Dendrochronological dates for the Warren and Polly Hull House and Barn

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The Warren and Polly Hull House and Barn sit on the north side of Genesee Street, across from the north end of Pavement Road, east of Lancaster, NY (42º 56′ 40″N, 78º 37′ 20″W). Under current management of Gary Costello and the Landmark Society of the Niagara Frontier, the house is in the process of major repair for its use as a historic museum for the Society. The house consists of two stories, an attic, and a full basement, and had a small L-shaped addition on its east side that has now been removed. Its Federal-style architecture and the history of the land and its ownership suggested, at first, that it was built around 1810 (see website http://www.landmark-niagara.org/hull/int/index.html), but a further investigation into local history indicates that since the building sits exactly with its center on the north-south line between two original lots, and Hull did not buy the west lot until 1814, that it is not an 1810 house (Ted Bartlett, pers comm 2010). The original house roof construction included a ridgepole, and ridgepoles were not generally used after *ca.*1800 in New England (Sloane 1965), and after ca.1820 in upstate New York (Stearns 2006 pers. comm.). However, the dendrochronological dates we obtained from the outer tree-rings of samples from timbers containing bark or a "waney edge" (only bark removed) clearly indicate that the two-story house was built in 1823-24. Intriguingly, though, there are two timbers used in the house construction that are probably from an earlier building and were re-used: the oak beam on the east side of the basement (outer ring 1804 with no more than 5 rings removed); and a hemlock scab used in the roof whose outer ring dates to 1816 along a waney edge. Both these dates suggest the presence of building(s) on or near this site prior to the Hull House, and they agree with some of the key historic dates associated with this property. The earlier dates and samples are discussed below.

The house was constructed mainly of eastern white pine (*Pinus strobus*), with eastern hemlock (*Tsuga canadensis*) used for the roof boards and a scab. Oak (*Quercus* sp.) is represented only in one of the main beams supporting the first floor, and ash (*Fraxinus* sp.) is found only in the small timber at the top of the stone pillar in the center of the basement. In the barn, two species of hickory (*Carya* spp.) were used for the roof plates; hemlock was used for the hayloft support beam, and pine was used for the boards in the inner wall of the granary. In

both house and barn, the widths of the boards are remarkable – many over half a meter wide – in the door frames and walls, with widths around 0.3m in the roof boards, indicating use of timbers from a primary forest. In contrast, the rafters in the roof of the L-shaped addition, now demolished, were small pine saplings, barely 0.15m in diameter.

The collection of samples

The house roof was opened up in the summer of 2006 for major repair, and Mr. Costello plus Carl Stearns and Ted Bartlett of Crawford and Stearns, Architects and Preservation Planners, of Syracuse, NY, asked us to date the roof plates that were being removed for replacement, along with other accessible beams, rafters, and boards, to determine the construction dates of the main building, the ell, and the barn. We took cores from 11 timbers in the buildings, including the ridgepole, two rafters, and a purlin in the main roof; one roof plate and a rafter over the addition; two beams in the basement ceiling; and two roof plates and a beam in the second floor of the barn. We sawed sections from removed and replaced timbers, including the south roof plate, a chimney scab, and a board from the main roof of the house, as well as from two boards in the barn, one an inner wall board of the granary, and the other a very wide loose board in storage. Seven sawn sections, sent later by Mr. Costello, were from the north roof plate, four roof boards, and the cellar door frame of the house, and another wide loose board. On our second visit (April 2007) we collected a core from a beam containing bark in the lintel of the then-exposed north door frame on the first floor, plus a second core from the oak beam, cores from 5 other basement beams in the SW corner and a segment from a small section of wood wedged in above the stone pillar in the center of the basement. Our most recent visit (September 2009) allowed us to core two support beams in the second story flooring which was open at that time for the installation of a new heating system.

