

Salt Lake Temple. As seen from the south about 1917. Courtesy Utah State Historical Society.

The Salt Lake Temple Infrastructure: Studying It Out in Their Minds

To offer their best to the Lord in constructing even the temple's infrastructure, the Saints researched and incorporated such available technologies as elevators and electricity.

Paul C. Richards

As an inveterate sidewalk superintendent, I have long been enthralled by raw infrastructure. Scrutinizing the innards of mines, engine rooms, bridges, and buildings creates a feeling of awe for the souls, largely unrecognized, who designed and built such works. The architectural infrastructure of the Salt Lake Temple, its foundations, engineering, and use of technology, engender similar feelings in me. Just as the outside of the temple is a tribute to the determination, resourcefulness, and faith of its builders, a great appreciation for them and their work can also be gained by considering details inside, where some of the infrastructure such as parts of the original foundation walls is still visible.

Knowledge of the temple's construction enriches an understanding of its history. An 1893 newspaper article emphasized the important role of the temple construction workers in perpetuating the temple's history:

In the interest of history these [temple construction veterans] should be asked and encouraged to impart and indite bits of experience in connection with the Temple that would otherwise be lost. All that pertains to it at any stage of its construction is sure to find a welcome in the hearts and memories of the people.¹

One hundred years later, the centennial celebration of the temple's 1893 dedication raised new interest in the building's history. Forgotten, little-known, or never-before-published information became available through books, periodicals, historic photographs,

architectural drawings, and a marvelous exhibit at the Museum of Church History and Art.² These recent materials and earlier sources, along with interviews with individuals involved in temple maintenance and refurbishment in this century, clarify and correct some of the commonly told stories about how the temple was built. While many of these accounts intend to be faith promoting, hinting that God dictated minute details of design and infrastructure, many common stories are not factual. Indeed, the stories may detract from the appreciation Latter-day Saints should have for the hard labors of mind and body the temple builders endured. While those builders were inspired, God still expected them to do their homework, to study the challenges in their minds, and they did.

Formulating Plans

Brigham Young's 1847 vision of the temple was general in nature, giving the Saints great latitude in determining particulars. For instance, on the day of the 1853 ground breaking, President Young said:

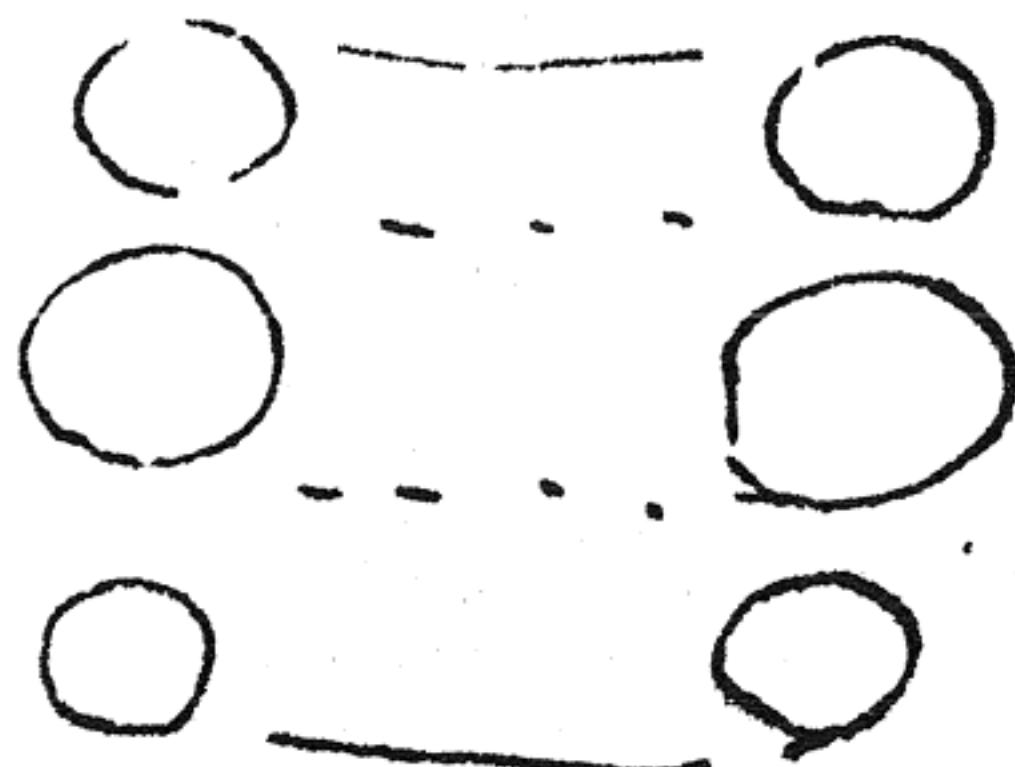
Concerning this house, I wish to say, if we are prospered we will soon show you the likeness of it, at least upon paper, and then if any man can make any improvement in it, or if he has faith enough to bring one of the old Nephites along, or an angel from heaven, and he can introduce improvements, he is at liberty so to do. . . . If any improvement can be made, all good men upon the earth are at liberty to introduce their improvements.³

In this same address, the pragmatic prophet told the Saints that in regard to the temple, they should not wait to be commanded in all things:

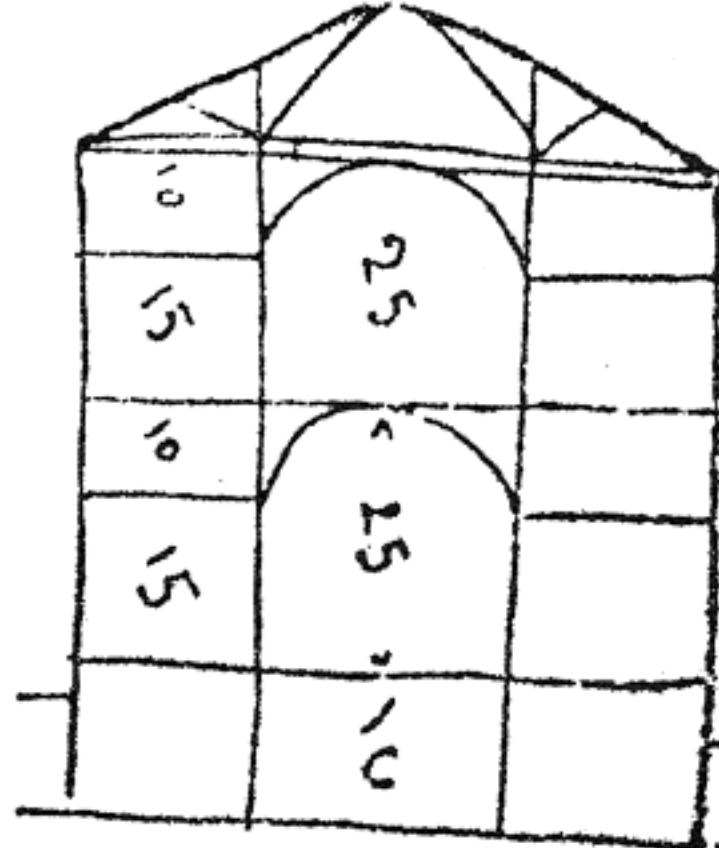
If you should go to work to build a dwelling house, you know you would want a kitchen, a buttery, sitting rooms, bedrooms, halls, passages, and alleys. He [Joseph Smith] said, you might as well ask the Lord to give revelation upon the dimensions and construction of the various apartments of your dwelling houses, as upon the erection of temples, for we know before hand what is necessary.⁴

William W. Ward, who became an assistant to temple architect Truman O. Angell Sr. in the early 1850s, later wrote:

The design was formulated in the following manner: Brigham Young drew upon a slate in the Architect's Office similar to this:



Brigham Young's sketch of the Salt Lake Temple towers. Reproduced from memory in 1892 by William Ward, assistant architect. This rough sketch was intended to show that the central towers would be higher than the flanking towers and that the body of the building would be built between the towers. *Temple Souvenir Album* 7 (April 1892): 7.



