Status Report to the Runestone Museum on Efforts to Find a Solution to the Removal of the Silicon Rubber Black Residue on the Kensington Rune Stone

By Richard Nielsen, Dr. of Technology
June 1, 2010

Executive Summary
The history of the discovery in October 2003 in Stockholm, Sweden of staining of the Kensington Rune Stone KRS by silicon rubber in the spring of 2003 in this report is discussed. This history includes a number of pre-staining and post staining comparisons of photographs from the KRS.

The current progress of the investigation into the stain removal since the report by Weiblen (2008) is discussed. It is strongly recommended that the Runestone Museum (RSM) seek professional curator support from the Minnesota History Center (MHC) or similar organization for future efforts to clean the KRS of its dark coating.

In Appendix A are recommendations for pursuing additional avenues of research concerning the results obtained from 3–D Imaging.

The definitive results from 3D imaging will be reported after Prof. Henrik Williams and Dr. Richard Nielsen are finished with the inspection of the KRS this coming September at the Runestone Museum.

Discovery in Sweden of the Staining of the KRS with Silicon Rubber.
In October 2003, Richard Nielsen inspected the KRS after it was delivered to The Swedish Historical Museum for display. He had just accompanied the KRS on its SAS flight to Stockholm from Chicago.
Fig. 1: The KRS arrives at the Swedish Historical Museum (SHM) in Stockholm in late October 2003. Richard Nielsen is standing to the upper right with three representatives of the SHM, among them Ola Olsson in the bottom left. The blacked condition of the KRS due to silicon rubber residue from the mold is sadly all too obvious.

It was Stockholm that the silicon rubber staining on the KRS was first discovered by Nielsen. The KRS was inspected by Nielsen in early March
2003 at a Ft. Snelling meeting and there was no silicon rubber staining to be seen on the KRS at that time.

Fig. 2: Silicon Rubber Blacked KRS on Lines 2-5 of the KRS in Wolter (2004a).

Löfvendahl et al (2004), in his report of August 2004 to the RSM remarked on the color change to the KRS seen for example in Fig. 2 was a major issue:

... Copies were constructed by the Smithsonian Institute in the 1940s, by B. Wallace in 1965 and in silicon by the Runestone Museum in 2002. According to Wolter some of the colour contrast of the runes was weakened after the latest process. The brightness of the bottom of the runes is a major issue in the discussion of the KRS.
The appearance of the KRS did not match the photographs that had been previously sent to the sponsors of the exhibit as seen in the comparison shown in Fig. 4. These had already been used to produce items for the display but now it was quite obvious to the SHM staff that the KRS had a significantly altered appearance. Hence, the RSM geological research lost credibility over this acute staining issue.

The dark staining is obvious in photographs in Fig. 4 below from reports in Wolter (2003: October 7, 9, 13 and 18) and Wolter (2004: April 1), when compared to photographs in Wolter (2001: Fig. 1).
Fig 4. : Photographs with post straining in Wolter (2003: Fig. 5) to the left and pre-staining condition in Wolter (2001: Fig. 1) to the right. The staining of the KRS was not reported by either Wolter (2003) or Wolter (2004a & B) or in Nielsen/Wolter (2006) where in the later black and white photos in the geology section effectively hid the staining.

Board Meeting of November 28, 2006.
In November 2006 Al Lieffort, a RSM board member, invited Darwin Ohman and Nielsen to a board meeting at the RSM on 28 November 2006.

We learned that the Museum Board was not aware of the staining of the KRS. We inspected the KRS relative to the earlier photographs of the KRS and the dark staining was obvious to all the members of the RSM board present.

In the fall of 2007, a meeting was convened by a group of individuals (now recognized consultants to the RSM) in Roseville, MN to discuss two primary
issues that impacted future research efforts regarding the KRS:

- The staining of the KRS and what may be done about it.
- The return of the research materials including the core sample and thin sections on the KRS that Scott Wolter, American Petrographics was refusing to return in spite of requests to do so.

As a result, Weiblen and Nielsen visited the Metropolitan Museum of Art in New York in end of March of 2008 in an attempt to find a solution to the staining.

