

NATIONAL HISTORIC LANDMARK NOMINATION

NPS Form 10-900

USDI/NPS NRHP Registration Form (Rev. 8-86)

OMB No. 1024-0018

STRATOBOWL

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United States Department of the Interior, National Park Service

National Register of Historic Places Registration Form

1. NAME OF PROPERTY

Historic Name: Stratobowl

Other Name/Site Number: Stratocamp; Stratosphere Bowl, Moonlight Valley, Bonanza Bar

2. LOCATION

Street & Number:

Not for publication: N/A

City/Town: Rapid City

Vicinity:

State: South Dakota County: Pennington

Code: 103

Zip Code: 57702

3. CLASSIFICATION

Ownership of Property

Category of Property

Private: X

Building(s):

Public-Local:

District:

Public-State:

Site: X

Public-Federal: X

Structure:

Object:

Number of Resources within Property

Contributing

Noncontributing

1

2 buildings

1

sites

2

structures

objects

4

2 Total

Number of Contributing Resources Previously Listed in the National Register: N/A

Name of Related Multiple Property Listing: N/A

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4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ____ nomination ____ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ____ meets ____ does not meet the National Register Criteria.

Signature of Certifying Official

Date

State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

Signature of Commenting or Other Official

Date

State or Federal Agency and Bureau

5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

- ___ Entered in the National Register
- ___ Determined eligible for the National Register
- ___ Determined not eligible for the National Register
- ___ Removed from the National Register
- ___ Other (explain):

Signature of Keeper

Date of Action

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6. FUNCTION OR USE

Historic:	Transportation Transportation Monument/marker Landscape	Sub:	air-related road-related commemorative marker natural feature
Current:	Landscape Transportation Monument/marker	Sub:	natural feature road-related commemorative marker

7. DESCRIPTION

ARCHITECTURAL CLASSIFICATION: No Style

MATERIALS:

- Foundation: N/A
- Walls:
- Roof:
- Other:

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Summary

The Stratobowl is nationally significant under NHL Criterion 1 as the launch site of the *Explorer I* and *Explorer II* flights, and *Strato-Lab I* and *Strato-Lab IV*. Comparable in importance and popularity to the manned space flights of the 1960s, the Stratobowl is known today as the “Cape Canaveral of its day.”¹ The *Explorer I* and *II* flights, launched in 1934 and 1935 respectively, made important contributions in the area of aerial photography, atmospheric science and physics, and proved the utility of using pressurized cabins for high-altitude flights. Project Strato-Lab was the first of three high-altitude balloon programs in the late 1950s that ushered in the second era of high-altitude ballooning and developed much of the gear and equipment later utilized in the U.S. space program. *Strato-Lab I*'s flight in 1956 set a world-altitude record at 76,000 feet, making it the first high-altitude flight since the *Explorer II* twenty-one years earlier. *Strato-Lab IV*, launched in 1959, proved the feasibility of satellite-borne astrolabs. Project Strato-Lab also pioneered the use of trained scientists as part of a crew for scientific observations, while a pilot maneuvered the aircraft.²

Describe Present and Historic Physical Appearance.

The Stratobowl³ is located on the southeast flank of the Black Hills uplift in Pennington County, South Dakota.⁴ The site corresponds to a natural, bowl-shaped basin on the south side of Spring Creek, an eastward-flowing tributary to the Missouri River watershed. In this location, Spring Creek flows through an oxbow-shaped channel deeply incised in Madison Formation limestone. Nearly vertical limestone cliffs rise 400 ft. above the north, east, and south sides of the basin floor, sheltering the land adjacent to the stream channel.

Although located within the administrative boundary of the Black Hills National Forest (U.S. Department of Agriculture Forest Service), the majority of the land in the bottom of the bowl and along the adjacent stream banks is privately owned—part of the Bonanza Bar Placer Claim. Patented in 1904, the claim contains 84.68 acres.⁵ The slopes above the basin floor, as well as the land adjacent to the east side of the rim, remains in federal ownership.

Stratobowl Road (described in detail below) provides the only direct vehicular access into the bottom of the bowl where it serves as a segment of the proposed NHL boundary. Once in the bottom, the road angles north-northeast across the northwest edge of the basin, dividing the lands adjacent to the stream channel from the remainder of the land in the bottom of the basin. West of the road, native pine forest covers the lower hill slopes and mining-modified stream terraces adjacent to Spring Creek. East of the road, the roughly ten acres of land at the bottom of the basin is nearly flat and planted in pasture grasses. The exception is a timbered bedrock outcrop that projects from the floor of the basin near its northern edge. This outcrop represents the terminal end of a bedrock ridge that extends southeast from the west side of Spring Creek. Several other low bedrock outcrops occur along the northeast edge of the bowl.

The bottom of the basin east of the road is planted in pasture grasses. Mowing keeps the area free of encroachment by shrubs and tree seedlings. Outside the mowed area, the lower hill slopes contain stands of

¹ Lee Payne, *Lighter than Air: An Illustrated History of the Airship*, rev. ed. (1977; repr., New York: Crown, 1991), 259.

² George P. Kennedy, “Stratolab, An Evolutionary Stratospheric Balloon Project,” accessed March 1, 2011, <http://stratocat.com.ar/artics/stratolab-e.htm>.

³ The site also has been referred to as the Stratocamp and the Stratosphere Bowl.

⁴ In geological terms an uplift is an area of land lying at a higher elevation than the surrounding land. The Black Hills uplift results from volcanic activity during the Tertiary period.

⁵ A patent is a grant made by a government that confers fee-simple title to public land. The official document of a grant is referred to as a patent. Miners originally called the area “Moonlight Valley.”

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native bur oak (*Quercus macrocarpa*). Second-growth stands of native lodge pole pine (*Pinus contorta*) occur at higher elevations on the slopes above the north, east, and south sides of the bowl.

Distinctive white limestone outcroppings located between 400 and 450 ft. above the stream channel, mark the rim of the bowl. The land beyond the rim on the east side is relatively level, covered with pine forest broken by grassy clearings. Black Hills National Forest Rim View Road (FR 370) extends from State Highway 16 to access an overlook and commemorative plaque at the northeast edge of the rim.

The county-owned Stratobowl Road noted above, provides vehicular access to private residences located in the bottom of the Stratobowl. Four of these are on the west side of the road (outside the NHL boundary), while one is located on the east side of the road (within the NHL boundary). Each residence occupies one or more of the seven subdivided lots associated with the Bonanza Bar MC 970 Subdivision. Residences on the west side of the road date to the early 1950s through the late 1980s. Because of the character of local vegetation and topography, the residences west of the road are not clearly visible from most areas east of the road and do not adversely affect the integrity of setting.

The house on the east side of the road lies within the NHL boundary. Located at the bottom of the bowl between the bedrock outcrop and the north edge of the basin, the house and its yard occupy the site of the Army tent camp erected in preparation for the 1934 *Explorer I* flight. Unlike the buildings located west of Stratobowl Road, the house in Lots 6 and 7 is visible from most areas east of the bowl.

Natural Features that Contributed to the Selection of the Site for the Explorer I Launch

According to historical documentation, members of the 1934 expedition chose the area adjacent to Spring Creek as the launch site for three reasons. Geographically, the site was located far enough west to allow a balloon to float between 700 and 800 miles east and still land in level, unforested terrain. Also, regional weather data indicated that the area was likely to have favorable conditions for a summer launch. At the local level, the expedition team selected the site because of its topography, particularly the 400-foot cliffs that ringed the basin, a feature that provided protection from prevailing winds during inflation prior to launch.⁶

Other factors, such as a sufficiently large level area in which to inflate the balloon, and space for a 100-person camp, also likely figured in the selection of the site. Spring Creek supplied domestic water for the occupants of the Army camp.

Generally speaking, there has been little change to the site's geological and topographical features since the 1930s and 1950s launches. However, the character of the native vegetation within the basin has changed. Immediately prior to the *Explorer I* launch, a portable sawmill had been operating in the vicinity of the Stratobowl.⁷ Contemporary photographs show that much of the timber from the hill slopes above the bowl had been harvested and milled, leaving a large sawdust pile at the east edge of the basin floor.⁸ In the 72 years since the *Explorer I* flight, the native pine forest has regenerated within the cut areas, with the result that the forest on the hill slope north of the basin is denser than it was during the 1930s launches. Although the character of the forest has changed since the period of significance, this change does not adversely affect the integrity of the site.

⁶ Albert W. Stevens, "Exploring the Stratosphere," *The National Geographic Magazine* 66, no. 4 (1934).

⁷ Alice (Pat) Tomovick, personal communication with author (Section 7) Janene Caywood, September 9, 2006.

⁸ The *Explorer I* expedition team used the sawdust to create a four-inch-thick cushion on which to rest the balloon prior to inflation. Canvas ground cloths were laid atop the sawdust to keep the balloon fabric clean and dry. Sawdust also "paved" the streets of the tent city. Stevens, "Exploring the Stratosphere," 400 and 405.

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Contributing Resources Associated with the Explorer I (1934), Explorer II (1935), and Strato-Lab I (1956) and IV (1959) Balloon Launches:

The sponsors of the *Explorer I* and *II* flights built several permanent manmade improvements to accommodate various aspects of the balloon launches. Those that remain include: the road built in 1934 specifically to provide access to the site, a gondola shed believed to date to the 1956 launch, and the overlook built for the dedication of the National Geographic plaque commemorating the *Explorer II* launch in 1935.⁹

Stratobowl Site: The Stratobowl site is where four highly successful, record breaking high-altitude balloon flights co-sponsored by the U.S. Army Air Corps and the National Geographic Society were launched. A temporary camp and tent city supported pre-launch activities in anticipation of each of these flights. Spectators witnessed the historic launchings from the rim of the bowl as well as the overlook.

Stratobowl Road: Built by Civilian Conservation Corps (CCC) enrollees in anticipation of the 1934 *Explorer I* flight, Stratobowl Road extends from the north side of State Highway 16 northward roughly one mile to the bottom of the Stratobowl basin.¹⁰ For most of its length, the narrow, unpaved road contours along the lower slopes of a north-to-south oriented tributary drainage, named Ohio Gulch, which enters the bottom of the Stratobowl basin on its southwestern edge.¹¹ The new road, built over the top of a previously existing foot trail, replaced an earlier ridge-top road located about a quarter mile east of the Ohio Gulch.¹² All of the personnel and materials associated with the 1930s and 1950s launches used Stratobowl Road, which was incorporated into the Pennington County road system after its construction. Stratobowl Road is counted as a contributing structure.

