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Numbers Five and Six, New Series

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H. GEIGER OMWAKE

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Bibliographic Note

This issue of the ASD Bulletin is the fifth and sixth in a series o. regular but unscheduled numbers, supplanting the original Bulletin series which comprised nine volumes with a total of twenty-seven issues, continuing from May, 1933 to March, 1958.

Bulletin Number One of the New Series (Spring, 1962) contained H. Geiger Omwake's "The Mispillion Site, 7-S-A1".

Bulletin Number Two of the New Series (Fall, 1962) contained the "Preliminary Report on the Harlan Mill Steatite Quarry (18 Ce 5)," by Elwood S. Wilkins, Jr., and Arthur G. Volkman's "Excerpts from Works of Henry David Thoreau."

Bulletin Number Three of the New Series (Spring, 1964) included "The Layman and the Library," by Richard C. Quick, and "Historical Archaeology: A Brief," by Allen G. Schiek.

Bulletin Number Four of the New Series (Spring, 1965) included "The Lighthouse Site, 7-S-D22, Cape Henlopen, Lewes, Delaware," by H. Geiger Omwake, "Preliminary Report of the Archaeological Survey Along the Right-of-Way of FA1-1, State of Delaware," by Jacob W. Gruber, "A Fluted Point Found Near Sandtown, Delaware," by George M. Reynolds, and Bert Salwen's "Archaeological Survey of the Hercules Powder Company Properties Near Lewes, Delaware."

The Bulletin is indexed in the American Indian Index, and in Abstracts of New World Archaeology.

Adrien L. Olivier
Editor
Fall, 1967

This Bulletin is dedicated to the memory of
Dr. J. Alden Mason and H. Geiger Omwake.

The Archaeological Society of Delaware is fortunate to have this photograph of H. Geiger Omwake, founder of the Archaeological Society of Delaware and his advisor in the formation of the Society, Dr. J. Alden Mason, taken on the Thirtieth Anniversary of the Society; February 16, 1963.

J. ALDEN MASON, Ph.D.

While monuments and buildings have been erected to the memory of many men there is no greater memorial than the recognition one receives in life. Such was the reward of J. Alden Mason who died on November 7, 1967, at the age of 82.

At this dark hour, we will not attempt to recount all of his achievements; these have been recorded elsewhere. But we would be remiss not to include here a portion of his curriculum vitae.

His experience embraced Assistant Curator positions with the Field Museum of Natural History, 1917-1924, American Museum of Natural History, 1924-1925, and was Curator, University Museum (U. of P.) American Section, 1926-1955, at which time he retired and was elected Curator Emeritus.

He was a member in several Archaeological, Anthropological and Scientific Societies, both here and in France. With his encouragement and guidance, the Archaeological Society of Delaware was formed with Dr. Mason a charter member. We assign high values to all of these accomplishments which included presidencies in many organizations to which he belonged. His field work extended to 10 states, 6 sites in Mexico, as well as Guatemala, Panama, Columbia, and Puerto Rico.

A bibliography of the works he authored reveals not only the vast extent of his knowledge and activities but, even more important, reflects the influence he had in his time and will have in the future.

Underlying these eminent earthly accomplishments we sense the depth of J. Alden Mason as a servant of man for he seemed to know in every circumstance of life what was required of him and how to avoid offense toward his fellow man.

Moral excellence, with an uncommon vigour of thought, a contagious fervor of spirit elevated him to greater and higher things than cool reason could have attained. He was never wide of truth, never fancied himself an earthly king, never walked in a vain shadow. Never thinking of himself as great or good — yet he exuded much greatness and goodness undeniable to those who knew him.

In simplicity he had his conversation with the world and those of us who remain behind resolve that he will be with us always.

L. T. Alexander

H. GEIGER OMWAKE

The misfortune of death struck us again on the cold Sunday morning of December 31, 1967, when the spirit of H. Geiger Omwake, a leading Delaware educator and archaeologist, departed his flesh.

An elaborate exposition of his accomplishments is not expected in an encomium of this nature — it would detain you too long — but we must recite a few particulars of this public servant's achievements, avoiding either the extreme of too much or too little.

So, let us be reminded that he was one of the founders of the Archaeological Society of Delaware in 1933, the Sussex Archaeological Society (now Sussex Society of Archaeology and History) in 1948 and the Kent Archaeological Society in 1965.

He served conscientiously as a member of The Delaware Archaeological Board since its inception in 1953. Recognition was accorded him when he was conferred as a Fellow of the Pennsylvania Institute of Anthropology and it is noteworthy that he was the only amateur Fellow of The Society for Historical Archaeology. His efforts as an active archaeologist resulted in his writing many valuable reports, analyses, and evaluations of both historic and pre-historic man.

His outstanding virtues were prudence and fortitude in that he had the ability to regulate and discipline himself through the exercise of his reason. His firmness of mind in meeting adversity, his resolute endurance (in spite of impaired health in his later years) and the tenacity of this truly devoted person must be deeply impressed on the heart of every friend of archaeology.

Each of us has his faults and handicaps and H. Geiger Omwake rose above his and overcame them to a degree where his true greatness is revealed. His efforts influenced many minds and spanned our international borders into Canada and across the sea to England.

"His tongue will no longer occasion any vibrations in the air" but his memory will be with us forever.

L. T. Alexander

AN EVALUATION OF AN ASSORTMENT OF WHITE KAOLIN PIPE BOWL AND STEM FRAGMENTS SURFACE-COLLECTED FROM AN APPARENT COLONIAL PERIOD REFUSE DISPOSAL AREA NEAR CHESTERTOWN, MARYLAND.

H. GEIGER OMWAKE

INTRODUCTION

Through the courtesy of Mr. C. Douglass Buck, Jr., of Wilmington, Delaware, an assortment of white kaolin pipe bowl and stem fragments surface-collected from a relatively restricted area of his property near Chestertown, Maryland, was made available for study and evaluation. Mr. Buck's property is situated along Langford Creek on the east side of a section of land known locally as Quaker Neck. Whether the apparent refuse disposal area was originally a sub-surface pit or an above ground heap, either one disturbed by subsequent cultivation, remains to be determined. The surface yield, in addition to the pipe fragments, included numerous ceramic sherds of several types, many pieces of heavily patinated glass, without doubt the remains of old bottles of various kinds, small bits of glazed and non-glazed bricks, and other miscellaneous materials. The present study is concerned only with efforts to evaluate the pipe materials as to date(s) and probable source(s) in order better to understand the occupational history of the site.

All fragments were first carefully examined under magnification in an attempt to discover any marked specimens. The bores of all stem fragments, with or without portions of bowls or heels attached, were cleaned out and their diameters measured and tabulated.

DISCUSSION

Evaluation of the collection may, perhaps, be best accomplished through discussion of the stem bore diameters first, followed by discussion of the marked and/or ornamented bowl and stem fragments, each separately, and finally by brief comments in regard to diagnostic or non-diagnostic aspects of the collection in general.

