modernize the building's appearance. The flat roof was changed to a low gable, the stucco building was clad in Roman brick and siding, and the windows were replaced in the same style in the existing openings. The well house was clad in brick at the same time. However, because these changes occurred before the end of the period of significance, provided protection from deterioration, and were designed and executed by Dr. Preston, they do not detract from the integrity of the district.

Because little has been changed and the essential building and landscape features remain intact, the integrity of feeling and association of Preston Laboratories remains except as noted. Preston Laboratories is clearly recognizable from the period of significance, and retains the features necessary to illustrate the scientific activities and the productive life of Dr. Frank Preston.

Preston Laboratories was the workplace and residence of Dr. Frank Preston. In his professional career, Preston conducted scientific research on many characteristics of glass, especially glass fracturing. He built equipment for glass container testing, wrote American Society for Testing and Materials (ASTM) standards, invented machinery for the glass industry, invented an oven leading to Corelle ware, consulted on ceramic heat shields for the U.S. space program, and served as a consultant to the glass industry. In his spare time, he explored other scientific interests, becoming involved in ornithological research, ecology and geology, resulting in the creation of the Western Pennsylvania Conservancy and Moraine State Park, among others. His historical importance and activities at Preston Laboratories define the property

Property History

The property is part of a former larger agricultural holding going back to the nineteenth century. Two of the owners, William and Henry Miller, granted a right-of-way to the Pittsburgh-Harmony-Butler-New Castle Street Railway Co. an electric interurban streetcar line, in 1907. A single track north of the center of the property was constructed in the east-west right-of-way along with a trestle over Sawmill Creek. Anticipating growth from the interurban, Henry Miller created a residential plan, the cost and failure of which resulted in bankruptcy and the selling of parcels of land. By 1936, an approximate 66-acre parcel was owned by Albert Troutman, a colleague and friend, to Dr. Preston. He employed Preston briefly at Standard Plate Glass in Butler. He offered the property free to Preston, but Preston declined and purchased it (Preston: Chapter XI, 71-80).

This 66-acre lot formed the nucleus of Preston Laboratory. It encompassed most of the land from the district's southern boundary north to the abandoned interurban right-of-way. In 1937, Preston purchased approximately 20 acres north of his initial lab property. That purchase extended from the interurban right-of-way north to the present property line. The final pieces were added in the mid-1940s, a two-acre triangle forming the southeast corner of the district and an approximate one-acre lot along South Eberhart Road (Butler County Deeds). No further changes in the use of the property have occurred.

Frank W. Preston

Frank Preston was a person important in history and science beginning in the early years of his career and continuing through his lifetime and on to the present. From 1926 to 1959, he was the pre-eminent, pioneering glass scientist with respect to the breakage of glass, especially glass bottles. He was referred to as the father of glass fractography for identifying and naming glass fracture surface markings and fracture patterns. He laid the foundation for and created what is currently understood about glass fractures, glass strength, glass container handling machinery, and most testing protocols and equipment. Although initially focusing on glass bottles, his contribution is applicable to all glass materials. Many of his methods and equipment for glass handling are still in use in most countries. Following his retirement in 1959, he devoted himself to research and active involvement in ornithology, geology, ecology and conservation until his death in 1989.

Frank Preston was born to modest circumstances in Leicester, England in 1896, in a family that valued education. He graduated with honors from a prestigious local preparatory school in 1912. The honors distinction automatically conferred an Associates in Arts (A.A.) degree from Oxford University. From 1913-1917, he was "articled" (apprenticed) for five years to a municipal engineer for training as a civil engineer. At the same time, he took tests, but attended no classes, from the University of London and earned a Bachelor of Science (B.Sc. in England) in engineering in 1916 (Preston: IV, 16-18).

With his engineer's degree and B.Sc. in hand in 1917, Preston, on a whim, took a job in the Stoughton Street Glass Works of Taylor, Taylor and Hobson in Leicester. He quickly was promoted to Director of Research, working primarily in the field of lens polishing, glass quality and glass properties. He wrote that, "because of William Taylor I left engineering for glass research" (Preston: IV, 22). Taylor sent Preston to the U.S. in 1921 to study lens-grinding techniques at the American Glass Company in Southbridge, MA. Shortly after, George Eastman recruited Preston to study also at Kodak in Rochester, NY.

