

A Technical and Stylistic Comparison of Twelve Massachusetts State House Chairs

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Introduction

During an extensive structural conservation treatment of a chair owned by the Henry Francis Du Pont Winterthur Museum and attributed to the Boston cabinetmaker George Bright (1726-1805), I became curious about the fate of the other chairs from the original set of thirty made for the new Massachusetts state House. In the course of a year I have managed to locate, examine and measure a total of twelve chairs attributed to this set.

Although there was initially no reason to believe the twelve chairs were not all made by Bright or his apprentices, there were enough dimensional differences among the group to indicate later copies or a second set. Only five of the twelve chairs have provenance information, so to make an objective comparison of the existing twelve chairs, dimensions and stylistic characteristics were recorded, and cross-section finish samples were taken from ten of the twelve chairs to compare finish histories. The remaining two chairs have been so extensively refinished that there is no evidence of any surface left relatively intact. The data and evidence cited in this paper reflect the results of this research as of the April 1991 publication deadline.

Historical Background

On July 4, 1795 the cornerstone was set for the new Charles Bulfinch-designed state House in Boston, Massachusetts. This elegant building was officially opened in 1797 and among its furnishings was a set of thirty chairs made by the Boston cabinetmaker George Bright. The chairs were intended for the Senate Chamber, now the Senate Reception Room. Curiously, in 1796 there were thirty-three Massachusetts State Senators and one Senate President but the existing signed receipt is for thirty chairs. (1)

A contemporary description of the Senate Chamber indicates that it was a very impressive and important space:

“North of the center room is the Senate Chamber, 55 feet long, 33 wide and 30 high: highly finished in the Ionic order; two screens of columns support with their entablature a rich and elegant arched ceiling. This room is also ornamented with Ionic pilasters - - and with arms of the state, and of the united states, placed in opposite panels -- it is accommodated with a gallery for public use.” (2)

A receipt for payment dated 1797 and signed by George Bright provides only a very simple description of the chairs: “To making 30 mahogany chairs \$240.-”.

It might be expected that the furnishings for such a large and formal space would be equally oversized and impressive. In 1948, in an article printed in *Antiques* (3), Mabel Swan identified the George Bright chair form as a high-backed bergere-style upholstered chair with scrolled arms, turned front legs and curved back legs. In fact, these chairs are illustrated in a newspaper drawing of the Senate Chamber in 1852 (4). But they are stylistically too late to be accepted as the first set of chairs.

In 1964, Richard Randall, a Curator at The Museum of Fine Art in Boston, published an article in *The Art Quarterly* which identified the Bright chair form as a graceful Sheraton-style upholstered, barrel-backed form with turned front legs and arm supports. Randall pointedly disagreed with Swan's attribution, stating that that particular chair was in the style of the 1820s.⁽⁵⁾ Randall's article included, as an illustration of a Bright State House chair, a photograph of a low barrel-backed chair owned by Miss Dorothy Codman and now in the collection of The Society for The Preservation of New England Antiquities. The provenance for this chair also seemed to fit Randall's hypothesis that the remaining chairs in the set were either sold or given to Massachusetts Senators and Representatives when the State House was redecorated in the 1840s.

Locating and Identifying the Remaining Bright Chairs

Twelve chairs of this form have been located to date in the collections of museums, historical societies and private owners. The Society for the Preservation of New England Antiquities owns two chairs which came to it from two different branches of the Codman family. The Bostonian Society also owns two chairs, as does the Henry Francis Du Pont Winterthur Museum. The Henry Ford Museum owns one chair, and there is one chair in a private Boston collection. This privately owned chair is illustrated in Appendix A. Thomas Colville, a New York and Connecticut dealer, owns two chairs. Colville actually purchased a total of four chairs, then kept the two chairs he felt were best and sold the other two to the State of Massachusetts.

To further confuse matters, reproductions of the State House chair form were commissioned by the Henry Ford Museum from Century Furniture Co., in Hickory, N.C. sometime after the chair was acquired by the Museum in 1961. Some of these reproductions will undoubtedly be confused with the original chairs 50 or 100 years from now.

Of the group of twelve, only three chairs can be traced back to a connection with the Massachusetts Senate and House during the time in which the chairs were reputed to have been given away. In fact, a number of the original thirty chairs may not have survived that long. The chair is very graceful in form, but ill-suited to use in a public building. Each curved rail and arm is made of one piece of solid mahogany which is susceptible to breakage at the short grain sections of the curves. The arms and crest rail are tenoned into the top of each one-piece leg and these joins have a tendency to break apart where the mortises have been cut. In addition, the inside faces of the rails and arms have become fragmented and fragile from numerous reupholsterings.

Not surprisingly, the majority of the twelve chairs which have been located have undergone extensive restorations in the joined areas. The most common approach was to glue in massive patches where the arms join the top of the legs at the crest rail. Many of the chairs have added support in the form of new blocks or iron brackets to strengthen the one-piece front and back legs. The brass cuffs and casters have been removed on three of the twelve chairs, and new feet have been pieced-on to a number of the chairs. One winterthur chair has replacement seat rails, and additional wood has been added to the rails of the other winterthur chair and a Massachusetts State-owned chair.

Upholstery

The twelve chairs reflect different approaches and interpretations of the proper historic upholstery form and material. This is evident even within the same institution: one winterthur chair has black leather upholstery with a separate, quite thick black leather-covered cushion, while the Winterthur chair which was conserved had black haircloth and a thin seat cushion tacked directly to the rails.