Stratobowl Overlook: Another improvement located atop the rim is the designed Stratobowl Overlook, built in 1955, in anticipation of the dedication of the National Geographic Society plaque commemorating the 1935 *Explorer II* flight.¹³ The overlook is protected by safety railings made with log rails embedded in battered stone pillars. The bronze plaque is affixed to a limestone boulder just outside the railing, in the approximate center of the overlook. The Stratobowl Overlook is counted as a contributing structure.

1956 Gondola shed: The gondola shed is located at the south edge of the basin, east of Stratobowl Road in approximately the same location as the original gondola shed. The building measures 12 x 12 ft. and is 15 ft. high. Corrugated galvanized metal panels are nailed to the exterior of the dimensional lumber frame, and also cover the shallow front-gable roof. A set of double doors fills the front (northeast) wall of the building. A chain-link fence surrounds the gondola shed. The area inside and adjacent to the fence is used for storage. The existing gondola shed is counted as a contributing building.

⁹ The gondola shed built for the 1934 and 1935 launches is no longer extant. Other camp infrastructure installed for the *Explorer I* and *II* launches was of a more temporary character. The Army erected a tent camp east of the access road between the rock outcrop and the base of the slope at the northwest corner of the bowl. The camp included a water system, fire department (deemed necessary because of the potential for accidents when handling quantities of highly explosive hydrogen gas), telephone and teletype service, short-wave radio station, and two electrical light plants. With the exception of the telephone system, all of these improvements were removed after the launches.

¹⁰ In 1934, State Highway 16 was known as Highway 40.

¹¹ Mineral Survey No. 970, surveyed June 19 and 20, 1893; approved July 10, 1893. Copy available at the Montana State Office of the Bureau of Land Management, Billings, Montana.

¹² General Land Office (GLO) Survey Plat for T1S/R6E, Black Hills Meridian, surveyed May 12 – June 17, 1899; approved January 27, 1900. Copy available at the Montana State Office of the Bureau of Land Management, Billings, Montana.

¹³ The existing designed overlook occupies only a small portion of the original spectator viewing area used during the 1934 and 1935 launches. Historical photographs show that spectators were spread about a quarter of a mile along the rim to view the balloon launches.

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Noncontributing Resources and Site Integrity

A number of buildings and structures present during the 1930s launches have been removed from the site. For example, the 1934 *Explorer I* expedition crew used J. C. Jacobson's house as its "flight-camp administration cabin." Originally constructed in 1881 as part of the improvements associated with the Bonanza Bar mining claim, Jacobson's house consisted of a one-story log building with a half-story addition on the northeast side in 1934. Distinctive architectural elements included its half-log-covered roof and a massive rubble chimney on the southwest side. The building stood just beyond the end of the bedrock outcrop east of the newly completed Stratobowl Road; it faced southeast towards the open land in the bottom of the basin. Members of the expedition erected a flag pole in front of the building and raised the flag of the National Geographic Society during the first *Explorer* mission.

Today, a short two-track access road leads from the east side of Stratobowl Road to the vicinity of the Jacobson home—its exact location indicated by the ruins of its external stone chimney. A frame garage, estimated to have been built in the late 1940s or early 1950s, is located west of the Jacobsen house ruins. This one-story frame building is believed to post-date the *Explorer I* and *Explorer II* launches, but was probably already present by the time of the 1956 *Strato-Lab* launch. The garage is counted as a noncontributing building.

In addition to the Jacobson cabin, several other buildings were located along the southern edge of the basin—among them the 15 x 15-foot gondola shed built by the Rapid City Chamber of Commerce specifically to support the launch. A few other small buildings, some associated with the failed mining venture and some with the recreational use of the area, were located in the vicinity of the gondola shed. None, however, remain on site.¹⁴

Although most of the infrastructure built to support the 1934 and 1935 launches was located at the bottom of the basin, the Rapid City Chamber of Commerce paid for the construction of safety railings along the rim of the basin. Photographs taken during the 1934 or 1935 launches show that these simple railings consisted of unpeeled pine poles affixed to standing live trees, and to posts set in stone cairns set along the edge of the rim. All of the original railings have been removed.

Modern, noncontributing resources located within the NHL boundary are located within the bottom of the basin. These include the residence owned by the Rollers, which occupies Lots 6 and 7 of the Bonanza Bar Subdivision. Built in 1970, it is a one-and-one-half story frame residence with an attached garage. In addition to the house, a small prefabricated tool shed is located in the yard south of the residence. The house and shed and its associated driveway and yard occupy the area of the 1934 tent camp. The Roller house and associated tool shed are both counted as noncontributing buildings.

Other small-scale modern features at the bottom of the basin east of Stratobowl Road include a board fence built adjacent to the west side of the road, which controls access into the open basin floor. A gate at the south end of the fence provides access to the front of the gondola shed. The gate is posted with "No Trespassing" and "Private Property" signs, and also has a routed wood sign designating the site as the "Strato-bowl." According to Ken Tomovick, the fence is about seventeen years old. Two mounds of rock—one on either side of the gate—may mark the 1934 entrance to the Stratobowl site. Another gate located farther north opens onto the driveway leading to the noncontributing frame garage associated with the old Jacobson house.

¹⁴ Alice (Pat) Tomovick has indicated that her uncle built a small cabin at the edge of the bowl where he resided part of the year. Alice Tomovick, personal communication with author Janene Caywood, September 9, 2006.

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The area proposed for inclusion in the Stratobowl site boundary incorporates the distinctive natural features that led to its selection as the site of the 1934 *Explorer I* balloon launch and subsequent launches in 1935, 1956, and 1959. These features include the roughly ten-acre open area in the bottom of the natural basin and the steep slopes that surround and protect the basin. Although most of the man-made improvements built to support the three launches lack integrity or have been removed entirely, the majority of these were of a temporary character not intended for long-term use. The important aspects of the site, namely its natural features and systems, retain high integrity and continue to evoke the events of 1934, 1935, 1956, and 1959.

Summary of Contributing and Noncontributing ResourcesContributingNoncontributing

Buildings: Gondola shed (1)

Roller house and shed (2)

Sites: Stratobowl Site (1)

Structures: Stratobowl Road; Overlook platform (1955) (2)

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8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties:
 Nationally: X Statewide: Locally:

Applicable National
 Register Criteria:

A X B C D

Criteria Considerations
 (Exceptions):

A B C D E F G

NHL Criteria:

1

NHL Theme(s):

VI. Expanding Science and Technology
 1. Experimentation and invention
 2. Technological applications

Areas of Significance:

Exploration/Settlement
 Invention
 Science
 Transportation

Period(s) of Significance:

June 1-July 28, 1934; July 11-12 and September-November 12, 1935;
 November 8, 1956; November 28-29, 1959

Significant Dates:

July 27-28, 1934; November 10-11, 1935; November 8, 1956; November 28-29,
 1959

Significant Person(s):

N/A

Cultural Affiliation:

N/A

Architect/Builder:

N/A

Historic Contexts:

*American Aviation Heritage: Identifying and Evaluating Nationally Significant
 Sites in U.S. Aviation History*

XIV. Transportation

H. Airplanes and Travel

XIII. Science

A. Physical Sciences

1. Astronomy

XVIII. Technology (Engineering and Invention)

J. Earth and Space Exploration

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State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.**Introduction¹⁵**

Considered the “Cape Canaveral of its day,” the Stratobowl is the site of four highly successful, record breaking high altitude balloon flights co-sponsored by the U.S. Army Air Corps and the National Geographic Society, *Explorer I and II*, and *Strato-Lab I and IV*.¹⁶ Many of the experiments conducted aboard these flights, particularly the suits developed to accommodate the atmospheric conditions at high altitudes, paved the way for the NASA space program. *Explorer I* was also the first flight to be broadcast nationally and internationally. The balloon maintained constant contact with the ground throughout the entire flight and NBC broadcast the dramatic events of the descending gondola to millions of radio listeners. The national attention attracted by the *Explorer* flights make them comparable to the manned space flights of the 1960s. The Stratobowl is being nominated under NHL Criterion 1.¹⁷

The *Explorer I and II* flights, launched in 1934 and 1935 respectively, made important contributions in the areas of aerial photography and atmospheric science and physics, and proved the utility of pressurized cabins for high-altitude flights. The latter flight was the last high-altitude flight of the 1930s and the end of the great era of human stratosphere ballooning.¹⁸ The next high-altitude flight would not take place for another twenty-one years until *Strato-Lab I* was launched from the Stratobowl in 1956 setting a world altitude record of 76,000 feet. Project Strato-Lab was one of two highly successful manned balloon programs (the United State Air Force’s Project Manhigh being the other) developed to test human responses to space-like conditions; to improve pressure-suits and cabins to manage human physiological responses to high-altitude environments; and to establish high-altitude flight procedures. This research was later incorporated into the U.S. space program. *Strato-Lab IV* was also launched from the Stratobowl in 1959 gathering meteorological, cosmic ray, and scientific data for the improvement of safety at high altitudes, and proved the feasibility of satellite-borne astrolabs.¹⁹ The topographical and natural features of the natural bowl made the site appealing for the launch of these historic flights.

Background

A great many balloon flights of the twentieth century focused on science and, in particular, the sun and cosmic rays. Balloons could provide a stable instrument platform free from the vibration and the electrical interference generated by aircraft engines. They could also climb above most of the Earth’s atmosphere and measure atmospheric and cosmic conditions without atmospheric interference. Much of our knowledge of the universe began with a 1912 balloon flight that physics professor Bruno Rossi called “the beginning of one of the most extraordinary adventures in the history of science.” On August 7, 1912, Austrian physicist Victor Hess took three electroscopes up to 16,000 feet in an open balloon basket. With these instruments, which detected and

¹⁵ Note that italics are used only when referring to a specific balloon. When referring to the projects themselves italics are not used.