**Prior Report**
Weiblen (2008) reported on the initial examination of the staining of the KRS. Excerpts in Appendix B are from Paul Weiblen’s “Report to the Board of the Runestone Museum on “My Involvement in Studies of the Kensington Runestone”, University of Minnesota, June 26, 2008. Investigation continued under the direction of Weiblen until the fall of 2009.

**New Report Requested**
In October 2009, the RSM requested that Nielsen and Weiblen provide a current report on the removal possibilities for silicon rubber stains on the KRS

----- Original Message -----
From: Runestone Museum
To: Richard Nielsen ; Paul Weiblen
Sent: Tuesday, October 13, 2009 2:38 PM

**Subject: Staining of the Runestone**
Dear Dick and Paul -
The museum is concerned that the Runestone is getting darker. Dick, you may have noticed this on your last visit. The museum was under the impression that you may have found a way to restore the stone to its condition before the mold was taken. Is the museum correct in this assumption? If so, is there an update you could give us in regard to your progress in this area? Any information would be encouraging.

Thank you -Julie
Results Obtained After the Report of Weiblen (2008)

This report is written to summarize the concluding efforts following those reported in Weiblen (2008), which was concluded in the fall of 2009. It is meant to set the stage to obtain expert advice from museums with experience in cleaning silicon rubber from porous material.

Ancillary to this work should be an effort to examine methods to extract mud believed to be present in some of the KRS punch marks and grooves. This mud extraction would help document the actual KRS word forms and possibly provide material for Carbon 14 dating in spite of numerous past cleaning efforts on the KRS. This work scope is described in Appendix A.

The Test Piece History

Weiblen obtained the greywacke cobble shown in Fig. 5 from Mr. Terrence Boerboom, staff scientist with the Minnesota Geological Survey. The cobble was found in glacial drift at an unspecified location in northeastern Minnesota. It is typical of rounded cobbles and boulders of greywacke from the Omarolluk Formation which is exposed on the Belcher Islands in Hudson Bay. The cobbles, referred to as “Omars” commonly have rounded pits that formed when calcareous concretions weathered out of the greywacke. The cobble shown in Fig. 1 is finer-grained than the KRS and the weathered patina appears smoother than that on the KRS. One might suspect that the weathered patina on the Omar might be less susceptible to staining than the KRS. This turned not to be the case.

The GL 1000 resin was allowed to set up overnight on the test piece. Following the suggestion of Ron Street of the Metropolitan Museum, Weiblen washed and brushed the Omar with acetone, at room temperature and warmed. There was no visible change in the color of the coating or the acetone.

Other tests were made. Samples of the test greywacke with the black coating (PW believes this is a better term than residue) from G 1000 silicon rubber were placed in solutions of 1 normal and 10 normal hydrochloric acid, dilute (concentration not determined) sulfuric acid, methanol, ethyl
alcohol, acetone at room temperature for periods up to overnight with no discernable visual effect.

Because the temperatures and time periods were not systematic, the possibility remains that a more systematic study might demonstrate that any of the solutions might be a feasible solvent.

Some commercial paint strippers seem to partially reduce the darkening appearance of the KRS, but do not restore the weathered surface to its original visual appearance. Fig. 5 illustrates some of these results.

It occurred to Weiblen that it might be interesting to see what effect ordinary paint stripper might have. Left over night and washed with warm water the color of the coating was considerably reduced. Ohman suggested testing a special paint stripper, Klean Strip. As can be seen in Fig. 5 this lightened the coating somewhat but results were nowhere near to restoring the original patina color and texture of the KRS when compared the unstained plug.

Comments
In view of the above tests one can come to these conclusions:

• Although the use of commercial paint strippers appears to have some promise in minimizing the visual effect of the black silicon resin coating on the test greywacke samples, there are many questions (long term effect, interference with X-ray diffraction, etc) that must be addressed before it can be taken seriously as an appropriate method for removing a black silicon resin coating on a greywacke.

• The silicon rubber residue could render difficult any future weathering studies. The ingress of this black coating into the porous weathering rind may prevent instruments from detecting the small changes of mineral percentage that are needed to observe weathering rates.
Fig. 5: The Omar Cobble Test Piece for staining Studies on the KRS.