Four chairs have red leather upholstery with separate buttoned seat cushions (the State-owned chairs and the Colville chairs), and the Henry Ford Museum chair is also upholstered in red leather with a separate leather-covered cushion.

In 1963 the Bostonian Society sent its two chairs to Sanger Atwill, a Lynn, MA restoration firm, for refinishing and new dark green leather upholstery. Dark green was selected based on unrelated research by SPNEA Architectural Conservators which showed that the Senate Chamber was originally painted pale yellow and green. And in the 1970s the privately owned Boston chair was refinished and reupholstered in black haircloth with a separate buttoned cushion -- also by Sanger Atwill. None of the earlier upholstery was saved or documented in any of these restorations.

Both SPNEA-owned chairs have degraded brown leather upholstery, with separate buttoned cushions, which look to be quite old but not original. One of the SPNEA chairs may provide evidence of how the set was originally upholstered. This chair (accession number 1969.777) came to SPNEA through Miss Dorothy Codman. It apparently passed down through the Codman family from John Codman, to Charles Russell Codman, to Dorothy's father Ogden Codman Sr. Charles Russell Codman was a Senator in the new State House. (6)

When the loose seat cushion was removed, a red leather stamped, decorative strip at the lower edge of the upholstered back was revealed beneath the decorative brass nailing. This strip, which was protected by the cushion from damaging light exposure and wear, could indicate the original color of the chair -- assuming that this back is original.

In an attempt to determine whether there had been any earlier upholstery on the back, several radiographs were taken of the back at the join between the PR arm and crest rail. No additional holes, which would have indicated earlier tack and nail patterns, were visible on the radiographs. To be doubly sure, several loose, accessible decorative nails and brass tacks were removed from a small area of the back. Not only were the tacks and nails of early to mid-nineteenth century manufacture, there was also clearly another earlier set of nail holes in the frame. This back is old but unfortunately not original.

There was also one earlier set of webbing on the seat of this chair. Luckily there are still many red wool fibers caught under the shanks of tacks left in the seat rails. This red textile was probably the cover for the seat webbing and matched the leather show cover. It is not inconceivable that what appears to be a brown leather back on this SPNEA chair was originally red leather which has darkened and changed in color as a result of leather dressings, light exposure, wear and grime. It is also possible that this second upholstery treatment in red leather could well have been an attempt to replicate original red leather upholstery.

There is a precedent for red leather in the context of seating furniture for public buildings. In 1796, Jonathan Bright, George Bright's son and a successful upholsterer, submitted a bill for upholstery work for 19 chairs for the new State House in Hartford, Connecticut. The work was described as: "To seating 19 chairs in red Morocco Leather". (7)

Data Collection

In an attempt to establish valid relationships among the group, each chair was measured in specific areas such as overall width, depth, height (a problematic measurement because the casters had been removed from many of the chairs), circumference of the vase turning on the Proper Left (PL) arm support,

thickness of the crest rail and size of the seat rails. Any stylistic variations such as veneered seat rails, thick turnings above the casters and reeded arm supports were also noted. The diagram in the Appendix B illustrates where the measurements were taken.

All measurements and stylistic differences were recorded by the same person (this writer) to reduce the possibility of a variation in location or method of measurement. The twelve chairs were all examined on site so it was not possible to line them up together to make visual comparisons. However, it became apparent even when comparing pairs of chairs that there were obvious visual differences. For example: SPNEA chair number 1969.777 is slightly taller, narrower, and has more finely turned legs than its somewhat chunkier, clumsier companion 1969.778. A chart listing all the comparative measurements is contained in Appendix C.

Based on the initial measurements and visual comparisons, it was expected that the chairs could be divided into significant, related groups through statistical analysis. This was based on the initial assumption that thirty chairs made in the same shop during the same period would be made using templates, with the same cabinetmaker or apprentice assigned to make specific parts such as the turned legs or the curved rails. Thus there would be very little variation in the sizes and shapes of the elements.

Cross-section samples were also taken from ten of the twelve chairs in an attempt to identify and compare finish histories. This is a difficult comparison given that all but the SPNEA chairs appear to have been refinished at least once. Samples were taken from protected areas such as the interstices of the bead turnings on the front legs and the undersides of the seat rails at joins, in the hope of discovering remnants of earlier finishes.

All samples were then cast in Extec clear polyester resin, ground and polished to expose the cross-sections and examined in normal and ultraviolet light at 125X, 250X and 500X magnification. Ultraviolet light fluorescent stains were also used to identify the presence of proteins and oils in the wood and finish layers. (8) The SPNEA Conservation Center Olympus BH-2 series microscope was used for the examination. The excitation peaks for the U and V dichroic mirror assemblies are rated at 360 nm and 405 nanometers respectively.

Statistical Analysis of the Dimensional Data

The null hypothesis for this data collection and analysis was that all twelve chairs belong to the same set of thirty made in 1797 by George Bright.

The statistical analysis of the data was conducted at The University of Delaware by Dr. Chandra Reedy using the BMDP package with programs 1D (Means, standard deviations, minimum and maximum for each variable), 5D (Histograms for individual variables), and 4M (Principal Components Analysis). (9) The results indicated that the five style variables had no significant correlations with the numeric dimensions, and the only style feature with any variability was that of a thick, wide turning above the caster.

