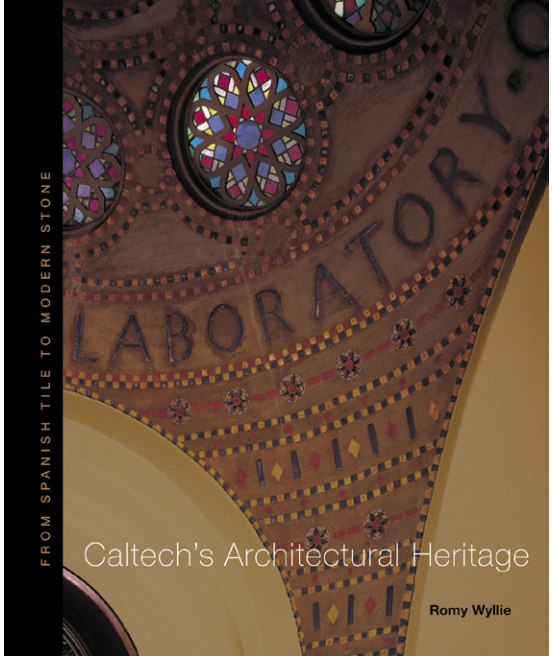
Chemistry and Physics

by Romy Wyllie



Drinking fountains in West (left) and East (see page 22) Bridge add to the Spanish ambiance of Goodhue's designs. The marble basins are surrounded with faience tile in a variety of designs and colorful glazes.

The book's cover (above right) also comes from chemistry—the interior hallway dome of Gates Annex library. It is decorated with rings of gold tiles, the names of the donors, and circular stained glass skylights containing stylized snowflakes.

Back in 1915, when Caltech was not yet Caltech and the campus was 22 acres of orange groves, George Ellery Hale pursuaded the board of trustees to hire Bertram Goodhue to design an architectural master plan for the young school. Although the campus has expanded far beyond its initial acreage and the buildings that house Caltech's laboratories and classrooms represent a number of different architectural fashions, Goodhue's plan and his eclectic, ornate Spanish Renaissance style dominate the look of the oldest part of campus, where the first chemistry and physics laboratories still stand (although the metamorphosis of High Volts into Sloan Lab leaves little to be seen of Goodhue).

This chapter is reprinted with the permission of Balcony Press from Romy Wyllie's book, Caltech's Architectural Heritage: From Spanish Tile to Modern Stone*, published in December. Wyllie traces the history of Caltech's unique architectural development, illustrating it with rare historical photos and pictures of stone and tile details that the average campus visitor (or student or faculty member) is likely to miss.*

Wyllie is an interior designer and cofounder of CATS (the Caltech Architectural Tour Service of the Caltech Women's Club). And she happens to be married to Peter Wyllie, professor of geology, emeritus. The Wyllies came to Caltech in 1983, and Romy shortly embarked on the mission of sharing the beauty of the campus with visitors and documenting its architectural history.

The book, which is available at bookstores or can be ordered from the Caltech Bookstore, is dedicated to President Emeritus Tom Everhart and his wife, Doris, who gave generous support to the project from discretionary funds.

Chemistry

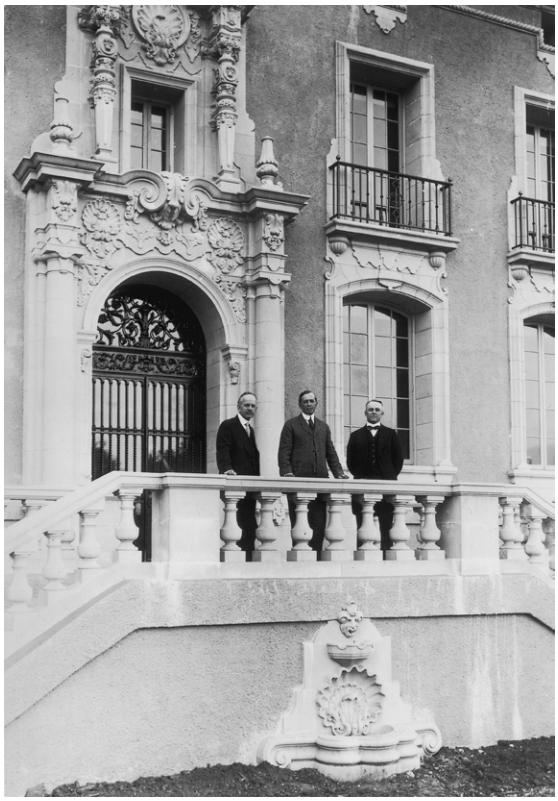
While President Scherer focused on the management of the school and raising funds, Hale worked at building up its faculty. It took many meetings, a two-year, part-time teaching appointment and the promise of a new building for Hale to persuade Arthur Amos Noyes to break a long and strong bond with MIT and become head of the Division of Chemistry at Throop College of Technology. Like Hale, Noyes believed in the importance of research in pure science, and that to be thoroughly educated scientists should study the humanities.