Archaeological significance

A thin piece of stone, suitable for chipping, shaped into the form of an arrowhead or spearpoint, perhaps more properly called a projectile, found on top of a ploughed field, is instantly recognized by almost everyone as an archaeological object. One can readily give it a name - arrowhead, spearpoint, dart, knife - and almost as readily recognize it as an ancient weapon used to shoot, kill, or cut people or animals. The common reply to the question "Who used it?" is apt to be a prompt "The Indians." - enough to satisfy most persons. The name, purpose and antiquity of the object are understood; in short, it has meaning in terms of the past, sufficient in most instances to cause the finder to pick it up, take it home, exhibit it as a curiosity, and toss it into a drawer. To any but the most inquisitive the story is complete at that point: he has found, fondled and preserved a bit of the past.

A thin, round, usually short piece of white clay, somewhat resembling a slim piece of common blackboard chalk but having a hole bored through it from end to end, found on the same ploughed field, perhaps immediately alongside a chipped "arrowhead", is not so instantly recognized as possibly an archaeological object. More often than not it is not picked up, even though the finder may recognize it as a piece broken from the stem of a white clay pipe. The reason is obvious: almost everyone knows that until a few short years ago clay pipes were smoked by lots of people, and perhaps the finder, as a child, delighted in blowing soap bubbles from one which did duty as a toy. For a great many people that's all there is to the story, and the object is, therefore, ignored.

Until the relatively recent arousal of interest in applying archaeological techniques to investigations of sites dated in the historic period, many professional archaeologists, as did their laymen brothers, tended, by and large, to disregard or minimize the broken fragments of white clay pipe stems and bowls. Literature pertaining to investigations of the slightly earlier sites of the so-called "contact" period frequently carried no more than a simple notation that a white clay pipe had been found, usually in a grave or pit. With the archaeological investigation of such famous sites as Jamestown and Williamsburg, and a few others of lesser magnitude, came recognition that the innocuous little pipe fragments might be of more significance than had hitherto been suspected.

From the excavations conducted at Jamestown, Williamsburg and Fort Frederica were recovered hundreds upon hundreds of white clay pipe bowl and stem fragments. Many came from specific areas securely dated by documentary or other very reliable evidence and archaeologist J. C. Harrington was faced with the problem of deriving from the stem fragments the maximum possible amount of information.

A piece of broken white clay pipe stem, by its very nature, would seem to offer few significant possibilities of contributing to knowledge. It has length, but that is a purely accidental matter. It has thickness, but that may be simply the fortuitous result of its original position in its complete stem. Many pipe stems are stout and thick near the bowl, and virtually all of them taper toward greater fragility and thinness near the bit end. Then, too, while the earlier pipe stems everywhere were heavy and thick and not very long, becoming thinner, more delicate and longer as time went on, they again became relatively short and stout in the 19th century. So, thickness is, at best, only an unreliable index of age and no index at all of point of origin. Texture and finish are equally undependable indices of age and origin, though it is true that the better the quality of the pipe clay used and the higher the degree of smoothing and polishing of the original product, the better the broken fragments survive the punishment and erosion meted out by the agents of both nature and man over long periods of time. On the basis of high quality clay, careful workmanship and delicate finishing it is sometimes possible to distinguish Dutch pipes from those of other origins, but origin is, for the most part, dependent on identification of the marks and/or

ornamentation carried by the fragments. The one attribute of all pipe stems which might offer possibilities for dating, although probably none for determining origin, is the bore.

Dating

Two methods of deriving dates from white clay pipe stems have been devised.

a. The Harrington Method.

Harrington observed that the bores of English pipe stems recovered from sites of early date seemed to be of greater diameter than those of stems recovered from sites of later date. Using the stems from datable contexts at Jamestown, Williamsburg and Fort Frederica, all English settlements, he measured the diameters of their bores in increments of 64ths of an inch. This increment was chosen, apparently, because suitable measuring implements graduated in 64ths of an inch - the butt ends of steel drills - were, conveniently, already at hand, because larger increments would have yielded little variation, and because smaller increments would have resulted in such proliferation of variation that interpretation of the results would have been all but impossible.

It may be stated briefly that as a result of his original research Harrington (1954) was able to demonstrate that during successive spans of years from 1620 to 1780 certain sizes of bores were most popular and that as time went on, there developed among English pipemakers (and presumably their customers) an increasing preference for smaller and smaller sizes of bores. Put conversely, it may be said that the larger the bore, the earlier the pipe stem. He translated his tabulations into percentages of the total numbers of stem fragments recovered from dated contexts and arranged the results in the form of a bar graph, from which one may determine how many chances in a hundred there are that a pipe stem having a bore diameter of a given size was made during one or another of his pre-determined time spans. Harrington warned, however, that his bar graph ought never to be used indiscriminately to date a single stem fragment or even a small collection of fragments because of the lack of reliability of such samples.

It must become apparent to anyone attempting to use the Harrington dating technique that only by the rarest of coincidences would a site match exactly the time spans used by him and even more rarely would the percentages of sizes from any given site precisely match those of the bar graph. Thus, careful interpretation of comparisons is essential. All pertinent factors must be considered, an allowance made for chance (judgment), and conclusions must be drawn only after careful synthesis of all data has been made. When used under the foregoing conditions, the Harrington dating technique has withstood the test of time, though no claim of infallibility has ever been made for it.

The distribution of the bore sizes of the Buck site stem fragments, by actual count and by conversion into rounded percentages, is shown in Table 1.

Bore Sizes	10/64	9/64	8/64	7/64	6/64	5/64	4/64	Totals
Number of Specimens	4	8	29	54	104	100	5	304
Percentage of Total	1	3	10	18	34	33	1	100%

Table 1. Distribution of bore sizes of Buck site stem fragments by actual count and by percentages of the total sample.

An adaptation of the Harrington bar graph, by percentages of bore sizes for the several time spans, to which has been subtended the percentage distribution of the Buck site sample, is shown in Table 2.

	Bore Sizes							
Time Spans	10/64	9/64	8/64	7/64	6/64	5/64	4/64	Totals
1750-1780					3	20	77	100%
1710-1750					15	72	13	100%
1680-1710				16	72	12		100%
1650-1680			25	57	18			100%
1620-1650		20	59	21				100%
Buck Site	1	3	10	18	34	33	1	100%

Table 2. Adaptation of Harrington bar graph, by percentages of bore sizes for the several time spans, with the distribution of bore sizes, by percentages, at the Buck site subtended.

Attention is first directed to the distribution of the Buck site sample as shown in Table 1. Little, if any, significance should be accorded the 10/64ths category (4 specimens, 1% of the total sample), the 9/64ths category (8 specimens, 3% of the total sample) and the 4/64ths category (5 specimens, 1% of the total sample). The presence of so few specimens having the largest and next largest bores probably means that on some early occasion(s), prior to the beginning of more or less permanent occupation, the site was visited by some passing traveller(s) who happened to discard two or three broken pipes which, by pure chance, became mixed with refuse subsequently deposited in the disposal area. Similarly, the presence of 5 stem fragments having the 4/64ths bore size probably means that years after termination of use of the site as a refuse discard area some farmer or passerby broke his pipe and quite by chance the pieces happened to land on the ancient dump. In all three categories the numbers of specimens are too few to represent habitation and should only be interpreted in terms of transients and chance discard.