After collecting all the data, reviewing the statistical comparisons, and then going back and closely re-examining the chairs, it became more obvious that three of the five style variables could be accounted for by later restoration work. The thick, wide turning above the caster was a later replacement made either when the casters were taken off and replaced with a new thicker foot or the original legs were repaired;

the chamfered seat rails were only present on the Winterthur chair which had replacement rails; and the veneered rails were only present on two chairs which had had extensive restoration to the rails. The fourth variable, chamfered side rails (on the underside) was present on all four chairs so it was not a discriminating factor. The fifth variable, reeded arm support, was present only on chair #59.1883 owned by the Bostonian Society.

This particular Bostonian Society chair entered the collection in 1883 as a loan from Warren G. Roby. No family connection has yet been discovered between Roby and the New State House. The chair is unique among the group as it is the only one with reeded arm supports, incised decorative lines on the front legs and arm supports, and a slight swelling between the bead turnings on the upper portions of the front legs. This chair is distinctly more ornate than the rest of the group and has been proposed as the Senate President's chair.

After determining that stylistic variations could not be used to distinguish among the group, it became that much more important to carefully analyze the dimensional data. The Principal Components Analysis was run for a second time, after removing the style variables, and the results showed that the variables which account for the greatest degree of variation are overall height, overall width and vase circumference.

The Principal Components Analysis also showed that all the variation among the chairs could not be reduced to one or two factors and thus the measurement variables are not strongly intercorrelated. Because this analysis showed that there were not definitely two (or more) clear clusters, the null hypothesis that this group of twelve is all part of the same set was supported. However, it is important to look at the other statistical measures before making a final determination.

Histograms generated for each dimensional measurement showed mostly normal distributions (bell-shaped curves) with the same chairs as consistent outliers. In other words, the outliers were outside the cluster of chairs with similar dimensions. The histograms also indicate the proximity of the groups (the chairs clustered about the means) to the outliers. Appendix D contains the histograms for all seven measurements. To identify where each specific chair is located (denoted as an "X" on the histograms) one must refer back to the table of measurements (Appendix C).

Overall Height: The mean overall height was 33.40 inches with a standard deviation of 1.07. There was no distinct grouping in terms of height, perhaps because many of the chairs had replaced feet or major restorations to their legs. Because of the wide distribution there were no obvious outliers based on this variable.

Overall width: The mean overall width was 23.98 inches with a standard deviation of 0.167. There is a distinct clump of five chairs with similar widths, and the clear outliers are:

Narrower width chairs:

Winterthur #70.1420

Winterthur #64.187

Wider width chairs:

Bostonian Society #59.1883

SPNEA #1969.778

Overall Depth: The mean overall depth was 22.85 inches with a standard deviation of 1.5. There was a bimodal distribution to the data (a curious phenomena if one believes that all the pieces in a large set would have been made from templates and thus very close in all dimensions). The one distinct outlier, with a considerably greater depth at 25 inches, is the Bostonian Society chair # 59.1883. The two groupings are as follows:

Narrower depth chairs:

SPNEA #1969.777

Both Massachusetts state-owned chairs Both Colville chairs

Henry Ford Museum chair

Deeper depth chairs:

SPNEA #1969.778

Bostonian Society #1943.17

Both Winterthur chairs

Private Boston collection chair

Seat Rail Height: In terms of the seat rail height the mean is 1.79 inches with a standard deviation of 0.116. There is a distinct cluster of chairs around the mean with three definite outliers:

Winterthur #64.187

Bostonian Society #59.1883

SPNEA #1969.778

Seat Rail Depth: The mean seat rail depth was 1.57 inches with a standard deviation of 0.153. The only two outliers are the two Massachusetts State-owned chairs, but given that these chairs have had extensively restored seat rails, with additional wood added on to compensate for wood loss due to numerous reupholsterings, this cannot be considered significant.

Crest Rail Height: The mean crest rail measurement was 3.01 inches with a standard deviation of 0.14. There is a fairly wide distribution of measurements in this area, although there is a clump of six chairs which measure close to the mean. The distinct outliers are:

Bostonian Society #59.1883

Winterthur #64.187

Massachusetts State-owned chair "A"

Circumference of Vase Turning: The mean value for the circumference of the vase turning was 5.6 inches with a standard deviation of 0.325. All but two of the chairs were grouped closely together, and the outliers are the SPNEA #1969.777 chair with a narrower circumference of 4.75 inches and SPNEA #1969.778 with a thicker turning of 6.19 inches.

Results of Cross-section Microscopy

Interpretation and comparisons of clear finish cross-sections can often be quite difficult if the objects have undergone refinishing, as is the case with most of the chairs in this study. The intent of taking finish cross-sections was to determine whether any original finish could be identified on these chairs, and if there were

any similar finish histories among the group which could provide additional evidence of being made and finished in the same shop.

Cross-section Characteristics: Ideally the information provided by the cross-sections would complement the results of the statistical analysis. The outliers would show an entirely different finish history from the chairs which were clustered close together on the histograms. In fact, the cross-sections provided interesting, but not definitive information about the various finish histories of the chairs. Half of the group stained positively for the presence of oil in the wood using 0.06% Rhodamine B in ethanol(11). But this staining could be the result of a later oil polish penetrating into the wood through the broken-up, degraded finish layers, instead of an original oil-bound finish. This is more likely the reason for the positive stain because there is no consistent indication for the presence of oil in any of the resin layers above the wood.