By 1922 Frank Preston was working for Frank Troutman at Standard Plate Glass in Butler, PA. While there he developed new glass polishing techniques and worked on plate glass handling equipment. In 1925 he earned his Ph.D. in engineering from the University of London by taking tests, again without attending classes.

Preston left Standard Plate Glass in 1925 to embark on a world tour. Upon returning from his travels in 1926, Preston realized he could lose his job at Standard Plate Glass due to economic conditions. He decided to leave and form his own glass research and consulting firm. He asked Jim Carrie, a mechanic and machinist from Standard Plate, to join in creating the operation. They rented the second floor of a drafty ramshackle frame building in Butler, owned by George Howard. There was no heat, primitive plumbing and ventilation came mostly from the wind through the walls. Preston and Carrie worked under these conditions for ten years before Preston built Preston Laboratories in Butler Township in 1936-37.

Because their initial laboratory building was unheated, Preston began leaving various kinds of bottles filled with water to freeze overnight. Hydrostatic pressure caused the bottles to fracture but the glass was held in place by the ice. That started his interest in glass surface markings and glass fracture (Preston, XI, 7-10). To make money, he worked on a variety of inventions, including automobile tire chains, but he was denied patents for most efforts (Preston: XI, 7).

The defining moment in his career was a bottle breakage lawsuit in 1931. A court case in 1931 opened the door for his career. A judge's ruling that became case law stipulated that the bottling industry had to develop safety standards to protect the public from injuries and to protect themselves in lawsuits. With the end of Prohibition in 1933,

beer bottling lines were in full operation, there were great problems with bottles exploding under pressure. Workers and the public were suffering injuries from such bottles. The industry turned to Preston because he was well known and well respected through his consulting and publications (R. Shott: interview March 2011).

Preston began to develop testing methods and invent machinery for physical bottle testing. This work brought a steady flow of money to his business, providing the resources to build a new glass research facility and leave the drafty first laboratory to be demolished.

When Preston purchased the first parcel from Albert Troutman, he hired Edwin Howard, a local architect and the son of George Howard, owner of the first lab building, to design the first building. Construction began in 1936 and Preston began work in the building as sections were completed. Initially all aspects of his glass science work were located in the building.

Preston directed Howard to include a small four-room apartment as a second floor to be a residence for a caretaker. He invited his long-time friend Hayes Perkins, groundskeeper at the Hearst estate, San Simeon, to be the caretaker. Perkins agreed and became the architect of Preston's landscape goal of creating the most attractive business setting in the glass industry.

Once Preston Laboratory opened in 1936, work quickly outgrew the original lab building. A machine shop was built in 1939 to fabricate Preston's inventions for the glass industry. Both scale and full size equipment were built here. The instrument building followed where testing of bottles and glass was conducted.

Preston continued to reside in modest apartments in the near-by city of Butler and commute ten miles round-trip to the lab each day. He also began regular consulting trips to glass factories in the northeast and mid-west, the heart of the bottle making industry.

He began assembling a staff as the business grew and his absence was routine. He was the overall owner and director of the business, the driving creative force. He hired Ph.D. research scientists in chemistry and physics, and engineers who worked on machinery design as well as projects on the property. Jim Carrie remained as the master machinist until his death in 1942. There was some disruption of the staff by World War II, but by the late 1940s a solid core of leaders and technicians was firmly in place. Major employees included John McCormick, engineer, Dr. L. Ghering in physics, a Dr. Lehnard, and Henry Dimmick, one of the purchasers of Preston Laboratories in 1959. Laboratory technicians and machinists formed a second tier. Preston had three secretaries and until technology changed, a telephone switchboard operator. There were support people in maintenance and grounds-work as well.

The number of employees stayed within a range of 20-25 people. Both females and males were part of the workforce in the laboratories. Preston declined opportunities to

expand into a large business. His model allowed him to maintain an intimate relationship with his employees. At the beginning of every workday he stopped and chatted with each employee and reportedly was thoughtful and generous in helping with personal and financial problems (Alexander Shott 2012). Preston Laboratories was a variety of an English paternalistic business.