¹⁶ Kurt R. Stehling and William Beller, *Skyhooks* (New York: Double Day, 1962), 231.

¹⁷ William E. Kepner, in collaboration with John H. Scrivner, Jr., “The Saga of Explorer I: Man’s Pioneer Attempts to Reach Space,” *Aerospace Historian* (September 1971): 126; George McElrath, “The Part that Radio Played,” *National Geographic Magazine*, technical paper, 91, Smithsonian Institution, National Air and Space Museum Library, Washington, DC (hereafter cited as NASM).

¹⁸ The stratosphere is the layer of the atmosphere above the troposphere but below the mesosphere.

¹⁹ Craig Ryan, *The Pre-Astronauts: Manned Ballooning on the Threshold of Space* (Annapolis, MD: Naval Institute Press, 1995), 225, 232-33. Navy Historical Center, last modified January 8, 2008, accessed February 24, 2011, <http://www.history.navy.mil/faqs/faq124-1.htm>; David H. DeVorkin, *Race to the Stratosphere: Manned Scientific Ballooning in America* (New York: Springer-Verlag, 1989), 307.

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measured radiation, he made an unexpected discovery—high-energy particles not seen on the surface of the Earth were bombarding the upper atmosphere. He concluded that “a radiation of very great penetrating power enters our atmosphere from above” and is absorbed by the atmosphere before reaching the Earth’s surface. These particles received the name “cosmic rays” in 1936 by physicist Robert Millikan of the California Institute of Technology (Caltech).

In 1914, Charles Greeley Abbot, director of the Smithsonian Astrophysical Observatory, sent specially designed instruments that measure solar radiation into the upper atmosphere to study solar energy and its impact on the Earth. Since the Earth’s atmosphere absorbs much of the light and radiation from the sun, balloons helped Abbot study solar energy by taking instruments above most of the atmosphere—15 to 20 miles above the Earth’s surface. In July of 1914, Abbott initialized his study of solar energy through the use of a standard balloon that he launched from a Weather Bureau Station located in Omaha, Nebraska. Through the use of balloons to launch scientific instruments into the nether reaches of the atmosphere, Abbott discovered that at approximately 7 to 10 miles above the Earth’s surface there was an unexpected variation in temperature. Instead of the temperature consistently dropping the higher the balloon traveled into the atmosphere until the temperature reached an absolute zero, as expected by Abbott, the temperature unexpectedly remained constant and even increased by a few degrees. Abbott referred to this “region of static temperature” in the Earth’s atmosphere as the isothermal layer.

In 1927, aeronaut Capt. Hawthorne C. Gray of the U.S. Army Air Corps, ventured into the stratosphere. He set a U.S. altitude record at 29,000 feet on his first flight, and although he attained 42,000 feet on his second flight, it was not officially recognized because he parachuted out of his balloon as it descended. He was low on both gas and ballast which resulted in an unsafe rate of descent. His balloon, Army No. S-30-241, was a 70,000-cubic-foot single-ply rubberized silk envelope coated with aluminum paint. Gray’s three flights offered him the opportunity to test high-altitude clothing, oxygen systems, and instruments as well as set a new record. On his third flight in November 1927, he once more reached 42,000 feet but was deprived of oxygen on his descent. Consequently, although his balloon reached the ground, he was dead upon arrival from oxygen deprivation. This ascent marked the last high-altitude flight in an open basket until 1955, when these projects were reinstated to develop pressure and spacesuits. Gray’s death underscored the central problem facing high-altitude balloonists—somewhere between 40,000 and 50,000 feet the air pressure becomes so reduced that a person’s lungs cannot function and gases begin to bubble out of the blood. To fly above 40,000 feet without a pressure garment or the protection of a pressurized vessel invited death.

The 1930s saw an increase in the number of flights into the stratosphere and Auguste Piccard, a Swiss physics professor, led the efforts with a May 1931 ascent. He had absolute faith that science could solve anything and considered the problem of oxygen deprivation to be no obstacle. A leading cosmic ray investigator, he needed to rise above the atmosphere to study it. In order to accomplish this, he would have to design a sealed, pressurized gondola. Using an apparatus developed by the Germans for use in submarines during World War I, Piccard built a gondola sphere 82 inches in diameter and weighing 300 pounds. The gondola was designed to keep two people alive for up to 10 hours above 40,000 feet. On May 27, 1931, Piccard and Paul Kipfer climbed into the stratosphere in a spherical, airtight, metal cabin suspended from a specially constructed, hydrogen-filled balloon. This balloon, with a capacity of 494,400 cubic feet, reached an altitude of 51,783 feet.²⁰

²⁰ The “Background” section on through the second to last paragraph, is directly excerpted from John D. Anderson, Jr., Marie Lanser Beck, Janet Daly Bednarek, Roger Bilstein, Caridad de la Vega, Susan Cianci Salvatore, and Laura Shick, *American Aviation Heritage: Identifying and Evaluating Nationally Significant Sites in U.S. Aviation History* (Washington, DC: Department of the Interior, National Park Service, draft 2008), 30-31.

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“Throughout the early 1930s the leaders of the Soviet Union attempted to use aviation as a means of establishing their position in the world pecking order.” They were not alone: another five countries also competed for dominance of the upper atmosphere throughout the early 1930s. Each of these countries tried to surpass one another for the world altitude record, presaging the space race of the 1960s. According to aviation historian Tom Crouch, the “race was on to explore” the stratosphere.²¹ In 1933, the race became so heated that a succession of high-altitude balloon ascents occurred almost every two weeks in the Soviet Union and in the United States. In the United States, Jean Piccard and his wife, Jeanette Piccard, were involved in stratospheric balloon flights not merely to set altitude records but to conduct experiments. One of the era’s most notable flights, *Century of Progress*, named after the 1933 Chicago’s World’s Fair theme, was responsible for precipitating a world race for the stratosphere. The high altitude balloon flights of the 1930s unleashed the same kind of competition witnessed during the space race of the 1960s between the United States and the Soviet Union. Instead of the moon as their objective the aeronauts jockeyed to recapture the world altitude record.²²

Explorer I: *The National Geographic Society – U.S. Army Air Corps Stratospheric Flight*

These early flights set the stage for a joint venture between the National Geographic Society and the Army Air Corps. In mid-January 1934, the National Geographic Society and the U.S. Army Air Corps announced a joint stratospheric flight capable of lifting three men and a full laboratory aloft. The flights moved beyond the mere goal of attaining an altitude record by proposing a robust scientific agenda – an understandable goal considering the sponsorship of the flights by the National Geographic Society. This agenda included five key goals: to measure the intensity and direction of cosmic rays; to locate and measure the thickness of the ozone layer; to collect air samples from the stratosphere; to ascertain whether spores or bacteria (indicating the existence of life) existed in the upper atmosphere; and to determine whether the traditional barographs and thermographs measured altitude more accurately than more recently developed photographic techniques. Capt. Stevens was responsible for making the flight possible; an enthusiast of stratospheric flights he convinced officials in the Army Air Corps to undertake the venture. With the army on board, Stevens subsequently approached the National Geographic Society for funding assistance; the Army Air Corps contributed their personnel, knowledge, and gear.²³

The flight personnel included veteran Army balloonists Maj. William Ellsworth Kepner as pilot and Stevens as scientific observer. Kepner was especially suited to the job as he was the former chief of the Materiel Division Lighter-than-Air Branch at Wright Field, and as a former meteorologist and teacher at the Balloon School at Omaha. At the time of the announcement he was the purchase branch chief at Wright Field. Albert Stevens began his army career during World War I when he was sent to Europe as an army observer. While abroad, his skills in photography secured him the rank of captain and he eventually became the chief photo officer of the First Army. In time, Stevens developed his own aerial photographic techniques.²⁴

Army Capt. Albert W. Stevens piloted the *Explorer I*, alongside co-pilot Maj. William Ellsworth Kepner and Orvil A. Anderson, operations officer. *Explorer I* had a balloon of three million cubic feet, five times the volume of the *Century of Progress*, making it the largest lighter-than-air craft at the time. The gondola was manufactured by the Dow Chemical Company and the envelope was fabricated by the Goodyear-Zeppelin Company. The envelope to lift the 700-pound, 100-inch diameter gondola was three times the size of that used for the *Century of Progress*; a hole 400-feet deep was required to protect the over 300-foot balloon from wind

²¹ Ryan, *Pre-Astronauts*, 48; Kepner, “The Saga of Explorer I,” 125. Both quotes, Tom Crouch, *The Eagle Aloft: Two Centuries of the Balloon in America* (New York: Little, Brown, 1983), 609.

²² Crouch, *Eagle Aloft*, 607-609; Although Jean was head of the project, Tex Settle was chosen as pilot for the *Century of Progress* flight. DeVorkin, *Race to the Stratosphere*, 3.

²³ Ryan, *Pre-Astronauts*, 52; Crouch, *Eagle Aloft*, 618; Payne, *Lighter than Air*, 259.

²⁴ DeVorkin, *Race to the Stratosphere*, 142.