Many of the finish samples had remnants of a white autofluorescent resin (probably some combination of plant resins) (12) in the upper cells of wood in the sample, although the finish above was generally an intact, comparatively new shellac layer. The presence of this resin in the cells indicates it was likely the earliest layer of finish, which was not removed even through rigorous refinishing efforts. The following chairs are included in this group:

Remnants of White Autofluorescent Resin in Wood Cells

Winterthur #64.187

Private Boston collection chair

Bostonian Society #59.1883

Henry Ford Museum chair

SPNEA #1969.778

Colville chair "B"

The lowest layer on three other chairs is an aged shellac layer. This layer is a characteristic bright orange shellac color under UV illumination and has a distinct pattern of cracking. The upper section of the shellac layer in these samples is paler in color -- where the surface has oxidized -- as is the area around each crack, where the coating was also exposed to air.

Lowest Layer is Aged Shellac

SPNEA 1969.777

Winterthur 70.1470

Colville "A"

Unfortunately the results of this cross-section analysis are not conclusive. It appears, based on the number of chairs with a white autofluorescent resin in the wood that the original finish on the set (if these are indeed all part of the same set) was a plant resin such as copal, dammar, mastic, sandarac, or some combination of these resins. But there is also no doubt that the shellac layer present on the three other chairs is quite old. More cross-sections will have to be taken to be absolutely sure that there is no white resin autofluorescent present in the wood of these three chairs. Sampling is an inexact art, and several of the cross-sections from these chairs were very small and incomplete.

It is interesting to note that all the chairs except for the Henry Ford Museum chair were refinished with shellac.

Conclusion

Of the group of twelve chairs there are only two chairs which can be separated out with a high degree of confidence. The Bostonian Society chair #59.1883 appears as an outlier in four of the six measurement categories and it is a more highly decorated chair. The measurements show it to be a wider and deeper chair, with larger crest and seat rails. It may have been intended as a more important chair for the Senate President and thus made separately and not included in the original group of thirty. More rigorous research is needed to determine whether a connection can be made to the State House through Warren G. Roby, the donor of the chair. The records of The Bostonian Society do not provide that connection.

The other chair which appears as an outlier in the dimension histograms is SPNEA 1969.778. It is a considerably wider chair, with a greater seat rail height, and the circumference of the vase turning on this chair is considerably larger than that of the other chairs. The chair may well have been made at a later date, but while the set was still in use, to replace a broken chair or to accommodate a new Senator. It seems very unlikely, based on this analysis, that it was part of the original set.

Given the existing comparative dimensions, cross-section results and available provenance information, the remaining ten chairs appear to be from the same shop and date of manufacture. This research process has confirmed that analyzing dimensional data through statistical measures and using cross-section information can provide a much more complete understanding of these types of objects, beyond what is available through traditional curatorial research.

Further Research Possibilities

This study is by no means complete. The results of the statistical analysis and cross-section microscopy show that additional dimensional measurements and cross-sections from each chair would help to more definitively divide the group. In addition, radiography of the joins of all the chairs would indicate whether they were all constructed in the same manner. Unfortunately, much of this work is beyond the budget and time available for this study.

More research into the provenance of the chairs is planned, as is a more thorough study of George Bright, his shop practices, other documented Bright furniture and probate records. All of this information will contribute to a better understanding of this original set of thirty and how they have survived.

Acknowledgements

Gregory Landrey, Furniture Conservator and Robert Trent, Curator and in Charge of Furniture at the Henry Francis Du Pont Winterthur Museum provided the opportunity to study the two winterthur chairs and encouraged me to extend this research to the entire set. Dr. Chandra Reedy, Assistant Professor and Ph.D Program Coordinator at the University of DelawarejWinterthur Program in Art Conservation graciously ran the statistical analysis program and contributed to the analysis of the results. And the Society for the Preservation of New Antiquities Conservation Center provided the time and funding which has enabled me to complete this work.

