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The Horizon Concept Revealed in the Application of the Mean Ceramic Date Formula to Spanish Majolica, in the New World

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by

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Stanley South

In a recent article I outlined an analysis tool in the form of a mean ceramic date formula for use in interpreting the median occupation date represented by English ceramics from British-American sites of the eighteenth century (South 1972:71). In that study the manufacture period of the ceramic types was used to arrive at a median manufacture date which was applied in the formula, along with the frequency of occurrence of fragments to produce a mean ceramic date. The median manufacture dates were determined from data compiled by Ivor Noël Hume (1970), and up-dated through an interview with him. From a total of sixteen sites for which the median historic occupation dates were known, the ceramic formula tended to overestimate the median historic date by 1.1 years, on the average (South 1972:217-18).

The explanation of why the ceramic formula dates tend to parallel the historic median occupation dates is seen in the broad and rapid spread of the ceramic types from their sources of manufacture at any one point in time. This horizon phenomenon has been explained by Willey and Phillips (1958:31-34) as:

> a primarily spatial continuity represented by cultural traits and assemblages whose nature and mode of occurrence permit the assumption of a broad and rapid spread. The archaeological units linked by a horizon are thus assumed to be approximately contemporaneous (Willey and Phillips 1958:31-34).

It was also suggested that:

> Colonial French and Spanish ceramics could also be arranged in a similar historical chronology provided the manufacture dates are known for the ceramic types (South 1972:76).

With this in mind the present study was undertaken to examine the application of the mean ceramic date formula to Spanish majolica in the New World based on the data compiled by John M. Goggin (1968).

Constructing the Majolica Model

The first step in constructing a majolica model was to examine Goggin's majolica types and the temporal brackets assigned by him. Twenty-three majolica types were used to determine median dates, and these are shown in Figure 1.

MAJOLICA TYPES WITH GOGGIN DATES AND SOUTH INDEX DATES

Majolica Type Ref. Number	Majolica Type Name	Goggin Date Range (ca.)	Ref. Page No. (Goggin 1968)	Goggin Median Date	South Index Date
1	Columbia Plain	1493-1650	124	1572	1535
2	Isabela Polychrome	1490-1560	128	1525	1445
3	Yayal Blue on White	1550-1600	130	1575	1532
4	La Vega Blue on White	1525-1575	131	1550	1507
5	Caparra Blue	1500-1560	135	1530	1487
6	Santo Domingo Blue on W.	1550-1630	133	1590	1547
7	Ichtucknee Blue on Blue	1550-1650	139	1600	1675
8	Ichtucknee Blue on White	1615-1650	150	1633	
9	San Luis Blue on White	1630-1690	157	1660	
10	Fig Springs Polychrome	1610-1660	154	1635	
11	Blue and Orange Polychr.	1625-1650	166	1638	
12	Puebla Polychrome	1650-1700	180	1675	
13	Puebla Blue on White	1700-1850	194	1775	
14	San Luis Polychrome	1660-1720	169	1690	
15	Abó Polychrome	1650-1700	172	1675	
16	Aranama Polychrome	1750-1800	198	1775	
17	Aucilla Polychrome	1650-1685	163	1668	
18	Tallahassee Blue on W.	1635-1700	159	1668	
19	Castillo Polychrome	1685-1704	185	1695	
20	Mt. Royal Polychrome	mid-century	161	1650	
21	Puaray Polychrome	1675-1700	183	1688	
22	San Agustín Blue on W.	1700-1730	189	1715	
23	Huejotzingo Blue on W.	1700-1900	195	1800	

Figure 1

on Blue, was assigned a date 75 years later than Goggin's Median Date. This was done to bring the seventeenth century sites into line with the generalized dates assigned by Goggin, and recent studies on seventeenth century sites (Deagan 1972; Milanich 1972).