One major client was Owings-Illinois in Toledo, Ohio. The founder, Michael Owens, had developed a method for making bottles efficiently and quickly and Owens became the largest bottle maker in the industry. While in Toledo, he met Jane Hupman, an executive secretary at Owens. She had a degree from Northwestern University in literature and arts. They were married in 1942 and made their home in Butler. They had no children.

In 1947, their landlord decided to sell the house they were in to a developer who proposed to demolish the building. Available real estate was still in short supply after World War II as were building materials. One Sunday in 1947 the Prestons drove to the laboratory for a nature outing at the small pond. Upon arrival they discovered the caretaker dead in his apartment. Jane decided this was a sign that she and Frank should move into the apartment, which they did.

Preston' prominence and reputation resulted in the United States government inviting him to an atomic bomb test at Bikini Atoll in 1947. In an epic journey on tramp steamers, Preston arrived and witnessed the test. He then secured glass that had been created on the bottom by the heat and pressure of the explosion and presumably performed tests on it. There is nothing in his memoir about the aftermath, likely due to the work being classified.

He joined with other prominent scientists around 1948 to create the Western Pennsylvania Conservancy, which he named. Preston became active in land conservation issues, with his great contributions coming after his retirement. The organization is still active and owns properties such as Frank Lloyd Wright's Falling Waters. There was never an ownership stake in Preston Laboratories.

Preston retired in 1959, selling Preston Laboratories to American Glass Research (AGR), still located near-by, where his seminal work has continued to the present day. AGR still honors him on their web site. His pioneering work remains the basis for standards of glass fracturing and for glass, metal and plastic container handling in most parts of the world. As well, through his other interests, he set the stage for another productive period in his life.

When he retired, Preston Laboratories as the defining location for the glass science work –research, testing, and innovation of Frank Preston came to an end. All the equipment associated with the work was sold and removed by AGR. There were no more daily science employees. Within seven or eight years Preston leased the machine shop and the instrument building to the Carnegie Museum of Natural Science and hung a sign at the entrance to the property stating "Meridian Research Center," clearly

signifying the closing of Preston Laboratories.

Dr. Preston continued to live on the premises and turned his scientific interests in other directions where he was part of larger organizations.

His deep love for and interest in the natural world surely traced back to the cultural traditions of his native England. These interests manifested over his entire life, natural science interwoven with glass science. The landscape of Preston Laboratories is a clear example of the role of science and nature in his worldview (Hoskins: *Making of the English Landscape,* 1955*; Leicestershire Illustrated History*; Fox: 1948).

Preston's retirement years were devoted largely to pursuit of this interest in the natural world. At the same time, he continued to consult to the glass industry as an individual rather than the owner of a research company. These combined activities led to seminal research, publications and public activism in the fields of ornithology, ecology, geology, and conservation as well as highly-respected and important glass-based products.

Preston joined the American Ornithologist Union in 1952, becoming a Fellow by 1971. He began studies of bird eggs with the same rigor he applied to glass, focusing on shell characteristics and fractures in methods from his glass research.

His knowledge of ecology and geology in the vicinity of Preston Laboratory developed from frequent expeditions into the glacial landscape of the Wisconsin terminal moraine in the Muddy Creek Valley, just a few miles from Preston Laboratories, and from relationships developed with Carnegie Museum and the University of Pittsburgh. In 1948 he led field trips to the glacial area with Otto Emery Jennings, a noted botanist and director of the Carnegie Museum, and several other scientists from Pittsburgh. The interest generated resulted in continuous field research by scientists from several disciplines in the area (Preston: XIII, 34).

At retirement, Preston owned several hundred acres in Muddy Creek Valley where he had proposed to build a residence. He donated his land to the Western Pennsylvania Conservancy with the intent that the valley be conserved and eventually become a park.

As a singular driving force in the 1960s, Preston went door to door in the area to purchase more land through the Conservancy and donated that land and some of his money for the preservation of the glacial moraine area. His efforts, and the efforts of others, culminated in 1970 when Muddy Creek Valley was flooded to create 3225 acre Lake Arthur, and Moraine State Park became part of Preston's legacy (Preston: XIII, 7).