Dendrochronological methods and results of the Hull House and Barn

Dendrochronology is based on comparing the patterns of wide and narrow rings in each tree-ring sequence to an established chronology to find the time period in which the tree grew. Secure crossdating is accomplished by matching long ring-width patterns that are unique to a particular period. This process gives us accurate dates for the whole tree-ring sequence, which includes the end date of each sequence, and that date helps establish the building date. The date of the outer ring of a sample from a whole timber with bark and a high ring count is the best

circumstance; it gives the felling date of the parent tree, and that is generally the building date (in construction an almost immediate use of newly-cut lumber was common; at most a few months of drying was allowed). Squaring a timber removes a lot of the outer rings, so the date of the outer ring from a squared beam or board may be literally decades earlier than the building date. Luckily in this case, many of the critical squared boards or beams still had a waney edge or even bark preserved in one or more of their corners. Samples from the boards and other squared timbers were collected mainly due to their high ring count, and their sequences were used to help build a secure chronology for the particular species at this site and to add to our regional chronologies.

The Hull samples were prepared by first gluing the cores into core-holders, than sanding the transverse surface of the cores and sections by sanding with 40- to 300-grit sandpaper, progressively. The ring-widths were measured on a moving table underneath a microscope with cross hairs, recording the widths with 0.01mm accuracy. Each sample's ring-width sequence was then compared, visually and statistically, with the sequences of the other samples of the same species to establish their relative placement in time (Figure 1, Table 1). Hull House chronologies were built with the relatively-dated sequences of white pine and of hemlock; and those chronologies plus the single oak sample sequence were compared with our existing modern and historic tree-ring chronologies of the same species from across upstate New York. All three species' sequences securely crossdate with their respective species' regional chronologies (see list below plus Figure 2, Table 1).

Below is a list of the Hull House and Barn pine and hemlock chronologies that we were able to build from this collection, plus the oak sample, indicating the dates covered by their tree-rings. The samples of hickory and ash could not be dated (see below), and the sequences in the samples from the ell were too short to date. The individual samples are listed in the Appendix.

N.B. The end dates of the chronologies and oak sample listed below include the date of an outer partial ring, indicated by a "+" if present. The partial rings are not included in the complete species chronologies. The "B" indicates the presence of bark; and "W" indicates a waney edge; "v" indicates that the outer ring is within 5 years of the waney edge or bark date; "vv" indicates unknown number of rings removed. For a more complete definition of the terms used below, see the opening paragraphs in the Appendix.

The Hull House and Barn chronologies:

Eastern white pine (*Pinus strobus)*

Hull House Pine Chronology, main construction: contains the ridgepole, two purlins, the north and south roof plates, support beams of the second story floorboards; the first floor north door lintel, cellar beams, a board from the cellar exterior door frame, and a random loose board (EHH-1, 3, 6, 17, 22, 23, 25-29, and 32-36). See text above and Figure 3 for discussion and illustration of the range of bark dates.

N = 108+1B **1716-1824+B**

Hull Barn Pine Chronology: a loose board and the granary wall board, EHH-15 and 16.

N= 199+1vv **1602-1801+vv**

Hull House & Barn Historic Pine Chronology: samples from the two chronologies above with the exception of the short sequences (<50 rings).

N = 222 **1602-1823**

Eastern hemlock (*Tsuga canadensis*)

Hull House Roof and Attic Chronology: contains the combined roofboards EHH-11, 19, 20, & 21, the possible roof board, EHH-18, the quartered beam in the attic wall, EHH-31, the scab, EHH-2, and a random board, EHH-30, all from the attic

N = 317+1W **1506-1823+W**

Hull Barn random board and hayloft beam contains EHH-14, the beam on the west side of the hayloft, and a random loose board, EHH-22. Both timbers are squared; neither has sapwood.

N = 243+1vv **1559-1802+vv**

Hull House and Barn Historic Hemlock Chronology: This chronology includes all of the above, EHH-2, 14, 18, 22, and the combined EHH-11, 19, 20, & 21 from the roof boards.

N = 317 **1506-1822**

Oak (*Quercus* sp.)

Hull House Historic Oak: EHH-9, the only sample of oak. The long sequence crossdates well with oak chronologies in New York (Table 2, Figure 2), and will be added to our regional oak chronology. Contains 18 sapwood rings.

N = **259v** **1543-1804v**

Hickory (*Carya* sp.)

Barn samples EHH-10 and 11 were collected from the north and south roof plates, and they each represent a different *Carya* species. There has been limited dendrochronological research on the hickory species, and the *Carya* species in general are listed as not successfully crossdatable except for between radii within the same tree. Our comparison of four hickory samples from

New York (the two Hull Barn samples included) agrees with the assessment that the growth patterns of the *Carya* species do not have the characteristics necessary for good crossdating between trees. EHH-10 and 11, two species of hickory, do not crossdate well with each other. (Species listing is on website http://web.utk.edu/~grissino/species.html.)