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during inflation. The largest hangar in the world at the time, the Goodyear Airdock (NR, 1973), could safely contain a balloon a fifth of the size of the *Explorer*. Finding a suitable site for the *Explorer* launch would become a large task in itself.²⁵

Kepner and Anderson traveled throughout the western United States for two weeks in search of a suitable site that would shield the balloon from high wind gusts during inflation – a common concern of these flights. Kepner and Anderson located the ideal place in the Black Hills gold-mining country near Rapid City, South Dakota. The site was initially known as the Stratocamp and later known as the Stratobowl.²⁶

Kepner describes his first encounter with the Stratobowl (also known locally as Moonlight Valley)²⁷ during his search:

We walked out of a wooded area and there it was. I could hardly believe it. The walls were vertical 400 feet high on two sides; the third side almost a fifty degree slope; and the fourth side well protected. The bottom was 600 feet in diameter – a log cabin in the bottom, a grass field, and a huge pile of sawdust that was most useful. A fair road that we traveled by auto down to the bottom, and, of all things a beautiful trout stream tucked into one corner...It was almost what I had described as needed when asked at Denver. It was a most remarkable shelter for our huge balloon. I would never have believed that such a natural shelter existed. It made inflation possible.²⁸

The site had an additional advantage as an Army post, Fort Meade, was located just 60 kilometers from the bowl. Fort Meade had the capacity to house the approximately 100 Army personnel needed for flight preparation as well as storage capabilities for the equipment and supplies. Geographically, the site was located far enough west to allow a balloon to float between 700 and 800 miles east while still landing in level, unforested terrain. Other requirements included a 20,000-volt power line, a roadway able to accommodate large trucks, and a railroad.²⁹

Much as cities around the world compete for the prestigious honor of hosting the Olympics, numerous cities in the western United States competed for the opportunity to host the *Explorer* flight. The Stratobowl was one of forty sites considered for the launch by Kepner and the Weather Bureau. Before making his final determination, Kepner collected wind and air current data to determine the suitability of the site. Only after Kepner sent aloft small hydrogen balloons, burned old tires to analyze smoke streams, and spoke with weather specialists from nearby Fort Meade, did he make his final recommendation: the Stratobowl was perfectly suited as a launch site.³⁰

Once a site had been secured, preparations for the first *Explorer* flight got underway. Through an agreement between the Bonanza Bar Mining Company and the Army Air Corps, the land at the bottom of the bowl was leased for three months with the option of renewal for an additional two months.³¹ Rapid City also committed itself to providing several improvements and services, including the construction of a road especially for access to the base of the bowl, electricity and telephone service to the site and the cabin, and transportation for six

²⁵ Kepner, "Saga of Explorer I," 126; DeVorkin, *Race to the Stratosphere*, 148.

²⁶ DeVorkin, *Race to the Stratosphere*, 146-147.

²⁷ Crouch, *Eagle Aloft*, 619.

²⁸ Kepner, "Saga of Explorer I," 126. Stevens, "Exploring the Stratosphere."

²⁹ DeVorkin, *Race to the Stratosphere*, 147; Stevens, "Exploring the Stratosphere"; Kepner, "Saga of Explorer I," 125.

³⁰ DeVorkin, *Race to the Stratosphere*, 148; Thomas W. McKnew (Secretary, Advisory Committee) to Mr. G. W. Scales, National Aeronautic Association, Sheridan, Wyoming, May 16, 1934, Sheet 3, Explorer I folder, National Geographic Society Archives, Washington, DC (hereafter cited as NGS).

³¹ "Option," Card 50, Explorer I, NGS.

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carloads of equipment from the Rapid City railroad yards to the site. The Rapid City County Commissioner, the Civilian Conservation Corps (CCC), and the Forest Service jointly built a road from Highway 40 to the site. All of these services were provided free of charge by the city. At the entrance to the access road, the Army erected a sentry tent with military personnel on guard around the clock monitoring access to the bowl.³²

Capt. Orville Anderson arrived at the Stratobowl on June 1, 1934, to establish the base camp, under his supervision, to ready the balloon and crew for the impending flight.³³ Capt. Anderson specialized in aerial reconnaissance during his time in the Signal Corps and was the first person to photograph the moon's shadow on Earth during an eclipse. At the bowl itself, a temporary "tent city" was erected to support a portable radio broadcasting station, a press tent, a weather station, a hospital, and a mess hall, among other facilities, to accommodate flight personnel and the more than one-hundred support personnel. Temporary structures at the site included a gondola shed especially built for storage and a log cabin that served as the Society's offices. Fort Meade, the South Dakota National Guard, and troops from the Fourth U.S. Cavalry provided additional support staff.³⁴ Liquid hydrogen was transported to the site in fifteen hundred steel-cylinders and protected with sandbags and fresh-cut pine boughs.³⁵

The camp was a flurry of activity preceding the flight with such auxiliary groups as the National Broadcasting Company (NBC), the weather bureau, and the telephone company setting up equipment in preparation for the flight; all this was in addition to the many scientists who were already assisting Stevens in readying the equipment inside the gondola.³⁶

On July 6, using a borrowed Army Air Corps balloon modified to resemble the stratosphere balloon, cavalrymen from Fort Meade practiced inflating the balloon in preparation for the real inflation. On the morning of July 7, Kepner and Anderson made a test flight in a wicker basket in lieu of the actual gondola from the bowl, and on July 9 the balloon was christened *Explorer* by the wife of then-Governor of South Dakota, E. Y. Berry. By July 10, everything was in order for the launch.³⁷

While waiting over a two-week period for optimal weather conditions to materialize for the launch, NBC provided pre-launch programming from the headquarters cabin at the base of the Stratobowl. Interviews with flight personnel and scientists regarding the preparations further contributed to the pre-launch excitement. One of the scientists, Victor Neher of the California Institute of Technology, who was responsible for the shielded cosmic-ray experiments, noted on the broadcast that "The great size of this balloon permits for the first time at this altitude the study of the radiations with accurate instruments surrounded by thick shields." The scientists sought to "distinguish between two or more theories" on the origins of cosmic ray radiation. This was a rare opportunity for the cadre of scientists participating in the flight since it was unusual for scientists to receive national exposure of this kind.³⁸

³² "Agreement," Card 50, Explorer I file, NGS; Tom to Mr. George W. Hutchinson, Secretary, National Geographic Society, June 13, 1934; Card 51, Explorer I, NGS.

³³ Kepner, "Saga of Explorer I," 126.

³⁴ Tom to Hutchinson, June 13, 1934, Explorer I; Ryan, *Pre-Astronauts*, 53; "Agreement," Explorer I file; Payne, *Lighter than Air*, 262.

³⁵ *National Geographic Society*, Contributed Technical Papers, 406; Ryan, *Pre-Astronauts*, 53.

³⁶ Kepner, "Saga of Explorer I," 126.

³⁷ *Ibid.*; DeVorkin, *Race to the Stratosphere*, 160.

³⁸ DeVorkin, *Race to the Stratosphere*, 162-164. For quote see untitled and undated transcripts of radio broadcast, NGS, pg. 5, quoted in DeVorkin, 164.

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NBC hoped to achieve two-way communication between the ground crew and the balloonists during the flight.³⁹ The National Geographic Society and NBC arranged “for one of the most extensive radio hook-ups ever planned in covering a scientific event.” *Explorer I* was the first flight to be broadcast nationally and internationally. The specially-built equipment allowed for two-way communication between the balloonists, the ground crew, and Washington, paving the way for the famous television telecasts of the 1960s moon walk.⁴⁰

Once the scientific agenda of the flight had been set, it became apparent that a third crew member would be necessary to assure the success of the mission as the flight agenda was too cumbersome for just two pilots. On July 27, the night before the launch, a third crew member was added to the mission explicitly to help perform the scientific experiments, Capt. Orville A. Anderson.⁴¹

Finally, on July 27 at 1:30 p.m., the all clear was given for the flight. At 7:30 that evening, the balloon was uncrated and helium began flowing into the envelope. Large numbers of spectators were expected at the launch, and thus, precautions were taken to secure the fence at the top of the rim of the bowl to safeguard the crowds. Any type of accident could preclude a second launch at the site. Meanwhile, word spread rapidly throughout Rapid City and the adjacent communities about the approaching launch. Thousands of cars parked all along the rim of the bowl. An estimated thirty thousand spectators witnessed the ascent on that morning.⁴²

Before launch at dawn on July 28, the gondola was wheeled out of its shelter and attached to the ropes beneath the balloon. At 5:45 a.m. (MST), the balloon started its ascent from the Stratobowl. The balloon rose and remained temporarily static at an altitude of 12,400 feet so that instruments could be tested and scientific instruments could perform tests. The balloon leveled off again at a height of 40,000 feet so that cosmic ray measurements could be obtained. It was at this time that the crew sealed themselves inside the gondola. It wasn't until 1 p.m. while at a height of 60,000 feet that Kepner realized something was amiss; a tear in the lower section of the envelope had developed. The balloon had risen to 18 kilometers at their peak altitude before making a rapid descent. The three aeronauts aborted the gondola safely before the capsule crashed onto a Nebraska corn field. NBC captured the entire ordeal as millions of listeners anxiously awaited the fate of the aeronauts. Shortly after the gondola crash, Kepner called Air Corps Area Headquarters from a farmhouse to report the end of their flight. He was subsequently connected to a live radio broadcast to recount his safe landing, much to the relief of the listeners tuned in that afternoon.⁴³

The flight narrowly missed the world altitude record by 624 feet because of a rip in the balloon that ultimately caused the *Explorer* to explode on its descent. Some data collection from the mission did survive and some important temperature and altitude data were salvaged.⁴⁴ Readings from the spectograph were salvaged since it was dropped from a separate parachute and the film was saved. Enough data were recovered to help confirm some theories.⁴⁵ According to Stevens:

Our most cheering thought of the recent ascent is that we feel we have successfully solved the problems of living and working efficiently in the stratosphere. It is gratifying to state that not a single

³⁹ McElrath, “Part that Radio Played,” 91, NASM.

⁴⁰ Quote, “Millions of Radio Owners to Listen In on Stratosphere Flight,” press release, *Explorer I* file, Card 80, NGS; Kepner, “Saga of *Explorer I*,” 126.

⁴¹ Kepner, “Saga of *Explorer I*,” 126.

⁴² Thomas W. McKew, Secretary, Advisory Committee, to Mr. R. L. Bronson, Secretary, South Dakota Chamber of Commerce, Re: “Additional precautions for safety of visitors who may view stratosphere ascent and preparations from top of cliff,” June 16, 1934, *Explorer I* file, Card 51, NGS; Ryan, *Pre-Astronauts*, 54; Kepner, “Saga of *Explorer I*,” 126.

⁴³ Ryan, *Pre-Astronauts*, 54-55; DeVorkin, *Race to the Stratosphere*, 166-167; Kepner, “Saga of *Explorer I*,” 126.

⁴⁴ Ryan, *Pre-Astronauts*, 55.

⁴⁵ DeVorkin, *Race to the Stratosphere*, 175; Kepner, “Saga of *Explorer I*,” 128.

