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# A REVIEW OF THE RED SANDSTONE TRIM ON SPOONER HALL; ITS POSSIBLE ORIGIN, MINERALOGY AND RECOMMENDATIONS FOR PRESERVATION

by

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The purpose of this memorandum is three fold: first, to review efforts to identify the source of the red sandstone trim on Spooner Hall, second, to present the results of optical and x-ray diffraction examinations of the stone, and three to recommend a method to increase the durability of the said stone by reducing its susceptibility to weathering.

Spooner Hall was constructed of local Oread Limestone and a red sandstone trim stone of unknown origin in 1893-1894. The building was made possible by a donation of $91,000 from the estate of William Spooner, uncle of then Chancellor Snow. The building was designed by Henry Van Brunt, who became a well-known architect of his time and designed several buildings in Kansas City. In Lawrence, Van Brunt also designed the old Union Pacific Depot in north Lawrence. Personnel at Western Manuscript (Holcomb Hall on the campus of U.M.K.C.) found no reference to Spooner Hall in Van Brunt's papers but said information on the early Van Brunt years (1890's) was quite limited.

The 1887 compilation of building stones in the U.S. Natural Museum Collection by George Merrill mentioned 19 states that had submitted red sandstones. However, many of these states did not extensively quarry such stone; it was used on local buildings. A review of several books devoted to dimension stones used through the early 20th century revealed no reference to Spooner Hall. Merrill's book (1910 edition) titled Stones for Building and Decoration also reviewed states producing sandstone. Among the areas producing reddish colored stone were the Triassic age beds in the eastern states, the Lake Superior area and Colorado. Regarding the latter state, red sandstone from one quarry was being shipped to Chicago while another quarry produced a stone that "was much in demand as a trim stone." Merrill also mentions two other sources of red sandstone from Colorado.

One reference refers to Dakota sandstone as the source of the red sandstone. As for a Kansas source, Dakota Formation sandstone is commonly buff and depending on the iron content, often weathers to a brown color. Older buildings at Wilson, Kansas are good examples. Some Dakota beds are red but are usually soft or upon occasion, very hard, thus making them unsuitable for building purposes. There are also some sandy-natured Permian red beds which could have been mistakenly identified as Dakota in south central Kansas that were sparsely used for a few local buildings. On the whole, Kansas has a shortage of red sandstone sources suitable for dimension stone, and there are no historical references to such stone being quarried to any extent. In fact, the 1897 University Geological Survey of Kansas volume states that Dakota stone was seldom used for buildings. Considering the date and source of this publication, Spooner Hall would surely have been mentioned, had Dakota sandstone from Kansas been used for its construction. Thus, Kansas does not appear to be a likely source for the Spooner stone. In addition, I have never seen stone from Kansas that resembles the Spooner Hall stone.

Another possibility seemed to be Dakota (Territory) sandstone. While some red sandstone does occur, it was not quarried to any extent in the 1890's. Only quartzite was used during this period. Furthermore, later references indicate the red sandstone from this area weathered to a brown color. Thus, the Dakotas do not seem a likely source.

If the term Dakota is meaningful, it would eliminate the Triassic Age redbeds of the eastern United States. At the time of Spooner's construction, many of these were actually brownstones. Of the actual red sandstones quarried, some were relatively coarse grained and contained significant amounts of feldspar. In addition, there would be large transportation costs to ship stone from this area. Henry Van Brunt, architect for Spooner Hall, was undoubtedly familiar with these stones since he had studied in Boston. However, the fashionable stones in Boston at that time were mostly brownstones and they often showed rapid deterioration so Van Brunt may well have had misgivings about using these eastern sandstones.

The area around Lake Superior (Minnesota, Michigan and Wisconsin) was known to contain several red and red-brown sandstone quarries and would seem to be a possible source for Spooner Hall.

Circumstantial evidence favors the source to be from Colorado. Certainly rail transportation existed at that time from the Denver area. Sandy Weichert recalled that Katy Armitage had found mention to a sandstone shipment from Colorado. Katy kindly sent me a copy of the 1990 Journal World reference

(100 years ago column) to a load of red sandstone from Colorado being delivered to Lawrence in 1890 for the Union Pacific Depot. Since Van Brunt was architect for both the Depot and Spooner Hall and their construction was only a few years apart, it seems likely that Van Brunt would have "returned" to Colorado for his source. Whether the same quarry supplied the stone is open to question. Incidentally, there is a ridge of red sandstones west of Denver that is Dakota age sandstone. Finally, some of the Colorado red sandstone is described as fine-grained, mostly quartz with little feldspar, containing iron oxide with occasional small grains of magnetite. I examined early volumes of the Colorado Bureau of Mines but these volumes were dominated by metalliferous ores and stone quarries were merely mentioned as being present. There were no references to market areas or buildings in association with the quarries.

## EXAMINATION OF THE STONE

Samples of stone that had fallen from Spooner Hall were examined under a reflected light microscope. The samples are dominantly quartz. The individual grains are relatively fine and of a relatively uniform particle size. Seldom do the grains appear colorless; nearly all grains possess a red color coating from the iron oxide mineralization. Occasional grains of black particles are observed and some possess an iridescent nature and are more or less rounded. Thin sections were fabricated from these samples and examined under a polarized light microscope. Almost all grains are quartz and feldspar is seldom observed. The iron mineralization varies in color but occasionally has the blood red color typical of hematite. Typical carbonates appear to be absent, thus, bonding of the grains is primarily by iron oxide mineral(s) and interlocking grains.