Ash (*Fraxinus* sp.)

Sample EHH-24, from a scab or small beam found above the stone pillar in the middle of the basement contains 103 rings, but a chronology for that species is not yet established.

Figure 1 shows the constituents of the pine and hemlock chronologies together; Figure 2 shows the two species chronologies and the oak sequence compared with their respective New York State regional chronologies; and Figure 3 shows the placements in time of the calendar-dated pine, hemlock, and oak samples that are included in the chronologies. Table 1 gives the results of the statistical tests used in crossdating the samples and chronologies, both between the samples in order to build the chronologies (internal values), and between the Hull and regional chronologies.

Construction of the House

The Hull House Pine chronology contains bark dates of both 1823 and 1824 and the Hull House Hemlock chronology has a bark date of 1823 (Figure 3). These dates indicate that the house took over a year to build, with the basement beams going in first. All but two of the basement beams have a partial ring in 1823 which indicates that the trees were cut down before the end of the growing season in that year. The beam in the north door lintel (1st floor) has a complete ring for 1823 and no 1824 ring, as do the beams supporting the second story floor and one timber in the stonework around a window in the attic. These trees were cut down sometime between September 1823 and April 1824. The attic south roof plate and, interestingly, the squared cellar beam next to the basement stairway both contain a complete 1823 ring plus a partial ring for 1824; those trees were cut down in the spring of 1824.

The two earlier-dated samples - "odd-men out"

We were asked to date this building because it was thought at that time that it was probably built pre-1810 due to the presence of the ridge beam and the unusual circumstance of a house built Federal-style surviving the Indian massacres in Buffalo in 1810. While the majority of the beams with bark or a waney edge do indicate an 1823-1824 building date, there are two timbers in the house whose felling dates need an explanation.

These two earlier dates are those of the outer tree-rings in the hemlock scab and the oak beam. The scab (EHH-2) ran from the chimney to the roof. The sample had no squaring along the outer edge of its ring growth and the outer ring continues along the outer edge. Thus the outer ring is most likely the waney edge, and it dates to 1816. The narrowness of this sample's tree-rings and the lack of curvature in its ring structure imply that its 200 rings came from the outside of a very big tree. Thus there are two possibilities: the tree may have been dead when felled in 1823-24; or it may have been cut down for its wood to be used in an earlier construction.

The oak beam (EHH-9) has 18 sapwood rings, but the presence of a waney edge is not certain. Crossdating the oak's measurements with our regional New York oak chronology (Figure 2) gives us a certain outer ring date of 1804, with a "v" – this might be the waney edge, or it certainly is within 5 years of its felling date. Our current count of sapwood rings in oak samples from other sites across New York State gives a range of 6 to 29 (average 14) for sapwood count. With the 18 rings I think 1804 is the most likely felling date, but a few rings may be missing. Any date within that range, from 1804-1809, indicates that this beam was most likely reused from another building, but the beam's presence in the east side of the SE corner, where the structure of the basement indicates the possible presence of a smaller room, also suggests the possibility that that part of the basement was part of an earlier, much smaller, building that was mostly torn down before the Hull House was built. The corner stonework and the beam could have been the only parts preserved, and the earlier building's dimensions would have been expanded in two directions (north and west, after the west lot was bought) for the current basement of the Hull House. However, the log easily could have been taken from an earlier building elsewhere.

The Barn

The absence of any end date of the barn samples past 1802 does imply an earlier construction than the mid-1800s, but for that we have no clear evidence. The end date of the hayloft beam (EHH-14, hemlock) at 1802+vv indicate that it was built sometime after 1802, but it and the granary wall board do not have sapwood, waney edge, or bark. It is very unfortunate that the hickory samples cannot be dated. All the tree-rings can say is that the barn was built sometime after 1802, which implies that at least part of the barn may have been built before the house, but further sampling is necessary for a more secure date.

Besides securely dating the construction of the Hull House, the best outcome of our analyses of the Hull House and Barn samples is that all three of our regional pine, hemlock, and oak chronologies for upstate New York now have more data to extend and bolster them in the 16th through 18th centuries. The NY regional hemlock chronology now goes back to 1506, the regional oak chronology to 1507, and the regional white pine chronology to 1542.