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piece of scientific equipment attached to the gondola failed us during the flight; every instrument worked exactly as planned. As for the balloon, we think that another can be built, that would go to its calculated maximum elevation without mishap.⁴⁶

My own feelings then and I dare say of others present were the same as I had later when watching my young friend Col. Ed White and his companions ‘lift off’ into space at Cape Kennedy for the first space walk.⁴⁷

Although the first *Explorer* flight was not a complete success, this did not deter the National Geographic Society and the Army Air Corps from making a second attempt with its successor, *Explorer II*.⁴⁸

Explorer II: *The End of an Era*

The army quickly began to recuperate from the loss of the first *Explorer* by planning for a second ascent by its successor, *Explorer II*. With an infrastructure already in place from the first *Explorer* flight, including the gondola shed, the access road, and a reinforced fence for spectator safety, the National Geographic and Army Air Corps once again chose the Stratobowl as their launch site. This flight would be the last high-altitude flight of the 1930s. The balloon had an envelope of 3.7 million cubic feet and was fabricated by the Goodyear-Zeppelin Corporation making it the largest balloon constructed at that time. It was also the first balloon inflated with helium to minimize the risks of a gas-induced explosion like its predecessor *Explorer I*. Gilbert Grosvenor of the National Geographic Society proclaimed helium a “wonder gas.” A nine-foot gondola made of DOWMETAL, a magnesium alloy lighter than aluminum, would shelter Capt. Albert W. Stevens as scientific observer, and pilot Orville A. Anderson, both veterans of the first *Explorer* flight.⁴⁹

Once again, the flight crew and personnel returned to the Stratobowl. The scientific instruments for the flight were custom-built to one-fifth of their original size to accommodate the cramped quarters and provide maximize usage. Among these were cosmic ray equipment, a telescopic camera, and a spore-collecting device supplied by the Department of Agriculture. The balloon carried the largest payload of instruments assembled until that time. The flight’s goal was to obtain knowledge that could help resolve issues in commercial aviation, meteorology, and electrical issues while also obtaining a pre-determined height that would set a new world record if reached.⁵⁰

According to Gilbert Grosvenor of the National Geographic Society:

The Stratobowl camp was. . . a city of scientists and technicians operated with the aid of military men intent on peacetime accomplishments. And it reflected the geography and the cosmopolitanism of science. Men from 21 states and the District of Columbia, representing 21 colleges and universities and

⁴⁶ Albert W. Stevens, “Exploring the Stratosphere,” in *The National Geographic Society-U.S. Army Corps Stratosphere Flight of 1934 in the Balloon “Explorer” 1935*, quoted in Devorkin, *Race to the Stratosphere*, 175.

⁴⁷ Kepner, “Saga of Explorer I,” 126.

⁴⁸ Ryan, *Pre-Astronauts*, 55.

⁴⁹ Smithsonian Institution, National Air and Space Museum, “*Explorer II*,” accessed March 3, 2011, <http://www.nasm.si.edu/collections/artifact.cfm?id=A19370060000>. Special to *New York Times*, “Balloonists Trap Science Secrets: Their Gondola Bore Into Stratosphere Laboratory Unique for Exploring Unknown,” November 12, 1935, clippings file, NASM; *Geographic News Bulletin* no. 1, “Largest Gondola for Stratosphere Flight Completed,” December 9, 1935, File A2U-394200-01 USA, “*Explorer II*,” Documents, NASM; “Instruments Hung from Brackets in Newest Stratosphere Cabin,” *Geographic News Bulletin* no. 3 (April 29, 1935); Ryan, *Pre-Astronauts*, 55, 58-60.

⁵⁰ Special to *New York Times*, “Balloonists Trap Science Secrets,” NASM.

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nearly a score of professions worked together in this little city built overnight in the hills, each laboring ceaselessly for many weeks that two men might fly for eight hours.⁵¹

The First Attempt Aloft - *Explorer II*

The first attempt at launching *Explorer II* was in July 1935. The crew began inflating and roping the balloon on the evening of July 11 and into the morning of July 12, when the balloon, within a mere seven seconds, unexpectedly collapsed over the gondola and buried three crew members. During the few seconds before its final collapse, those on the ground were uncertain as to where the heavy cloth would ultimately fall and who would be buried in the process. During the inflation process fabric holding together the upper end of the rip panel tore causing the entire upper section of the balloon to fail. The failure in the balloon envelope delayed the launch into the fall until Goodyear-Zeppelin could rebuild and reinforce the balloon and flight procedures could be further evaluated to prevent any future incidents. Military personnel and support staff at the camp were relieved of their duties until the repair could be completed. The camp was not reestablished until early September; preparations for the second attempt at launching were complete by October. The most important variable at this juncture was a bout of good weather.⁵²

The Second Attempt

After six weeks of delays due to inclement weather - primarily wind and rain - ideal weather conditions for the launch finally materialized on the morning of November 10, 1935. At 1:00 p.m. (MST), the order was issued to start inflation of *Explorer II*, but due to yet another tear in the fabric that had to be mended, the balloon did not take off until the following morning. The planned stop at 53,000 ft. would be cancelled to make up for the time spent repairing the fabric and thereby eliminating two hours from the flight. Once the repair was complete, the balloon was inflated with helium as the lifting gas, for the first time ever, to the height of a thirty-one story building. Helium was supplied from 1,685 steel cylinders stored at the side of the bowl and delivered to the balloon through 400-foot hoses; 40 cylinders simultaneously distributed the gas into the envelope. On the ground, a crew of one hundred soldiers assisted by anchoring restraining ropes from thirty-six snubbing posts during inflation. The lower 100 ft. of the bowl was lit by floodlights.⁵³

Meanwhile, braving six-degree weather, a crowd of 20,000 spectators gathered to witness the launch of *Explorer II* from the Stratobowl on November 10 and 11. At 7:01 a.m. (MST), *Explorer II* successfully ascended on an over eight-hour trek into the upper reaches of the atmosphere. However, moments after take-off, a sudden infusion of warm air into the bowl almost caused the balloon to collide with one of the Stratobowl's jagged canyon walls, but through the quick release of ballast contact was avoided. Ballast was released directly above the spectator's heads as they scattered to avoid a collision with the balloon. At 15,000 feet, the rate of ascent was retarded to allow Stevens to rig the instruments. Once this was accomplished, the aeronauts sealed themselves inside the nine-foot gondola. Stevens then turned on all the instruments that had not yet been started. Like the *Explorer I* flight, the crew maintained constant radio contact throughout the flight, and their communications were broadcast throughout the U.S. and Europe. Stevens also took pictures when the opportunity arose and even shot the first motion picture in the stratosphere. At 12:10 p.m., Capt. Stevens radioed to ground crew a barometric pressure of 29 millimeters indicating an altitude of 73,000 ft., constituting a new altitude record. Within four hours, the aeronauts had attained their pre-determined altitude of

⁵¹ Gilbert Grosvenor, "The Stratosphere Expeditions," *Black Hills Engineer* (September 1936): 49-50, quoted in Crouch, *Eagle Aloft*, 632.

⁵² DeVorkin, *Race to the Stratosphere*, 187, 192-193; Crouch, *Eagle Aloft*, 632 and 634.

⁵³ Ryan, *Pre-Astronauts*, 58; Capt. Orville Anderson, "Flight's Thrill Told by Anderson; Avoiding Cliff Was 'Toughest Spot,'" NASM.

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73,000 ft. where they remained for an hour and forty minutes. They were positioned over the Niobrara River over northern Nebraska.⁵⁴ Capt. Anderson describes the Earth from this vantage point:

I attempted to pick out stars in the heavens, but was not able to see any. The moon was not out yet. The sky was a dark blue, tinged with purple.

Beneath us, nearly fourteen miles away, the earth lost much of its detail and the horizon was an indistinct blur. Railroads and highways were scarcely visible. Only rivers, towns, and a small checker-board design of farms could be seen.⁵⁵

Stevens describes his impression of the Earth below: "...No sign of actual life could be detected. To us it was a foreign and lifeless world. The sun was the one object that commanded our attention; we were temporarily almost divorced from Mother Earth." At 12:23 p.m. they started their descent. The balloon landed approximately 8 hours after lift-off. All of the scientific and photographic equipment returned undamaged this time.⁵⁶

Piloted by Anderson and Stevens, *Explorer II* reached 72,395 ft. and set a world altitude record that would stand for the next twenty-one years. Important milestones in reconnaissance took place during this ascent. Aerial photographs showing the division between the troposphere and the stratosphere and the curvature of the Earth were taken from this altitude. On this flight, Anderson and Stevens became the first humans to witness the Earth's curvature with the naked eye. In addition, the scope of experiments conducted was enhanced by an increase in the number of scientific instruments utilized on this flight. Experiments involving cosmic ray research, the ozone layer, aeronomy⁵⁷, meteorology, biology, and radio propagation in the high atmosphere were conducted during this eventful ascent. The flight was most successful in the realm of aerial photography, capturing for the first time images showing the division between the troposphere and the stratosphere, and the Earth's curvature. Anderson and Stevens made their landing in an open prairie field in the vicinity of White Lake, South Dakota. The day after the record-breaking flight, the camp was disassembled. This flight marked the end of the great era of human stratosphere ballooning.⁵⁸

A *New York Times* piece described Stevens and Anderson as the "Vikings of the atmosphere."⁵⁹ The *Explorer II* flights made heroes of Stevens and Anderson who were compared in contemporary media accounts as "intrepid explorers" on the scale of Columbus and Magellan in the fifteenth century. Rather than exploring the vast blue seas in search of alleged far-away lands promising riches, Stevens and Anderson were exploring the vast expanse of the stratosphere. "That second flight not only set a world's altitude record, but put the United States solidly into the business of space research."⁶⁰

⁵⁴ Anderson, "Flight's Thrills Told by Anderson"; "Balloon's Log in Record Trip to Stratosphere," newspaper name unknown (Rapid City, South Dakota), November 12, 1935, NASM. The article provides a timed record log of the flight. Quote, Anderson, "Flight's Thrills Told by Anderson"; Ryan, *Pre-Astronauts*, 58-59; Capt. Albert W. Stevens, "'Exploring the Stratosphere, October 1934', and 'Man's Farthest Aloft, January 1936,'" in *Worlds to Explore*, edited by Mark Jenkins (Washington, DC: National Geographic Society, 2006), 406.

⁵⁵ Anderson, "Flight's Thrill Told by Anderson," NASM.