Rough vertical section of the Salt Lake Temple. Reproduced in 1892 by William Ward, assistant architect. This sketch was drawn by Truman O. Angell Sr. according to President Young's instructions in response to a question about height. *Temple Souvenir Album* 7 (April 1892): 7.

[sketch] and said to Truman O. Angell, "There will be three towers on the East, . . . also three similar towers on the West. . . . The body of the building will be between these and pillars will be necessary to support the floors."⁵

Ward continued, "Angell then asked about the height, and drew [a] vertical section [sketch] according to Brigham's instructions." [sketch] The basement containing the baptismal font was to be sixteen feet high. The first and second stories were each to be twenty-five feet high with pillars and a tier of rooms above the side aisles. "The construction of the roof was left to Mr. Angell. . . . Angell's idea and aim was to make [the temple] different to any other known building and I think he succeeded as to the general combination."⁶

Although the overall design followed Brigham Young's vision, it is clear that Angell did not consider the prophet's dictated dimensions sacrosanct. In his 1854 description of the temple, Angell said the two large rooms on the first and second stories were to be thirty-four feet high—not twenty-five feet high as President Young had instructed.⁷ Furthermore, the finished temple did

not have an open assembly room on the first floor, nor did it have tiers of rooms above the aisles in the assembly room on the top floor, even though President Young had called for these structures.

Material for the Walls

That human deliberation was a factor in the temple's construction is also clear from an 1852 address by Heber C. Kimball: "I want a vote from the congregation concerning the temple, whether we shall have it built of the stone from Red Bute, or of adobies [sic], or timber, or of the best quality of stone that can be found in the mountains."⁸ President Kimball gave this address before granite had been found in Little Cottonwood Canyon.

Following Heber C. Kimball's address, Brigham Young told the congregation he favored adobes. After naming other options, he stated:

But I give it as my opinion that adobies [sic] are the best article to build it of. . . . I want it to stand, and not fall down and decay in twenty or thirty years, like brother Taylor's one would, that he was giving an exposition of; "that when we go within the vail into the heavenly world, we need not be ashamed of it, but when we look down upon it, it will be of solid rock;" but if it is built of San Pete rock, when he looks down to see it he will find it *aint there*, but it is gone, washed into the Jordan.⁹

Adobes were still the material of choice as late as March 1854, as indicated by an architect's note pertaining to the four corner towers, where the circular stairways were to be placed: "The inner line shows where the adobes will be when finished[,] one course to be left out & built up with the stairs after the building is up."¹⁰ But in 1856, Brigham Young told the Saints, "We are going to suspend labor upon the Temple for a year, until we can prepare ourselves more fully for that work. We have abandoned the idea of using adobies in the walls of that building, and intend to use granite."¹¹

The granite quarrying operations that began in 1860¹² are the genesis of one of the most often repeated folktales about the temple's construction, according to Jennifer L. Lund, curator of education at the Museum of Church History and Art. She says members of the Church visiting the 1993 temple exhibit told curators hundreds of stories about the building, including one about quarriers

taking advantage of freezing water to split boulders.¹³ However, freezing water was not actually used, according to Wallace A. Raynor. In 1959 he conducted extensive interviews with William Kuhre, then ninety-seven, who began working in the quarries at age eleven.¹⁴ Raynor concludes:

The popularly told account of filling the drill holes with water and saturated wooden pegs, which upon freezing would split the stone is in no way substantiated by factual findings. It may have been tried, as might well have been many other methods. An objective survey of the weather in this area during the quarrying months [they did not quarry in winter] and the relative[ly] short period of time from the receipt of the rock order sheet until its delivery to Temple Block illustrates the poor logic of such a belief.¹⁵

The Foundation

Between 1853 and the summer of 1855, before granite quarrying began, workers laid 7,478 tons of roughly hewn stones called ashlars¹⁶ from Red Butte Canyon to form the footings of the temple. (This was one-third more rock than was used in the entire Nauvoo Temple.) Even then the footings¹⁷ were only 7.5 feet high,



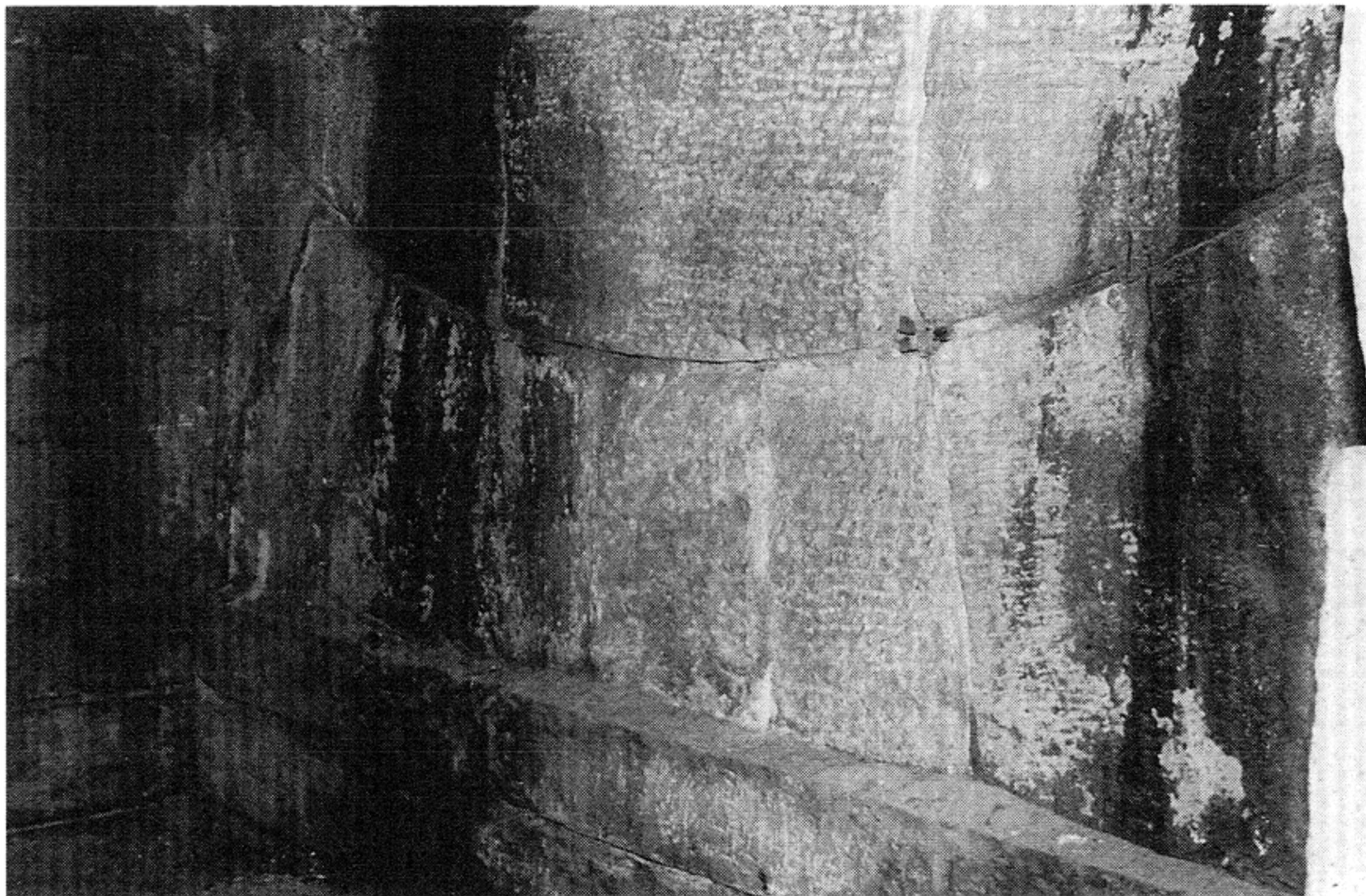
Salt Lake Temple footings. The 7.5-foot-high footings required 7,478 tons of roughly hewn stones. Conglomerate was used between the main support footings. Photographed in 1960 by Wallace Alan Raynor.

