Preprint of letter by Garman Harbottle, *Radiocarbon*, **48**:123-6 (2006).
Harbottle (private communication) has noted that the 1954 date given for the Russian “Tsar-bomba” is incorrect, but that this does not affect his argument at all.

LETTER TO THE EDITOR

Dear Sirs,

I have recently become aware of the interesting letter of Ambers and Bowman (2002) commenting on our discovery of a "substance" associated with the parchment of the Vinland Map (Donahue et al. 2002) during our carbon-dating procedures. They note, as we did, that the substance was labeled with carbon containing post-bomb C-14. Since they discuss the "forgery" hypothesis they also focus on the means by which old parchment might best be prepared for the fraudulent creation of a Vinland Map; for example one could start with a genuine, but old document and then remove "any existing markings, probably by abrasion". In other words, create the Vinland Map on a palimpsest (Burleigh and Baynes-Cope 1983). It is worth noting, however, that several authors have made statements, summarized by Seaver (2004:361): "None of the various scientific investigators have found indications of a palimpsest on the map parchment, so it is probably safe to assume that removal of earlier ink was not necessary."

Ambers and Bowman were the first authors, to my knowledge, to point out that our discovery might have some new significance in that while "dating of the parchment itself does not necessarily have any direct relevance to the question of the authenticity of the map drawn on it" our paper "has, however, brought something additional to the debate: there is a large amount of modern material on, or in, the parchment. The identification of this material would be of great interest, but would not necessarily resolve the debate over the authenticity of the map". I shall suggest a reason why the identity of the material is of *very* great interest, below.

Of course they are right about relevance; each bit of new knowledge "proves" nothing of and by itself. There can be no "magic bullet" for proving authenticity but we have also seen magic bullets which were widely accepted as "proving" forgery, that only proved to be untrustworthy. One can recall: (1) a heavy percentage of anatase (titanium dioxide) crystals of a size and shape that could only have been made after 1917 or 1920 or maybe 1923 in the ink and (2) an outline of Greenland that could only have been known in modern times (McCrone 1988, McCrone and McCrone 1974, Washburn 1971). Both of these "proofs" of forgery have been discredited by subsequent research (Cahill et al. 1987, Painter 1995, Olin 2003, Weaver 1976). We discussed the possible relevance of our radiocarbon date of 1434 ±11 AD to the authenticity question in our paper (Donahue et al., 2002, pp. 50-51): we can summarize it by saying that it seems highly unlikely that a forger would get a parchment of *exactly* the right radiocarbon date, i.e. agreeing with all the other evidence for authenticity, not knowing what that date was going to be when the

forgery was executed, and probably unaware of the then far-in-the-future capability of C14 dating.

The purpose of this letter is to expand on what the presence of the bomb-labeled material, comprising about 30% of our parchment sampling, implies for the history of the Vinland Map. I believe it is a substantial piece of new information, with several important implications. I also believe that the search for "magic bullets" will prove fruitless and the final acceptance or rejection of authenticity for the Vinland Map will be decided by old-fashioned, hard-slogging research, whether in the library or the laboratory, and not by pundits, TV programs and quick-science magazine articles. I concur with Dana B. Durand at the Washburn Conference in 1966 (Washburn 1971:55) "In my opinion the map is authentic; it is obviously of tremendous importance.... I do not think that you can prove or disprove it by scraping a little ink off of it."

Many observers and students of the Vinland Map have commented on its present odd appearance, usually characterized as "washed-out". Baynes-Cope (1974:209) says on the basis of his 1967 examination of the map that "The drawing is very faded, and the parchment has a 'washed-out' appearance, suggesting that it may have been chemically treated in some way" and "It was ..clear that it had received treatment, almost certainly of a rather drastic nature".. Seaver (2004:171) recounts the testimony of several experts, for example D.B. Quinn, who was "troubled ... by the indications of an attempted cleaning, which might well be responsible for the washed-out appearance of the map's parchment". She concludes (Seaver 2004:169) "the map's parchment ... clearly underwent fairly traumatic treatment at one point". Painter (1995:xvi) says: "During this turn-of-the-century rebinding the map was washed and cleaned from almost five centuries of soiling". Other observers mention the odd, atypical fluorescence of the map under ultraviolet excitation (Baynes-Cope 1974), and I believe that Ambers and Bowman are right on the mark to explain this "by the presence of organic materials on the surface of the parchment". They cogently add: "It could, of course, be equally argued that the presence of a large quantity of modern material might be the result of rather clumsy conservation treatment applied at the time of the first discovery of the piece..."