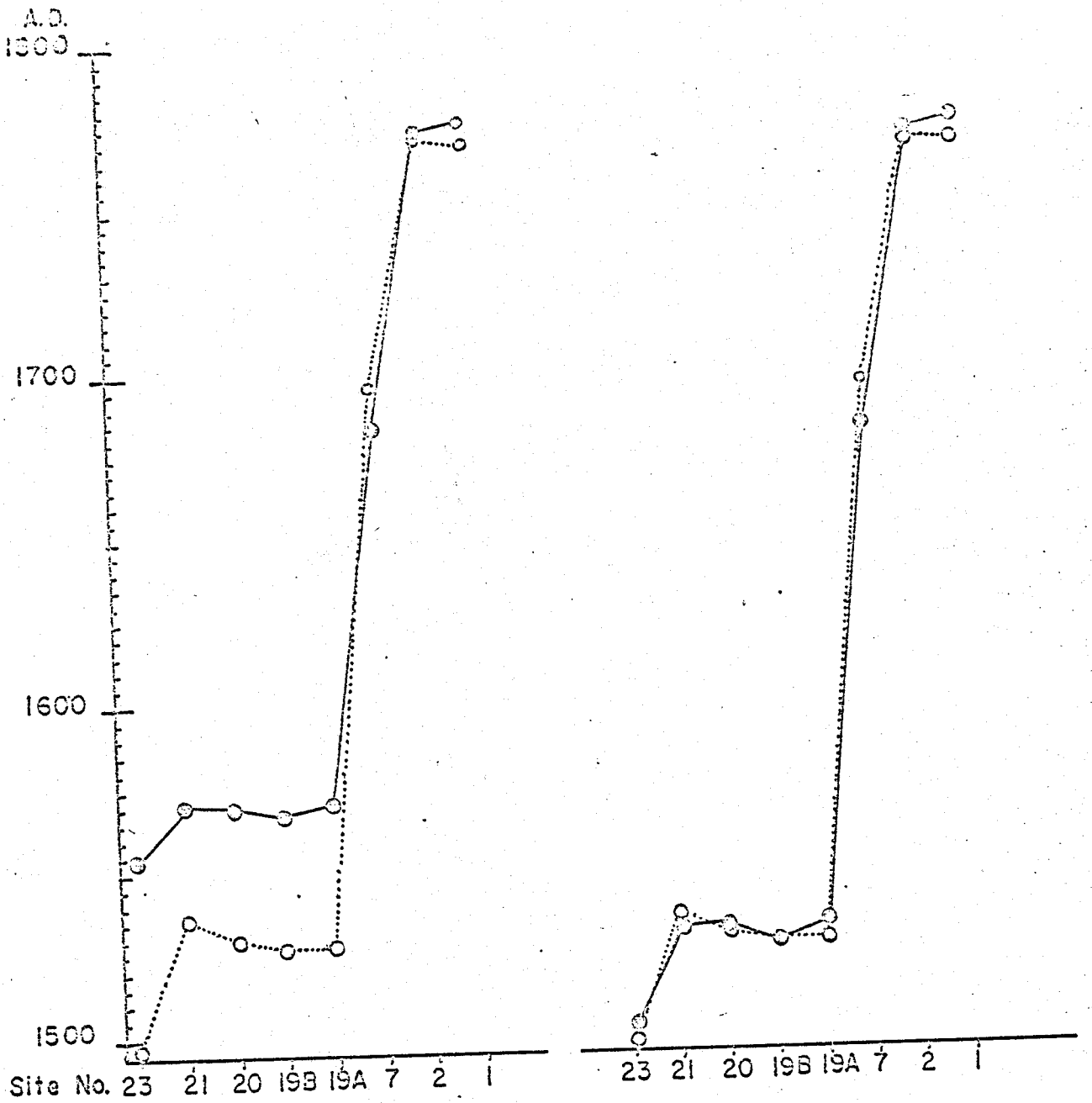
Using the assigned Index Date for the first seven majolica types, and Goggin's Median Date for the remaining types, the Mean Ceramic Date Formula can be used to determine a date for use in interpreting the median occupation date represented by the sample. The result of this adjustment to produce the model is seen in the table in Figure 2, with the sherd counts for these eight collections in Appendix I. The sum of the differences between the historic median dates and the formula dates using the Goggin Median Dates is seen to be plus 210.4 years for the eight collections, whereas using the Index Dates for the first seven majolica types and Goggin's Median Date for the remaining types produces a sum of differences of only 5.5 years. The comparison between the historic median and the formula dates using the Goggin Median Dates entirely, and using the combination Index Date and Goggin Median Date, can be seen in the graphs in Figure 3.

With our adjusted model producing a sum of differences for the eight collections of only 5.5 years, for an average overestimate of the majolica formula of .69 years above the known median dates, we can have some degree of confidence in our model. In order to infer from this small sample the range in which the total population mean might fall, we use the formula (D. South 1972:165):

$$\bar{Y} \pm t\alpha/2 \ {}^{S}/\sqrt{n}$$

From this (Figure 2) we determine that there is a 95% confidence that the total population mean (μ) would fall between 6.217 and -4.837. This,

COMPARISON OF THE CERAMIC FORMULA DATES
WITH THE MEDIAN HISTORIC DATES
USING THE GOGGIN MEDIAN AND THE INDEX DATE
ON MAJOLICA SAMPLES FROM EIGHT SITES



UNADJUSTED MODEL

Formula Dates Using Goggin Median Dates for all Majolica Types

ADJUSTED MODEL

Formula Dates Using Index Dates for Seven Majolica Types

Ceramic Formula Date———
Median Historic Date·····

Figure 3

plus the fact that the majolica formula overestimates the known historic median dates by an average of only .69 years, allows us with some confidence, to apply our model to data from sites for which the historic dates are not known, but for which there is some relative chronological data derived from seriation and stratigraphy. If our model formula replicates the temporal sequence revealed through seriation and stratigraphic excavation, we have additional data to support the validity of our analysis tool.

Application of the Ceramic Formula to Goggin's Stratigraphic Data

At Huejotzingo, Mexico, Goggin has stratigraphic data by six inch levels to a depth of 54 inches (Goggin 1968:99). Application of the ceramic formula to this data revealed the following sequence.

Level	Formula Date
0-6"	1727.7
6-12"	1698.8
12-18"	1697.9
18-24"	1654.6
24-30"	1643.3
30-36"	1636.7
36-42"	1636.1
42-48"	1635.0
48-54"	1635.0

Goggin interprets the 24-30" level as representing an occupation dating around 1650, and the formula date for this level is 1643.3, with the level above having a formula date of 1654.6, which is entirely in keeping with Goggin's interpretation. The sherd count by majolica type for each level is seen in Appendix 2.

From the Convento De San Francisco, Dominican Republic, Goggin reveals stratigraphic data from levels to a depth of 85 inches (Goggin

1968:109). Application of the ceramic formula to this data produced the following sequence.

Level	Formula Date	Goggin (1968:113) Interpretive Date	
0-8"	1603.3		
8-16"	1605.7	Post-1800	"a sudden increase in European chinaware dating from the second half of the 18th century." (108)
16-24"	1547.0		
24-32"	1629.3	1750-1800	
32-40"	1708.2	1700-1750	
40-48"	1649.8	1650-1700	
48-51"	1636.0	1615-1650	
51-59"	1557.1	1580-1615	
59-67"	1534.5		
67-79"	1534.8	1500-1580	
79-85"	1531.7		

The bottom seven levels produce a consistent sequence from the second quarter of the sixteenth century to the early eighteenth century. At the 24-32" level, however, there begins a reversal of ceramic formula dates, clearly reflecting a change in the cultural factors relating to majolica that resulted in the consistent sequence observed in the lower levels. One explanation for this phenomenon could be that the site in the area of this stratigraphic cut was subjected to a cultural use varying dramatically from that represented in the deeper levels of the deposit, resulting in a greater disturbance of the ground in the higher levels. However, another, more likely explanation is seen in cultural phenomena of a broader scope, i.e. a dramatic change in the role played by majolica in the culture represented by the deposits above the 32" level. The explanation is clearly seen in Goggin's statement that with the 24 to 32" level there was "a sudden increase in European chinaware dating from the second half of the 18th century" (Goggin 1968:108). This decrease in the importance of majolica in the culture is also reflected in the fact that from the 32" level up to the surface only 32 majolica sherds