The specimens in the remaining four categories constitute 95% of the pipe stem evidence from the site. The number of fragments suggests the breakage and discard of many pipes which, in turn, suggests habitation as opposed to transient visitation. The frequency of occurrence of the several sizes suggests that occupation began when preference for the 8/64ths size was waning and that for the 7/64ths size increasing, remained fairly steady during the periods of peak popularity of the 6/64th and 5/64ths sizes, and abruptly ended before the 4/64ths size came into vogue.

(Note: It is granted that some skeptic might argue at this point that the increasing numbers of fragments in each category of size might mean only that the resident population, though probably few in number, became more indulgent in their smoking habits, or that pipes, having become cheaper and more readily available, received less protective care, leading to greater consumption, or that white clay pipe stems, having grown longer, thinner and more fragile, were less able to withstand usage or were subject to a higher rate of breakage. However, in point of fact, change in bore size was a gradual thing. Occupation began during a period at which one size was giving way to another, continued all through the ascendancy of the 6/64ths size and for, perhaps, half of the succeeding popularity of the 5/64ths size. The picture seems to represent a consistent rate of accumulation rather than great changes in the number of either smokers or the availability of pipes.)

Attention may next be focused on Table 2. First it is noted that Harrington did not record any evidence of the existence of the 10/64ths inch bore. It is logical to assume, therefore, that it was used prior to the beginning of his earliest time span ca. 1620 and quickly gave way to the three succeeding smaller sizes he records for the 1620-1650 period. This evidence supports the postulated early visitation of the Buck site by transient persons.

Table 2 indicates that during the 1620-1650 span 80% of all pipe stems had bores smaller than 9/64ths inch. At the Buck site only 3% of the stem fragments had a 9/64th bore and only 1% had the 10/64ths bore. These few specimens, while not matching, can represent only casual discards of two or three pipes, supporting the view that transients, as opposed to occupants, were responsible for them.

Harrington's bar graph indicates that the 8/64ths size bore achieved maximum acceptance during the 1620-1650 time span but decreased in popularity by almost half during the subsequent 1650-1680 period. At the Buck site, the actual count of 8/64th inch bore specimens seems too large to represent random disposal by transients. While the 10% of the total sample which they constitute is less than half the percentage Harrington found representative of the 1650-1680 span, the proportion is still large enough to suggest that at least tentatively permanent occupation of the site began during the latter half, or, perhaps, third, of that period, ca. 1665-1670.

There is remarkable agreement between the 18% of the 7/64ths bore size at the Buck site and the 16% Harrington found typical of the 1680-1710 time span, but it is noted that 18% is slightly in excess of 16%. This may be interpreted to indicate that occupation was in progress during the latter part of the 1650-1680 period as popularity of the 7/64ths size was rapidly declining but prior to the time when it reached its lowest point. Thus the picture presented by the 7/64ths inch size at the Buck site agrees with that presented by the 8/64ths inch size, and both point to ca. 1665-1670 as the time at which occupation began.

According to the Harrington bar graph, the 6/64ths inch size bore first came upon the scene during the 1650-1680 period. Evidently it met with ready acceptance and during the subsequent 1680-1710 span was present in almost three quarters of all pipe stems made. Even more rapidly than it was accepted it declined in popularity to a mere 15% during the subsequent 1710-1750 period. At the Buck site 34% of the total sample had the 6/64ths inch bore. This represents a decline of 38 points from its peak popularity during the 1680-1710 span but is 19 points greater than the percentage Harrington found for it during the subsequent 1710-1750 period. The picture thus presented suggests fairly intensive (steady) occupation of the site during the latter half of the 1680-1710 period and the early years of the 1710-1750 span.

The 5/64ths inch category may now be considered. Harrington indicated that this size bore first came into use in modest quantity during the 1680-1710 period. At the Buck site it occurred in 33% of the total sample. Obviously, occupation (accumulation of the sample) was in process while the 5/64ths inch size bore was on the rapid increase. This would have taken place during the 1680-1710 span and the middle years of the 1710-1750 period. Thus the picture presented by the 5/64ths bore size is in agreement with that presented by the 6/64ths size.

The almost total absence of the 4/64ths inch bore size at the Buck site can only mean that accumulation of the sample (occupation of the site) came to an abrupt end before this smallest size bore became popular, as it very rapidly did, beginning during the latter years of the 1710-1750 time span.

On the basis of the bore sizes presented, as compared with the Harrington expectancy, use of the Buck site disposal area appears to have begun ca. 1665-1670 and to have ended suddenly ca. 1725-1730. Whether this means that another disposal area was put to use or that actual occupation terminated depends on further exploration of the property and on thorough research into the documentary history of the site.

b. The Binford Formula.

In more recent years archaeologist Lewis R. Binford (1961), using Harrington's basic pipe stem bore data, devised a straight-line arithmetic regression formula by which the mean date of the period of accumulation of a sample (i.e. occupation) could be determined. The formula becomes inapplicable to samples accumulated after ca. 1780 but is particularly useful for verifying the dating of structures said or known to have been erected at different dates within a single complex which, in its entirety, is datable before 1780. The mean date is, of course, the middle date of the period of years during which the sample accumulated. For single component sites, such as the Buck site, the method provides a useful check on age estimates derived through application of the Harrington technique.

The Binford formula is y = 1931.85 - 38.26x, in which y is the mean date one is attempting to find, 1931.85 the theoretical date at which bore sizes would reach 0 if the regression were continued beyond 4/64ths inch, 38.26 the interval of years between the mean of one metrical category and that of the next (i.e. if the mean bore diameter of one sample were 5/64th and that of the next 6/64ths, the interval of years between them would be 38.26), and x the mean bore of the sample under consideration.

Using all stem fragments, including those of the 10/64ths, 9/64ths and 4/64ths categories, the mean bore size of the Buck site sample is 6.13815. When this value is substituted for x, the formula reads: y = 1931.85 - 38.26 x 6.13815, or y = 1931.85 - 234.8456190 (y = 1931.85 - 234.85), or y = 1697, the mean date for the accumulation of the sample (occupation). If one accepts the premise that the 10/64ths, 9/64ths and 4/64ths sizes represent transient activity and may be eliminated from consideration, the mean bore diameter becomes 6.04181 and the mean date 1700.69.

It was postulated earlier in this report that on the basis of the Harrington technique use of the disposal area began ca. 1665-1670 and terminated ca. 1725-1730. Using various combinations of these years, one can arrive at mean dates of 1695, 1697.5, 1697.5, and 1700.

A computer-determined version of the original Binford formula, which involves a curved line rather than a straight line regression, not previously published, reads y = 1929.189 - 36.818x. If one substitutes in this revision the 6.04181 mean bore resulting from elimination of the 10/64ths, 9/64ths and 4/64ths inch bore size stem fragments, one derives a mean date of 1706.74.

The Binford Formula dates are almost fantastically close to all of the mean dates possible for the postulated ca. 1665-70 - ca. 1725-1730 occupation, dictating belief in the reliability of the suggested period of occupation. Only the computer determined version of the Binford Formula yields a result which differs markedly from all of the other possible mean dates of occupation, and that by less than 7 years. Mrs. Audrey Noel Hume has found that the computer revision of the formula yielded mean dates consistently five to nine years higher than those which resulted from application of the Binford Formula to materials from five sites (Noel Hume, A. 1964).