On March 10, 1916, ground was finally broken for Noyes' promised chemistry laboratory. The building was named for the principal contributors, Charles and Peter Gates, Pasadena businessmen, who had made their money in lumber. Arthur Fleming paid for equipment and an annual maintenance income.

The 18,000-square-foot building would contain offices, a lecture room, large and small laboratories, chemical stock rooms, and a library with Professor Noyes' office in the southwest corner of the first floor. Goodhue suggested locating the new structure, now called the Gates Chemistry Laboratory, to the northwest of Throop Hall, near San Pasqual, where it would help to form the layout of his central square.

He agreed with Scherer's suggestion to move it 12 feet closer to Throop Hall, so that its long axis would be centered on Michigan Avenue, a north-south street intersecting San Pasqual Street.

Elmer Grey was the principal architect of the laboratory but Hale asked Bertram Goodhue to design the exterior. Fortunately Grey and Goodhue, who already knew each other and were good friends, cooperated amicably. Hunt and Grey's master plan had made Throop Hall, sitting on an elevated site, the highest building on the campus with a two-story, chemistry laboratory at a lower level. But Goodhue tried to persuade Grey to raise the height of Chemistry because he wanted the buildings flanking his central courtyard or "Court of Honour" to have more presence. Scherer ended the discussion by prohibiting any competition with Throop Hall.



Above: Goodhue's rendering of Gates Laboratory of Chemistry with the Memorial Building dome (which was never built) in the background. To strengthen his Spanish Renaissance theme, Goodhue used baroque ornamentation called Churrigueresque. The style is named for the Churrigueras, a family of Spanish architects. Right: The triumvirate, George Ellery Hale, Arthur Amos Noyes, and Robert Andrews Millikan, in front of Gates Laboratory of Chemistry. Underneath the double stairway is one of Goodhue's many charming fountains with a head and shell design above the basin.

Although Goodhue was not responsible for the Gates Chemistry Laboratory plan and interior, his revision of Grey's "frontispiece, fenestration and cornice" established the Spanish Renaissance decoration which Hale had designated as the overall theme for the campus. He retained Grey's arrangement of doors and windows but made his ornamental balconies functional. Goodhue also added his own embellishments, consisting of interpenetrating lambrequin shapes under the windows, a rope design framing the cornice and an elaborate Churrigueresque style carving of shells, spirals, and leaf-entwined columns framing a grand entry door made of ornamental iron work.

All of Goodhue's ornamental stone work was made from "cast stone," an artificial sandstone-like material formed by cement-casting sand in molds. The decorations for the Gates Laboratory were prepared from models made by a Mr. Piccirilli, whom Goodhue refers to as his "pet modeller here in New York." The Piccirilli family were in fact well-known sculptors and stone cutters and responsible for several of New York's civic monuments.

To the south of the building Goodhue and Grey cooperated in the design of an arcade using a style of column found at Mission San Juan Capistrano. Goodhue changed Grey's three arches to five and replaced Grey's plaster ceiling with wood beams. These Spanish portales would be extended as other buildings were constructed.

Noyes' new laboratory was completed in 1917, but it was not until 1919 that he broke his ties with MIT and took a full-time position at Throop College.

PHYSICS

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As early as 1912 Hale had hoped that the Carnegie Foundation would add to the Mount Wilson Observatory project by funding physical chemistry and physics laboratories in Pasadena. But his hopes were dashed when the Carnegie Foundation experienced financial problems. By 1917, with a chemistry laboratory completed and a director designated, Hale (urged on by Noyes) renewed his efforts to find the funding for a physics division. Both men agreed that Robert Millikan was the obvious choice, but an inducement in the form of a laboratory with assurance of money for research would be needed.

Robert Andrews Millikan was born in 1868 in Illinois where his father was a Congregational minister. After obtaining his doctorate in physics from Columbia, he studied at the universities of Berlin and Göttingen before joining the faculty at the University of Chicago. In 1917, just before America entered World War I, Millikan agreed to spend three months a year at Throop College. He was appointed director of physical research and began a series of public lectures.