In 1974, Preston wrote a monograph published by the Carnegie Museum of Natural History entitled, "Drainage Changes in the Late Pleistocene in Central Western Pennsylvania." It still stands as a seminal baseline study of the area.

Preston also played a role, through the Western Pennsylvania Conservancy, in preserving what became McConnell's Mill State Park and the development of the

Jennings Environmental Education Center. Jennings contains a relict prairie grass stand that was typical of the region in the post-Pleistocene period. It caught Preston's attention because of his interest in local glaciation, and prior to retirement he had planted a stand of Wisconsin (named from the glacial age) prairie grass on the Preston Laboratories property. The grass is a protected conservation area by the Preston will. (R. Shott: personal communication, 2012; A. Shott: personal communication 2011)).

His relationship with the Carnegie Museum and the Western Pennsylvania Conservancy led to his providing space in buildings at Preston Laboratories for several years beginning in the mid-1960s and ending around 1980. The museum was under threat from anti-Viet Nam war protestors and feared for loss of irreplaceable resources in the archaeology and taxidermy departments. These departments were moved full-time into the instrument building and the machine shop respectively as part of Preston's scientific ethic. The Museum's activities continued for about 12 years in those buildings. The museum built the storage building in Preston Laboratories that is now owned by Butler Township. It is vacant. (A. Shott and R. Shott: personal communication, 2011).

This was a period of considerable activity. The museum's archaeological projects staged from here, artifacts were cleaned, curated and stored. The taxidermy department handled everything from large mammals (a giraffe) to tiny insects (A. Shott: personal communication, 2012).

Although retired, Preston continued consulting to the glass industry, traveling regularly to Corning Glass in Corning, NY until the age of 90 in 1987.

Dr. Preston died on March 4, 1989 at 92.

Jane Preston lived on the premises for another nineteen years, moving her living space from the second story apartment to rooms on the first floor of the laboratory building. She remained active in organic gardening and vegetarian education. Her maintenance and upkeep of the property was less systematic than Dr. Preston's but in all kept the grounds as they were as the planted landscape continued to mature and kept the buildings from structural damage and decay.

Mrs. Preston died in 2008 and left Preston Laboratories to Butler Township for use a public recreational space. The township took title in 2010. The grounds are maintained, the trails have been dressed up and are in public use. The buildings are vacant and face an uncertain future.

Significance:

Frank Preston was the first glass scientist to study glass fracturing or Fractography. His early experiences with fractured bottles in his unheated laboratory started a career that eventually led to glass testing methods, machinery and standards that are significant nationally and internationally to the present day.

He was a prolific writer and always published articles on his research in the glass industry journals. Eventually, through publications and consulting work, Preston became noticed in the in the glass container industry. A court case in 1931 opened the door for his career. In that year, a young girl lost sight in one eye when a soda bottle she was handling exploded. With no standards for bottle safety either in the industry or the company, the Peerless Glass Company could not demonstrate that the accident was not the fault of its bottles and was forced into bankruptcy.

In 1932-33, a judge issued an opinion that became case law. The glass industry was told they must test their containers prior to sale. At the end of Prohibition with beer bottling lines in full operation, there were great problems with bottles exploding under pressure. Workers and the public were suffering injuries from such bottles. The industry turned to Preston because he was well known and well respected through his consulting and publications (R. Shott: interview March 2011).

Preston was responsible for protecting people's health from the dangers created in the glass industry where the focus was mass bottle production at the expense of quality and public safety.

As there were no protocols for measuring or testing bottles, Preston started with a blank slate and had to develop testing methods and then invent machinery to conduct bottle testing. This was seminal creative scientific research that shaped his career at Preston Laboratories. Preston's innovations provided a previously unfulfilled but critical and legal requirement of technical support and research for the glass container industry. In the course of this endeavor, Dr. Preston and his team of researchers uncovered the fundamentals of fracture diagnosis, established glass strength performance characteristics and developed essential test procedures that are still used routinely today.