If, as seems very likely, the map *was* washed and treated, an obvious corollary that has escaped most commentators and students, is that observers have actually been studying the map in its laundered, treated, and thus necessarily much-altered state, and of course basing their conclusions on their examination of the map *in that state*. This is particularly important to high-tech laboratory examinations: for example one could ask, "of what value were McCrone's micron-sized particle identifications and anatase size distributions when a tsunami of prior conservation treatment had already washed over the document and its ink?"

The labeling of the "substance" by bomb C14 gives us a handle on the date of this cleaning and/or conservation that involved the treatment of the map with something that may have been used as a fixative to make the map's flaking ink adhere more firmly. Ambers and Bowman suggest a number of substances, including cellulose nitrate and Margaret Lawson, a parchment/paper conservator at the Metropolitan Museum of Art

recently made the same suggestion (Lawson 2005), referring me to the classic textbook of Plenderleith and Werner (1971). Cellulose nitrate or acetate would indeed possess the observed properties: they would contain atmospheric carbon 14 introduced through the cellulose component, would persist through ~50 years on a parchment lying open to the air, are very soluble in acetone and were used with medieval parchment during this period (1950's). I shall say more about some unpleasant implications that this "treatment" would have, below.

When did it happen? The lower limit to the date is of course the start of thermonuclear testing in 1952, because only after that date does excess C14 begin to appear, and atmospheric "fractions of modern" begin slowly to rise above 1.00 (Oxford). Actually, the rise in C14 due to the bomb tests does not become pronounced enough to explain the level in the parchment until the Russian Novaya Zemlya "Tsar-bomba" 50 megaton shot in 1954, after which time it begins to rise more rapidly (Baxter et al. 1969,CALIBOMB). On the other hand, the date of the treatment *cannot have been later* than 1957, because after that date the Vinland Map goes to Yale, and we understand from their records in the Beinicke catalog entry for the map, 350A (Shailor 1987), that no such conservation occurred there. Thus for the possible date of "treatment" we are crowded into a narrow date range of only 3 or 4 years immediately preceding the map's arrival in New Haven. It would seem that during most of this period, the Vinland Map-Tartar Relation volume was in the hands of Ferrajoli (Seaver 2004). If the "conservation treatment" was, as Ambers and Bowman suggest it might have been, "clumsy", it is hard to imagine it being inflicted on the Vinland Map by an experienced antique book dealer like Rauch or Davis (Witten). Besides, the map wasn't theirs to bleach; only Ferrajoli can have been responsible, in my opinion.

Can we infer something about the probable treatment? Indeed we can. Plenderleith and Werner (1971) give us this strong hint, after describing how an application of sodium hypochlorite is used as a bleach to clean soiled manuscripts (just the sort of thing that a map-seller in the 1950's might do to make his difficult-to-sell wares more attractive to dealers and buyers): "During the bleaching process any iron-gall inks will disappear unless protected beforehand. This is done while the paper is still dry, by a local application of a solution of nitrocellulose 5% in a mixed solvent of equal volumes of acetone and amyl acetate. The nitrocellulose can be removed by a wash of acetone at the conclusion of operations". Use of a hypochlorite bleach step would surely account for the almost-universal observation that the map has a "bleached look", and our work (Donahue et al. 2002) confirms that the unknown substance is readily removed by acetone.

Considering the nature of the rebinding, which has been described as amateurish or "undistinguished" (Parker 1971:20), "not a very professional job" (Greenfield 1983) it is not difficult to imagine that the Ferrajoli restorers also failed to remove the nitrocellulose, or whatever it was that was used to protect the map during the bleach, at the end. Or perhaps they felt that it should be left in the better to secure the ink from flaking. The hypochlorite is washed out with pure water rinses, according to Plenderleith and Werner. The implication of our work for all this is that the dismantling, washing and rebinding

were all done sometime during 1952-1957 with a slight preference for 1954-1957, by someone other than a professional conservator or a first-line dealer in antique books. This was, of course, just when Ferrajoli was peddling the map around Europe. This date would also fit with several observers' estimation of a post World War II date for the physical binding (Parker, J. 1971, Baynes-Cope 1989, Greenfield 1983). Baynes-Cope notes: "the tail-band was formed ... on a bright pink mono filament... in a form which I remember appearing in the U.K. c.a. (sic) 1946-7".

Let me conclude this letter with a note of concern, directed to Yale's Beinicke Library. It is imperative from the conservation standpoint to identify what you have permeating your Vinland Map. If it indeed proves to be cellulose nitrate ("nitrocellulose" or "guncotton") then it is chemically unstable. The pure substance is, of course, a high explosive and while I am not sure that a 30% nitrocellulose - 70% parchment mix would actually detonate, I do feel pretty certain that it *would be highly inflammable*. Therefore I would respectfully suggest that, to be on the safe side, you allow no more laser probes of the Vinland Map as in the measurements of Brown and Clark (2002) until you can identify this unknown substance. A laser spot, though small, could raise the local temperature to the point where damage is readily observable, perhaps with accompanying photolytic reactions (De Jesus et al.2003), and after all these years it would be a pity to see the Vinland Map damaged in any way.