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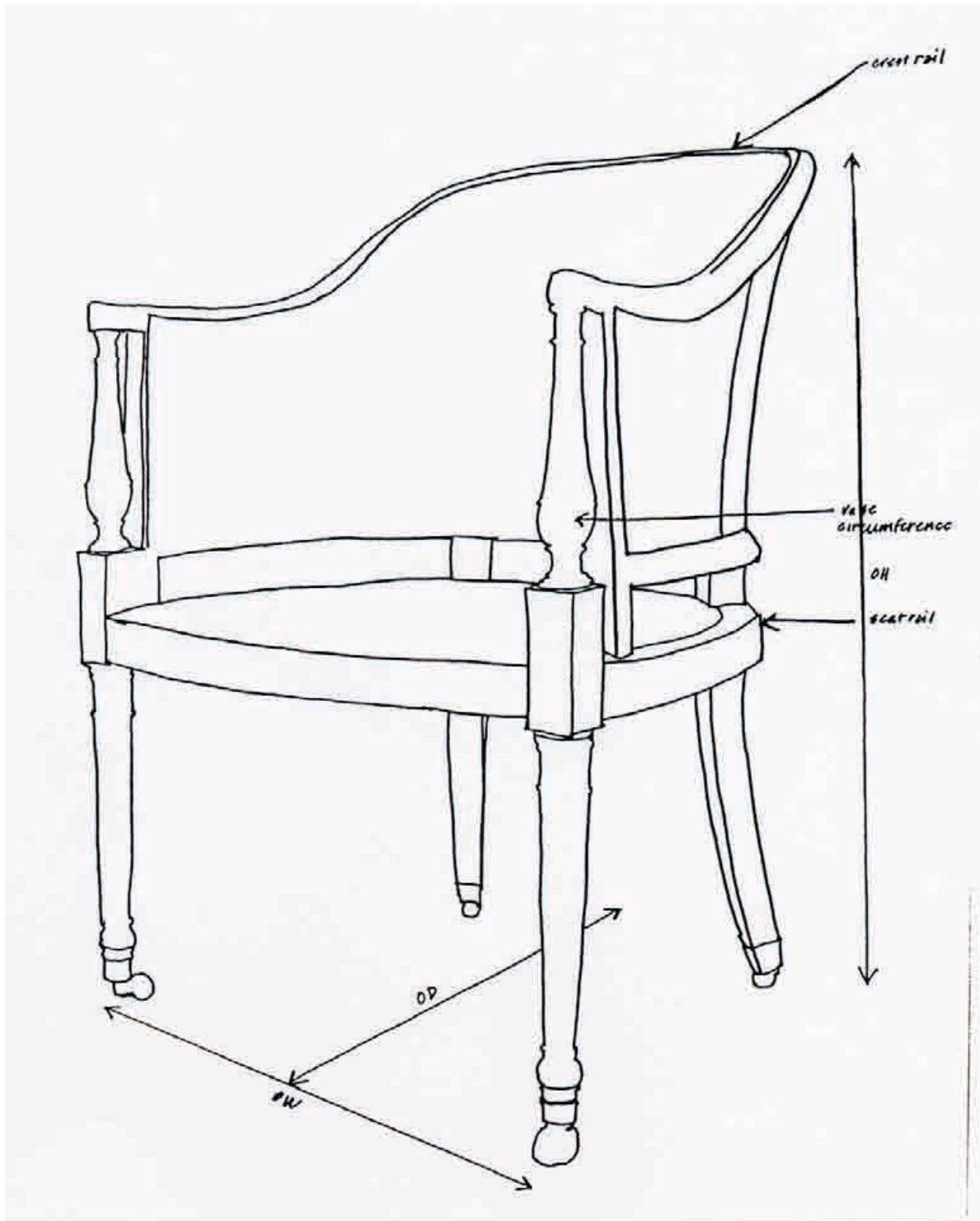
Appendix A

This George Bright Massachusetts State House Chair is in a private collection in Boston, Massachusetts.



Appendix B

Diagram of Measurement Locations:
Overall Height, Overall Width, Overall Depth, Height of the Crest Rail,
Height of the Seat Rail, Width of the Seat Rail,
and Circumference of the Vase Turning



Appendix C

Comparative Table of Dimensions

	OH	OW	OD	Seat Rail (1)	Seat Rail (2)	Crest Rail (3)	Vase Circ. (4)
1. Winterthur 70.1420	34.00	23.75	24.00	1.72	1.59	3.00	5.56
2. Winterthur 64.187	34.00	23.81	24.50	1.56	1.56	3.19	5.56
3. SPNEA 1969.777	32.37	23.87	21.25	1.75	1.50	2.87	4.75
4. SPNEA 1969.778	32.00	24.31	24.00	2.00	1.50	3.00	6.19
5. Bostonian Society 1943.17	32.12	24.00	24.00	1.75	1.50	3.12	5.62
6. Bostonian Society 59.1883	33.25	24.25	25.00	1.94	1.50	2.75	5.75
7. Massachusetts (A)	34.25	24.00	21.37	1.87*	1.75	3.25	5.75
8. Massachusetts (B)	34.37	24.00	21.31	1.87	2.00	2.87	5.50
9. Private Boston Collection	34.12	23.94	24.37	1.75	1.50	3.00	5.62
10. Henry Ford Museum	31.62	23.81	21.44	1.75	1.50	3.00	5.50
11. Colville (A)	34.50	24.00	21.50	1.75	1.50	3.06	5.75
12. Colville (B)	34.25	24.00	21.44	1.75	1.50	3.06	5.62

1. Height at center of back seat rail
2. Depth at center of back seat rail
3. Measurement at center of crest rail
4. Circumference of vase turning on arm support (PR)

*1/4" added wood at the top of the seat rail.

Appendix D

Histogram of Overall Height

```
# Buck2/hist 1991 March 31
# BMDP 5D
# Histograms of distribution of variables
# Is it a normal distribution (all one group), bimodal, or what?
# 12 George Bright chairs
```

```
/INPUT      file = save.
            code = chandra.
/PLOT type = hist.
            var = oheight to tncaster.
/END
```