The first machine to be developed and patented by Preston was the thermal shock machine, which subjected bottles filled with hot water to a cold water bath. Careful temperature control and timing pinpointed under what conditions of heat, cold and rapid temperature change bottles of different types fractured. After that came studies of glass density and internal stress using a polariscope to detect internal stresses in glass using polarized light. Preston also invented an internal pressure-testing machine for glass containers where clear-taped filled bottles were put under pressure until they fractured. Strength of glass and its variables as well as impact machines that struck glass objects with controlled force and impact studies followed. Preston had to conceive and develop the tests necessary and create standards, and then had to create the machine to perform the test (Preston Archives, Testing Equipment file) (Preston: XI, 12).

The thermal shock machine created a demand for Preston's testing expertise and a demand for the machine. As the sole scientist in his field and the patent holder on the machinery, the income allowed Preston to start construct of Preston Laboratories in

1936-37 and to go on to a pre-eminent role in the study of glass fracturing and ultimately in safer products for consumers.

Frank Preston wrote the standards for the measurement of glass characteristics, their identification, and methods of testing, which became the American Society for Testing and Materials (ASTM, now ASTM International) standards for glass containers and were later adopted by the entire world as International Organization for Standardization (ISO) standards for glass containers. Many of these standards and practices remain in effect worldwide (Preston Archives: ASTM files).

There were several types of activities that occurred at Preston Laboratories. Bottle testing was the major activity, done under exclusive contract to a trade group, Glass Container Manufacturers Institute (GCMI). Most bottle making companies belonged to GCMI, and their bottles went through the trade group to Preston Laboratories, thousands each year. Preston conducted the tests and reported results to GCMI along with an analysis of deficiencies, if present. He also routinely published articles that were quantitative and analytical in glass science journals, the first of a true scientific nature that reportedly made the glass industry move away from anecdotal reporting to basic scientific research models (R. Shott: personal communication, May 2011).

Bottle testing and handling equipment patented by Dr. Preston was continually refined through research and manufactured in the machine shop. Bottle makers, bottling companies, and large glass making companies were the purchasers.

Consulting to the glass industry in breakage issues was another major contribution. Preston was permitted to consult with bottle makers and bottlers outside the GCMI contract, and he consulted with most glass companies regarding fracturing of glass. The glass items included, for example, glassware, stemware, glass lids, glass tabletops, and occasionally some architectural glass such as windows. Preston would devise testing equipment for the type of glass, run tests and report to his client and to the industry through journal articles. He worked as a consultant to major glass companies such as the various Owens-Illinois, Corning Glass, Brockway Glass, Glass Container Corp, Kerr Glass, Anchor Glass, Chattanooga Glass, Midland Glass, Glenshaw Glass, and many others (R. Shott: personal communication, 2012).

Dr. Frank W. Preston's impact on the glass industry was profound. His methods and standards became the national and international methods and standards of the industry. He held a very large and unknown number of patents for equipment such as impact testing machine, hydraulic testing machine, thermal shock machine, annealing machines (a process of slowly cooling glass to relieve internal stresses; glass which has not been annealed is liable to crack or shatter when subjected to a relatively small temperature change or mechanical shock), structural glass, glass block improvements, methods of heat treating glass and many more. By the 1950s his reputation was worldwide. He became a teacher and mentor for high-level scientists and executives in the glass industry from companies in Europe, Australia, and Asia. Japanese scientists

seemed to be especially drawn to Dr. Preston and Preston Laboratories. These scientists paid to spend time at Preston Laboratories to observe and learn from Preston, disseminating his findings to all continents.

Before he retired, Preston read an article in *Science* about the thermal fissuring found on the ocean floor (if this relates to his work with the atomic bomb test or not is unknown). From this he had an idea about a glass furnace that would produce no pollution (Vermel [Vertical Melting] Furnace), except for a small amount of water vapor, and increase efficiency by at least 50%. The glass container industry showed little interest due to large development costs. Corning Glass (a Preston client for decades) became interested, and in the 1960s, after Preston retired, undertook development costs. This led to the creation of Corelle ware, estimated to be in half the households in the United States (Gable: personal communication, 2012). Corelle was another enduring result of Preston's work that has lasted well beyond his career at Preston Laboratories.