rising from their 16-foot-deep and 16-foot-wide base to a point 8.5 feet below ground level. It was here that sandstone flagging was laid to form the base for the 8-foot-wide foundation wall containing skillfully executed inverted arches.¹⁸ These arches, according to Lund, are also the subject of stories; in these tales, the arches are designed to allow the huge stones in the wall to move during earthquakes. Temple engineer Ken Hacking, whose love for the building can be fully understood only by fellow engineers, has intimate knowledge of the structure.¹⁹ He says that close examination of the arches shows there is absolutely no movement between stones. Their purpose is weight distribution, not movement. As George Q. Cannon wrote, the temple was “built to stand, without crack or quiver, for a thousand years.”²⁰

The first stone containing records, placed in 1857,²¹ rests on top of the sandstone flagging where the southeast tower meets the south main wall of the temple. Its exact location was unknown for many years until summer 1993, when construction workers, under the direction of the Church Historical Department, dug down to the top of the footing and made test drillings into the wall.²² Following James E. Talmage’s description, workers searched the vicinity of “the south-east corner of the building immediately beneath the first layer of granite.”²³ After finally locating the stone in the center of the wall, they drilled a larger hole to remove the contents of the box. The contents, which included books, pamphlets, periodicals, and coins,²⁴ had not been inspected since 1862, when the stone was temporarily removed during repairs of cracks in the foundation. A 1993 *Church News* article states, “Although all the items except the coins were in an advanced state of decay, sufficient fragments remained to allow identification of approximately half the items from the stone’s original inventory.”²⁵

The Plant Conservatory

The area where the construction crew had dug to find the record stone was once a covered plant conservatory outside the garden room. Talmage said, “On the sides of the altar [in the garden room] are large doorways opening directly into a conservatory of



Inverted arch. Placed on a sandstone flagging base, the inverted arches in the Salt Lake Temple's foundation were designed to help distribute the weight of the temple. Photographed in 1960 by Wallace Alan Raynor.

living plants.”²⁶ The conservatory can be seen in a number of historic photographs.²⁷ Robert W. Edwards, who has had a keen interest in the temple’s history for several decades, says the doors were used until the late 1920s or early 1930s.²⁸ They are pictured in an interior photograph taken by Ralph Savage in 1911.²⁹

The conservatory is probably a vestige of an earlier plan drawn by Truman O. Angell Sr. for a forty-five-by-seventy-foot greenhouse south of the temple that was to serve as the garden room complete with live plants.³⁰ According to the plan, the creation room was to be located where the garden room is now. From the greenhouse, patrons would enter the temple on the main landing of the grand staircase. Truman O. Angell Jr., who assisted his father, and Joseph Don Carlos Young, who was a son of Brigham Young and who became temple architect after Angell Sr. died, altered the conservatory and other earlier plans to create the present-day layout of the temple.³¹

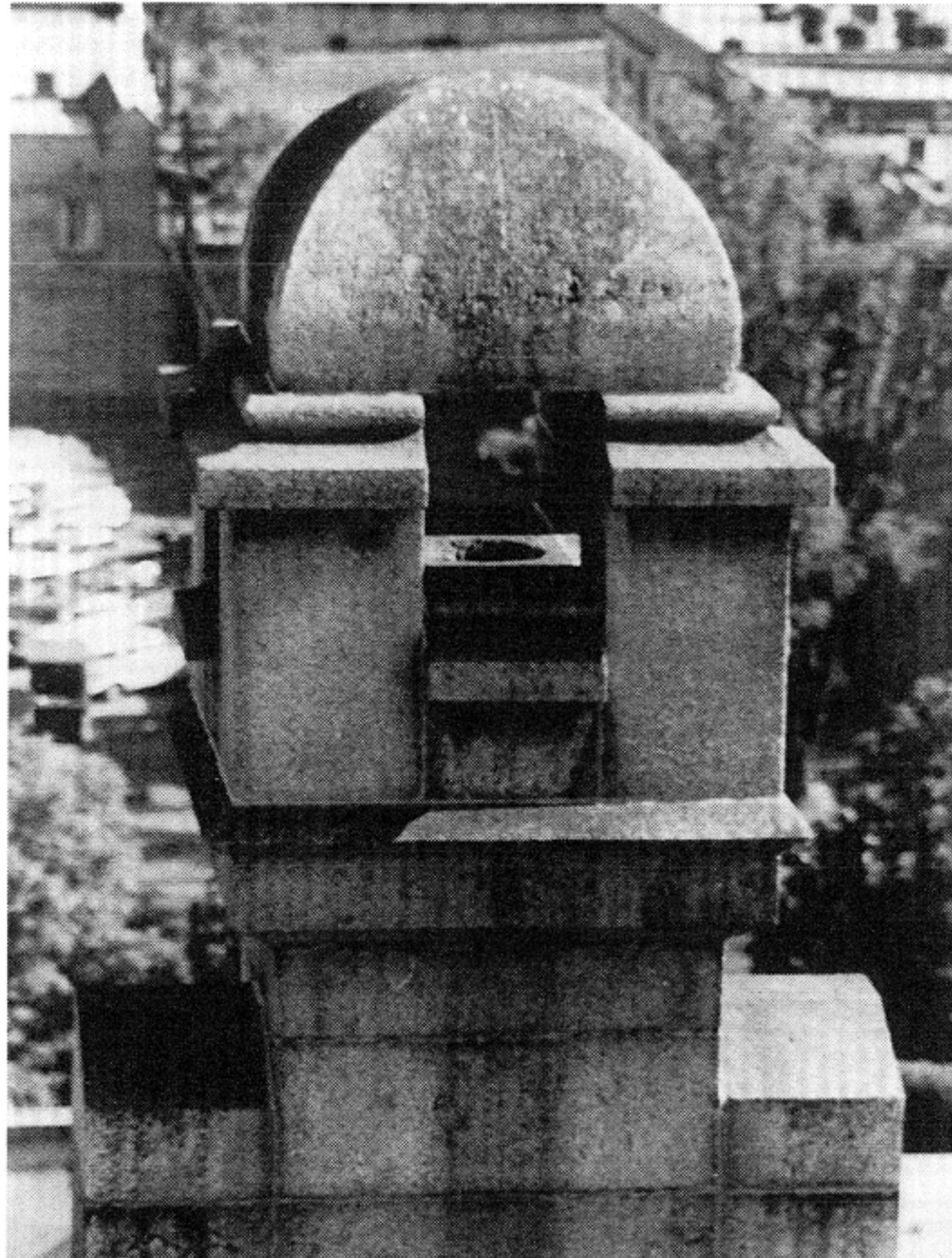
The Star Stone

Another possible change in the temple's design, though on a smaller scale, is evidenced by a small six-pointed star in the attic of the temple. It is about six and one-half inches across and cut three-eighths of an inch deep in one of the granite stones on the inside of the east center tower.³² The star may have had something to do with the Ursa Major (Big Dipper) pattern on the west tower since it is the same size and shape as the stars in that pattern. Like them, it is angled slightly so as to stand on two of its points, and it is not centered in its stone block. Construction photographs show that the block would have been laid before work on the Big Dipper began. Could it be that the star was an experiment? Perhaps the sunken design was abandoned in favor of stars in raised relief. If so, rather than discard the stone, masons placed it inside where it would not be seen as easily.