References:

Conlin, J.H. 1998. *The Warren and Polly Hull House Historic Structure Report*, unpublished ms. Available on the website http://www.landmark-niagara.org/hull/conlin/1/index.html.

Sloane, E. 1965. *A Reverence for Wood*, New York: Ballantine Books, 111pp.

Table 1. The statistical results of the tests between the samples included in the Hull House and Barn chronologies, and between those chronologies, the oak sample, and the regional eastern white pine, eastern hemlock, and oak species chronologies around New York State. The internal crossdating numbers are the average of the statistics between the samples in the chronologies. All values are statistically significant.

	Student's *t*-score	Correlation coefficient	Trend coefficient	No. of crosses	Average Overlap
Hull House Pine Chronology:					
Average internal crossdating	3.67	0.43	64.2	69	53
with NY Regional Pine Chronology	7.37	0.44	67.0	1	222
Hull House Hemlock Chronology:					
Average internal crossdating	5.50	0.51	71.0	16	93
with NY Regional Hemlock Chronology	13.45	0.62	76.0	1	294
Hull House 9, oak sample:					
with NY Regional Oak Chronology	5.45	0.32	59.3	1	259

The statistics: The correlation coefficient is Pearson's correlation coefficient. The Student's *t*-score is a sum of the correlation coefficients in short segments along the overlap divided by the number of segments. That process adjusts to temporal variations in amplitudes, better than Pearson's linear correlation coefficient. The trend coefficient is the percentage of year-to-year changes (positive or negative) that are the same for two data sets in the overlapping period.

Appendix

The sample list below includes the samples' dimensions. Each section's dimensions represent the end dimensions of the boards or beams (no length). Each core's dimension is the length of the removed core and is generally approximately half the radius of the sampled timber. Each ring count in the list below ("A = 1+ 145+ 1vv," for example) indicates how many rings were measured along one radius, if there were any partial unmeasured rings at either ends of the radius, and the nature of the end dates. The notations used in the ring counts are: a "1+" or "+1" to indicate the presence of an unmeasured partial ring before or after the sequence of complete measured rings, respectively; a "p" to indicate the presence of the pith (center) ring; a "±p" to indicate that the inner measured rings are near the pith; a "vv" to indicate an unknown number of rings were removed beyond the sample's outer ring, possibly by squaring or during removal of the bark; a "v" to indicate that the outer ring of the sample is close to the outer ring of the timber due to features such as the presence of sapwood rings or closeness to other bark dates in the samples; a "W" to indicate that the "waney" or outer ring is present (with only bark removed); and a "B" to indicate the presence of bark. The date and presence of outer partial rings are included in the dates of the measured sequence in the "Dates (AD)" column. Multiple letters in the ring counts (A, B, etc) indicate that more than one radius of ring-widths was measured for that particular sample. Figure 1 shows the placement of the dated samples in time with the same notations.

The following dates listed in italics are only tentative dates, due to short sequences (<50 rings). Short sequences can crossdate well (= match ring-width patterns) in more than one place in time, both visually and statistically, and thus the dates are not as secure as those determined by crossdating long sequences. The tentative dates are based on the crossdating, but the additional information of the building dates indicated by the longer sequences, the location of the sample in the building, plus the shape of its timber (whole or squared), and presence or absence of sapwood rings, adds substantially to its placement.

The presence of sapwood rings in any hemlock, pine, or oak sample indicates that the date of its outer ring is generally closer to its felling date than in a sample without sapwood rings. However, the range of the number of sapwood rings common in pines or hemlocks is quite large, so that it is not reasonable to estimate the felling date from its presence alone.