⁵⁶ *New York Times*, "Rose 72,395 Feet Into Stratosphere," November 22, 1935, NASM; Ryan, *Pre-Astronauts*, 59; Anderson, "Flight's Thrill Told by Anderson"; Quote, Stevens, *Worlds to Explore*, 408.

⁵⁷ Aeronomy is defined as: the study of the chemical and physical processes taking place in the upper regions of the atmosphere. Paul Dickson, *A Dictionary of the Space Age* (Baltimore: John Hopkins University Press, 2009), 5.

⁵⁸ "Balloonists' Data Rushed Eastward," White Lake, SD (newspaper name unknown), November 12, 1935, NASM; Ryan, *Pre-Astronauts*, 58-60; Smithsonian National Air and Space Museum, "*Explorer II*," accessed March 03, 2011, <http://www.nasm.si.edu/research/aero/aircraft/explorer.htm>; Stevens, *Worlds to Explore*, 410.

⁵⁹ Ryan, *Pre-Astronauts*, 60.

⁶⁰ Kepner, "Saga of Explorer I," 123.

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A combination of financial and political concerns precluded another manned ascent until the 1950s. Because the nation was still feeling the effects of the Great Depression private financiers were reluctant to fund such costly projects. The United States' entrance into World War II also added to this reluctance and the next manned balloon ascent did not occur until 1956 with *Strato-Lab I*. Technological advancements in balloon design and construction allowed the expansion of aerospace research during the '40s and '50s with unmanned scientific balloons. This became the era of unmanned balloon ascents with sounding balloons reaching further into the upper atmosphere.⁶¹

Strato-Lab I: Setting the Stage for the Space Age

The launch of *Strato-Lab I* initiated the first manned flight of the late 1950s and provided a testing ground, under comparable conditions, for the instruments, equipment, and gear that would become standard-issue within the U.S. space program. However, the launch of the manned *Strato-Lab I* had implications beyond just science and technology; the race to space became another stage in the politics of the Cold War. Having proved its suitability for launches twice before and having been, twenty-one years previously, the site of the last high-altitude launch, the Stratobowl was once again chosen for the first manned launch of Project Strato-Lab.⁶²

Dr. Charles B. Moore of General Mills, and Navy Lieutenant Commanders Lee Lewis and Malcolm Ross who were assigned by the Office of Naval Research (ONR) to the General Mills balloon team, were instrumental in the birth of Project Strato-Lab. Ross was a physicist for the Office of Naval Research Air Branch and Lewis was ONR's balloon project officer. Following World War II, the General Mills Company became a major player in balloon research. During the war, General Mills had diversified beyond foodstuffs to secure more government contracts through its newly established Aeronautical Research Laboratory. Moore became an enthusiastic advocate of manned balloon flights. Originally a manned balloon project called Helios, sponsored by the ONR and General Mills, the project was divided into an unmanned scientific military balloon program and a manned high-altitude balloon project later known as Project Strato-Lab. The objective of the flight was to provide a high altitude laboratory, test the physical response of humans within high-altitude environments, and conduct specific scientific experiments. Moore believed that polyethylene balloons could provide an inexpensive testing ground for scientists to study the issues of manned space flight.⁶³

The *Strato-Lab* flight used the refurbished *Helios* gondola and a two million cubic-foot balloon made of polyethylene - a plastic. Ross and Lee made a test flight prior to the *Strato-Lab* ascent using a polyethylene balloon, however, the *Strato-Lab* flight was the first official manned flight to use this new material. *Strato-Lab I* was the first in a series of Strato-Lab missions to test human responses to space-like conditions, improve pressure suits and cabins to manage human physiological responses to high-altitude environments, and establish high-altitude flight procedures. The Air Force Aeromedical Laboratory at Wright Patterson Air Force Base furnished the flight crew with pressure suits reminiscent of those worn by test pilots in rocket-powered aircraft.⁶⁴

Almost twenty-one years after the *Explorer II* flight, *Strato-Lab I* ascended from the Stratobowl on November 8, 1956, at 6:19 a.m. (MST). U.S. Navy Lieutenant Commanders Malcolm Ross and Lee Lewis piloted the

⁶¹ Crouch, *Eagle Aloft*, 635; Kirschner, *Aerospace Balloons*, 16.

⁶² Crouch, *Eagle Aloft*, 653; Ryan, *Pre-Astronauts*, 228.

⁶³ John D. Anderson, Jr., Marie Lanser Beck, Janet Daly Bednarek, Roger Bilstein, Caridad de la Vega, Susan Cianci Salvatore, and Laura Shick, *American Aviation Heritage: Identifying and Evaluating Nationally Significant Sites in U.S. Aviation History* (Washington, DC: Department of the Interior, National Park Service, 2011), ch. 14, "Civil Aviation," 206-207; Ryan, *Pre-Astronauts*, 226; DeVorkin, *Race to the Stratosphere*, 305-06.

⁶⁴ DeVorkin, *Race to the Stratosphere*, 305-306; Kennedy, "Stratolab."

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Strato-Lab I balloon to a new official high-altitude record of 76,000 ft., surpassing *Explorer II's* previous record by 3,000 ft. The flight was the first in a series that scientifically paved the way for the 1960s space program.⁶⁵

Otto Winzen, a successful scientist and balloon manufacturer, noted in 1958:

...It is now generally recognized in scientific circles that the manned balloon capsule is the prototype for the manned space cabin. It serves not only for the study of the human factors of space flight, but for the selection and training of space pilots and as a test bed for the multitude of accessories and components which will eventually go into the construction of the sealed cabin which will carry the first man into space.⁶⁶

The aeronauts remained at their peak altitude of 76,000 ft. for only a few minutes before starting an unexpected descent due to a malfunctioning helium valve. Once at a safe level, they started jettisoning equipment out of the portholes to slow their rate of descent. They finally made a safe landing on level, sandy soil near a ranch in Brownlee, Nebraska. Despite the defective valve, the flight was successful in providing new scientific and technical information, and according to author Craig Ryan, "It was a clarion call announcing that the United States was now officially back in the business of exploring the stratosphere by means of balloon." President Eisenhower awarded Ross and Lewis with the Harmon International Aviation Award in August 1957 acknowledging their work with the Strato-Lab project.⁶⁷

Strato-Lab IV

Physicist and veteran pilot of *Strato-Lab I*, Malcolm Ross, saw ballooning as "the logical step toward space astronomy."⁶⁸ To pursue his agenda of solving major problems in astronomy using a combination of unmanned and manned balloon flights, he asked for proposals from physicists and astronomers to the ONR for projects. This request led to the agenda for *Strato-Lab IV*. On the afternoon of November 28, 1959, *Strato-Lab IV* was launched from the famed Stratobowl. Ross once again served as crew member but his co-pilot for this ascent was Dr. Charlie Moore of General Mills. Moore served as scientific observer and was responsible for the inception of the project. The balloon reached an altitude of 81,000 ft.; Ross and Moore spent the evening with a 16-inch telescope and spectrograph observing the water vapor in the atmosphere of the planet Venus.⁶⁹

The flight also gathered meteorological, cosmic ray, and scientific data for the improvement of safety at high altitudes. They descended the following morning over Manhattan, Kansas. The flight proved the feasibility of satellite-borne astrolabs. According to aerospace historian Gregory P. Kennedy, "Strato-Lab retained the configuration and certain design elements of balloon gondolas of the 1930s. Thus, it bridged the gap between pressurized gondola designs of the 1930s and modern spacecraft." Project Strato-Lab "also pioneered having a trained scientist on board to make observations while a pilot handled the aircraft."⁷⁰

⁶⁵ DeVorkin, *Race to the Stratosphere*, 306; Crouch, *Eagle Aloft*, 652.

⁶⁶ Otto C. Winzen, "From Balloon Capsules to Space Cabins," *Proceedings, IXth International Aeronautics Congress, Amsterdam*, 1958, p. 562, quoted in Crouch, *Eagle Aloft*, 653.

⁶⁷ Crouch, *Eagle Aloft*, 652; Ryan, *Pre-Astronauts*, 230. Quote, Ryan, *Pre-Astronauts*, 230.

⁶⁸ Malcolm D. Ross, "Plastic Balloons for Planetary Research," *The Journal of the Astronautical Sciences* 5 (Spring 1958): 5, quoted in DeVorkin, *Race to the Stratosphere*, 307.

⁶⁹ Navy Historical Center, accessed February 25, 2011, <http://www.history.navy.mil/faqs/faq124-1.htm>; Ryan, *Pre-Astronauts*, 232-33; DeVorkin, *Race to the Stratosphere*, 307. Ryan mistakenly notes that they were observing the planet Mars, however, various other sources note Venus and not Mars.

⁷⁰ Navy Historical Center, accessed February 25, 2011, <http://www.history.navy.mil/faqs/faq124-1.htm>; Ryan, *Pre-Astronauts*, 232-33; DeVorkin, *Race to the Stratosphere*, 307. Quote, Kennedy, "Strato-Lab."

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Comparison of Properties***The Century of Progress and the Goodyear Airdock***

The first era of stratospheric ballooning started with the flight sponsored by the Chicago World's Fair, *Century of Progress* in 1933, and ended with the ascent of *Explorer II* two years later in 1935. Few stratospheric balloon ascents of the era were as notable as the *Explorer* flights that took place at the Stratobowl. This site was known as the "Cape Canaveral" of its day due to the media attention and public interest it attracted. No other site is as closely associated with high-altitude manned balloon ascents as the Stratobowl.