Note: On Sep 24, 2009, at 4:57 PM, Jim Adam [Board member] wrote to the RSM: “Julie … Remember, Darwin [Ohman] has been working with Paul Weiblen and they have discovered a method to remove the tainted surface from the KRS without damage to the stone itself … the process should improve the presentation by restoring the stones appearance to closer to its original hue. …. Jim.”
Recommendations
As a starting point it is believed essential that the RSM seek professional help from the MHC or other such credible organizations to assist in the stain removable. Some grants are certainly available for restoration of Minnesota artifacts. Appendix A describes additional research possibilities for the KRS when under a professional museum curator control.

References
Weiblen, Paul W., 2001, Report on a Partial Mineralogical Characterization of the Kensington Rune Stone, pp. 45 and three appendices, unpublished report to the Kensington Runestone Museum, but


Appendix A
Suggested Additional Scope of Work When Investigating the Staining of the KRS.

The following figures document the results of Three-D imaging and provide a guide for future examination to establish the actual runic evidence on the KRS. This evidence might help to determine the age of the inscription. The Steward photograph of 1899 (see Fig, A1) is vital to help determine the initial condition of the runes, since the Three-D imaging can only document the present condition.

Steward Photograph of 1899 and the Larsson Rune-Row

Fig A1- The first 7 lines of the KRS from the Steward Photograph of 1899. Blegen (1968: 44)
The KRS þ–rune in þagh (day) on the 6th line appears to have a dot in the loop for denoting eth (dh).

The KRS ā–rune has but one dot in āptir (after) on the 6th line. The dot to the right is to mark the end of the hook.

Fig.A2: The Larsson Rune-row II of Edward Larsson 1885 and two apparent variations on the KRS to be confirmed. There are other variations as well, but done as conclusive as these two if proven correct. Prof. Willams and Dr. Nielsen hope to examine the KRS for these features in September 2010 on the occasion of a planned visit to the RSM.
Investigation of Mud in Punches and Grooves for Carbon 14 Datable Material; Microbes, lichen, and the like.

There is now no basis that the KRS was buried initially, as postulated in Nielsen and Wolter (2006: 234) in their book, *The Kensington Runestone-Compelling New Evidence*. This theory no longer has a basis with current known facts. The authors were remiss in not researching evidence of a standing KRS that already existed from photographs published in 1956. These show a ground line on the KRS, clearly indicating that the KRS was placed in the ground in an upright position. Inspection of the KRS in 2006 by a Swedish runic expert also dedicates that the KRS rocked in the wind against rocks placed at its base to support its standing position. He indicated this practice is also found in Sweden.

![KRS Ground line. Holand (1956: 133. Fig. 8).](image)

The clear ground line on the early KRS photographs in Holand (1956: 133. Fig. 8) in his book, *Explorations in America before Columbus*. Wahlgren (1986:98) also has a
photograph showing this clear ground line in his book, *The Vikings and America*. These photographs show that the KRS must have been upright for some time. This means there might have been time for lichen to grow within the rune grooves and punches. When the KRS finally fell on its face the mud seems to have encapsulated both grooves and punches. The time of this event might be dateable by carbon 14 methods if the mud as protected the material from subsequent application of ether, oil, and silicon rubber during the two molding operations (1930s and 2003) and cleaning for the Smithsonian exhibit in circa 1948 and the World Fair held at Flushing Meadows, New York in 1962.

These Holland and Wahlgren photographs in Figure A3 and A4 are also reproduced in Nielsen’s (2009) article on *Theories on the Hooked X Presented in Epigraphic Society Occasional Papers* Vol. 26 in Epigraphic Society Occasional Papers Vol. 27, pp. 124-5.
**Documentation of Mud Filled Punches and Grooves on the KRS.**

Each candidate punch on grooves on the KRS, thought to contain mud, must be photographed and then examined for mud. Its removal then can be approved and documented. These features may have the capacity to demonstrate the date of the mud if Carbon 14 dateable material can be extracted.

**Single dotted A-runes**

With the discovery of a single dotted ā-rune all a-runes were inspected for signs of dots that may have been missed. Typical candidates in this category are shown in Figs. A5-A6.