Chimneys or Vents

In contrast to the stone in the attic, the eighteen buttresses that rise more than one hundred feet on the north and south walls are both distinctive and readily apparent. Observant Temple Square visitors often ask about openings that can be seen near the tops of alternate buttresses.³³ (There are similar openings in six of the buttresses on the roof side of the temple's corner towers.) Several architectural plans indicate shafts in the buttresses.³⁴ Angell Sr.'s journal entry for May 31, 1867, verifies the plan for shafts: "I propose to start the flues say 10 in[.] in the bacement and inlarge to a foot 1st story[,] 14 in[.] next[,] 16 the next and 18 in nex[t] and last."³⁵ Note that Angell Sr. refers to the shafts as flues. Then, in a later undated drawing, he uses the word "chimney" to label a buttress top.³⁶ A photograph by Edward Martin taken around 1870 clearly shows horizontal shafts in the walls of the temple's basement stonework corresponding to alternate buttresses.³⁷

Peter Danzig, who worked on the temple during a major renovation in the early 1960s, found additional evidence that the buttresses were designed to be used as chimneys.³⁸ He says that while he was chipping plaster in the temple a small portion of wall caved in, revealing a horizontal shaft longer than his arm. In the course of



Flued buttress. Note the eleven-inch opening underneath the capstone. Alternate buttresses contain flues intended as chimneys for fireplaces or heating stoves but apparently were never used. Photographed in 1960 by Wallace Alan Raynor.

renovation, workers found several such shafts and could feel air drafting into them. These apparently connected to the vertical shafts in the buttresses. Wallace Raynor, measuring these flues in 1960, found them to be eleven inches in diameter at the top,³⁹ indicating that Angell's plan to increase them to eighteen inches never was implemented.

Talmage mentioned the vertical shafts when he wrote:

Between the end towers, that is to say in the main body of the building, the walls carry nine buttresses or pilasters on both north and south sides. Each . . . is capped by a granite block. . . . Of these pilaster caps, four on either wall are open and constitute the tops of ventilator shafts which extend to the basement.⁴⁰

Citing Talmage's description, some may claim the shafts were to be used for ventilation as was done in the ZCMI building.⁴¹ However, early photographs of the temple's interior do not show gratings or openings in the walls. If the shafts found by Danzig and fellow workers were intended to be used as vents, why had they been plastered over?

Another clue to the purpose of the shafts is the beautiful fireplace, with a bird's-eye maple mantelpiece and base and facings of Utah onyx,⁴² in the western wall of the waiting room suite, south of the celestial room. An inside look at the chimney reveals that it angles south in the wall toward one of the flued buttresses.⁴³ The connection between the chimney and the flued buttress further suggests that the original plan was to use the flues as chimneys for fireplaces or heating stoves. Perhaps as central heating came into vogue, the plan was abandoned. Since the flues had already been incorporated into the stonework from the beginning, they were completed, but it was not necessary to enlarge them as originally proposed by Angell.

Knowledge of Technological Advances

Jennifer Lund at the Museum of Church History and Art says stories proliferate about vertical shafts being constructed in the temple without the pioneer builders knowing their purpose. Later these shafts turned out to be just the right size for elevators. Museum docents have heard similar tales about workmen wondering why they were cutting channels in the granite walls of the temple. Then, the story continues, when electricity was discovered, these shafts were used to run wiring.

What these stories say, in essence, is that Mormon pioneers were unaware of the industrial and technological advances of the nineteenth century. Nothing could be further from the truth. Truman O. Angell Sr. went on an architectural fact-finding mission to England and France in 1856. While there, he not only studied significant buildings and monuments, but also sugar factories, iron works, and shipyards.⁴⁴ At the time of his mission, the following developments had taken place or were about to take place.

The Elevator. In 1743, Louis XV of France installed an elevator at the Palace of Versailles.⁴⁵ In 1829 the Regents Park Coliseum in London began operating a ten-passenger mechanical elevator.⁴⁶ In 1853, Elisha Graves Otis demonstrated the first safety device for an elevator at the Crystal Palace trade exposition in New York City, and in 1857 he used the device on a five-story elevator in a New York department store.⁴⁷

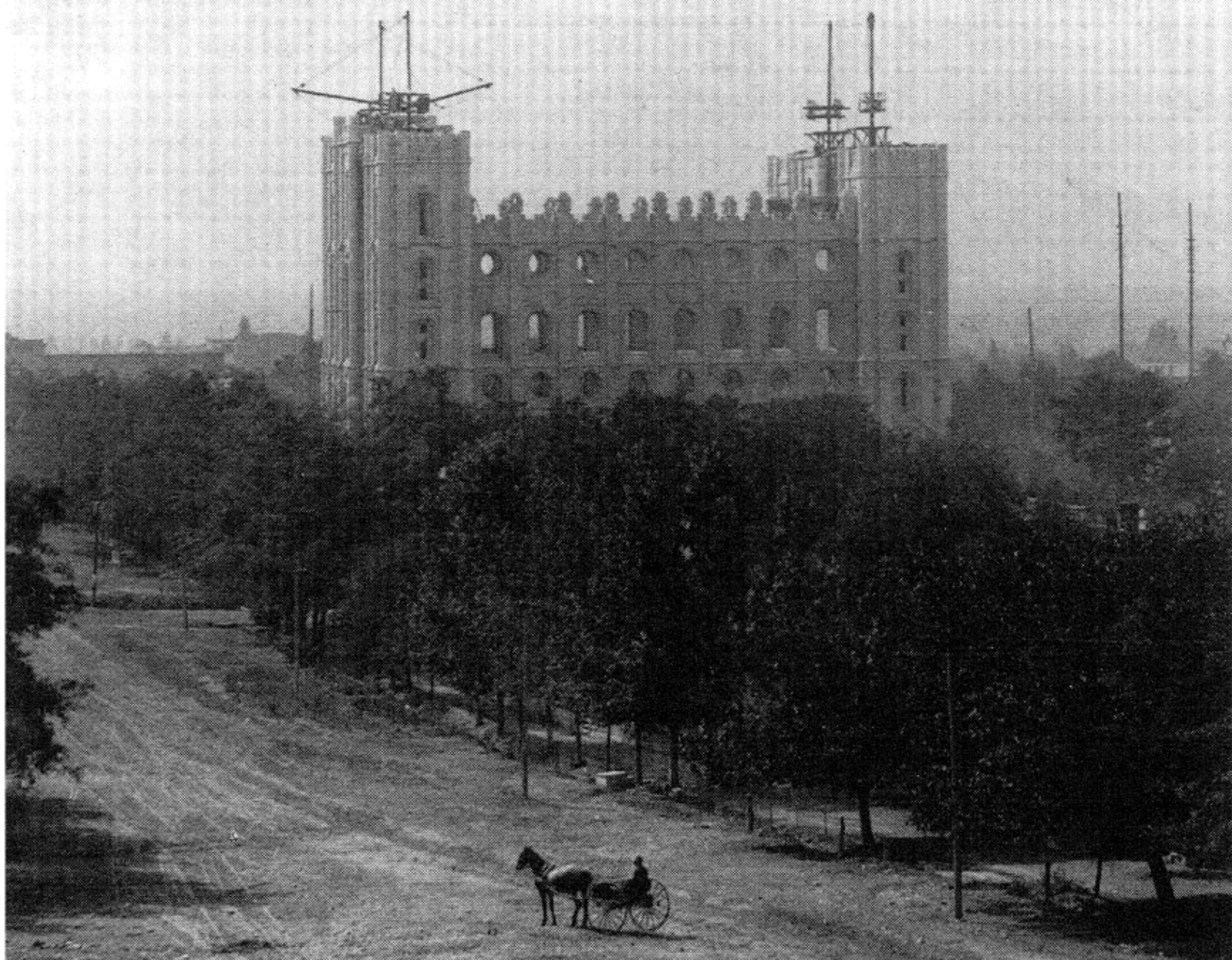
The Telegraph. In 1837 the telegraph became operational in England and the United States,⁴⁸ and in 1842, Samuel Morse laid a telegraph cable in New York harbor between Battery Park and Governor's Island.⁴⁹ A transchannel telegraphic cable was laid between Dover and Calais in 1851.⁵⁰ Brigham Young must have been aware of such developments, for on the day of the temple cornerstone layings in 1853, he said, "This day, and the work we have performed on it, will long be remembered by this people, and be sounded as with a trumpet's voice throughout the world, as far, as loud, and as long as steam, wind, and the electric current can carry it."⁵¹ By 1867, when the temple walls were just reaching above ground, the first successful transatlantic cable was laid.⁵²