MARKED FRAGMENTS (other than rouletted rim sherds)

The numbers prefixed to certain of the following paragraphs are intended merely to facilitate reading of the discussion. They do not identify specimens.

1. On the right side of a low heel of medium size there is present, in relief and in the horizontal position, an eroded letter, judged to have been a D originally, representing the first initial of the pipemaker's last name. Many possibilities for identification exist. There were at least 81 pipemakers in England, over the years, whose last names began with a D and during the years from ca. 1665-1670 to ca. 1725-1730 at least 33 of them probably were at work. Had the left side of the heel been present, it might be possible to narrow the field somewhat. Under the circumstances further elimination is impossible. The horizontal position of the letter is not diagnostic. The 5/64ths inch diameter of the bore of the stem of this specimen could place it at any date between ca. 1680 and 1780.

2. The badly worn, wart-like pedestal seen on the left side of the basal portion of the bowl fragment probably carried a mark of some kind when the pipe was made but of which all trace has been eroded away. This sort of supplemental bowl marking is Dutch in concept (Omwake 1965:8) and was designed to prevent the plagiarization of well-known products or to prevent unscrupulous merchants from mixing second grade pipes into overseas orders for first quality pipes (Helbers and Goedewaagen 1942:48). The time at which supplemental marks were first used in Holland remains vague and probably antedates 1739 when the government of the Etats de Hollande et de Friesland-Ouest authorized use of the Arms of Gouda as a supplemental body mark for the reasons cited above. Because of the probability of Dutch origin, the measurement of the bore of the stem of this specimen was eliminated from all stem bore calculations.

3. By all odds the most interesting specimen in the Buck site assemblage is, in fact, unique and has not previously been reported from any site in America within the experience of this examiner. Its features require full discussion.

In England the makers' marks customarily were placed on the bottom of the heel (impressed or stamped), on the sides of heels or spurs, on the back of the bowl (incised or impressed), on the sides, almost always the right, of the bowl (mold imparted), on the stem, accompanied by one or more bands of geometric figures, encircling it in a slightly spiral manner (impressed by a rocker-type or a rotary tool), or on one side of the stem parallel with its long axis (mold-imparted, rarely stamped). Only rarely are the maker's initials impressed or incised alone on top of the stem. The position of the maker's initials, in relief, on the opposite sides of the basal portion of the bowl, as in the case under discussion, is most unusual, and the literature pertaining to English pipes which is available to this reporter contains no references to such placement. Similar placement of marks has, however, been observed on a very few pipe bowls recovered from English colonial sites in Virginia (Noel-Hume 1962, Footnote # 96, p. 220; Noel-Hume 1966:14 and Fig. 16; item #14, p. 28; Kelso 1966:107 and Fig. g, item 11). In

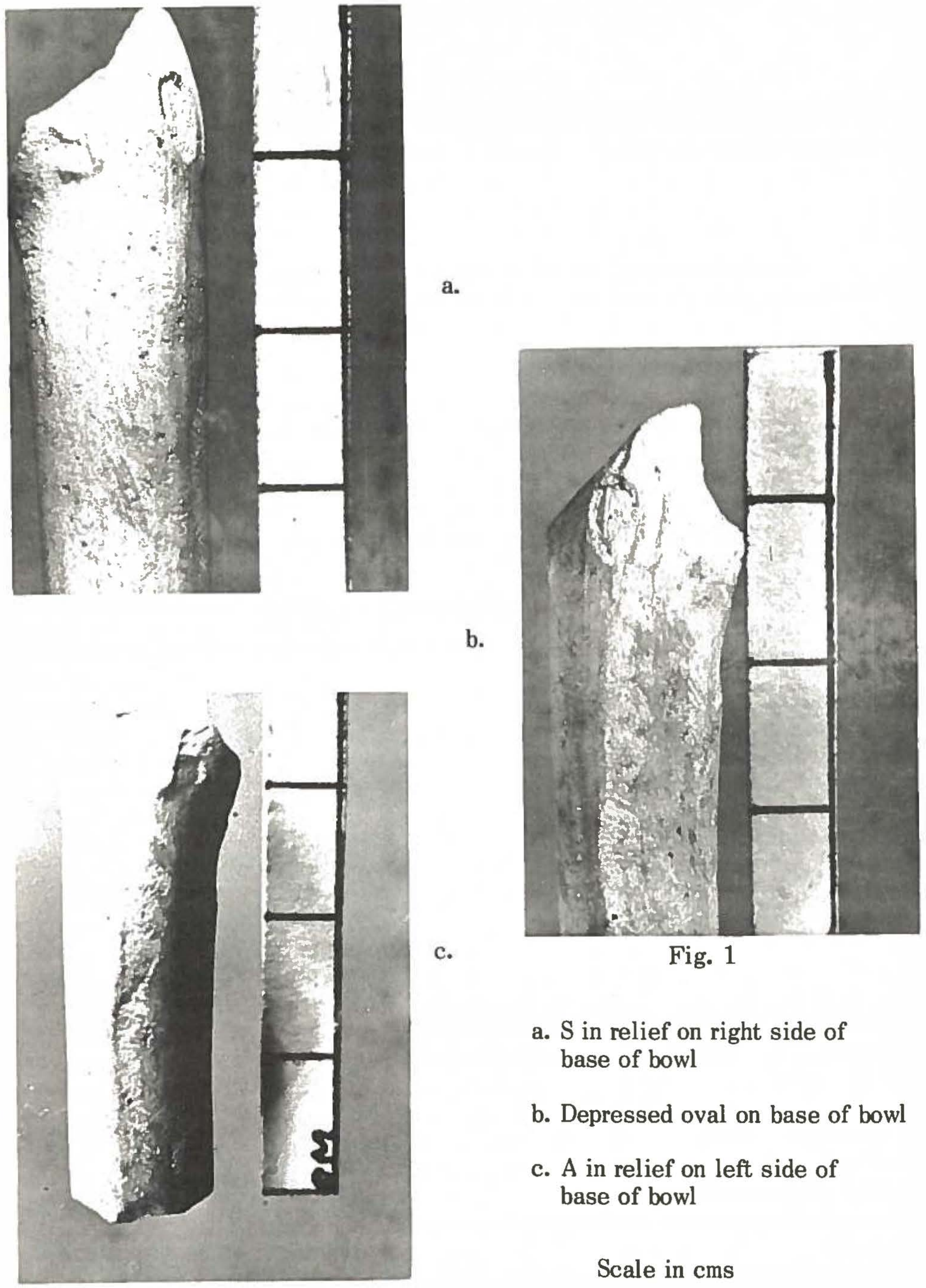

Fig. 1

a. S in relief on right side of base of bowl

b. Depressed oval on base of bowl

c. A in relief on left side of base of bowl

Scale in cms

all three instances a large letter S appears in relief on the left side of the basal part of the bowl and an A appears in the same position on the opposite side. On the Buck site specimen the positions of the respective letters are reversed, A appearing on the left and S on the right (Fig. 1, c, a).