COMPARISON OF THE CERAMIC FORMULA DATES WITH GOGGIN'S SERIATION CHART
(Figure 1 in Goggin 1968:25-27)

Site Reference Number and Name in Goggin Seriation		Ceramic Formula Date	Historic Median Date And Goggin Comment
1	Falcon Reservoir, Texas	1777.2	1770
2	Aranama, Texas	1773.0	1771
3	Quiburi, Arizona	1770.3	
4	N. Senora de la Leche, Florida	1718.9	
5	Pine Tuft, Florida	1676.0	"probably destroyed 1700-06"
6	Zetrouer, Florida	1677.3	
7	Fort San Luis, Florida	1684.0	1697
8	Scott Miller, Florida	1676.8	"terminal date ca. 1685"
9	Beaty, Florida	1667.2	"late 17th century"
10	Wright's Landing, Florida	1653.2	"early 1650's"
11	Darien Bluff (Ft. King Geo.), Fla.	1639.1	
12	Mt. Royal, Florida	1633.3	"middle of seriation [1640?]"
13	Fig Springs, Florida	1615.7	"1615-50 postulated"
14A	Maurica, Venezuela (Rocx 15)	1633.6	"between 1620 & 1645"
14B	Maurica, Venezuela (All units)	1627.2	"between 1620 & 1645"
15	Punta Mosquito, Venezuela	1620.7	"early 17th century"
16	Obispo, Venezuela	1646.3	"about 1630"
17	Richardson, Florida	1620.2	"ca.1615"
18	Cepicepi, Dominican Republic	1615.9	"ca.1600"
19A	La Vega Vieja, Dom. Rep. (1952)	1534.0	1528.5
19B	La Vega Vieja, Dom. Rep. (1953-4)	1528.5	1528.5
20	Nueva Cadiz, Venezuela	1532.5	1530.0
21	Jacagua, Dominican Republic	1532.0	1536.5
22	Juandolio, Dominican Republic	1520.4	"early 16th century"
23	Isabela, Dominican Republic	1502.8	1498.0

Figure 4

From this comparison it is evident that there is only a minor difference between the sequence arrived at by Goggin, and that resulting from the application of the ceramic formula, the Fig Springs, Florida, site and the Obispo, Venezuela site being those most out of place in the seriation. The majolica sherd counts for each site in the seriation are seen in Appendix 4. The known historic median dates for eight of the collections are also shown in this figure, and as has been pointed out the formula dates overestimate these historic median dates by an average of .69 years, with the greatest discrepancy being the -13 years for the collection from Fort San Luis, Florida (see Figure 2).

A slight difference is seen in the listing of the sites here from that of Goggin, in that there is a 14A and 14B, and a 19A and 19B. This was done as a check against the ceramic formula. Collections 14A and 14B are from Maurica, Venezuela, with Goggin using the majolica from one excavation unit (Rocx 15) as representative of all those excavated (14A). The majolica sample 14B represents the entire collection from all units including Rocx 15. The date for the one excavation unit used by Goggin was 1633.6, and the date for all the majolica from all units was 1627.2 a difference of only 6.4 years.

A different comparison is seen in collections 19A and 19B, from the La Vega Vieja, Dominican Republic site. Goggin used 19A, a collection made in 1952, in his seriation. Collections made in 1953 and 1954, and combined, are designated 19B. The 1952 collection from the site produced a ceramic formula date of 1534.0, and the combined collections of 1953 and 1954 produced a formula date of 1528.5, only 5.5 years apart, with 19A being 5.5 years removed, and 19B the same as the historic median date of 1528.5. The majolica sherd counts for all collections used in the seriation are seen in Appendix 4.

Application of the Ceramic Formula to Various Archeological Sites

A number of collections of majolica from various sites were discussed by Goggin that were not used in his seriation. Those for which he had some temporal comment are included here along with the ceramic formula date.

Site	Ceramic Formula Date	Goggin's Temporal Range and Comments
Awatovi, Arizona	1668.6	1629-1680
Tumacacori, Arizona	1777.1	1701 -
Kuaua, New Mexico	1675.0	before 1680
Puaray, New Mexico		
(First Sample)	1678.6	
(Second Sample)	1747.7	

Goggin says that these two samples apparently represent "two occupations, one previous to the revolt of 1680 and a second in the 18th century" (Goggin 1968:84). The formula dates support this interpretation.

Adaes, Texas	1737.6	1721-1773

Goggin felt that there must have been two settlements represented by this collection because of the presence of types 12 and 15 of the seventeenth century, and the presence of 37 fragments of type 13 of the third quarter of the eighteenth century. One settlement he thought would have been "about 1680" and the other during the documented period of 1721-1773 (Goggin 1968:81). However, the ceramic formula indicates a date only 9.4 years from the known historic median date for the eighteenth century occupation of the site. Types 12 and 15 reveal a ceramic formula date of 1675.0, with types 22 and 13 producing a formula date of 1770.5, which is certainly in keeping with Goggin's interpretation, if we divide the collection as Goggin did.

Fox Pond, Florida	1635.1	1630-1650
Middle Plateau Trading Post, Macon, Georgia	1684.2	1690-1710

Goggin felt this sample of 12 sherds "equates perfectly with the supposed date of the trading post" (Goggin 1968:79), but the ceramic formula date certainly indicates a date earlier than the middle of Goggin's historic time range. The sherd counts for the majolica in these collections are seen in Appendix 5.

Explanation in Terms of the Horizon Concept

The sites from which the majolica collections used in this study came are from a broad area including Georgia, Florida, Texas, Arizona,

and New Mexico, as well as Mexico, Venezuela, and Dominican Republic. Any patterned relationships existing between majolica types having temporal consistency, such as demonstrated through the application of the ceramic formula in this study, is a clear indication that there was a broad and rapid spread of majolica throughout the area involved in this study. This is interpreted in terms of the horizon concept of Willey and Phillips (1958: 31-34), with any one point in time being reflected in similar majolica type relationships from contemporaneously occupied sites.