A venture born out of the 1933 Chicago World's Fair, the *Century of Progress* flight was promoted by fair officials. On its first launch attempt, the balloon was only aloft for a couple of minutes because of a valve malfunction; it did not get further than the nearby train tracks.⁷¹ This flight took place at Soldiers Field (Grant Park Stadium) which no longer retains historic integrity. The site had its designation withdrawn in 2006. The second launch of the *Century of Progress* took place at the Goodyear Airdock in 1933. Thomas G. W. "Tex" Settle and Chester Fordney, the pilots for the *Century of Progress*, were the first two Americans to travel into the atmosphere in a pressurized cabin, and their November 20, 1933, flight marks the first time a balloon launched from American soil successfully reached the stratosphere.⁷² The second launch by Settle and Fordney was done at the Goodyear Airdock to avoid the crowds that had gathered at the first, unsuccessful flight at the Chicago World's Fair. Whereas the second flight of the *Century of Progress* could be safely contained within the Goodyear Airdock at Akron when fully inflated,⁷³ the larger *Explorer* balloons had to be inflated in an outdoor venue to adequately accommodate and protect such large-capacity balloons. The *Explorer* flights pushed the limits of rubberized balloon cloths. General Mill's Dr. Moore regarded *Explorer II* as the "swan song" of the classic era of rubberized cloth balloons."⁷⁴

The Goodyear Airdock is recommended for further study under the National Park Service's *American Aviation Heritage: Identifying and Evaluating Nationally Significant Sites in U.S. Aviation History* for its association with the development and construction of lighter-than-air craft and for Settle's and Fordney's ascent. The Goodyear Airdock and the Stratobowl meet the requirements for NHL consideration since each represent different but equally important facets of manned high-altitude balloon history. While the Goodyear Airdock is significant for the history of lighter-than-air craft in general, the Stratobowl represents two distinct and specific eras of high-altitude ballooning that paved the way for the U.S. space program.

Projects Strato-Lab, Manhigh, and Excelsior

Strato-Lab was the first high-altitude balloon program to be established in the 1950s ushering in the second era of high-altitude ballooning. The Air Force followed suit with its own high-altitude balloon programs, Projects Manhigh and Excelsior, however, Manhigh eventually ran out of funds and further tests for the space program were continued by Project Strato-Lab.⁷⁵

⁷¹ DeVorkin, *Race to the Stratosphere*, 81 and 89.

⁷² Crouch, *Eagle Aloft*, 613.

⁷³ DeVorkin, *Race to the Stratosphere*, 89.

⁷⁴ *Ibid.*, 305.

⁷⁵ Payne, *Lighter than Air*, 265-266.

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Conclusion

The Stratobowl was a popular launch site because its topographical and natural features provided the protection and cover required for the successful inflation and launching of the larger balloons being manufactured during this time. Larger payloads required larger balloons creating space issues for indoor inflation. The Stratobowl proved the ideal outdoor venue for safely inflating the balloons used in four successful and renowned flights: *Explorer I* and *II* and *Strato-Lab I* and *IV*. Each of these flights not only paved the way for the U.S. space program by further testing and improving the equipment and gear later used, but made important contributions in the areas of aerial photography, atmospheric science and physics, and proved the utility of using pressurized cabins for high-altitude flights, in addition to setting two altitude records. *Explorer II* marked the last high-altitude flight of the 1930s and the end of the first great era of human stratosphere ballooning while *Strato-Lab I* heralded the beginning of the second era of high-altitude manned ballooning and the space age, twenty-one years later.

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Previous documentation 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: Approximately 65.71 acres, including 63.71 acres in the bowl and another two areas of land included in the Stratobowl Road prism (assumes 16-foot-wide road).

UTM References:	Zone	Easting	Northing
A	13	632663	4870863
B		632865	4870913
C		633022	4870619
D		632946	4870339
E		632792	4870106
F		632553	4870626
G		632363	4870447
H		632362	4870135
I		632327	4869795

Verbal Boundary Description: The boundary proposed for this property is formed by both natural and man-made features. From the 1955 overlook platform, the boundary extends south and then northeast around the rim of the bowl—roughly following the 4,380' contour interval. At the southwest corner of the rim, the boundary follows the crest of an unnamed ridge into the bottom of the bowl. Once in the bottom, the boundary corresponds to the west edge of the Stratobowl Road. From the end of the maintained segment of the road, an arbitrarily drawn line connects the bottom of the bowl with the rim just northwest of the overlook platform. In addition to the natural bowl defined above, the boundary also incorporates the road prism of Stratobowl Road, from just north of the point at which it exits Highway 16.

Boundary Justification: The boundary includes all of the natural features that contributed to the success of the *Explorer I*, *Explorer II*, *Strato-Lab I*, and *Strato-Lab IV* balloon launches. These include the level camp and staging area in the bottom of the basin where the expedition crews established their temporary field camps and

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inflated the balloons, as well as the surrounding cliffs that sheltered the inflated balloons prior to launch. Within this core area, infrastructure varied from launch to launch, yet the natural characteristics of the basin itself remained largely unchanged. Also included in the landmark boundary is Stratobowl Road, built specifically to improve access into the bottom of the bowl for the 1934 launch. All of the personnel and materials required for the preparation and launch were transported over this road. Stratobowl Road retains integrity and contributes to the eligibility of the historic site.

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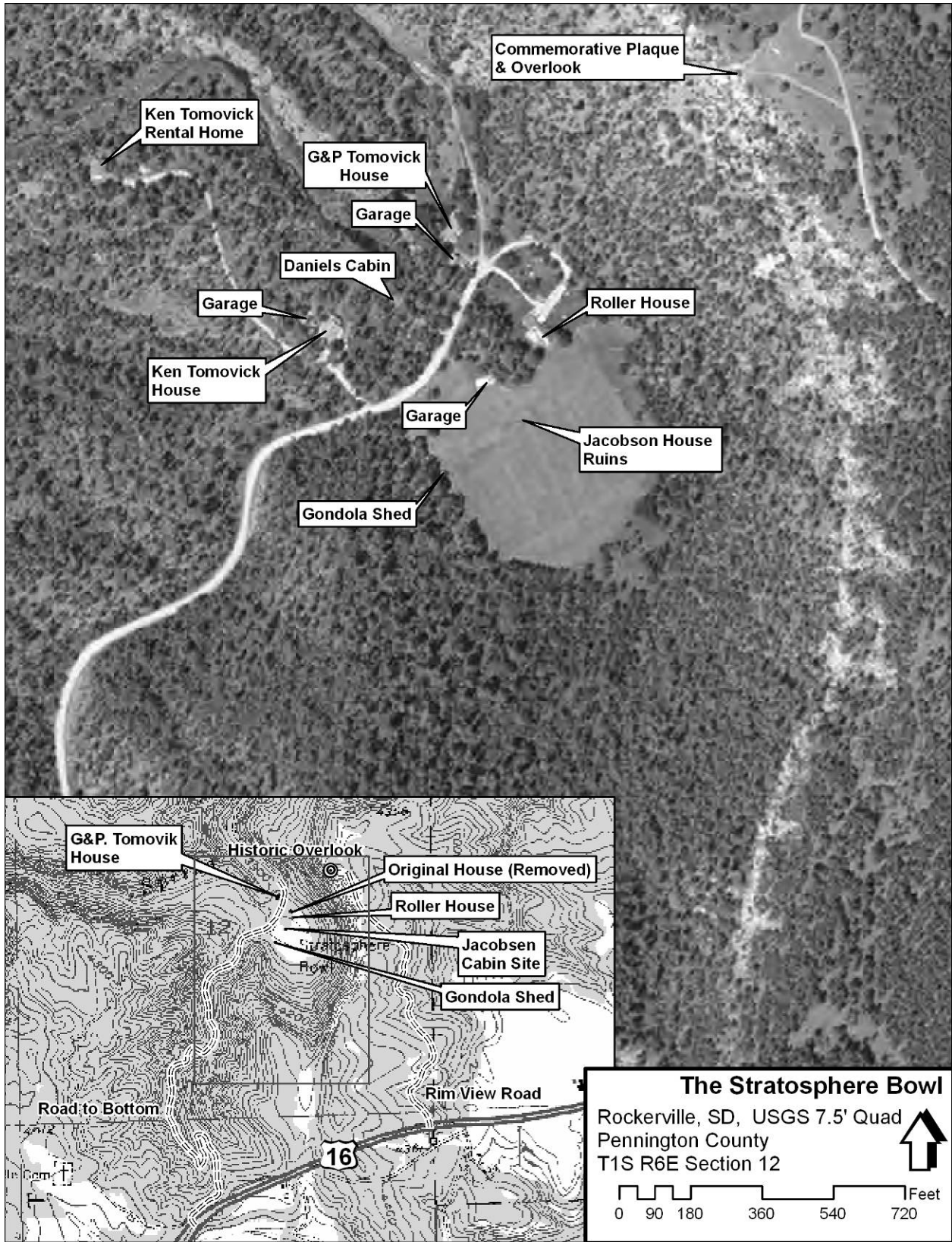
NATIONAL HISTORIC LANDMARKS PROGRAM
March 23, 2011

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The Stratosphere Bowl
Rockerville, SD, USGS 7.5' Quad
Pennington County
T1S R6E Section 12



0 175 350 700 1,050 1,400 Feet

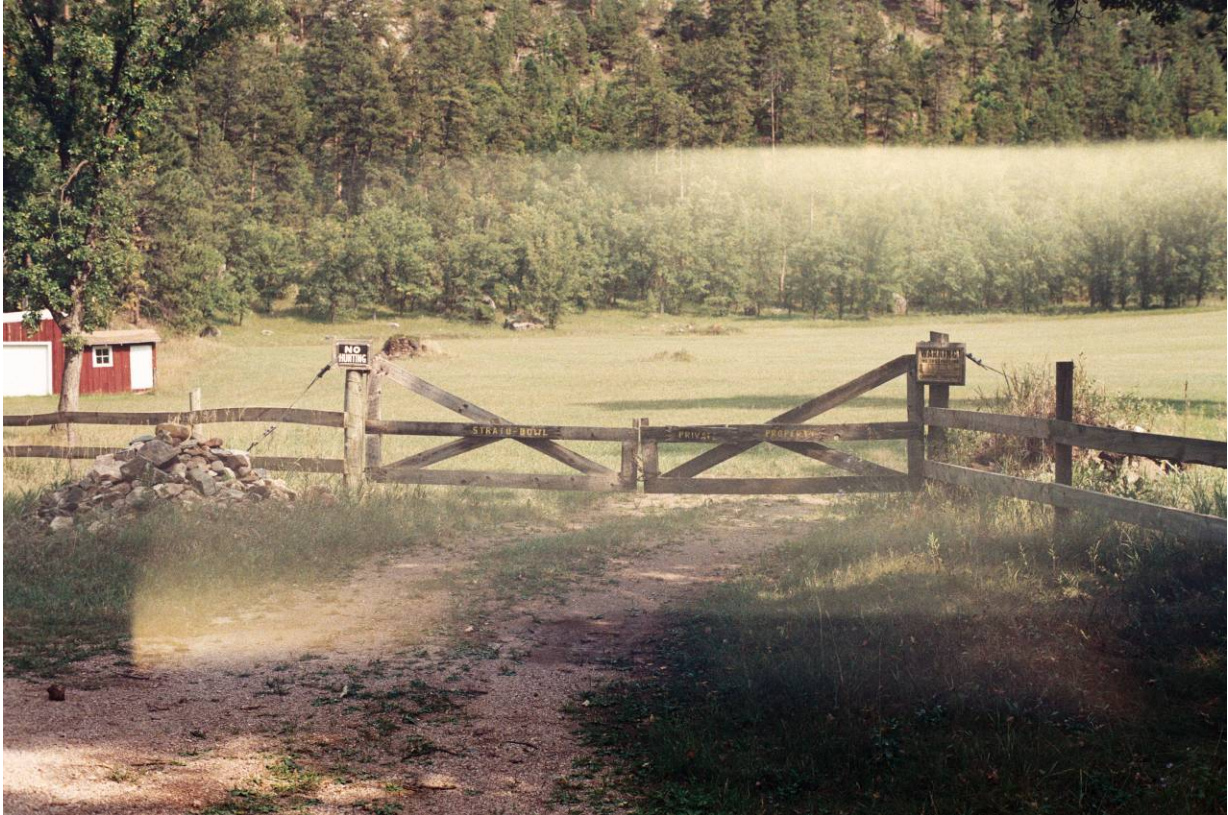
Derek Beery, Historical Research Associates, December 2006