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REFERENCES

Ambers,J. and Bowman, S. 2002 Letter to the Editor: *Radiocarbon* **44**: 45-52.

Baxter, M.S., Ergin, Al. and Walton,A. 1969. Glasgow University Radiocarbon Measurements I *Radiocarbon* **11**(1) 43-52.

Baynes-Cope, A.D. 1974. The Scientific Examination of the Vinland Map at the Research Laboratory of the British Museum, *The Geographical Journal* **140**: 208-211.

Baynes-Cope 1989. Letter to Wilcomb Washburn dated October 28, 1989.

Brown, K.L., and Clark, R J.H. 2002. Analysis of Pigmentary Materials on the Vinland Map and Tartar Relation by Raman Microprobe Spectroscopy, *Analytical Chemistry* **74**: 3658-3661

Burleigh, R. and Baynes-Cope, A.D. 1983. Possibilities in the Dating of Writing Materials and Textiles, *Radiocarbon* **25**(2) 669-674.

Cahill, T.A., Schwab, R.N., Kusko, B.H., Eldred, R.A., Möller, G., Dutschke, D. and Wick, D.L. 1987. The Vinland Map, Revisited: New Compositional Evidence on its Inks and Parchment, *Analytical Chemistry* **59**: 829-833

CALIbomb n.d. See http://calib.qub.ac.uk/CALIBomb/frameset.html.

De Jesus, M.A., Giesfeldt, K.S., and Sepaniak, M.J. 2003. Use of a Sample Translation Technique to Minimize the Adverse Effects of Laser Irradiation in Surface Enhanced Raman Spectroscopy, *Applied Spectroscopy* **57:** 428-438.

Donahue, D.J., Olin, J.S. and Harbottle, G. 2002 Determination of the Radiocarbon Age of the Parchment of the Vinland Map," *Radiocarbon* **44**: 45-52.

Greenfield 1983. Letter to Jacqueline Olin from Jane Greenfield, letterhead "Yale University Library", dated June 8, 1983. Kindly made available to me by Dr. Olin.

Lawson, M. 2005. Private communication.

McCrone, W.C. 1988 The Vinland Map, *Analytical Chemistry* **60**: 1009-1018.

McCrone, W.C., and McCrone, L.B. 1974 The Vinland Map Ink, *The Geographical Journal* **140**: 212-214

Olin, J.S. 2003 Evidence that the Vinland Map Is Medieval," *Analytical Chemistry* **75** 645-647

Painter 1995 in Skelton et al., 1995 (VMTR95): xiv

Parker, J. 1971 in Washburn 1971 p.20

Plenderleith, H.J. and Werner, A.E.A.1971 Conservation of Antiquities and Works of Art, London, Oxford University Press.

Seaver, K.A. 2004. *Maps, Myths and Men: The Story of the Vinland Map* Stanford University Press.

Shailor, B.A. 1987. *Catalogue of Medieval and Renaissance Manuscripts in the Beinecke Rare Book and Manuscript Library, Yale University*, Vol. II: MSS 251-500. Medieval & Renaissance Texts & Studies, Binghamton, New York.

Skelton, R.A., Marston, T.E. and Painter, G.D. with Introduction by Alexander O. Vietor. *The Vinland Map and the Tartar Relation* Yale University Press, 1965 (*VMTR*), 1995 (VMTR95). Reprinted in 1995 with new prefatory essays by Painter, Wilcomb E.

Washburn, Thomas A Cahill and Bruce H. Kusko, and Laurence C. Witten II (*VMTR95*), but original pagination retained in body.

Washburn, W.E. 1971. *Proceedings of the Vinland Map Conference (PVMC)*, held 1966, with contributions by Paul Fenimore Cooper, Jr., Armando Cortesão, Thomas E. Goldstein, Einar Haugen, Melvin H. Jackson, Gwyn Jones, Ib Rønne Kejlbo, Stephan Kuttner, Robert S. Lopez, Oystein Ore, John Parker, Konstantin Reichardt, Vsevolod Slessarev, Boleslav B. Szczesniak, Erik Wahlgren, and Laurence Witten, and extended commentary by the invited participants. University of Chicago Press.

Weaver, C.E. 1976 The Nature of TiO2 in Kaolinite *Clays and Clay Minerals* **24** 215-218.