Summary

In this paper we have constructed a model ceramic formula based on data compiled by John M. Goggin from Spanish majolica found on sites in the New World (Goggin 1968). It was found that the median date for six sixteenth century majolica types was too late for producing a ceramic formula date closely approximating the median historic occupation date for the sites for which these dates are known. One seventeenth century type was seen to have a median date too early to produce formula dates closely approximating Goggin's estimates for seventeenth century sites. Because of this an Index Date was assigned to these seven majolica types, and when these dates were used along with Goggin's median ceramic dates for seventeenth and eighteenth century sites, the ceramic formula model produced dates that are seen to overestimate the known historic median occupation date for the sites by an average of only .69 years.

Using this majolica model formula with the stratigraphic data gathered by Goggin it was found that the ceramic formula dates closely replicated the stratigraphic sequence. Applying the ceramic formula to the sites used by Goggin in his seriation chart also produced a close replication of the sequence arrived at by Goggin using traditional seriation methods.

The fact that the majolica formula is seen to work as well as it does within the limits of the Goggin data illustrates that it is likely a reliable means of expressing the Goggin data. This study has attempted to construct a model based on Goggin data and expressed in terms of a formula, that can be used to compare with data from sites not included in this study and for which there is some chronological control other than majolica. Since Goggin's data was used to construct the formula, the formula cannot then be tested by reference to the same data. Internal consistency between the model formula and Goggin's data can be demonstrated, such as we have done with the seriation and stratigraphic data comparisons and comparisons with collections from sites of known occupation periods. Testing, however, in terms of reliability must come through application of the formula to data lying outside that used by Goggin. If subsequent research demonstrates that the formula is invalid for dating majolica collections, then this may reflect an area where the formula was not internally consistent with Goggin's data, or it may represent a need to adjust Goggin's conclusions in the light of new evidence, and thereby the Index Dates whereby the formula date is derived.

Since the majolica formula is a model designed to express the Goggin data through statistical means, we are free to manipulate the Index Dates toward the end of producing consistent ceramic dates from the formula that are in keeping with the Goggin data. It is not necessary, therefore, that the Index Dates correlate with Goggin's estimates for the time period during which each majolica type was being deposited on occupation sites, so long as the resulting mean ceramic date obtained from the formula is reasonably consistent with the chronology outlined by Goggin.

The Index Date represents, therefore, a functional expedi with un-
limited flexibility for use in arriving at ceramic formu ites that
can be used, with some degree of reliability, as an inter tive aid in
establishing the occupation period represented by majoli mples. The
Index Date is not the median manufacture date such as wa ed in con-
structing the Mean Ceramic Date Formula for British Cera (South 1972),
nor does it represent the period of maximum use of the m ica type to
which it is assigned. It is an index number designed to duce consis-
tent results from the majolica formula that are internal consistent
within the Goggin data. As more data become available s fically
dating sites on which majolica is found, using controls er than
majolica, the Index Dates assigned here may well have to revised to
accommodate the new data. Cultural variation may well b und to be
reflected in the formula dates, for instance Indian-occu as opposed
to Spanish-occupied sites, where we may find that the fo a dates
from Indian-occupied sites will be earlier than Spanish- pied sites
of the same time period. As we discover and program ne a into the
majolica formula we should eventually have a formula tha ill be so
firmly rooted in research that its reliability will be enough to
allow it to become a basic chronological tool.

When the above point is understood it should be eas seen how
this concept could be applied to prehistoric ceramic se ces for which
there is a well defined series of ceramic types within latively
short period of time, and for which there is some compa ve control,
such as dendrochronology or two or three radiocarbon da A firmly
established seriation such as this, verified by stratig ic control
could be the basis for constructing a model where inde es were

assigned to the various ceramic types, using the radiocarbon or cross dating dates as control for the chronology. Once such a model was constructed, the South Mean Ceramic Date Formula used in the majolica study and in the study of British ceramics could be applied. The formula dates would first have to be seen to have internal consistency within the sequence used to construct the model, then the formula could be tested by application to site collections in the same area where the ceramic types are found. Once reliability was demonstrated by temporal controls other than those of the ceramics themselves, the formula could be applied with confidence that the resulting mean ceramic date could be used to interpret the occupation period represented by the ceramic collections with perhaps a more sensitive degree of temporal separation than is now enjoyed through traditional seriations. An important application would be in quick relative temporal placement of a site from a surface survey, where pottery is the primary data recovered. The application of the formula to prehistoric collections should focus on temporally confined ceramic sequences for the most effective model.

As was emphasized in my paper in which the mean ceramic date formula was used to analyze ceramics from British American sites, the explanation for why the formula works as it does relates to the fact that there was a broad and rapid spread of these artifacts at any one point in time (South 1972). The fact that the ceramic formula is seen to be applicable to majolica collections as demonstrated in this paper illustrates that the horizon is the cultural phenomenon responsible for this patterning. It is emphasized that any site not subject to the trade contacts producing the broad and rapid spread of majolica, would obviously not produce data lending itself to analysis by means of the ceramic formula due to the absence of majolica from such sites.

The patterning in the archeological record seen in our research in British ceramics and Spanish majolica and expressed through the formula, has been explained in terms of culture process by means of the horizon. This does not mean, however, that the use of the formula would have to be limited to the horizon as the explanatory phenomenon. In some instances it may be found that the formula can be applied to data representing a tradition within a restricted geographic area. Answers to questions such as these, however, can only come through the application of the formula model concept to the archeological data.