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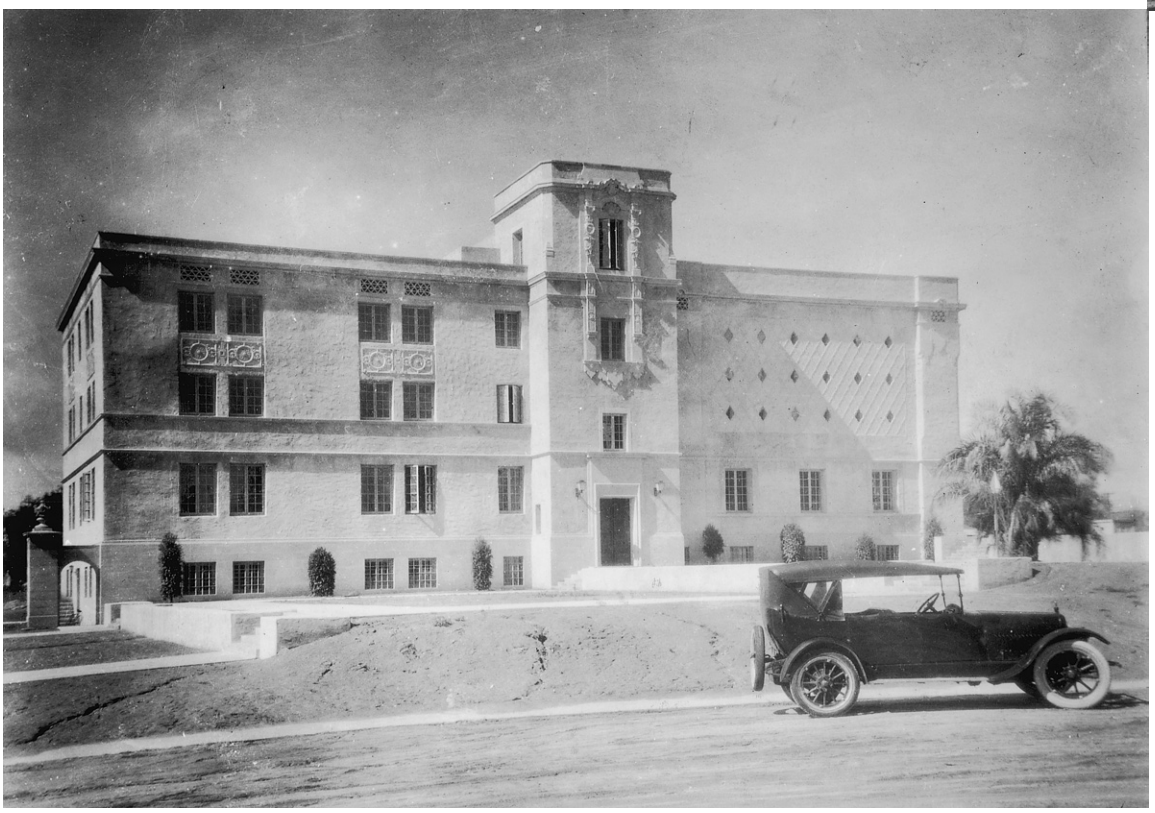
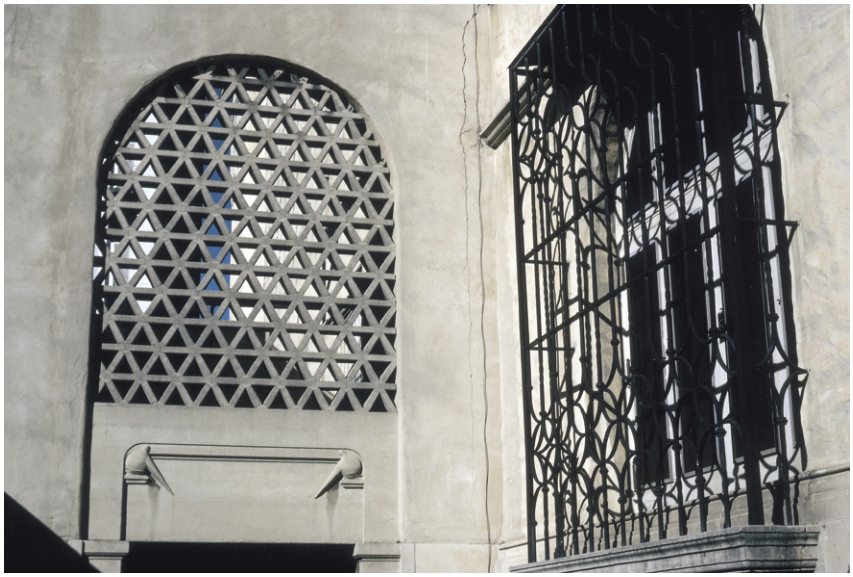
To help make the expansion into physics a

Below: The East Bridge tower. On one side of the tower a plain wall is enlivened with 18 elongated quatrefoil-shaped windows set like jewels into an overall repetitive motif called a diaper design. The same Moorish-inspired pattern is repeated on the north and west facades, so that the building would relate to the Memorial Building with its tiled dome overlooking the central court.