In Holland, particularly in the city of Gouda, which was the focal point of the Dutch industry during the 17th and 18th centuries, it was common practice to impress the mark on the very bottom of the bowl, but the Dutch marks were of an entirely different character from those of the Virginia and Buck site examples. It is just impossible to attribute to the American pipes any origin other than England.

When the maker's initials appear on the opposite sides of the heel or heel-like spur, they are always read from left to right as the pipe is held in the normal smoking position. The first initial of the pipemaker's given name invariably is on the left side and that of his family name on the right (Oswald 1960:50). Assuming that the rule holds true for initials which appear on the sides of the basal parts of bowls, one would read AS for the Buck site specimen and SA for the Virginia examples. In all instances the positioning of the letters makes it virtually impossible to read them unless one turns the bowls bottom side up, in which case, if one reads normally, they become SA on the Buck site bowl and AS on the Virginia specimens, a very confusing matter.

The pipemaker's purpose in marking his pipes was, of course, the promotion of sales. Two questions seem pertinent: (1) did some pipemaker who initially followed the standard left to right rule discover that only by upending the bowl were the initials visible, in which case they would be backwards unless he reversed their positions, and, therefore, had new molds made? or (2) should the general left to right rule be followed regardless of visibility of the letters? In the latter instance, the reversed letters would signify the existence of two pipemakers, one whose initials were AS and another whose initials were SA, both working at the same general time and making pipes having the same general characteristics and both placing their initials in the same unique position and employing the same style of letters. While these coincidences seem too realistic to be the result of chance, one must stick with the left-right rule and assume, until such time as it can be otherwise proven, that there were two separate pipemakers whose products have come to light at American sites.

It has been observed that virtually all white clay pipes excavated from documented sites in England are possessed of heels or spurs, both of which varied in size and shape through time and, despite the occasional revival of older forms, tended to become smaller and smaller. Heels originally were designed as rests for the pipe when it was not in use but later served as carriers of the maker's mark or fulfilled a purely aesthetic function. The ratio of heel-less pipes to heeled or spurred pipes in England is estimated to be about 1 to 400 (Oswald 1953: personal communication). In America most white clay pipes recovered from Colonial period sites are without heel or spur, and it has been suggested (Oswald 1955:246) that the heel or spur was omitted from pipes intended for export because of the danger of breakage. On second thought, the suggestion must be held untenable because the base of the bowl and the heel are actually the least fragile parts of a pipe. It is more probable that English pipemakers were simply returning to America white clay facsimiles of the Indian models supplied them by the early explorers.

This brings us to a peculiar aspect of the Buck site example. Between the A and the damaged S may be seen an oval depression which, at first glance suggests an elongated letter O. Under magnification it becomes clear that the outline which seems to be in relief really is not but is simply the edge of the depressed area made prominent by the smoothing and finishing processes applied to the bowl. Attention is directed to the surface of the depressed area. It has, itself, undergone some smoothing but not enough to remove what seems to be a raised line which, slightly off-center from the mold mark of the stem, transects the depressed oval almost parallel with its long axis (Fig. 1b).

It is noted that the oval depressed area has exactly the size and shape as would be possessed by a small spur at its conjunction with the body of a bowl and this suggests two possible explanations for its presence. First, could the bowl have originally carried a spur which was, in some manner, broken off? Or, second, is it possible that the pipemaker attempted to alter a mold, which originally incorporated provisions for forming a spur, in such a way as to eliminate the spur from his end product?

The literature pertaining to the manufacture of pipes during the 17th and 18th centuries in England indicates that pipe molds consisted of two halves which, when brought together, imparted form, shape, marks or ornamentation to the clay of which pipes were made. They were certainly among the most expensive tools of the trade and were used for as long a time as the buying tastes of the public would allow. If possible, a pipemaker might readily have modified a mold rather than incur the expense of a new one. It seems to this examiner that the Buck site specimen represents a case in point. Had a spur been broken off, the edges which outline the oval area would have been sharp and rough but, instead, they have been smoothed. Had the smoothing resulted from normal erosion and wear, it is unlikely that the letters would have survived so clearly. Similarly, had a spur been broken off, the surface of the depressed oval areas would have been rough, even granular, to the touch, but, except for the transecting line, it is relatively smooth.

It is believed that the Buck site specimen represents a clear effort on the part of the pipemaker to fill with some sort of material, perhaps lead, the hollow parts of the mold by which a spur would have been formed and that the transecting line merely represents the coming together of the filled part of each half of the mold and somehow escaped adequate smoothing.

Identification of the maker of the Buck site specimen and establishment of its probable dating become immediate problems. In his list of English pipemakers, which is, by any standard, the most comprehensive extant, Oswald (1960:91) records the names of those whose initials were AS: Abraham Shitton of London, who became a freeman in 1659; Ann Smith of Bristol, whose name first appears in the records in 1700; and Alec Simms of Leeds, who began work in 1808. Of these Shitton and Smith must be regarded as possible makers of the Buck site pipe. Simms came on the scene much too late to warrant consideration.

Little is known about Shitton. According to Atkinson (1962:188) there occur at London sites pipes which have on opposite sides of their small heels, in relief, the letters A and S, each surmounted by a crown and of a type which he dates to ca. 1690 (1962:185). The shape he illustrates, entirely English in conception, may very well have been a low heeled type ancestral to the heel-less Buck site specimen.

Ann Smith was the widow of Thomas Smith of Bristol who received his freedom to manufacture pipes on May 24, 1651 by the express order of the Mayor and Aldermen upon payment of 40 shillings and ordinary fees (Ralph 1948:18). There is no record of his having taken apprentices into his shop and it appears likely that he and Ann operated a quiet little family business, evidently for half a century. There is no known record of the date of Smith's death but it is recorded that on April 10, 1700 Edward Smith, "Apprentice of his mother Ann," was made a freeman and, a little later, that on Sept. 18, 1704 Thomas Smith, "Apprentice of his mother Ann" gained his freedom (Ralph 1948:18).

These two sons appear to have been born to Thomas and Ann late in life if they followed the general custom of entering into apprenticeship training while not yet in their teens. The duration of apprenticeship was normally 7 years which means that Edward probably began his training ca. 1693 and Thomas, Jr., his ca. 1697. It is possible that both began under the tutelage of their father and finished up under the guidance of their mother. One may guess that the elder Thomas died late in 1697 or fairly soon thereafter, certainly before 1700 when Ann is listed as a "widow." There appear to have been no strictures against a widow carrying on her late husband's business and there seem to have been no special requirements if she so chose, as the records indicate was often the case. Ann's name would not appear in the Freedom Rolls until such time as her first apprentice completed his training and applied for admission to the Freedom. The Rolls do not indicate that Ann took any apprentices other than her two sons nor do they show that either young man himself took boys to train. The business appears to have remained a small family affair and Ann may have become inactive after Thomas, Jr., became a Freeman.

One is faced with making a choice between Abraham Shitton of London and Ann Smith of Bristol as the more probable author of the Buck site specimen.