The formula approach presented here and in the analysis of ceramics from British American sites (South 1972), has implications far beyond the use of formulas for analysis of historic ceramics. Richard Carrillo (1972) has used this same conceptual base in an analysis of English wine bottle attributes to construct a statistically based chronology which provides a means for independent temporal comparison with that derived from use of the ceramic formula. Much broader implications are inherent in the formula approach in that if seriations anchored in historical control (such as Goggin's) are valid then we may have some assurance that prehistoric frequency seriations constructed in a like manner might have validity. If the cultural data upon which such seriations are based can be seen to be reliably expressed in terms of statistical formulas, then we will have moved toward a better understanding of culture process represented by the archeological record.

The following is a list of the events in the process of development of the majolica formula, and a paradigm of the role of the formula model in explaining culture process from the archeological record.

SEQUENTIAL EVENTS IN MAJOLICA RESEARCH

1. Majolica type manufacture period unknown.

2. Majolica types accumulated on occupation sites.

3. Goggin collected majolica from occupation sites of known historic periods.

4. Majolica types were assigned temporal brackets based on occurrence or non-occurrence on sites of known historic periods.

5. Majolica collected from sites of unknown historic period was used to assign interpreted occupation period for the site.

6. Stratigraphic tests were used to clarify the temporal relationship of majolica types.

7. Seriation was used to aid in determining the temporal position of sites for which no documented period was known.

8. Seriation was used to clarify temporal relationships among majolica types.

9. Sites of known occupation were used as a controlling framework for the seriation.

10. Goggin's majolica median dates were used with South's Mean Ceramic Date Formula to test the fit of the formula to majolica data.

11. Index Dates were assigned to seven majolica types to adjust the fit of the formula dates to the documented median occupation dates for sites and Goggin's estimates of the occupation period represented by majolica collections from occupation sites.

12. Formula dates were compared with Goggin's stratigraphic test to check for internal consistency of the formula to the strata dates assigned by Goggin.

13. Formula dates were compared with Goggin's seriation sequence of sites based on majolica types.

14. The formula dates were seen to have a high degree of correlation to to the median historic occupation dates and with Goggin's estimates of the occupation period represented by the sites from which the majolica samples were recovered.

...The extent of present research...

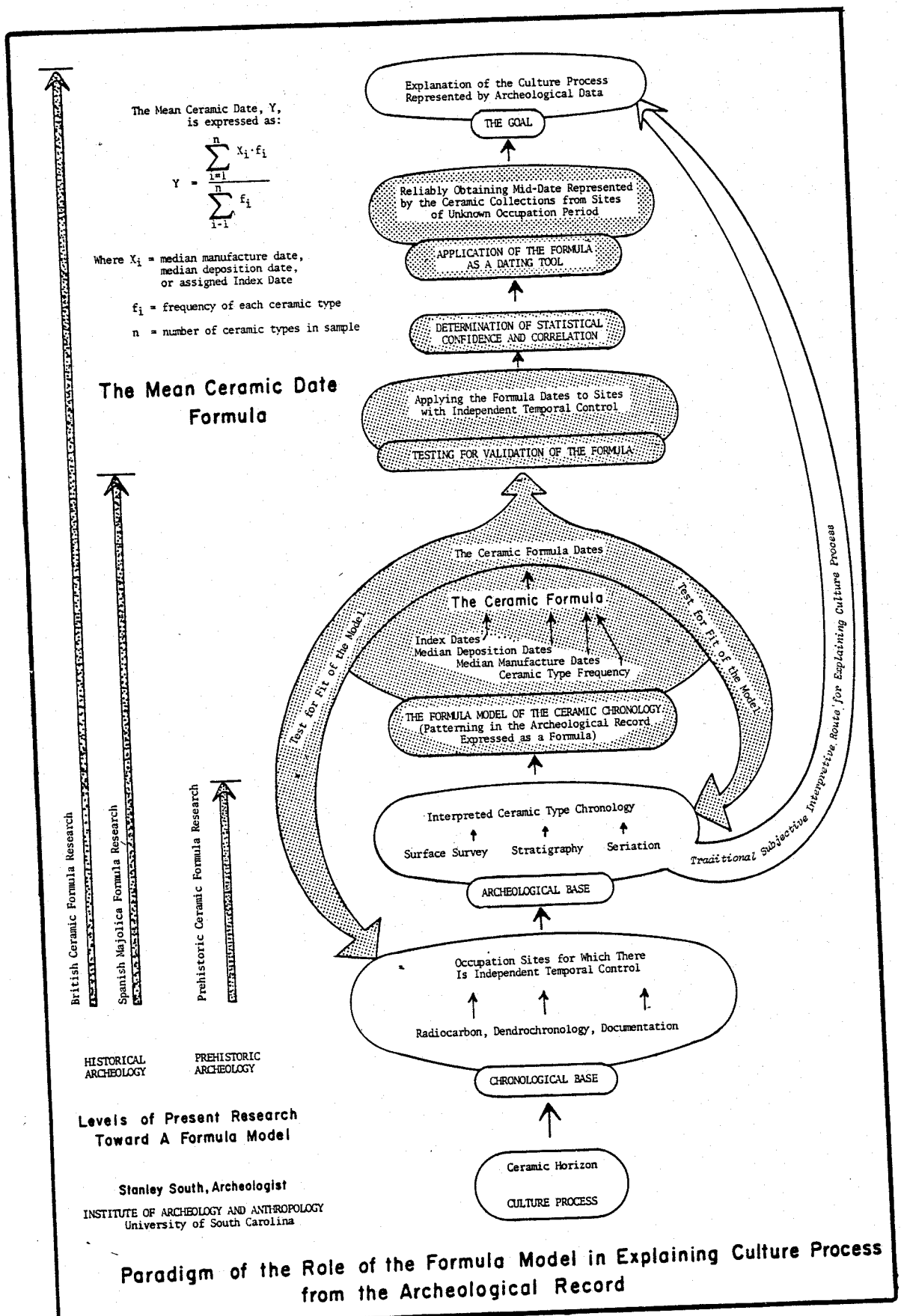
15. The next step is to test the formula by applying it to majolica

samples from sites where there is some independent temporal control: historical documentation, artifact analysis of known artifact types, cross dating of artifact types of known temporal period, dendrochronology or radiocarbon dating.