Sample	**Description**	**Ring Count**	**Dates (AD)**
Samples EHH-1 to 16 were collected at the site on 18 August 2006. EHH-1-6 and 11 are from the main roof: EHH-7 and 8 are from the ell, EHH-9 and 10 from basement beams, and EHH-12-16 are from the barn.			
EHH- 1	Section from removed S wall roof plate, a squared whole timber, 29.5 x 22.5 cm, *Pinus strobus*. Its center rings had disintegrated. The "W" (waney edge) was assigned due to the presence of sapwood, plus the 1823 bark dates of EHH-29, 35, and 36.	A = 1+ 68+1v	
		B = 1+ 76+1v	
		C = 1+ 64+1W	
		ABC = 1+77+1W	1746-1824+W

Sample	Description	Ring Count	Dates (AD)
EHH- 2	Section from removed scab of chimney rafter, squared on all but the outer side, 6.5 x 9.5cm. *Tsuga canadensis*. Sapwood rings present.	A = 1+169W B = 1+199+1v AB = 1+199+1v	1616-1816+v
EHH- 3	Core, 10cm, from six-sided roof ridgepole. *Pinus strobus*. Its tree-ring patterns best match those of EHH-17, the roof plate on the N wall, one of the original timbers. Unknown number of rings removed in the squaring process.	A= ±p+ 1+ 52+1vv	1715-1768+vv
EHH- 4	Core, 6.8cm, from 3rd rafter from east wall, west end. Whole timber, *Pinus strobus,* sapwood present.	A= 1+ 31+1v *tentative date only: 1791-1823+v*	
EHH- 5	Core, 8cm, from roof rafter, west end. Whole timber, *Pinus strobus,* Sapwood present.	A= ±p+ 1+ 48+1v *tentative only: 1774-1823+v*	
EHH- 6	Core, 10.3cm, from squared roof purlin in west end, *Pinus strobus*.	A= 1+ 30+1vv	1792-1823+v
EHH- 7	Core, 6.3cm, from roof rafter in ell. Whole timber with bark, *Pinus strobus,* with sapwood rings.	A = ±p+ 1+ 25+ 1B	not dated
EHH- 8	Core, 2cm, from squared roof plate at top of north wall of ell. *Pinus strobus.*	A <10, too few rings	not dated
EHH- 9	Core from N-S squared basement beam, 20cm radius. *Quercus* sp. Two sapwood rings in A; B has 18 sapwood rings; outer ring close to waney edge.	A = +p+1+203+ 1vv B = 1+259v AB = 1+259v	1543-1804v
EHH-10	Core from N-S joist in basement ceiling, next to EHH-9. *Pinus* sp. Too few rings - cored twice with only small segments emerging.	A <10, B <10	not dated
EHH-11	Section from squared roof board, 36.5cm x 2.1cm thick: removed for replacement in 2006. *Tsuga canadensis*. Same tree as EHH-19, 20, and 21.	A = 1+157vv B = 1+133+1vv	1628-1785vv 1638-1772+vv

Sample	Description	Ring Count	Dates (AD)
EHH-12	Core, 12cm, from S roof plate in barn, squared whole timber. *Carya* sp.	A= 1+ 80+ 1vv	not dated
EHH-13	Core, 13.5cm, from N roof plate in barn, squared whole timber. *Carya cordiformis*.	A = 1+ 82+ 1vv	not dated
EHH-14	Core, 11.2cm, from interior squared N-S support beam in barn on east side of the hay loft. *Tsuga canadensis.*	A= 1+ 106 + 1vv	1695-1802+vv
EHH-15	Section of squared loose board stored in center of barn, 56.5cm wide, 3.5cm thick. *Pinus strobus.*	A =1+165+1vv	1635-1801+vv
EHH-16	Section of squared board in inner wall of granary, 53.5cm wide, 3cm thick. *Pinus strobus*. Section contains almost equal ring count on both sides of near-pith center ring.	A = 1+131+1vv B = 1+125+1vv AB = 1+131+1vv	1601-1733+vv

Mr. Costello sent the following samples, EHH-17 to EHH-23, in the fall of 2006:

EHH-17	Halved section of removed roof plate from N side of house, 14.5 (~half) x 22.5cm, squared whole timber. *Pinus strobus*. Ring pattern is very similar to that in the ridgepole.	A = 68+1vv	1728-1796+vv
EHH-18	Section from possible roof board, squared with pith in center, 28.3 x 2.2cm. *Tsuga canadensis*. Possibly same tree as EHH-11, 19, 20, and 21.	A = p+133+1vv B = p+134vv AB = p+134vv	1505p-1639vv
EHH-19	Section from squared roof board, 36.5cm x 2.2cm, *Tsuga canadensis*. Same tree as EHH-11, 20, and 21.	A = 1+132+1vv B = 153vv	1635-1772+vv 1628-1780vv
EHH-20	Section from squared roof board, 28.1 x 2.2cm, *Tsuga canadensis*. Same tree as EHH-11, 19, and 21.	A = p+1+198vv	1564p-1762vv

Sample	Description	Ring Count	Dates (AD)

EHH-21 Section from squared roof board, 37.5 x 2.2cm, *Tsuga canadensis*. Same tree as EHH-11, 19, and 20.