Atkinson (1962:188) noted that London pipes marked A and S on the sides of the heel also carried a crown above each letter. By and large, English pipemakers

of the 17th and 18th centuries did not add a crown above their initials. In Holland, on the other hand, Dutch pipemakers, about as often as not, did surmount their initial, number, or figure marks with a crown. Atkinson also indicated (1962:189) that he had observed the crown above the initials on pipes which carried the letters RH, TH and WM on the heels of pipes he had found in London. In the appendix to the standard reference work on Dutch pipes may be found the names of Gouda pipemakers whose initials were RH, TH, and AS. Only WM is missing. (Helbers and Goedewaagen (1946:246-249).) The suspicion arises that all of the examples found by Atkinson in London may have been of Dutch origin and it is known that despite the large number of Englishmen engaged in the pipemaking business, Dutch pipemakers enjoyed a substantial export business to England.

It appears to this examiner that the Buck site AS pipe without crowns is attributable to Ann Smith of Bristol and is datable to ca. 1700, the approximate mean date at which the sample accumulated.

Perhaps one may be forgiven for introducing at this point a conjecture which is insupportable scientifically but none the less intriguing. It is most probable that the heels or spurs of Thomas Smith's (the elder) pipes carried his initials T and S on opposite sides. Could it be, since income was probably very limited, that when Ann took over the business following the death of her husband, she not only had his molds altered to eliminate the spur, which itself was ingenious, but also had her own initials engraved in the old molds in the unique position to replace those of her husband which had been on the sides of the spur? A new gimmick - testimony to the resourcefulness of a woman?

4. Many stems carrying the letters LE and an accompanying band of ornamentation exactly similar to that of the Buck site specimen have been reported from sites in Pennsylvania, New Jersey, Delaware, Maryland, New York and Virginia and they have generally been associated with pipe fragments carrying initials which can be identified with pipemakers of Bristol who were active during most of the third and fourth quarters of the seventeenth century (Fig. 2). If there is

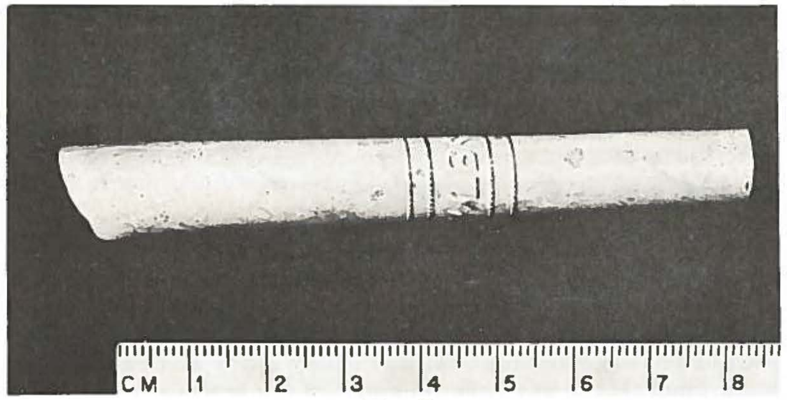

Fig. 2

such a thing as absolutely certain attribution of a mark to one single maker, it occurs in the case of the LE's. These initials are unknown in Holland and in Oswald's master list (1960:53-102) of the names of 2000 odd pipemakers in various centers of the industry in England, as well as in other lists of English pipemakers whose names have come to light since publication of Oswald's list, there is only one pipemaker whose initials were LE - Lluellin Evans of Bristol.

(Note: In the Parish Register of St. James and in the Bristol Burgess and Apprentice Rolls the given name appears as Llewellin, Llewellen, Lluellin; elsewhere it appears in the simplest form, Luellin.)

Evans obtained his freedom on May 31, 1661 after completing his apprenticeship under James Fox (Ralph 1948:8). He had a long career, taking a number of apprentices, the last of whom was Devereaux Jones who became a Freeman on July 3, 1691 (Ralph 1948:11). Apparently Evans soon thereafter may have retired or died; at least he took no more apprentices, and pipes bearing his LE mark are datable from 1661 to 1691.

The position of the initials on the underside of the Buck site specimen is most unusual and not at all in harmony with the tenor of Evans' work. Invariably on all other LE examples seen by this examiner the letters are carefully centered on the top of the stem and the stems themselves exhibit a higher quality of finish and smoothing than is often seen on the products of Evans' contemporaries. The Buck site stem must be regarded as one which escaped the master's notice before shipment overseas.

5. The geometric decoration which spirals around another short stem fragment, despite observable differences, holds close affinities with the LE stems and often occurs at sites which yield them. The decorations, since they include no initials, cannot be attributed to any particular maker but they may be regarded as contemporary with those on LE stems.

6. The stem fragment having the fine line flutes as the bowl requires little comment beyond the notation that it is out of harmony with the balance of the marked speciment from the Buck site. Similarly decorated stems, some with bowls attached, were excavated from the site of the original John Deere Blacksmith Shop, Grand Detour, Illinois, datable 1837-1847 (Omwake, personal examination). The Buck site specimen must be regarded as intrusive (transient? farmer?) and at least 100 years out of context.

7. The marking on a bowl body sherd appears to have consisted of two letters but the fractures it has received make determination of the first virtually impossible and that of the second something less than secure. Judged by the remnants of the second, both were in the block style. The second may have been an E but appears more likely to have been an F. Only a tiny portion of the base of the first letter hints that it may have been part of the arm of an L or part of the base of the stem of an I. One is reminded of Luellin Evans or of James Fox,

his tutor, who was still at work as late as 1668 when another of his apprentices, William Hix, became free on Jan. 26 (Ralph 1948:10). Another possibility would be John Fryer, Jr., who gained the freedom on August 7, 1723 (Ralph 1948:8).

Fryer would be an unlikely prospect for several reasons. First, he came on the scene, probably as a very young man, toward the close of the occupational period at the Buck site. There seems little chance that he could have established himself in the export business before occupation terminated. Second, by Fryer's time it was more popular to place maker's marks in relief on the side of the bowl than to impress them around the stem. Finally, to choose Fryer would be to ignore the demonstrable association of Luellin Evans with James Fox. Logic, therefore, dictates that one attribute this small bowl body fragment either to Luellin Evans or to James Fox, depending on what one conceives the damaged initials originally were.

OTHER DIAGNOSTIC ASPECTS

To this point, with the exception of two marked body sherds and one bowl fragment believed to have been of Dutch origin, this evaluation has concerned itself with stem fragments. And for good reason: the remaining body sherds offer no features on which judgments might be made. Most of them are too small to permit estimates of bowl size or shape, both of which varied through time, the latter being a generally reliable aspect on which diagnoses may be based. It may be noted, however, that none of the sherds appears to have come from a bulging type bowl - an early form. All appear to have been parts of the more nearly straight-sided bowls which became popular at the turn of the eighteenth century.

One other aspect of a few of the body rim sherds requires mention if for no other reason than that its omission might be cause for question. Reference is made to the few rim sherds which exhibit some form of "rouletting" or "milling" just beneath the lip of the bowl. Rouletting is not a diagnostic trait. From the earliest days of the pipe making industry up to comparatively recent times many makers have chosen thus to embellish pipe bowls. The decoration occurs in a great many forms, some very delicate, others crude and coarse, but in no instance is its presence or absence diagnostic of anything more than a pipemaker's fancy.