16. If the formula dates for majolica from many such sites can be statistically demonstrated to have a high degree of correlation with the independent temporal control prediction, then confidence can be placed in the reliability of the formula dates.

17. When this point is reached the formula can, for the first time, be reliably used to arrive at a date upon which interpretation can be made as to the occupation period represented by the majolica sample from an archeological site.

18. When such reliability is established we will have demonstrated that the patterning in the archeological record resulting from culture process can be expressed by means of a formula. In so doing we will hopefully have taken a step toward testing some of our assumptions regarding frequency seriation, and toward the eventual application of the formula concept to prehistoric data.



Paradigm of the Role of the Formula Model in Explaining Culture Process from the Archeological Record

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APPLICATION OF THE CERAMIC FORMULA TO MAJOLICA COLLECTIONS USING THE GOGGIN MEDIAN DATE AND INDEX DATE FOR CONSTRUCTING THE MAJOLICA MODEL FORMULA

Majolica Type	Goggin Median	Index	Sherd Count	Median Product	Index Product
Site Reference No. 1					
FALCON RESERVOIR, TEXAS 1760? - 1780? (Goggin 1968:82)					
13	1775		90	159750	
17	1800		16	28800	
22	1715		1	1715	
16	1775		45	79875	
			152	270140 ÷ 152 = 1777.2	
Date using Goggin Median = 1777.2				Historic Median Date = 1770	
Site Reference No. 2					
ARANAMA, TEXAS 1749 - ca. 1793 (Goggin 1968:82)					
22	1715		25	42875	
13	1775		293	520075	
23	1800		30	54000	
16	1775		25	44375	
			373	661325 ÷ 373 = 1773.0	
Date using Goggin Median = 1773.0				Historic Median Date = 1771	
Site Reference No. 7					
FORT SAN LUIS, FLORIDA 1690 - 1704 (Goggin 1968:76)					
14	1690		63	106470	
12	1675		35	58625	
19	1695		10	16950	
15	1675		5	8375	
9	1660		7	11620	
22	1715		2	3430	
17(?)	1668		1	1668	
			123	207138 ÷ 123 = 1684.0	
Date using Goggin Median = 1684.0				Historic Median Date = 1697	
Site Reference No. 19B (1953-54 Collection)					
LA VEGA VIEJA, DOMINICAN REPUBLIC 1495? - 1562 (Goggin 1968:79)					
1	1572	1535	149	234228	228715
3	1575	1532	27	42525	41364
2	1525	1445	7	10675	10115
5	1530	1487	11	16830	16457
4	1550	1507	8	12400	12056
7	1600	1675	1	1600	1675
			203	318258 ÷ 203 = 1567.8	310282 ÷ 203 = 1528.5
Date using Goggin Median = 1567.8					
Date using Index Number = 1528.5				Historic Median Date = 1528.5	

Majolica Type	Goggin Median	Index	Sherd Count	Median Product	Index Product
Site Reference No. 19A (1952 Collection)					
LA VEGA VIEJA, DOMINICAN REPUBLIC 1495? - 1562 (Goggin 1968:28)					
1	1572	1535	442	694824	678470
3	1575	1532	17	26775	26044
2	1525	1445	4	6100	5780
5	1530	1487	5	7650	7435
7	1600	1675	2	3200	3350
4	1550	1507	4	6200	6028
6	1590	1547	2	3180	3094
			476	747929 ÷ 476 = 1571.3	730201 ÷ 476 = 1534.0
Date using Goggin Median = 1571.3					
Date using Index Number = 1534.0				Historic Median Date = 1528.5	
Site Reference No. 20					
NUEVA CADIZ, VENEZUELA (Ex. 5) 1515 - 1545 (Goggin 1968:43)					
1	1572	1535	202	317544	310070
3	1575	1532	10	15750	15320
5	1530	1487	9	13770	13383
2	1525	1445	1	1525	1445
			222	348589 ÷ 222 = 1570.2	340218 ÷ 222 = 1532.5
Date using Goggin Median = 1570.2					
Date using Index Number = 1532.5				Historic Median Date = 1530.0	
Site Reference No. 21					
JACAGUA, DOMINICAN REPUBLIC 1511 - 1562 (Goggin 1968:29)					
1	1572	1535	265	416580	406775
3	1575	1532	8	12600	12256
2	1525	1445	8	12200	11560
4	1550	1507	3	4650	4521
6	1590	1547	2	3180	3094
5	1530	1487	1	1530	1487
			287	450740 ÷ 287 = 1570.5	439693 ÷ 287 = 1532.0
Date using Goggin Median = 1570.5					
Date using Index Number = 1532.0				Historic Median Date = 1536.5	
Site Reference No. 23					
ISABELA, DOMINICAN REPUBLIC 1493 - 1503 (Goggin 1968:24)					
1	1572	1535	61	95892	93635
2	1525	1445	34	51850	49130
3	1575	1532	1	1575	1532
5	1530	1487	2	3060	2974
			98	152377 ÷ 98 = 1554.9	147271 ÷ 98 = 1502.8
Date using Goggin Median = 1554.9					
Date using Index Number = 1502.8				Historic Median Date = 1498.0	

APPENDIX 2

APPLICATION OF THE CERAMIC FORMULA TO STRATIGRAPHIC DATA AT HUEJOTZINGO, MEXICO (Table 6 in Goggin 1968:99)