Left: Bridge Laboratory of Physics, 1922–24. The first unit, East Bridge, is a fine example of Goodhue's sense of balance and proportion. Between the rectangular upper windows he placed medallions representing Fire, Water, Earth, and Air, the four essential components of all matter, according to the ancient Greek philosophers. Similar panels of medallions on West Bridge symbolize modern science: one medallion represents the Compton effect (the scattering effect of electrons), the other the structure of the carbon atom.

Right: Drinking fountain in East Bridge.



Bridge Annex with two distillation flasks below an arch. The geometrical stone lattice-work filling the arch is similar to mashrabiyya grilles used in Muslim architecture to provide privacy but allow breezes to cool the interior.

reality, Trustee Norman Bridge had agreed to provide the funds for a complex of three buildings. Dr. Bridge had practiced and taught medicine in Chicago before moving to Southern California, where he turned his assets into a fortune by investing in oil exploration. In Pasadena he promoted music, art and education, and helped establish La Viña Sanatorium. He was President of Throop's Board of Trustees for many years.

Goodhue's early plans located a physics building on the north side of the campus to prevent the vibration of trolley cars on California Boulevard from interfering with delicate machinery. Located next to the Gates Chemistry Laboratory, it would have butted up to the science museum on the west and the Memorial Building on the south. But when it became necessary to enlarge the package to attract Millikan, Goodhue suggested that an area south of Throop Hall parallel to California Boulevard would provide ample space for several buildings. The new plan consisted of an open court, which would be flanked by a U-shaped physics complex on the west side and a High Potential Research Laboratory on the east side.

The physics group, built between 1920 and 1924, represents the essence of Goodhue's academic buildings. East Bridge, asymmetrical but perfectly proportioned, has strong horizontal lines interrupted by a vertical entry tower whose upper windows are decorated with Churrigueresque and lambrequin ornamentation. The two buildings flanking the "U" of the physics group are three stories high with two floors below ground, but the joining annex, which runs parallel to the central court, has only one story to permit the dome of the Memorial Building to be viewed from the street.

The construction is reinforced concrete with the columns, outside walls, and floor slabs carrying the weight. Interior partitions of hollow tile free of wiring or piping could be removed, or additional walls could be added. The main lecture hall seated 260 people and was lit by a skylight with motorized curtains. Earnest C. Watson, who began a public lecture series which continues today, was hired in 1920 to supervise the construction of the buildings. Students in electrical engineering installed the electrical wiring and equipment. For the convenience of scientists who wished to play tennis during the day, two showers and a dressing room were installed in the subbasement.

In order to create continuity between the academic buildings, Goodhue designed the first floor

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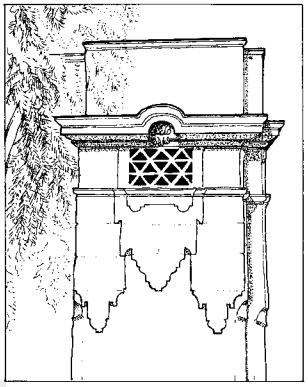
corridors with similar features and materials: padre tile floors, vaulted ceilings, decorative light fixtures, wrought-iron stair railings and doors opening onto important rooms, and water fountains set in marble basins surrounded with faience tile in a variety of designs and colorful glazes. East Bridge sets the standard for other buildings on campus. Opposite the entrance and double staircase, a wrought-iron door crowned by the newly created initials of the California Institute of Technology opens onto a reading room with a central light fixture in the form of a medallion of the four elements. The central library of the Institute, moved from under the dome in Throop Hall, filled the annex between East and West Bridge. Many years later it was divided into offices and its decorative beamed ceiling destroyed.

In 1921, with the physics laboratories under construction, research funds found, and equipment promised, Millikan agreed to move permanently to California.