Electricity. In 1847, Englishman W. E. Staite invented the electric arc lamp, and in 1857 street lights were installed in Lyons, France.⁵³ With Latter-day Saint missionaries traveling extensively and converts coming to Utah from many parts of the world, it is difficult to imagine the Saints were unaware of these technological advancements. While elevators and electric appliances were not in common usage in the mid-1850s, they certainly were not unknown. In the early 1860s, the Saints gained firsthand knowledge of electrical devices when they helped build the transcontinental telegraph line and then, under sponsorship of the Church, built their own Deseret Telegraph system connecting cities from Logan to St. George.⁵⁴

Elevators

The matter of elevator shafts deserves further examination. The temple was built of stone walls, with large open spaces left to be filled in later with beams, floors, and interior walls. At the completion of the outside walls, the center area of the temple could have been considered a huge, open shaft from basement to battlements. The center towers on the east and west also were constructed with open shafts, such as in bell towers. These open shafts are evident on numerous floor-plan drawings of the temple.⁵⁵

Early plans do not show elevators, but an 1887 drawing by Angell Jr. shows two elevator shafts in the northwest and southwest corners of the west center tower (their present location).⁵⁶



View prior to the construction of the temple's interior. About 1888, looking south along East Temple. The outside walls were built first, leaving a large open space in the interior. From certain angles a person could see clear through the temple, as is the case in this photograph (note the upper windows on the left of the temple). Courtesy Utah State Historical Society.

They occupy less than 20 percent of the floor space in the eighteen-foot-square tower shaft. Since they are in the corners of the tower, they are abutted by granite walls on only two sides—not three sides, as would be the case if shafts had been constructed specifically for them.⁵⁷

Although elevators were not part of early plans, there are four in the temple, not including those in the sealing-room addition, which was constructed during the 1960s renovation. The two already mentioned in the west tower serve eight floors from basement to roof. One just off the west side of the main hallway was built in the 1960s and runs from the basement to the celestial-room level. The last is behind the altar in the garden room and is no longer in use.

As suggested, stories about the west tower elevators abound. Over the years, the author has heard claims that they were hand operated, passengers using a crank inside each car, or that they were not installed until after the turn of the century—in spite of published accounts to the contrary. Eugene Young, a grandson of Brigham Young, toured the temple in 1893 just prior to its dedication and wrote the following for *Harper's Weekly*: "Two large and costly elevators are in the west end of the building."⁵⁸ That same year, an official description published by Church authorities in the *Deseret News* quoted James H. Anderson's comments on the machine room's "motive power" for the two handsome elevators in the central west tower.⁵⁹ In 1912, Talmage also mentioned elevators: "At the west end of the structure are two commodious elevators running in separate shafts of granite from basement to roof. At first hydraulic elevators were installed, but these have been replaced by automatic electric lifts."⁶⁰

His use of the term "hydraulic" raises questions because modern hydraulic elevators such as the one in the El Cortez Hotel in San Diego have long cylinders, with equally long piston rams, buried in the ground at a depth equal to the height that the elevators rise above the ground. Drilling two shafts near the inside corners of the temple's west tower to accommodate ninety-six-foot-long cylinders while workmen were erecting stone battlements and spires seems highly improbable.

But in fact, the first elevators were hydraulic. A June 12, 1889, contract proposal to the Church from Otis Brothers and Company, New York, states:

We propose to furnish and erect in a workmanlike and substantial manner Two Standard Hydraulic Passenger Elevators in the Mormon Temple at Salt Lake City to be operated by water pressure, from combined pressure and gravity tank according to the following specifications:

Size of hatchways [elevator shafts] to be about 5 ft x 6 ft. Rise of Cars, from lower to upper floor, being about 96 feet 0 inches.

Each car to be handsomely finished in cabinet work of such style and design as may be decided on by you or the architect.⁶¹

The system included the Otis "Gravity Wedge Safety Apparatus."⁶²

In those days, Otis did not bury cylinders in the ground as is done now. Instead, the company used sheaves, or grooved wheels, in a pulley arrangement that moved the elevator car three feet for every one foot of travel by the hydraulic ram. This meant that a thirty-two-foot cylinder and ram, plus sheaves, could be erected above ground alongside the elevator shaft well within the height limits of the building. Cables from the pulley system went up to other sheaves at the top of the elevator shafts and down to the cars. The original mounting beams for these sheaves are still in the tower.⁶³ A similar system was used on the Eiffel Tower elevators built by Otis in 1889.⁶⁴ Water pressure of ninety pounds per square inch was produced by gravity feed from a tank at roof level and a steam-driven Blake Duplea pump. The pump drove pistons that were twelve and one-half inches in diameter.

Talmage states that an electric lift system had replaced the hydraulic system by 1912.⁶⁵ Although Talmage failed to document the nature of this change, it is likely that only the driving mechanisms were changed—not the elevator cars and railings. Wallace Raynor, who rode in one of the elevators just prior to the 1960s renovation, says the car was an elaborate wrought-iron, gilded affair typical of early elevators, and the ride was rackete and loose.⁶⁶

Apparently the north elevator ceased to function sometime in the early part of the century because workmen found the old car in the bottom of its shaft as they prepared to install new elevators during the 1960s renovation. Wood floors had been built in the shaft to create closets on each floor. Peter Danzig recalls removing the floors and chiseling out eight-inch-deep columns in the granite at the back and side of each shaft to accommodate counterweight runs and side railings for the new elevators.⁶⁷ The old railings were located diagonally at two corners of each car.⁶⁸

The elevator in the garden room is hydraulic and was originally driven by the city's pressurized water system. Robert Edwards recalls old timers telling of problems with the elevator when the baptismal font was being filled. Apparently the water pressure dropped, leaving the elevator sluggish or nonoperable.⁶⁹ The system was later changed to pump-driven oil hydraulics, and the elevator performed faithfully until sometime between 1982 and 1985, when its use was discontinued.⁷⁰

Electricity

What about the serendipitously placed channels in the walls that were allegedly used for wiring? In 1873 when derricks were first erected, a *Deseret Evening News* article explained, “There will be four of these scaffolds upon which the derricks will be raised, one near each corner of the interior of the building.”⁷¹ This meant that construction of interior walls and floors could not take place until about 1886, when the derricks were moved from inside the building to positions between the center and outside towers. Photographs at that time show that one could see clear through the building with nothing to block the view.⁷²

By the time interior construction began in 1886, both the incandescent lamp and the telephone had been in existence a little less than a decade.⁷³ The Salt Lake Power, Light and Heating Company had been established in 1880, ZCMI had installed two voltaic arc lamps at its Main Street location that same year, and the first electric generating plant had been operational since 1881.⁷⁴ Salt Lake City was one of the first cities in the United States to install electric street lights. Other cities of similar size were still using or were just beginning to use gas lights, whereas Salt Lake City had established a gas utility company as early as 1872.⁷⁵

Since work on the walls and floors did not begin until 1886, it was not necessary to cut channels for utilities. It was much easier to route wiring and pipes through the wood and brick interior structures as they were being built during the final seven years of construction. Furthermore, furring for lath⁷⁶ and plaster was mounted on granite walls in many areas of the temple,⁷⁷ providing additional space between the stone and the plaster for routing utilities without having to cut channels in stone.