Level	Majolica Type No.	Goggin Median or South Index Date	Sherd Count	Product	South Formula Date
0-6"	9	1660	1	1660	
	14	1690	6	10140	
	12	1675	5	8375	
	15	1675	1	1675	
	17	1668	2	3336	
	13	1775	13	23075	
	22	1715	6	10290	
	16	1775	4	7100	
			38	65651 ÷ 38 =	1727.7
6-12"	9	1660	2	3320	
	14	1690	30	50700	
	12	1675	4	6700	
	15	1675	1	1675	
	13	1775	5	8775	
	22	1715	5	8575	
	23	1800	1	1800	
			48	81545 ÷ 48 =	1698.8
12-18"	10	1635	1	1635	
	9	1660	1	1660	
	14	1690	12	20280	
	12	1675	1	1675	
	17	1668	1	1668	
	13	1775	3	5325	
	22	1715	1	1715	
			20	33958 ÷ 20 =	1697.9
18-24"	10	1635	12	19620	
	9	1660	1	1660	
	14	1690	1	1690	
	17	1668	1	1668	
	13	1775	1	1775	
	22	1715	1	1715	
			17	28128 ÷ 17 =	1654.6
24-30"	10	1635	19	31065	
	14	1690	2	3380	
	12	1675	1	1675	
	15	1675	1	1675	
			23	37795 ÷ 23 =	1643.3
30-36"	10	1635	28	45780	
	9	1660	2	3320	
			30	49100 ÷ 30 =	1636.7
36-42"	10	1635	21	34335	
	9	1660	1	1660	
			22	35995 ÷ 22 =	1636.1
42-48"	10	1635	10	16350 ÷ 10 =	1635.0
48-54"	10	1635	1	1635 ÷ 1 =	1635.0

APPENDIX 3

APPLICATION OF THE CERAMIC FORMULA TO STRATIGRAPHIC DATA AT CONVENTO DE SAN FRANCISCO, DOMINICAN REPUBLIC
(Table 12 in Goggin 1968:109)

Level	Majolica Type No.	Goggin Median or South Index Date	Sherd Count	Product	South Formula Date	Goggin (1968:113) Interpretive Date Range
0-8"	1	1535	3	4605		
	7	1675	2	3350		
	8	1633	1	1633		
	10	1635	1	1635		
			7	11223	÷ 7 = 1603.3	
8-16"	1	1535	4	6140		Post-1800
	10	1635	1	1635		
	13	1775	1	1775		
	14	1690	1	1690		
			7	11240	÷ 7 = 1605.7	
16-24"	6	1547	1	1547	÷ 1 = 1547.0	
24-32"	1	1535	6	9210		
	7	1675	2	3350		
	8	1633	1	1633		
	9	1660	1	1660		
	10	1635	1	1635		
	12	1675	1	1675		
	13	1775	1	1775		
	14	1690	4	6760		
			17	27698	÷ 17 = 1629.3	1750-1800
32-40"	1	1535	4	6140		
	9	1660	7	11620		
	10	1635	1	1635		
	11	1638	1	1638		
	12	1675	4	6700		
	13	1775	13	23075		
	14	1690	9	15210		
	16	1775	9	15975		
			48	81993	÷ 48 = 1708.2	1700-1750

APPENDIX 3 (Continued)

Level	Majolica Type No.	Goggin Median or South Index Date	Sherd Count	Product	South Formula Date	Goggin (1968:113) Interpretive Date Range
40-48"	1	1535	10	15350		
	6	1547	2	3094		
	7	1675	9	15075		
	8	1633	6	9798		
	9	1660	14	23240		
	10	1635	12	19620		
	12	1675	14	23450		
	13	1775	3	5325		
	14	1690	7	11830		
	15	1675	1	1675		
	16	1775	1	1775		
	17	1668	2	3336		
	18	1668	2	3336		
	19	1695	1	1695		
			84	138581	÷ 84 = 1649.8	1650-1700
48-51"	1	1535	17	26095		
	6	1547	4	6188		
	7	1675	4	6700		
	8	1633	4	6532		
	9	1660	8	13280		
	10	1635	10	16350		
	11	1638	1	1638		
	12	1675	2	3350		
	13	1775	12	21300		
			62	101433	÷ 62 = 1636.0	1615-1650
51-59"	1	1535	136	208760		
	2	1445	1	1445		
	5	1487	2	2974		
	6	1547	2	3094		
	7	1675	18	30150		
	8	1633	7	11431		
	9	1660	6	9960		
			172	267814	÷ 172 = 1557.1	1580-1615
59-67"	1	1535	188	288580		
	2	1445	1	1445		
	3	1532	9	13788		
	6	1547	1	1547		
			199	305360	÷ 199 = 1534.5	
67-79"	1	1535	34	52190		
	3	1532	3	4596		
			37	56786	÷ 37 = 1534.8	1500-1580
79-85	1	1535	26	39910		
	2	1445	1	1445		
			27	41355	÷ 27 = 1531.7	

APPENDIX 4

APPLICATION OF THE CERAMIC FORMULA TO GOGGIN'S SERIATION CHART
(Figure 1 in Goggin 1968:25-27)

Site Ref. No.	Majolica Type No.	Goggin Median or Index Date	Sherd Count	Product	South Formula Date	Historic Median Date And Goggin Comment
1	FALCON RESERVOIR, TEXAS 1760? - 1780? (Goggin 1968:82)					
	(See Appendix I for Data)				1777.2	1770
2	ARANAMA, TEXAS 1749 - ca. 1793 (Goggin 1968:82)					
	(See Appendix I for Data)				1773.0	1771
3	QUIBURI, ARIZONA (Goggin 1968:91-92)					
	13	1775	670	1189250		
	23	1800	11	19800		
	22	1715	68	116620		
	16	1775	57	101175		
			806	1426845 ÷ 806 = 1770.3		
4	NUESTRA SENORA de la LECHE SHRINE, FLORIDA (Goggin 1968:65)					
	9	1660	2	3320		
	14	1690	18	30420		
	12	1675	5	8375		
	22	1715	69	118335		
	13	1775	20	35500		
			114	195950 ÷ 114 = 1718.9		
5	PINE TUFT, FLORIDA ? - ca. 1704 (Goggin 1968:75)					
	12	1675	401	671675		"probably a mission destroyed in 1700-06"
	14	1690	57	96330		
	9	1660	19	31540		
	18	1668	9	15012		
	15	1675	2	3350		
			488	817907 ÷ 488 = 1676.0		
6	ZETROUER, FLORIDA ? - 1706 (Goggin 1968:73)					
	12	1675	234	391950		
	14	1690	92	155480		
	9	1660	43	71380		
	15	1675	2	3350		
	19	1675	6	10170		
			377	632330 ÷ 377 = 1677.3		
7	FORT SAN LUIS, FLORIDA 1690 - 1704 (Goggin 1968:76)					
	(See Appendix I for Data)				1684.0	1697
8	SCOTT MILLER, FLORIDA ? - 1706 (Goggin 1968:75)					
	14	1690	55	92950		
	12	1675	54	90450		"terminal date... perhaps 1685 would be close"
	15	1675	42	70350		
	9	1660	21	34860		
	18	1668	9	15012		
	17	1668	10	16680		
	20	1650	1	1650		
			192	321952 ÷ 192 = 1676.8		