HISTOGRAM OF VARIABLE		2 oheight		SYMBOL		COUNT	MEAN	ST.DEV.							
		X		12		33.404	1.074								
		EACH SYMBOL REPRESENTS		1 OBSERVATIONS											
INTERVAL		5	10	15	20	25	30	35	40	45	FREQUENCY	PERCENTAGE			
NAME												INT.	CUM.		
+-----+-----+-----+-----+-----+-----+-----+-----+-----+															
*31.6	+											0	0	0.0	0.0
*31.68	+X											1	1	8.3	8.3
*31.76	+											0	1	0.0	8.3
*31.84	+											0	1	0.0	8.3
*31.92	+											0	1	0.0	8.3
*32	+X											1	2	8.3	16.7
*32.08	+											0	2	0.0	16.7
*32.16	+X											1	3	8.3	25.0
*32.24	+											0	3	0.0	25.0
*32.32	+											0	3	0.0	25.0
*32.4	+X											1	4	8.3	33.3
*32.48	+											0	4	0.0	33.3
*32.56	+											0	4	0.0	33.3
*32.64	+											0	4	0.0	33.3
*32.72	+											0	4	0.0	33.3
*32.8	+											0	4	0.0	33.3
*32.88	+											0	4	0.0	33.3
*32.96	+											0	4	0.0	33.3
*33.04	+											0	4	0.0	33.3
*33.12	+											0	4	0.0	33.3
*33.2	+											0	4	0.0	33.3
*33.28	+X											1	5	8.3	41.7
*33.36	+											0	5	0.0	41.7
*33.44	+											0	5	0.0	41.7
*33.52	+											0	5	0.0	41.7
*33.6	+											0	5	0.0	41.7
*33.68	+											0	5	0.0	41.7
*33.76	+											0	5	0.0	41.7
*33.84	+											0	5	0.0	41.7
*33.92	+											0	5	0.0	41.7
*34	+XX											2	7	16.7	58.3
*34.08	+											0	7	0.0	58.3
*34.16	+X											1	8	8.3	66.7
*34.24	+											0	8	0.0	66.7
*34.32	+XX											2	10	16.7	83.3
*34.4	+X											1	11	8.3	91.7
*34.48	+											0	11	0.0	91.7
*34.56	+X											1	12	8.3	100.0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+															
		5	10	15	20	25	30	35	40	45					