Truman O. Angell Sr. died October 16, 1887, after nearly four decades of masterminding construction of the temple footings, foundation, and walls. Completion of the spires and interior, plus construction of the annex and boiler house north of the temple,⁷⁸ fell to the lot of Joseph Don Carlos Young, who had earned a degree in engineering from Rensselaer Polytechnic Institute in 1879.⁷⁹ It was under his aegis as Church architect that the final decisions were made on heating, electrical, and physical facility matters.⁸⁰

Apparently initial planning called for gas lighting in the temple, according to Robert Edwards.⁸¹ Prior to the renovation of the temple in the early 1960s, Edwards and Raynor were among several volunteers who helped temple engineer Linden W. Millgate conduct a physical plant inventory. While taking measurements, they could not account for a space of about three feet between the south wall of the terrestrial room and a set of restrooms on the other side of the wall. The mystery was soon solved when they discovered a trap door in the floor of an upper hallway that allowed them to climb down into an abandoned utility room. It contained dust-covered gas plumbing and electrical wiring, the latter connected to old-style knife switches⁸² mounted on control panels. The gas plumbing had never been used, and the electrical wiring had long since been disconnected.

When it was in use, the utility closet was accessed through a door just a few steps beyond the top of the grand staircase in the west wall of the upper hallway. Edwards says he does not know when it was sealed off, but it was done in such a way that the entrance appeared to be nothing more than a decorative archway. Today, it forms an alcove for a drinking fountain. A 1911 photo shows a fountain on the wall directly opposite the archway, indicating that the door was in use at that time.⁸³ All of the utility equipment in the closet was removed during renovation.

Printed Descriptions

When the temple was dedicated in 1893, both local and visiting journalists were obviously impressed not only with its overall appearance, but also with its fixtures, utilities, and state-of-the-art infrastructure. “The Temple is fitted throughout with most costly electroliers, for it is lighted entirely with electricity,” wrote Eugene Young.⁸⁴

After examining the finely appointed plumbing arrangements for the baptismal font and adjoining washing and anointing rooms, another journalist said, “The perfection of these arrangements suggests a thought as to the ingenuity employed in other plumbing appliances.”⁸⁵ He described the fifteen onyx wash stands of rare beauty at various places in the building as well as the five unique

and costly drinking fountains of variegated onyx. "The sanitary arrangements throughout are faultless," he noted.⁸⁶

In regard to plumbing, Angell Sr. and William W. Ward made provisions on several 1855 plans for a water pipe to run under the north wall to the center of the temple where the baptismal font was to be located. There were also two drains exiting three feet eight inches underneath the flagging of the west footing.⁸⁷ Angell drew plans in 1869 for a sewer built of specially shaped stone.⁸⁸

In 1893 the *Deseret Evening News* told of four steam engines and four dynamos⁸⁹ that "repose in drowsy might or move in stately measure" in an underground chamber just west of the temple. Anderson described the machinery as follows:

Two of these engines are seventy-five horse-power, and the other two twenty-five horse-power each. These operate four Edison dynamos. The capacity for electric lighting is two thousand sixteen candle-power lamps, sufficient for the illumination of the Temple, Tabernacle and Assembly Hall, though only the first named building is at the present time supplied from that source.⁹⁰

Anderson also described the boiler house three hundred feet north of the temple as being of "elegant design and commodious and convenient extent." This two-story structure, with its unique, mosque-style chimney, was designed by Joseph Don Carlos Young. It housed four coal-fired boilers: two for steam to run the dynamos and elevator engine and two for hot water to heat the temple. A twelve-inch pipe ran from the boiler house to the temple through a stone tunnel.

The heating system included an expansion tank in the attic of the temple from which hot water was distributed to radiators in all rooms below.⁹¹ The tank was later removed, but portions of the support beams protruding from the inside wall of the east center tower and support brackets hanging from roof beams are still visible.⁹²

Journalists described the cooling system as being "equally effective" as the heating system, though by modern standards it would have been inadequate. "Ventilation will be secured by pressing electric buttons, which will throw open transoms⁹³ in the various rooms and start sixteen fans, each of one-half horsepower," one newspaper account stated.⁹⁴

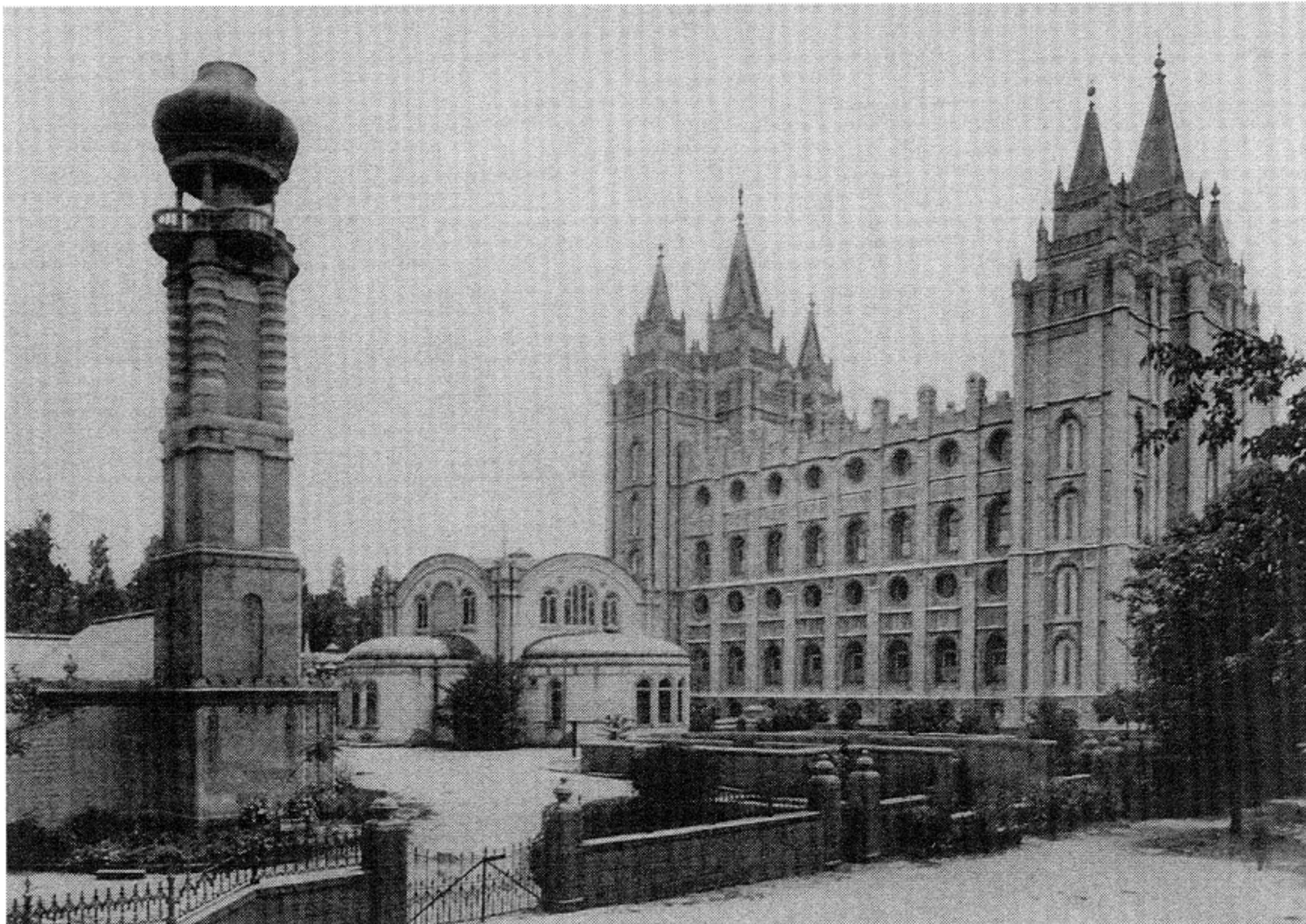
Journalists also were impressed with the fire hoses in the four corner towers, "so that in case [of] the unexpected . . . adequate