Site Ref. No.	Majolica Type No.	Goggin Median or Index Date	Sherd Count	Product	South Formula Date	Historic Median Date and Goggin Comment
13	FIG SPRINGS, FLORIDA (Goggin 1968:74)					
	1	1535	58	89030		
	7	1675	43	72025		
	8	1633	43	70219		"1615-50 postulated"
	10	1635	66	107910		
	18	1668	17	28356		
	6	1547	12	18564		
	11	1638	2	3276		
			241	389380	÷ 241 = 1615.7	
14A	MAURICA, VENEZUELA (Rocx 15) (Goggin 1968:45-46)					
	1	1535	10	15350		"between 1620
	6	1547	2	3094		and 1645"
	7	1675	24	40200		
	8	1633	20	32660		
	10	1635	13	21255		
	9	1660	6	9960		
			75	122519	÷ 75 = 1633.6	
14B	MAURICA, VENEZUELA (All units) (Goggin 1968:46)					
	1	1535	31	47585		
	6	1547	5	7735		"between 1620
	7	1675	37	61975		and 1645"
	8	1633	31	50623		
	10	1635	35	57225		
	9	1660	24	39840		
	18	1668	6	10008		
			169	274991	÷ 169 = 1627.2	
15	PUNTA MOSQUITO, VENEZUELA (Goggin 1968:44)					
	1	1535	34	52190		
	7	1675	51	85425		"early 17th
	8	1633	15	24495		century"
	10	1635	4	6540		
	9	1660	7	11620		
	6	1547	5	7735		
			116	188005	÷ 116 = 1620.7	
16	OBISPO, VENEZUELA (Goggin 1968:43)					
	1	1535	5	7675		
	8	1633	6	9798		
	7	1675	29	48575		"about 1630"
	10	1635	10	16350		
	9	1660	1	1660		
	6	1547	1	1547		
			52	85605	÷ 52 = 1646.3	

Site Ref. No.	Majolica Type No.	Goggin Median or Index Date	Sherd Count	Product	South Formula Date	Historic Median Date and Goggin Comment
17	RICHARDSON, FLORIDA ca. 1606 - ? (Goggin 1968:72)					
	2	1445	1	1445		
	1	1535	5	7675		"about 1615"
	7	1675	11	18425		
			17	27545 ÷ 17 = 1620.2		
18	CEPICEPI, DOMINICAN REPUBLIC (Goggin 1968:31)					
	1	1535	24	36840		
	7	1675	34	56950		(ca. 1600 A.D.)
	6	1547	1	1547		
			59	95337 ÷ 59 = 1615.9		
19A	LA VEGA VIEJA, DOMINICAN REPUBLIC (1952 Collection) (Goggin 1968:28) (See Appendix I for Data)				1534.0	1528.5
19B	LA VEGA VIEJA, DOMINICAN REPUBLIC (1953-54 Collection) (Goggin 1968:29) (See Appendix I for Data)				1528.5	1528.5
20	NUEVA CADIZ, VENEZUELA (Ex. 5) 1515 - 1545 (Goggin 1968:43) (See Appendix I for Data)				1532.5	1530.0
21	JACAGUA, DOMINICAN REPUBLIC 1511 - 1562 (Goggin 1968:29) (See Appendix I for Data)				1532.0	1536.5
22	JUANDOLIO, DOMINICAN REPUBLIC (Goggin 1968:30)					
	1	1535	267	409845		
	2	1445	42	60690		
	3	1532	6	9192		"early 16th
	5	1487	24	35688		century"
			339	515415 ÷ 339 = 1520.4		
23	ISABELA, DOMINICAN REPUBLIC 1493 - 1503 (Goggin 1968:24) (See Appendix I for Data)				1502.8	1498.0

APPENDIX 5

APPLICATION OF THE CERAMIC FORMULA TO VARIOUS ARCHEOLOGICAL SITES

Majolica Type No.	Goggin Median or Index Date	Sherd Count	Product	South Formula Date	Goggin's Temporal Range Comments
AWATOVI, ARIZONA (Goggin 1968:90)					
10	1635	14	22890		
9	1660	3	4980		
12	1675	4	6700		
21	1688	4	6752		
19	1695	1	1695		
22	1715	1	1715		
13	1775	3	5325		
		30	50057	÷ 30 = 1668.6	1629 - 1680
TUMACACORI, ARIZONA (Goggin 1968:91)					
13	1775	33	58575		
23	1800	3	5400		
		36	63975	÷ 36 = 1777.1	1701 -
KUAUA, NEW MEXICO (Goggin 1968:84)					
12	1675	30	50250		
15	1675	2	3350		
		32	53600	÷ 32 = 1675.0	before 1680
PUARAY (BANDELIER'S PUARAY), NEW MEXICO (Goggin 1968:84)					
12	1675	5	8375		
21	1688	8	13504		
15	1675	13	21775		
17	1668	1	1668		"two occupations, one previous to the revolt of 1680 and a second in the 18th century."
		27	45322	÷ 27 = 1678.6	
Second Sample					
15	1675	2	3350		
12	1675	1	1675		
13	1775	8	14200		
		11	19225	÷ 11 = 1747.7	