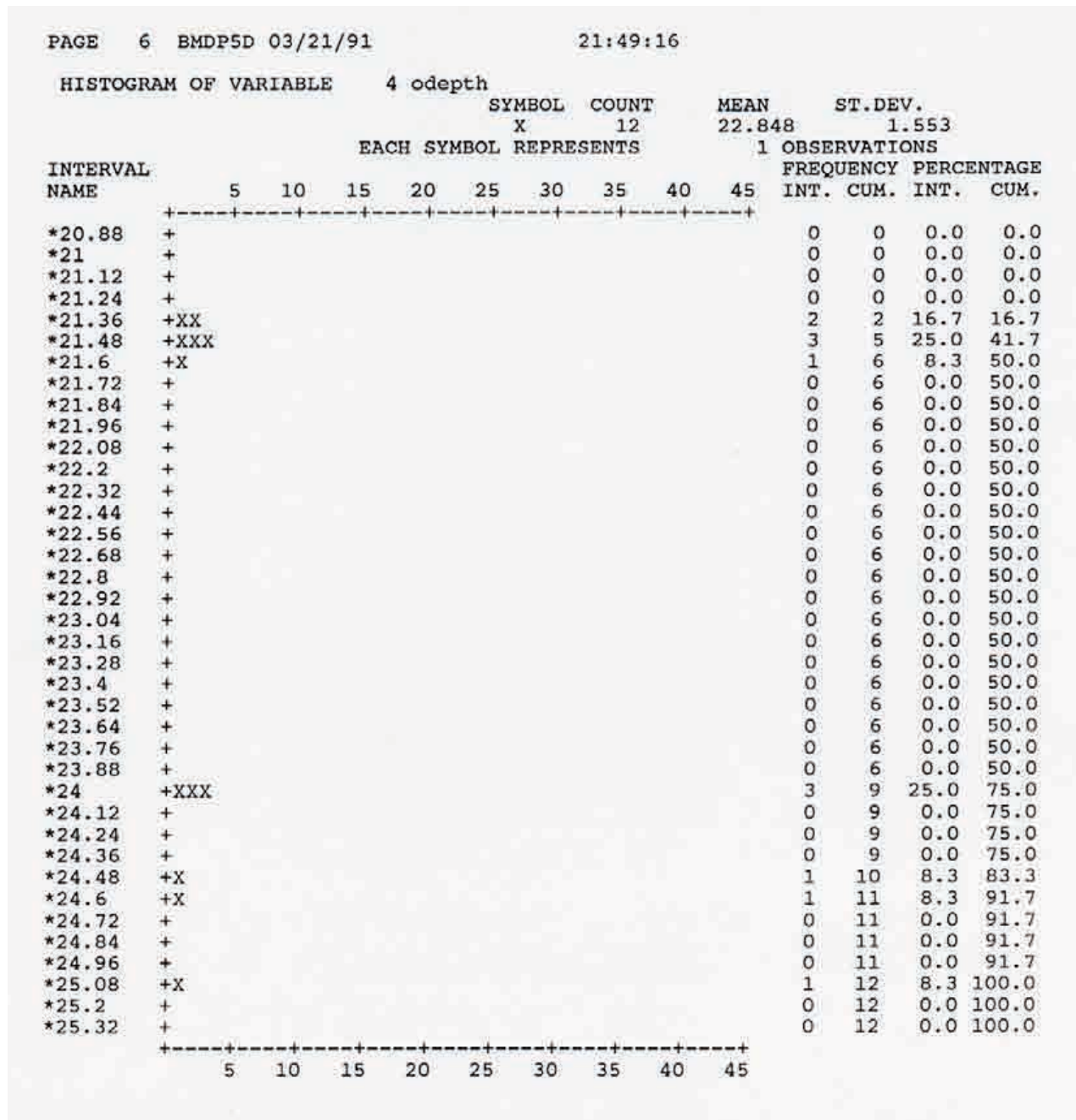
Appendix D Histogram of Overall Width

PAGE 5 BMDP5D 03/21/91

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HISTOGRAM OF VARIABLE		3 owidth		SYMBOL COUNT		MEAN		ST.DEV.				
		X		12		23.978		0.167				
		EACH SYMBOL REPRESENTS		1 OBSERVATIONS								
INTERVAL		5	10	15	20	25	30	35	40	45	FREQUENCY	PERCENTAGE
NAME											INT.	CUM. INT.
+-----+-----+-----+-----+-----+												
*23.706	+										0	0.0
*23.724	+										0	0.0
*23.742	+										0	0.0
*23.76	+X										1	8.3
*23.778	+										0	8.3
*23.796	+										0	8.3
*23.814	+XX										2	16.7
*23.832	+										0	25.0
*23.85	+										0	25.0
*23.868	+										0	25.0
*23.886	+X										1	33.3
*23.904	+										0	33.3
*23.922	+										0	33.3
*23.94	+										0	33.3
*23.958	+X										1	41.7
*23.976	+										0	41.7
*23.994	+										0	41.7
*24.012	+XXXXX										5	41.7
*24.03	+										0	83.3
*24.048	+										0	83.3
*24.066	+										0	83.3
*24.084	+										0	83.3
*24.102	+										0	83.3
*24.12	+										0	83.3
*24.138	+										0	83.3
*24.156	+										0	83.3
*24.174	+										0	83.3
*24.192	+										0	83.3
*24.21	+										0	83.3
*24.228	+										0	83.3
*24.246	+										0	83.3
*24.264	+X										1	91.7
*24.282	+										0	91.7
*24.3	+										0	91.7
*24.318	+X										1	100.0
*24.336	+										0	100.0
*24.354	+										0	100.0
*24.372	+										0	100.0
+-----+-----+-----+-----+-----+												
		5	10	15	20	25	30	35	40	45		

Appendix D Histogram of Overall Depth



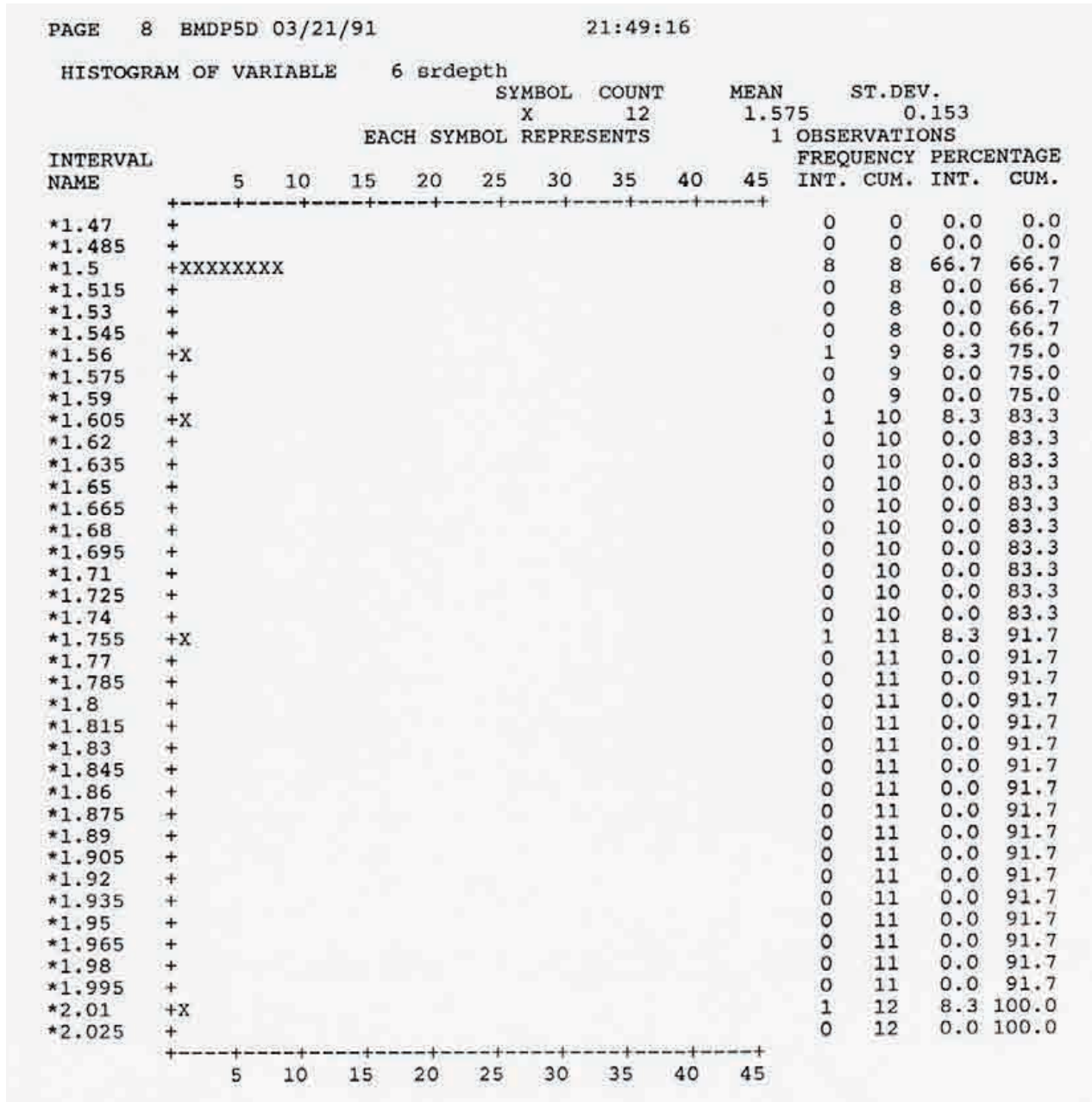
Appendix D Histogram of Seat Rail Height