Through a long and successful career encompassing several disciplines, Frank Preston published more than 2000 scientific papers in glass, ornithology, geology and conservation, much of the research seminal in the field. He is one of the few authors to have some of his early-published papers republished after his death in recognition of their importance in understanding current technology.

During the time of Preston Laboratories, 1936-1959, Frank Preston was known in the glass industry as a pioneer in the field of glass fracturing. Starting with no model, he created glass testing methods, wrote the standards for testing, invented the testing machinery and wrote those standards. His work brought uniformity to glass breakage research, assisted in the creation of much safer glass products from household goods to industrial production. All of these contributions disseminated world-wide where they remain if effect. Frank Preston was significant in state, regional, national and international history.

Context and Comparisons

Preston Laboratories was the facility for testing glass fracturing, primarily glass bottles, in the nation. During the period of significance, the glass industry in general was concerned with creating new products and with faster means of production (Lamoreaux and Sokolof: 6-7, 1997). Until lawsuits and emerging case law forced the bottle industry into creating standards for safe bottles, there was little concern for the issue.

Once the bottling industry turned to Preston Laboratories for help, Frank Preston's study of glass fracturing led him to create the standards and methods needed to produce high quality glass to go along with greater efficiency and volume of production. Preston Laboratories filled a specific need, and with Preston's expertise and patents he created a niche in the glass industry.

Preston's expertise grew beyond bottle fracturing and included scientific study of the processes that made glass strong and less likely to fracture. It was this well-rounded knowledge and consequent respect in the glass industry that made him an invaluable resource.

For example, Corning Glass, a glass manufacturer founded in the 1850s and based in Corning, New York, was one of the firms at the forefront of creating new glass products. Their innovations included heat-resistant glass globes for railroad lanterns (1912) to prevent them from shattering; creation of a machine to produce incandescent light bulb globes (1926); and the development of silicones (1934), a cross between glass and plastic. When it came to testing their glass and making sure it met the necessary standards, however, Corning went to Preston laboratories (Gable, personal communication, 2012).

For many years, Preston partnered with Jesse Littleton of Corning Glass to study heat-treating of glass to produce a desired hardness or other characteristics (annealing) of glass. Preston commuted regularly to Corning, NY until the age of 90. Of his work, a CEO in the 1950s wrote that Preston brought the glass industry into the modern age through his study of fracturing (Gable, personal communication, 2012).

Preston was a major consultant to the Owens conglomerate. The bottle making industry traditionally was a skilled-labor operation using old blowing techniques. In 1903, Michael Owens of Toledo Glass (later Owens) invented a fully automatic bottle-making machine that could produce 240 bottles a minute and reportedly reduced labor cost in bottle factories by 80 percent. Owens and Edward Libbey joined to produce the machines. The machine was adopted widely, imitated, and eventually improved by others. By 1918 over twenty million bottles were produced annually in the US (Lamoreaux, 6). Owens moved into bottle production in 1919 and became a major manufacturer (Gable, personal communication, 2012).

Frank Preston became a consultant to all the Owens companies initially regarding bottle fracturing problems. Despite their own laboratories, the company's research was generally on matters of rapid production, different types and shapes and colors of bottles, bottle composition but not on issues of fracturing and safety. It was more economical to hire Preston as a consultant than to devote laboratory time to the subject. Eventually Preston became involved in testing breakage problems with such glass objects as glassware, dishes, and jars.

In 1936, the two clients Owens Glass and Corning Glass formed a joint venture to produce insulation from glass fibers. Preston Laboratories became a testing site for the product. The second floor of the instrument building was dedicated to the task of studying what adhesives best held the glass fiber insulation together.

Preston Laboratories was the locus of glass breakage and testing science. Frank Preston's team of engineers and Ph.D. scientists in physics and chemistry were the only known people specializing in the field. Preston was without peer and Preston Laboratories was known worldwide during the years 1936-1959. It was some of Preston's own researchers who purchased the business and created American Glass Research built on the Preston Laboratories model. That firm still uses many of Preston's methods and updated testing equipment on a global scale.