A = 1+164+1vv 1603-1768+vv
B = 1+153+1vv 1603-1757+vv

The two A and B radii from each of EHH-11, 19, and 21 plus the A radius from EHH-20A (all from same tree) were averaged according to the similarities of their measurements:

Radius A = EHH-11B, 19A, 20A and 21A = p+207+1 1564p-1772+vv
Radius B = EHH 11A, 19B, and 21B = 1+182vv 1603-1785vv
Roof Board sequence (all combined) = p+221vv 1564p-1785vv

EHH-22 Section from random squared board – could be from either house or barn. It is much wider than the roof boards, and not nearly as weathered, so was probably used for some interior wall or floor. *Tsuga canadensis*. 51.1 x 2.2cm.

A = ±p+1 +178+ 1vv
B = ±p+1 +180vv
AB = ±p+1 +180vv 1558 -1738vv

EHH-23 Section from squared board from cellar entrance door frame, removed in spring 2003. 45.5 x 2.2 cm (note on sample says 5-6cm missing). Contains near-pith rings, and there are about twice as many rings on the B radius as on the A radius (not measured). *Pinus strobus.*

B= ±p+1+79+1vv 1722 -1802+vv

EHH-24 to 34 plus EHH-9B were collected in 25 April 2007, with the help of Dr. Tomasz Wazny of the Cornell Tree-Ring Lab. One sample (EHH-29) from the frame of the first floor north door was the main purpose of this visit; the door frame had been opened for the first time in the restoration process.

EHH-24 Section of small scab located above the stone pillar supporting the center of the house. *Fraxinus* spp. Max width 16.2cm, thickness 3.2cm.

A=103+1vv not dated

EHH-25 Core of squared cellar beam east of stairwell, containing waney edge in one corner. *Pinus strobus*, 0.15m radius.

A= p+ 62+1v 1762-1824+v

EHH-26 Core of whole beam west of stairwell, east side of SW fireplace cradle. *Pinus strobus*, 0.11m radius.

A= p+ 65+1B 1757p-1823+B

Sample	Description	Ring Count	Dates (AD)
EHH-27	Core of whole beam, N side of SW fireplace cradle. *Pinus strobus*, 0.11m radius.	A= ±p+ 58+1W	1765-1823+W
EHH-28	Core of whole beam, S side of SW fireplace cradle. *Pinus strobus*, 0.11m radius.	A= ±p+1+58+1W	1764-1823+W
EHH-29	Core of first floor north door lintel beam. *Pinus strobus*, 0.11m radius.0.153m radius, with bark.	B= 1+68B	1755-1823B
EHH-30	Approximately half of a section of random board in attic, 0.022m thick, 0.13m wide. *Tsuga canadensis.*	A=1+87+1vv	1730-1818+vv
EHH-31	Section from end of quartered beam rafter, against east end stone wall in attic, *Tsuga canadensis*, max dim 0.125cm, radius 0.08m. Contains waney edge.	A = 2+ 97 +1W	1724-1823+W
EHH-32	Core of north purlin support post, east end, in attic. *Pinus strobus*, 0.112m radius.	A = p+42+1	1780p-1823+W
EHH-33	Core of whole beam, 2nd beam from west wall in basement, *Pinus strobus*, 0.136m radius.	A=p+1+60+1W	1761p-1823+W
EHH-34	Section from semi-loose, partially squared beam, partially contained in the west attic wall near the window. *Pinus strobus.* Possibly an original support in building the west stone wall. Max radius 0.115m.	A= 1+76W	1747- 1823W

Collected in September 2009, when second story floor support was exposed for adding heating facilities:

EHH-35	Core from N-S second floor joist with waney edge. *Pinus strobus*, approx 0.17m radius. Waney edge.	A = 1 +40W	1783-1823W
EHH-36	Core from E-W second floor support beam with bark. *Pinus strobus.* Approximately 0.6m radius.	A= 1+41B	1782-1823B