CONCLUSIONS

The white clay pipe material retrieved from a refuse disposal area on the Buck site was accumulated over a period extending from ca. 1665-70 to ca. 1725-30.

The site appears to have been itinerantly visited both before and after the period of accumulation (occupation).

Because all the evidence came from the surface of the ground, one may assume that the rate of accumulation was fairly steady, justifying the use of formulae for determining a mean date for the disposal area.

Synthesis of the evidence derived from the pipe stem sample indicates the mean date of accumulation to have been ca. 1697-1700.

The postulated period of accumulation is supported by the presence of a stem fragment attributable to Luellin Evans of Bristol, 1661-ca. 1691, and of a bowl fragment attributable to Ann Smith of Bristol, ca. 1700-ca. 1704.

With one possible exception, the white clay pipe material recovered from the refuse disposal area most probably originated in Bristol, England.

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SUPPLEMENTAL REPORT ON ADDITIONAL WHITE CLAY PIPE EVIDENCE RECOVERED FROM THE BUCK SITE NEAR CHESTERTOWN, MARYLAND.

H. G. OMWAKE

Two additional white clay pipe fragments recovered from the surface of the ground near the area presumed to have been a refuse dump on his property were submitted by Mr. C. Douglass Buck, Jr., for examination and comment. One was a small bowl fragment, the other a short length of broken stem. The problem: to determine to what degree, if any, the two fragments are in harmony with the collection of white clay pipe bowl and stem remnants previously assembled from the site and evaluated by the writer.

Bowl Fragment.

The specimen represents a small section of the back of a bowl, broken from its host just above the point of jointure of bowl and stem. It carries a simple, elemental type of fluting, the flutes extending only partway, perhaps half, up the sides of the bowl. The specimen carries no markings by which the name of the maker or the place of origin might be suggested. Although the fragment is small, it is large enough to indicate that it derived from a small to medium-sized bowl, certainly not from one of the large bowls popular from the last quarter of the 19th century until recent years.

Evaluating white clay pipe bowls and bowl fragments necessarily requires consideration of possible sources of origin and of the practices in vogue in each of them at any given time, so far as presently can be determined or logically postulated on the basis of acceptable indicators. Even so, the door must be kept open, in all but a very few instances, for the discovery of new information which might alter one's conclusions. There is very, very little, unfortunately, about which one can be absolutely and unequivocally certain. The best that one can do is to explore and examine all available sources of pertinent information and arrive at the most probable synthesis from which conclusions can be drawn.

Broadly speaking, bowl decoration was not a common trait of pipes manufactured in England before the turn of the 19th century, a few odd examples excepted. Oswald notes (1960:50) that in the latter part of the 18th century and in the 19th bowl decorations "generally consisting of oak leaves down the front of the bowl or *fluted sides*" (italics mine) did occur. This reporter has no record that a similar development took place in Holland, but it is difficult to believe, in view of the intense competition prevalent among the pipemakers of the several countries in which the industry more or less flourished, that Dutch pipemakers did not employ the fluting motif to enhance the appeal of their products.

In France, which, in terms of pipe manufacture in England and Holland, was Johnny-come-lately to the industry and the export of its products, fluting appeared on a few bowls being turned out in 1771 (duMonceau 1771: plates 1 through 4). Of 32 types of bowls illustrated, simple fluting occurred on two and a more sophisticated type on 1. By a stretch of the imagination, it can be conceived that a complicated kind of bowl ornamentation seen on pipes of German origin occasionally recovered archaeologically from shallow sites of the eastern United States, datable post 1850, can be conceived to have roots traceable to

simple fluting. Both the French and German bowls are much larger and of different shape than the small fragment indicates for the Buck site specimen.

In the United States, particularly in Missouri River Valley military and trading post sites as far west as Wyoming and Montana, a wide variety of types of fluting may be seen on pipe bowls archaeologically recovered. These bowls, for the most part, are very much larger in all respects than the Buck site specimen is presumed to have been.

In the Missouri River Valley sites occur white clay pipes of provable Irish, Scottish, English, French, Dutch and Canadian origins and one variety which is seemingly American made, attributable to P. Lorillard Co. of New York, whether manufactured by or for the company. Interestingly, none of these is fluted. Additionally there are recovered many pipes which carry technologically advanced and sophisticated varieties of fluting but none of these types can be unreservedly assigned a definite point of origin. Finally, there is recovered a wide variety of types of semi-sophisticated fluted bowls made from red, brown, and grey-black clay, usually, but not always, glazed. The clay is tightly compacted and, in firing, takes on the appearance and consistency of stoneware. All require the addition of a hollow reed stem. Undoubtedly they are of American origin. Many may have come from factories in or near Akron, Ohio, which in the middle 1850's was the pipe-making capital of the United States, supporting at least six clay products companies among whose output the clay smoking pipes have drawn special notice (Blair 1965:26-30). Among the leading producers of smoking pipes in the Akron vicinity was E. H. Merrill who established a pottery of the same name at nearby North Springfield, Ohio, in 1831. In 1843 or 1844 Calvin, a brother of E. H. Merrill, invented a machine for making pipes. Thus, hand-molding of pipes and the use of individual molds and other hand tools became obsolete and the E. H. Merrill Co., for the moment, enjoyed a virtual monopoly on the manufacture of clay and stoneware smoking pipes in Akron and vicinity.

Sometime immediately prior to 1880 William Merrill of Akron, undoubtedly a member of the pottery making family, established a pipe-making factory at Pamplin in Appomatox County, Virginia. Local elderly informants in Pamplin state that Mr. Merrill, meaning William Merrill, "closed down his pipe factory in Akron and moved the machinery to Pamplin." The first half of that statement is only partially true. The Merrill Company did not close down.

In 1900 the E. H. Merrill Co. was combined with the Whitmore, Robinson and Company to form the Robinson-Merrill Company in which E. H. Merrill remained active until his death in 1902. What is more likely is that by the 1870's so many other firms had entered the pipe-making field that that branch of his business had ceased to be sufficiently profitable and Mr. E. H. Merrill abandoned it in favor of other types of clay products. The second part of the statement probably is true. At least one variety of Pamplin pipe was labelled the "Akron Shaker" and undoubtedly was named for one of the products of the E. H. Merrill Co. It seems very likely that it was produced by machinery which once was operated in the Akron plant established by the company in 1847. Undoubtedly a member of the family, Mr. William Merrill, gained possession of the pipe-making machinery and moved it to Pamplin.

It is of interest to note that evidence suggests the high probability that red clay pipes, strikingly similar to those manufactured by the Pamplin Smoking Pipe and Manufacturing Company, had been handmade and molded by the rural farm women of Appomatox County for an unknown number of years before the Pamplin factory was established. The ladies bartered their pipes to the merchants of Pamplin in exchange for other commodities and household necessities.

The Pamplin factory continued in business until the early 1950's. Indeed, in 1953 a trader who operated a store on the Fort Peck Indian Reservation in Montana, after selling a Pamplin pipe to an ethnologist associated with the United States National Museum, remarked that he had been unable to purchase any more stocks of pipes from the Pamplin factory for a couple of years. (See note subtended to the bibliography at the end of this report.)