Fig. A5: The single dotted ā-rune starting the last word on line 6 of the KRS, which is äptir (after), a medieval manuscript practice.
Fig. A5: The single dotted ä-rune starting the last word on line 6 of the KRS, which is a word for “after”, a medieval manuscript practice.

A single dotted a-runes for ä was a Dalecarlian runic practice until at least 1650. Was it known in 1898 in Minnesota is the question? See Nielsen (2009: 111-126),

Fig. A6: Photograph of the mud filled hook shown in Fig. A5 (Photo by Jeff Roste for Nielsen (2008). A single dotted a-rune of any type was unknown in 1898, but they appear in Dalarna, Sweden from 1600-1650. It shows the KRS runes are older versions than those on the Larsson Rune-Row.
Fig. A6. Photograph of the mud filled hook shown in Fig. B1 (Photo by Jeff Roste for Nielsen (2008). A single dotted a-rune of any type was unknown in 1898 but they appear in Dalecarlia, Sweden from 1600-1650. It shows the KRS runes are older than those on the Larsson Rune-Row.

This mud feature may be quite significant, since at the present time geologists connected to the Minnesota Geological Survey confirm that the instruments available for detection of minerals are not accurate enough to detect small amounts of any mineral; hence their complete removal by weathering can never be fully determined due to their weak signals masked by minerals of higher proportion. Hence carbon 14 dating may be the last chance to date the KRS by present scientific means.
• Medieval Runic Traits on the KRS?
Certain punches (dots) on the KRS may also demonstrate medieval age in certain runes if their use cannot have been known in 1898 in books or other means, such as the Larsson rune-row. Their current state on the KRS must be carefully documented. These candidates have been detected by 3D imaging since a fully filled punch is detected with its features that are similar to a mud filled pothole in the road; this being its texture, its concave dimple effect, and its change in volume when wet or dry. If mud is present, the safe removal of the mud can perhaps be effected by either water jetting or with safe mild solvents or by other means known to the MHC or other professional curators.

Some dozen candidate punches have been identified and these will be inspected by Williams and Nielsen in September 2010 at the Runestone Museum to determine if they are either intended punches or natural features of the KRS. A full report on punch features of the KRS will then be prepared for the KRS.

Appendix B:
History of Staining of the KRS by Prof. Paul Weiblen (July 2008)

Quoting Weiblen (2008), "My next involvement with the KRS was after I saw the black coating on the stone during a visit to the Runestone Museum in the spring of 2007. Subsequent discussions with Dick Nielsen and Darwin Ohman initiated an effort to determine the origin and nature of the black coating and development of a plan to restore the surface, if possible. The progress to date in our joint effort is described below.

In mid January 2008, Dick Nielsen and I visited Bob Johnson who made the mold of the KRS in his home at, 1000 West Broadway, Minneapolis, MN. He told us he used the two-part silicone based rubber GI 1000 to make the mold without using any surface sealant. Bob Johnson confirmed that he was
commissioned and paid to make a mold of the KRS by Scott Wolter in early 2003. He stated that he was furnished no protocol or test requirements. He further stated that he had made many molds for Scott Wolter of marine fossils but that he had no experience in making molds of stones. He stated that the subsequent casts of the KRS were commissioned with Ray Brooks of S. P. Fabrication & Decorating Co. 1750 Thomas Ave. St. Paul. (Note: The plug takes on increased significance since it is the only record of the condition of the KRS surface before it was damaged by the molding process (see note at the end of this report).

In a GOOGLE search for “Getty Museum mold residues” I found that conservators at the Getty Museum in California have been aware of the problem of staining during the molding process, for some time (Silicone Rubber Staining of Terracotta Surfaces by Jeffrey P. Maish, Studies in Conservation, Vol. 39, No. 4 (Nov., 1994), pp. 250-256 and A Case Study in the Use of Cyclododecane and Latex Rubber in Molding of Marble, Jeffrey Maish & Erik Kisser, Journal of the American Institute of Conservation, Vol. 41 No. 2, Article 3, pp. 127-137). The latter article states on p. 128 … In mold making, conservators have long been aware of the possibility of transferring mold-associated materials to the surfaces of art objects. The use of a protective barrier in itself presents challenges in that this material must be subsequently removed and in instances may interfere with the molding itself…