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Entrance gate to bottom of bowl facing southeast.
Janene Caywood, September 8, 2006.



Overview of bottom of the bowl and 1956 gondola shed facing northwest.
Janene Caywood, September 8, 2006.

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View of Stratobowl basin from rim overlook facing south-southwest.
Janene Caywood, September 10, 2006.



Overview of Stratobowl from commemorative overlook facing northwest.
Janene Caywood, September 8, 2006.

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Overview of Stratobowl from rim facing north-northwest.
Janene Caywood, September 10, 2006.



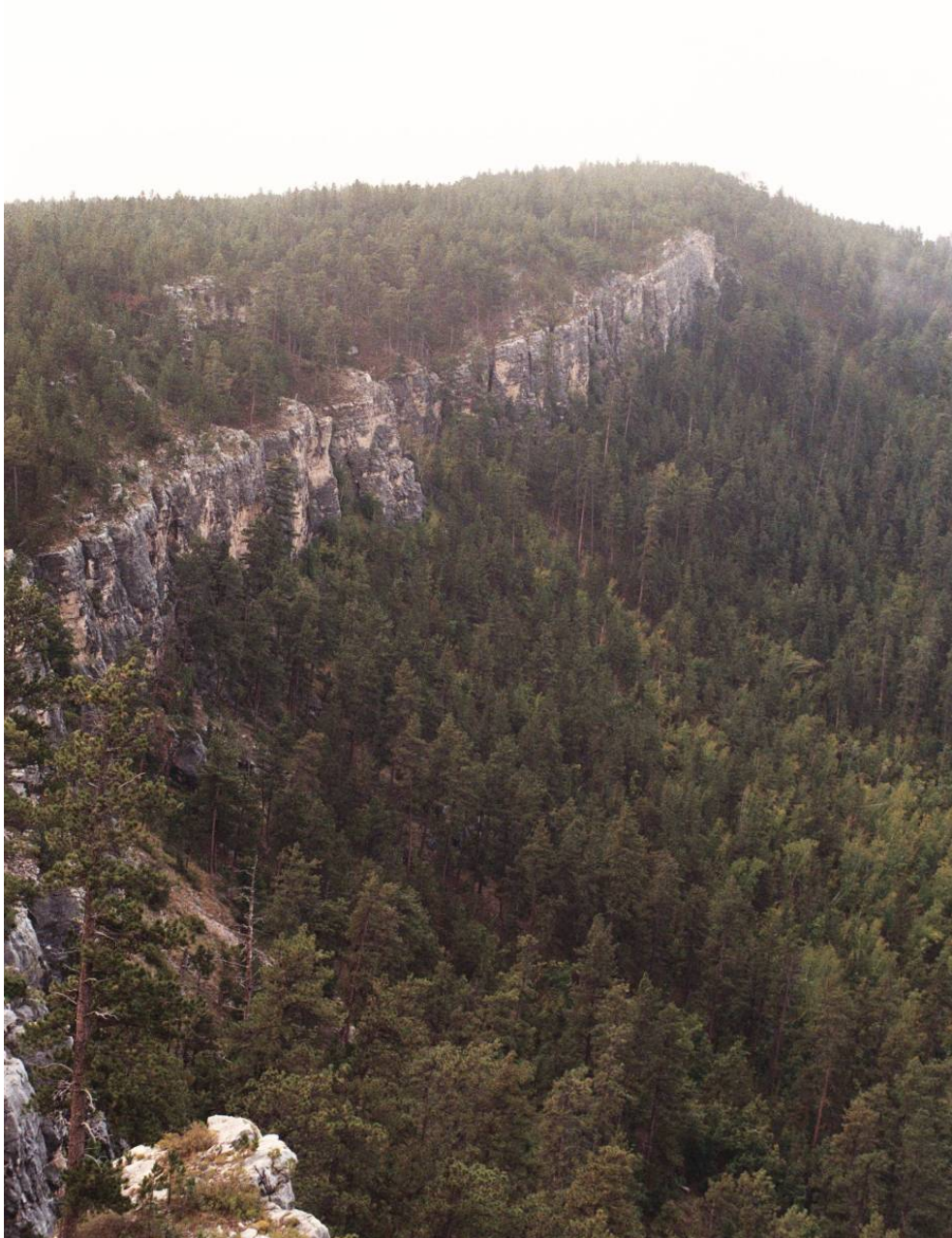
Overview of Stratobowl Road facing southwest.
Janene Caywood, September 8, 2006.

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View of cliffs around east edge of bowl from rim overlook, facing south.
Janene Caywood, September 10, 2006.

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Overview of Rim View Road facing northeast.
Janene Caywood, September 10, 2006.



Overview of interpretive overlook facing northwest.
Janene Caywood, September 10, 2006.

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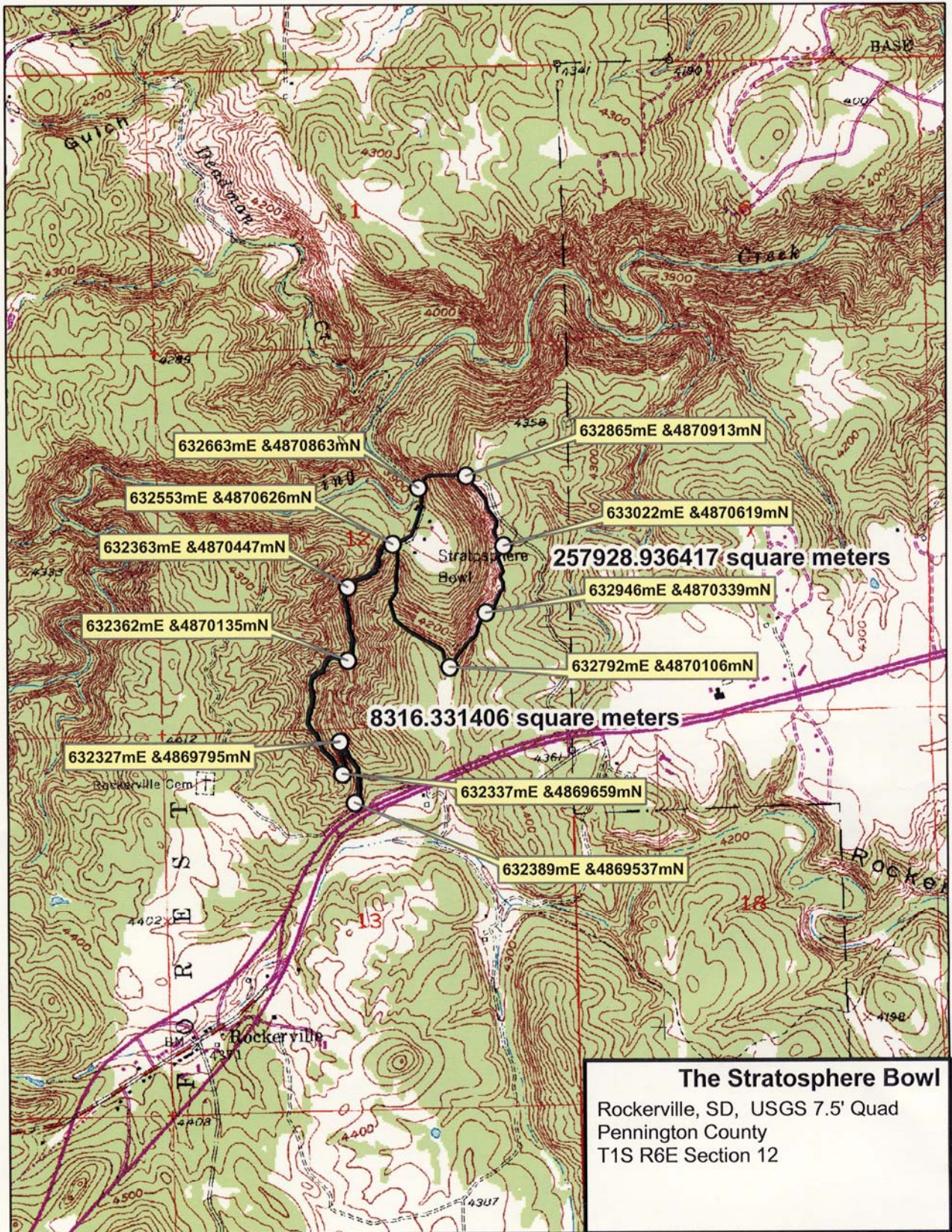
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1955 National Geographic commemorative plaque at overlook.
Janene Caywood, September 10, 2006.



The Stratosphere Bowl
 Rockerville, SD, USGS 7.5' Quad
 Pennington County
 T1S R6E Section 12

Derek Beery, Historical Research Associates, December 2006