remedy and protection would be at hand.”⁹⁵ These were connected to a 7,500-gallon water tank in the northwest tower.⁹⁶ The temple now is equipped with a sprinkler system, so the hoses and tank are gone, but anchor holes in top of the six-foot-diameter granite newel⁹⁷ in the tower are evident.⁹⁸ Many written accounts place the tank in the southwest tower, but insurance maps and the anchor holes indicate otherwise.

Nearly twenty years after the temple’s dedication, people were again impressed with the building’s infrastructure, particularly the heating and cooling systems that had both been changed since the dedication. Talmage in 1912 described “a very efficient apparatus for vacuum cleaning . . . connected with every room in the Temple.”⁹⁹ In that same work, he said that “prior to 1911 the Temple was supplied with heat and light from its own boilers and dynamos. . . . Steam and electricity are now furnished from a central plant situated immediately west of the Temple Block.”¹⁰⁰

The central plant Talmage referred to was the “Hotel Utah Power, Light & Heat Plant” in the center of the block southwest of Temple Square.¹⁰¹ Talmage reported that the plant supplied steam, water, and electricity and ammonia “for cooling purposes” through more than a quarter mile of tunnels to some twenty-five buildings and smaller structures belonging to the Church on and around Temple Square.¹⁰² The temple boilers and dynamos were shut down when the changeover was made. Although Talmage mentions ammonia for cooling, there is some question as to whether air-conditioning was used in the temple at that time. It was not until the 1960s renovation that a large equipment room was excavated under the baptismal font to house air-handling equipment, filters, and ducting.¹⁰³

During the 1960s renovation, workers uncovered a wooden truss supporting the floor above the baptismal font. It was obvious that part of the truss had been burned at one time. Peter Danzig says during the final years of temple construction, work continued year-round, and crews built bucket fires to keep warm in winter. Sometimes wood structures caught fire. This probably happened to the truss. A carpenter had repaired the damage, then signed his name—James R. Wilson.¹⁰⁴



Salt Lake Temple boiler house. Before 1915. Located three hundred feet north of the temple, this structure housed four coal-fired boilers, two each for the electric and heating systems. The engine room's stack is on the left. Courtesy LDS Church Archives.

Conclusion

The history of the Salt Lake Temple building is a rich one, filled with stories of inspiration, practicality, sacrifice, and dedication. The Saints knew God wanted them to build a temple, but they also knew that he expected them to study things out in their minds. As they pursued their labors, they researched available materials and technologies carefully, wanting to offer only the best to the Lord. Even in the most minute details, the facts of the forty-year feat of the intrepid souls who built the temple make a story as fascinating as any folklore.

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NOTES

¹*Deseret Weekly*, April 1, 1893, 45b.

²See *Ensign* 23 (March 1993): 2-43; Richard Neitzel Holzapfel, *Every Stone a Sermon* (Salt Lake City: Bookcraft, 1992); Nelson B. Wadsworth, *Set in Stone, Fixed in Glass: The Great Mormon Temple and Its Photographers* (Salt Lake City: Signature Books, 1992).

³Brigham Young, in *Journal of Discourses*, 26 vols. (Liverpool: F. D. Richards, 1855-86), 1:278, February 14, 1853 (hereafter cited as *JD*).

⁴Young, in *JD*, 1:278.

⁵William Ward to Magazine Printing Co., March 1892, *Temple Souvenir Album* 7 (April 1892): 7-9.

⁶Ward to Magazine Printing Co., 7-9.

⁷Truman O. Angell, Letter to Editor, "The Temple," *Deseret News*, August 17, 1854. This figure represents the sum of the side and center arch heights. In Angell's 1874 description, these rooms were to be thirty-five feet high. See *Millennial Star* 26 (May 5, 1874): 273-75.

⁸Heber C. Kimball, in *JD*, 1:162, October 9, 1852.

⁹Young, in *JD*, 1:220, October 9, 1852; italics in original.

¹⁰Salt Lake Temple Architectural Drawings, Archives Division, Church Historical Department, The Church of Jesus Christ of Latter-day Saints, Salt Lake City (hereafter cited as LDS Church Archives).

¹¹Young, in *JD*, 3:249, March 16, 1856.

¹²Wallace Alan Raynor, "History of the Construction of the Salt Lake Temple" (master's thesis, Brigham Young University, 1961), 70. This valuable 229-page thesis is the basis for W. A. Raynor, *The Everlasting Spires: A Story of the Salt Lake Temple* (Salt Lake City: Deseret Book, 1965).

¹³Jennifer L. Lund, telephone conversation with author, November 15, 1993.

¹⁴Raynor, "History of the Construction," 73 n. 14.

¹⁵Raynor, "History of the Construction," 81 n. 27.

¹⁶Raynor, "History of the Construction," 26-27.

¹⁷A footing is an enlargement at the base of a foundation wall or other supporting structure. The footing distributes the weight on the wall.

¹⁸See photo in Raynor, "History of the Construction," 127; and drawing in [C. Mark Hamilton], *The Salt Lake Temple: A Monument to a People* (Salt Lake City: University Services, 1983), 65.

¹⁹Ken Hacking, interview with author, November 8, 1993, Salt Lake City.

²⁰[George Q. Cannon], *House of the Lord, Historical and Descriptive Sketch of the Salt Lake Temple* ([Salt Lake City]: Geo. Q. Cannon and Sons, 1893), 14.

²¹A stone box placed in the foundation of the Salt Lake Temple on August 13, 1857. "Items Recovered from Stone Box in Temple Foundation," *Church News*, August 21, 1993, 7; Holzapfel, *Every Stone a Sermon*, 19. The second record stone is the capstone, which was placed April 6, 1892. See James E. Talmage, *The House of the Lord: A Study of Holy Sanctuaries, Ancient and Modern* (Salt Lake City: Deseret Book, 1971), 126.

²²"Items Recovered," 7.

²³Talmage, *House of the Lord*, 148.

²⁴"Items Recovered," 7.

²⁵“Items Recovered,” 7.

²⁶Talmage, *House of the Lord*, 157.

²⁷See Wadsworth, *Set in Stone*, 289; see also photograph 726.14, page 63, photo archives, Utah State Historical Society, Salt Lake City.