With this information Darwin Ohman located a supplier of the GI-1000 (Silicones, Inc, P.O.Box 363 – 211 Woodbine, High Point, North Carolina 27261, tel: 336-886-5018). We decided to make a mold of a hand-sized glacial boulder of greywacke with a gray, weathered surface similar to the KRS. When we peeled off the mold we found the rock had a black coating similar to that presently on the KRS. Some silicone rubber resins contain sulfur. Because sulfur can react with iron to form iron sulfide I decided to check the black coating on our test sample for iron sulfide. With the assistance of Darwin Ohman, I examined the black residue on our greywacke sample in the scanning electron microscope with energy dispersive x-ray analysis. We found no indication of sulfur and no iron above the concentration in the untreated greywacke.
During this time I discussed the residue problem with Tony Franz, a senior scientist in the Science Department of the Metropolitan Museum of Art in New York City. Our discussion led to an invitation from Tony Franz to visit his department and review problems with removing residues from museum objects with experts in his department. Tony Franz’s invitation eventually included an invitation for Dick Nielsen to present a talk on the KRS to the museum staff, discuss the residue problem, and explore possible collaborative relationships of the Metropolitan with the Runestone Museum in Alexandria.

Dick Nielsen and I visited The Metropolitan Museum of Art, New York City, NY on March 31 – April 1, 2008. Dick gave an excellent succinct, well-received lecture on the history of the KRS and the present status of his linguistic and runic studies to a dozen or so of The Metropolitan staff. Tony Franz asked whether the weathered surface on the spalled area on the upper left of the KRS might be compared with the rest of the surface to determine if the spalling might have occurred during the carving of the runes – thus revealing a possible time interval between the overall weathering and the weathering since the runes were incised. Others raised the question of archeological excavations at the KRS site.

I met a post-doctoral intern who is working on weathering patina on rock objects from South America for the Science Department at The Metropolitan. His internship will be over in a year and then he will be looking for other research projects. (Is research on the now-stained, weathered KRS a possibility?)

Dick Nielsen and I visited with Mr. Ron Street, who is in charge of the Science Department’s molding laboratory. When I showed him our stained greywacke sample his response was, “Hmm – that is what I found when I tried the silicone based rubber resins when they first came out! Fortunately I was able to remove the stain from a terra cotta piece with acetone while the stain was still wet.” He had no suggestions for removing a dried stain other than to try acetone. (I tried leaving a chip of our sample in acetone for several days with no visible effect.)."

...
Future Research
Further quoting Weiblen (2008), “Dick Nielsen, Darwin Ohman, and I are agreed that the effort to restore the surface of the KRS must be proceeded by a complete exploration of solutions on rocks similar to the KRS before any technique is tried on the KRS itself. This research must involve seeking the advice and experience of experts from major museums. In the meantime the KRS is best left in its unfortunate state.

I am of the same mind as Winchell who concluded that study of physical aspects of the KRS will probably not contribute much to establishing the authenticity of the runes. That is not to say that the ever-increasing sophistication of modern analytical techniques might someday definitively establish the time and manner in which the runes were carved, but from my experience and perspective that time is not now and may never be reached. This hinges on the fact that the rock weathering process involves such a wide variety of parameters that experimental data on rates of weathering from experiments cannot readily constrain interpretations of natural weathering processes.

For those interested in the physical aspects of the KRS, I would suggest, for what it is worth, that preservation of this very unique archeological object should be their primary concern, especially in view of the progress and discoveries that Dick Nielsen has made on the runes. Of course, preservation, though paramount, should not impede continued serious, professional linguistic or archeological studies.

Note on the importance of the cored plug from the back side of the KRS for future research.
As noted above in the fifth paragraph on page 2, the weathered surface on the cored plug is now the only surface area of the KRS that has not been contaminated by the recent molding process. The unstained cored plug is invaluable because future techniques might become available that would make it possible to resolve time differences between the weathered patina in the runes compared to the patina on the rest of the KRS (older) surface. For this reason it is crucial that there be in place a protocol for research on the cored plug and a documented chain of custody."