Samples were also examined by x-ray diffraction using -200 mesh powder. As expected, the patterns were dominantly quartz with only a trace of feldspar and kaolinite clay. No positive identification could be made for any iron minerals that are present. No carbonates were found. A sample pattern is attached.

In summary, the stone appears to match the description given in the early literature for the red, Colorado sandstones but this does not eliminate another source such as the Lake Superior area.

## RECOMMENDATIONS

The deterioration of the red sandstone columns and trim is significant and obviously needs treatment to retard the constant "sanding" and spalling effect whereby grains or chips are loosened by natural weathering phenomena, notably freeze-thaw cycling with possible contributions from heating and cooling and wetting and drying. With regard to the latter, deicing salts absorbed by the stone are generally damaging since during dry cycles the salts crystallize with accompanying volume changes and in the case of anhydrous salts may also undergo rehydration in moist periods with volume changes. In general, deicing salts should not be used since they contribute to the deterioration of any stone containing porosity. If it is determined that sizeable amounts of salts are present, poulticing and washing may be necessary to remove most of these salts prior to treatment.

Water-proofing is certainly one approach to reduce the effects of moisture related weathering. However, in the case of Spooner Hall, I recommend a stone strengthener be used before waterproofing to cement the grains of the stone together.

The primary requirements of such a strengthener is that it (1) be able to penetrate the stone adequately so the complete zone of weathering is treated, (2) cement the grains of the stone together thereby strengthening the stone and making it more durable with respect to moisture effects, (3) allow the stone to breathe so that water vapor can escape--in other words, it should <u>not</u> seal the stone's pore system, and (4) it should not produce any appreciable color change.

Many chemical treatments attempted on buildings in the past may have done more harm than good. While the stone grains on the surface may be cemented, little penetration may occur and thus, the subsurface zone of weathering is untreated. Many treatments fail requirement 3 and by sealing the pore system, the stone is unable to rid itself of moisture, which can become substantial and exert pressure. The situation is much worse during a hard freeze when this substantial moisture can freeze and produce large volume increases that exert pressures sufficient to disrupt the bonding in the stone. Also, sealing the surface in some cases has allowed the buildup of salts just below the surface that may also exert pressure during crystallization.

Some chemical treatments are actually colloidal suspensions, for example, aqueous "solutions" of alkali silicates. These agents are not likely to penetrate as deeply as would a strengthening agent that is completely dissolved. Also, colloidal suspensions are more likely to lighten the color of the stone (due to a high concentration of the colloidal particles near the surface) than using an agent that is completely dissolved and that also penetrates the stone deeply. Another possible problem with aqueous solutions is that they may not have a neutral pH value and could react with minerals of the stone and lead to discoloration.

The only stone strengthening agent I would recommend is sold by Process Solvents Co. in Kansas City, Kansas. It is based on silicic ethyl ester or ethyl silicate that is completely dissolved in a lightweight hydrocarbon, methyl ethyl ketone. The low viscosity and low molecular weights involved with this solution allow deep penetration of the stone. It also has a neutral pH and thus will not react with the iron oxide and produce discoloration of the stone. Once inside the stone, the silicate slowly reacts with moisture in the stone to produce a silica cement that binds the grains of the stone together. Based on my past laboratory experience testing different types of stones from historically important structures, this strengthener known as Conservare OH gives exceptional results with porous sandstones. After treatment it does allow the stone to breathe, produces large strength increases, and produces no significant color changes. To my knowledge, this is the best stone strengthening agent on the market that meets all the criteria for a good strengthening agent and Process Solvents (ProSoCo) is the only company in the United States that handles this product.

At the present time, I have two grants from the U.S. Army Corps of Engineers aimed at preserving some American Indian rock carvings at sites in Ellsworth County and I am using the Conservare OH product to achieve this goal. The laboratory results have exceeded my expectations with large strength increases, no discoloration of the stone, good depth of penetration and the stone still breathes after several treatments.

I strongly recommend you contact David Boyer or Fran Gale at ProSoCo, Inc., P.O. Box 171677, in Kansas City, Kansas 66117. Their phone number is 913-281-2700. They have a well-designed stone testing program, technical expertise and, in my opinion, the best stone strengthening product on the market. In addition, they have a line of waterproofing agents that are also based on organosilicate compounds. One (Conservare H) is a mixture of strengthener and waterproofing agents that might be applied after the Conservare OH treatment(s). Their stone testing program allows them to recommend the proper application rate and number of applications necessary to achieve maximum results.

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In addition to the above references, telephone conversations and/or correspondence over a period of years include the late Al Hornbaker and Steve Schowochow, Mineral Resources Section and John Rold, State Geologist, all of the Colorado Geological Survey, Katie Armitage of the Historic Mount Oread Fund, David Boutros, Betty Swiontek and Denise Morrison of the Western Historical Manuscripts Collection (Newcomb Hall, University of Missouri at Kansas City), personnel from the Clark and Harper County Historical Societies, and Robert Schoon, geologist at the South Dakota Geological Survey.