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HISTOGRAM OF VARIABLE		5 srheight										SYMBOL		COUNT	MEAN	ST.DEV.	
		X										12	1.788	0.116			
		EACH SYMBOL REPRESENTS										1 OBSERVATIONS					
INTERVAL		5	10	15	20	25	30	35	40	45	FREQUENCY	PERCENTAGE					
NAME											INT.	CUM.	INT.	CUM.			
+-----+-----+-----+-----+-----+-----+-----+-----+																	
*1.56	+X										1	1	8.3	8.3			
*1.572	+										0	1	0.0	8.3			
*1.584	+										0	1	0.0	8.3			
*1.596	+										0	1	0.0	8.3			
*1.608	+										0	1	0.0	8.3			
*1.62	+										0	1	0.0	8.3			
*1.632	+										0	1	0.0	8.3			
*1.644	+										0	1	0.0	8.3			
*1.656	+										0	1	0.0	8.3			
*1.668	+										0	1	0.0	8.3			
*1.68	+										0	1	0.0	8.3			
*1.692	+										0	1	0.0	8.3			
*1.704	+										0	1	0.0	8.3			
*1.716	+										0	1	0.0	8.3			
*1.728	+X										1	2	8.3	16.7			
*1.74	+										0	2	0.0	16.7			
*1.752	+XXXXXX										6	8	50.0	66.7			
*1.764	+										0	8	0.0	66.7			
*1.776	+										0	8	0.0	66.7			
*1.788	+										0	8	0.0	66.7			
*1.8	+										0	8	0.0	66.7			
*1.812	+										0	8	0.0	66.7			
*1.824	+										0	8	0.0	66.7			
*1.836	+										0	8	0.0	66.7			
*1.848	+										0	8	0.0	66.7			
*1.86	+										0	8	0.0	66.7			
*1.872	+XX										2	10	16.7	83.3			
*1.884	+										0	10	0.0	83.3			
*1.896	+										0	10	0.0	83.3			
*1.908	+										0	10	0.0	83.3			
*1.92	+										0	10	0.0	83.3			
*1.932	+										0	10	0.0	83.3			
*1.944	+X										1	11	8.3	91.7			
*1.956	+										0	11	0.0	91.7			
*1.968	+										0	11	0.0	91.7			
*1.98	+										0	11	0.0	91.7			
*1.992	+										0	11	0.0	91.7			
*2.004	+X										1	12	8.3	100.0			
+-----+-----+-----+-----+-----+-----+-----+-----+																	
		5	10	15	20	25	30	35	40	45							

Appendix D Histogram of Seat Rail Depth



Appendix D Histogram of Crest Rail Height

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HISTOGRAM OF VARIABLE		7 crail		SYMBOL COUNT		MEAN		ST.DEV.						
		X		12		3.014		0.140						
		EACH SYMBOL REPRESENTS		1 OBSERVATIONS		FREQUENCY		PERCENTAGE						
INTERVAL NAME		5	10	15	20	25	30	35	40	45	INT.	CUM.	INT.	CUM.
+-----+-----+-----+-----+-----+-----+-----+-----+-----+														
*2.73	+										0	0	0.0	0.0
*2.745	+										0	0	0.0	0.0
*2.76	+X										1	1	8.3	8.3
*2.775	+										0	1	0.0	8.3
*2.79	+										0	1	0.0	8.3
*2.805	+										0	1	0.0	8.3
*2.82	+										0	1	0.0	8.3
*2.835	+										0	1	0.0	8.3
*2.85	+										0	1	0.0	8.3
*2.865	+										0	1	0.0	8.3
*2.88	+XX										2	3	16.7	25.0
*2.895	+										0	3	0.0	25.0
*2.91	+										0	3	0.0	25.0
*2.925	+										0	3	0.0	25.0
*2.94	+										0	3	0.0	25.0
*2.955	+										0	3	0.0	25.0
*2.97	+										0	3	0.0	25.0
*2.985	+										0	3	0.0	25.0
*3	+XXXX										4	7	33.3	58.3
*3.015	+										0	7	0.0	58.3
*3.03	+										0	7	0.0	58.3
*3.045	+										0	7	0.0	58.3
*3.06	+XX										2	9	16.7	75.0
*3.075	+										0	9	0.0	75.0
*3.09	+										0	9	0.0	75.0
*3.105	+										0	9	0.0	75.0
*3.12	+X										1	10	8.3	83.3
*3.135	+										0	10	0.0	83.3
*3.15	+										0	10	0.0	83.3
*3.165	+										0	10	0.0	83.3
*3.18	+										0	10	0.0	83.3
*3.195	+X										1	11	8.3	91.7
*3.21	+										0	11	0.0	91.7
*3.225	+										0	11	0.0	91.7
*3.24	+										0	11	0.0	91.7
*3.255	+X										1	12	8.3	100.0
*3.27	+										0	12	0.0	100.0
*3.285	+										0	12	0.0	100.0
+-----+-----+-----+-----+-----+-----+-----+-----+-----+														
		5	10	15	20	25	30	35	40	45				

Appendix D Histogram of Vase Circumference

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