²⁸Robert W. Edwards, telephone conversation with author, November 3, 1993.

²⁹[Hamilton], *Salt Lake Temple*, 115.

³⁰[Hamilton], *Salt Lake Temple*, 64.

³¹[Hamilton], *Salt Lake Temple*, 57.

³²Wallace A. Raynor, telephone conversation with author, October 27, 1993; Peter Danzig, interview with author, March 6, 1970, Provo, Utah.

³³A buttress projects from a structure, such as a wall, and supports it. On the temple, the buttresses are made of stone.

³⁴[Hamilton], *Salt Lake Temple*, 64, 70.

³⁵Truman O. Angell Journal, May 31, 1867, LDS Church Archives; italics added.

³⁶Salt Lake Temple Exhibit, Museum of Church History and Art, Salt Lake City, 1993.

³⁷Wadsworth, *Set in Stone*, 63.

³⁸Danzig, interview.

³⁹See photo in Raynor, “History of the Construction,” 171; Raynor, “History of the Construction,” 170.

⁴⁰Talmage, *House of the Lord*, 146-47.

⁴¹A Journal History entry of June 25, 1875, pertaining to the new ZCMI building states: “Inside of the wall, at distances of only 12 feet apart, will be 18 inch square buttresses, in each of which will be two thimbles for ventilation registers, one row about two feet above the footing and the upper one about fifteen inches below the ceiling, to carry away everything in the shape of foul air, the flumes running clear to the roof.” *Deseret Evening News*, June 26, 1875, quoted in Martha Sonntag Bradley, *ZCMI: America’s First Department Store* (Salt Lake City: ZCMI, 1991), 192.

⁴²[Cannon], *House of the Lord*, 20. For a 1911 photograph of the fireplace, see Wadsworth, *Set in Stone*, 366.

⁴³Hacking, interview.

⁴⁴Raynor, “History of the Construction,” 21.

⁴⁵Valerie-Anne Giscard d’Estaing, *The World Almanac Book of Inventions* (New York: World Almanac Publications, 1985), 167.

⁴⁶Giscard d’Estaing, *World Almanac Book of Inventions*, 167.

⁴⁷Derek Birdsall and Carlo M. Cipolla, *The Technology of Man* (London: Wildwood House, 1980), 204.

⁴⁸Giscard d’Estaing, *World Almanac Book of Inventions*, 118-19.

⁴⁹Samuel Irenaeus Prime, *The Life of Samuel F. B. Morse, LL.D.: Inventor of the Electromagnetic Recording Telegraph* (New York: Appleton, 1875), 442-43.

⁵⁰Giscard d’Estaing, *World Almanac Book of Inventions*, 120.

⁵¹Young, in *JD*, 1:132, April 6, 1853.

⁵²Giscard d’Estaing, *World Almanac Book of Inventions*, 120.

⁵³Giscard d’Estaing, *World Almanac Book of Inventions*, 169-70.

⁵⁴Leonard J. Arrington, *Great Basin Kingdom: An Economic History of the Latter-day Saints, 1830-1900* (Lincoln: University of Nebraska Press, 1970), 228-29.

⁵⁵See [Hamilton], *Salt Lake Temple*, 74, 75, 78, 79.

⁵⁶Salt Lake Temple Architectural Drawings, LDS Church Archives; see also [Hamilton], *Salt Lake Temple*, 70.

⁵⁷Talmage's statement that there were "two commodious elevators running in separate shafts of granite" might give rise to speculation that shafts were cut specifically to size for each elevator. Talmage, *House of the Lord*, 168. Such is not the case since the two elevators occupy only a portion of one large shaft.

⁵⁸Eugene Young, "Inside the New Mormon Temple," *Harper's Weekly*, May 27, 1893, 510. See also [Cannon], *House of the Lord*, 29.

⁵⁹James H. Anderson, "The Salt Lake Temple," *Contributor* 14 (April 1893): 287.

⁶⁰Talmage, *House of the Lord*, 168.

⁶¹Salt Lake Temple Architectural Drawings, LDS Church Archives.

⁶²Salt Lake Temple Architectural Drawings, LDS Church Archives.

⁶³Hacking, interview.

⁶⁴Birdsall and Cipolla, *Technology of Man*, 224.

⁶⁵Talmage, *House of the Lord*, 168.

⁶⁶Raynor, telephone conversation.

⁶⁷Danzig, interview.

⁶⁸Elevator plans from 1889, Salt Lake Temple Architectural Drawings, LDS Church Archives.

⁶⁹Edwards, telephone conversation.

⁷⁰Edwards, telephone conversation.

⁷¹*Deseret Evening News*, August 16, 1873.

⁷²Photograph 726.14, page 19 (taken in 1887), photo archives, Utah State Historical Society. See also *Ensign* 23 (May 1993): 66.

⁷³Giscard d'Estaing, *World Almanac Book of Inventions*, 120, 170.

⁷⁴Kate B. Carter, comp., *Development of Lighting Systems in Utah* ([Salt Lake City]: Daughters of Utah Pioneers, 1944), 458, 476.

⁷⁵Thomas G. Alexander and James B. Allen, *Mormons and Gentiles: A History of Salt Lake City*, The Western Urban History Series, vol. 5 (Boulder, Colo.: Pruett Publishing, 1984), 107.

⁷⁶Furring is generally wood or metal mounted on a wall to provide a level surface or an airspace. Lath, in this case pieces of wood, is placed on the furring. Then plastering is spread over the lath, creating a smooth surface.

⁷⁷Hacking, interview.

⁷⁸For plot plan and photographs of these buildings, see Anderson, "The Salt Lake Temple," 245, 283, 286.

⁷⁹Dean C. Jesse, ed., *Letters of Brigham Young to His Sons* (Salt Lake City: Deseret Book, 1974), 264.

⁸⁰Holzapfel, *Every Stone a Sermon*, 34.

⁸¹Edwards, telephone conversation.

⁸²A knife switch consists of four pieces of metal mounted on a plate. Two pieces are mounted above the other two and can be brought into contact with the lower two.

⁸³[Hamilton], *Salt Lake Temple*, 116.

⁸⁴Young, "Inside the New Mormon Temple," 510.

⁸⁵[Cannon], *House of the Lord*, 15.

⁸⁶[Cannon], *House of the Lord*, 15.

⁸⁷Salt Lake Temple Exhibit, Museum of Church History and Art, 1993

⁸⁸Salt Lake Temple Exhibit, Museum of Church History and Art, 1993.

⁸⁹A dynamo, or dynamoelectric machine, is a generator, changing mechanical energy into electrical energy.

⁹⁰Anderson, "Salt Lake Temple," 283.

⁹¹*Temple Souvenir Album*, 29.

⁹²Hacking, interview.

⁹³A transom is a horizontal crossbar in a window, over a door, or between a door and a window above it.

⁹⁴*Deseret News*, January 1, 1893, 5.

⁹⁵[Cannon], *House of the Lord*, 21.

⁹⁶*Utah Maps II: Urban Salt Lake County, Utah, 1884-1916* in *Fire Insurance Maps of Utah, 1884-1950* (Pelham, N.Y.: [Sanborn Map, 1950]), 1898, microfilm (hereafter cited as Sanborn Maps).

⁹⁷A newel is the post a spiral staircase wraps around or the post at the bottom or on a landing of a straight staircase.

⁹⁸Hacking, interview.

⁹⁹Talmage, *House of the Lord*, 153-54.

¹⁰⁰Talmage, *House of the Lord*, 154 n. 1.

¹⁰¹Sanborn Maps, 1911.

¹⁰²Talmage, *House of the Lord*, 173-74.

¹⁰³Danzig, interview.

¹⁰⁴Danzig, interview.