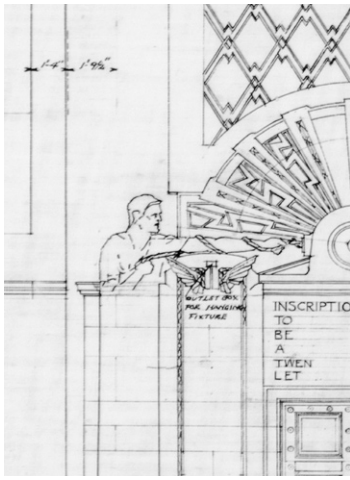
Above: Delicate overlapping lambrequins flowed down from the tops of piers, breaking up their scale.

High Volts Building from California Avenue. Goodhue covered the exterior walls in a diamond-shaped diaper pattern to detract from the absence of windows. Although Goodhue refers to Moorish architecture as his inspiration, similar patterns are also found on Mayan ruins, in particular those in Uxmal, where the walls of several buildings are decorated with repetitive geometric shapes.

When Hale realized that a laboratory dedicated to high voltage research might be the deciding factor in persuading Millikan to join the Caltech faculty, he devised "the Edison scheme." Hale's plan, in which the Southern California Edison Company would help to fund a laboratory in return for using its facilities, was supported by trustees Fleming and Robinson, both of whom were directors of Edison.

Caltech's bulletin of December 1923 stated, "It (High Volts) will be available both for the pursuit of special scientific problems connected with the structure of matter and the nature of radiation,

The entrance to High Volts (now Sloan Laboratory). Goodhue's sculptor, Lee Lawrie, originally showed a drawing of a man and a woman with extended arms, holding a cable and creating a powerful discharge of electricity (below). Perhaps because Caltech was an all-male institution, the sculpture over the door was changed to two men, mirror images of each other.



and for the conduct of the pressing engineering problems having to do with the improvement in the art of high tension transmission." Although such a cooperative effort was unusual, the effort paid off. The February 1949 issue of *Engineering and Science* described the early work in High Volts as "the first laboratory in the country to have a reliable 1,000,000 volt power frequency, provided by a chain system of transformers designed by Prof. Sorensen [who had been hired in 1909 as the school's first instructor in electrical engineering] . . . These facilities have been used to aid Southern California Edison in the development of high-voltage transmission lines [enabling them to bring power to Southern California from the Hoover Dam], to furnish lightning protection of oil storage tanks for the oil industry, to test insulators for numerous utility companies."

The final cost of the building was $139,915. Southern California Edison provided $105,000 and the Institute paid the balance. Alternately called the Edison High Tension Laboratory and the High Voltage Research Laboratory, it became known affectionately as "High Volts."

In a letter to Goodhue dated February 10, 1922, Millikan made sure that the interior space would be suitable for the high-powered work planned for it. "There must be a minimum clearance of 47 feet between the floor and the roof truss in order that the high potential discharge may not pass to the building; this means about 56 feet from the top of the building to the floor. An inside width of 58 feet will give the required clearance for a million volts." The letter went on to explain the

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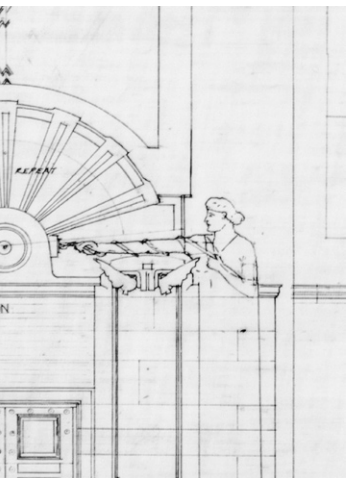
need for ventilation to allow ozone gas to escape but at the same time it must be light-tight. The final size of the building was 50 feet high, 60 feet wide, and 100 feet long. The construction consisted of a steel frame set on 9-foot-wide footings to offset the absence of floors. The frame, designed by the Edison engineers, was only the second one made of steel to be used in Pasadena.



To offset the plain industrial interior, Goodhue designed a decorative exterior. He covered the walls in a diamond-shaped diaper pattern to detract from the absence of windows, and lightened the visual weight of the piers with overlapping lambrequins. A sculpture over the entry door of two men holding a cable to create an arc of electricity symbolized the purpose of the building.

After the completion of High Volts and Bridge laboratories, arcades were built to connect the buildings and form the southern edge of the central courtyard. The arcades terminated in a wall with a tiled fountain outside the Bridge Annex building. At the northern end of the court between High Volts and East Bridge, another small fountain with a bronze background was set into the wall below the arcades. Both of these fountains have since been removed. □

Below: The spigot of a small fountain that once stood in front of the arcade wall between East Bridge and High Volts.