The origin of the Missouri River Valley white clay pipes which carry highly sophisticated forms of fluting remains unknown. Such pipes occur in sites which date, generally, post 1850, and, to date, none which carries any identifying mark has been reported. In the same sites pipes of Irish, Canadian, Scottish, French and Dutch origin carry marks which leave no doubts about their origins. In other sites of the same period and a little later occur pipes whose English and German origins are clearly indicated. One is left little choice except to suspect American manufacture for the white clay pipes which display the highly sophisticated forms of fluting.

The problem with this assumption is that although numerous American kilns are known and their products are on record, only one excavated American kiln is known to have produced fluted pipes of white clay. This kiln was located at Maspeth, Long Island, New York and was excavated in 1955 (Lopez). It was operated from ca. 1870 to 1920 as a branch of a large brick manufacturing company. From the kiln and an associated waster dump came white clay small cubes which may have been converted into dice, marbles, and both pierced and unpierced thick button blanks which eventually were covered with cloth and sewn on fabric. But of maximum interest to a student of white clay pipes were many fragments of large bowls and thick stems completely covered with clean and sharply moulded diagonal fluting. Some exhibited the initials TD in relief on the back of the bowl. These pipes do not resemble the highly sophisticated white clay pipes from the Missouri River Valley sites, but they do establish the fact that white clay pipes which carry a technologically advanced form of fluting were made in America, possibly during the period at which the western sites were active.

Let us return to the simply fluted Buck site specimen from the digressions indulged in the paragraphs above. Fragments of white clay pipe bowls having the same size, shape and elemental type of fluting as the Buck site specimen are

widely distributed on the surface of cultivated fields of the Atlantic coastal states and have been reported from Maine to Florida. Examples of similar pipes excavated from dated and documented sites are much rarer. The best established such site is that of the original John Deere Blacksmith Shop (1837-1847), Grand Detour, Illinois, excavated in the early 1960's by Dr. Elaine Bluhm, then a member of the faculty at the University of Illinois. The pipes recovered from the site were evaluated by the writer (Omwake 1964). No comprehensive report of the excavations and studies of artifacts recovered has, so far as the writer knows, been published to date.

Associated with the simply fluted bowls at the Deere site were several types of TD bowls of medium large size, most noteworthy of which were variations which carried the initials in relief on the back of the bowl enclosed within a circle of 13 stars, bowls carrying flutes from base to rim, partially or wholly fluted bowls whose mold marks, front and back, were camouflaged by ascending columns of alternating, generalized oak or wheat leaf decorations, bowls exhibiting refined types of fluting accompanied by several kinds of supplemental ornamentation which encircled the bowls just beneath the rims, bowls whose refined fluting completely covered the sides, flowing around their contours and extending on to the stems for varying distances and terminating in one, two, three or four raised bands which encircled the stems and behind which sometimes occurred a depressed panel on the left side parallel with the length of the stems and from which sometimes stood out, in relief, the clear initials CP or poorly formed or badly eroded letters which might be read as LP or CF and, finally, several examples of the well known and widely distributed Peter Dorni stems.

The initials CP may be attributed to any of three English pipemakers, Charles Powell, Jr., who began work in Chester in 1784, another Charles Powell who took up the trade in Liverpool in the year 1790, or Charles Piars who worked at Nottingham from 1818 to 1853, a period which completely encompassed that during which the John Deere Blacksmith Shop existed (Oswald 1960:85). The bowls which exhibit the TD within a circle of 13 stars clearly represent a very strong American patriotic theme and are frequently found on American campsites of the War of 1812. Undoubtedly they remained popular for many years after that unfortunate period of our history. One is tempted almost automatically to assume an American origin for these bowls and perhaps they did have such origin(s) but a note of caution should be sounded. It is well known that despite wartime conditions American merchants continued to import supplies of numerous commodities from the Motherland. Until the remains of an American pipe kiln yield similarly marked pipes, it is safer, really, to assume an English origin for them.

Perhaps most distinctive of all the pipe fragments recovered from the John Deere Blacksmith Shop site were those which carried on the stem, in relief, parallel with the length the name Peter Dorni, the given name on the left side, the surname on the right. Peter Dorni was a pipemaker who worked in northern France about 1850 (Helbers 1947). His pipes were so meticulously made and the stems so exquisitely ornamented that they achieved widespread distribution in the

United States to which they were exported in great numbers in response to the demand. After Dorni's death about 1880, the pipemakers of Gouda appropriated his good name and reputation but their products are usually distinguishable from the originals by their generally less careful finish, sloppily executed stem decorations and the use of several styles of lettering for the name. There is some evidence, based on the recovery of poorly made Peter Dorni pipes, which incorporate the deficiencies cited above, from American sites datable before 1880, that the Gouda makers were not above plagiarization even while Dorni was alive and working. Although Dorni was first noted in 1850 by the Gouda pipemakers because he was severly hurting their export business, he must have been at work for some time in order to establish such a good name. His products, therefore, could easily have reached the Deere site prior to termination of its existence in 1847.

With the definite exception of the Peter Dorni stems and the possible exception of the star encircled TD bowls, it appears that the Deere site specimens came from English kilns and that such an origin should be assigned to the relatively small bowls which carry the elemental type of fluting present on the Buck site specimen. The point would appear clinched by the presence of exactly similar fragments at Old Fort Niagara (1726-1850), New York, in an ash and charcoal layer, 40" - 48" below present ground level, which is certainly the burned out residue of English barracks destroyed during the War of 1812 (Haven).

Technologically simple and uncomplicated, the type of fluting which appears on the Buck site specimen is, in all probability, the type which Oswald (1960:50) noted was first developed about the middle of the 18th century and revived later in the 19th. That fluting persisted and became a popularly appealing motif of bowl ornamentation is attested by the many complex and sophisticated variations seen on bowls from the mid-19th century and later sites of the Missouri River Valley.

Stem Fragment.

The single supplemental stem fragment from the Buck site is approximately 2 cm. in length, has a slightly oval shape (certainly not intended) whose diameters measure 6 mm. and 7 mm., a plain undecorated and unmarked exterior surface and a bore of 8/64ths inch, measured from either end. The fragment obviously was broken from a relatively long, thin stem at a short distance from the mouthpiece.

According to Harrington (1954), the 8/64ths inch bore size was most popular (59%) during the 1620-1650 period but continued in notable quantity (25%) during the succeeding 1650-1680 interval. Undoubtedly it continued in occasional use in subsequent periods and it may be noted that after ca. 1800 many bore sizes were employed.

In evaluating white clay pipe materials, especially those of long past eras, one ought always to keep in mind that change was a gradual process, not a sudden, semi-dramatic switch from one practice to another. It depended in large measure on changes in the fancies of the addicts to pipe smoking, which, in turn more often than not depended on economic factors such as the availability of plentiful supplies of tobacco, its price, etc. Gradualism was the result, not swift discard of established practices. Thus bore sizes became smaller as increasing supplies of tobacco encouraged technological improvements, such as increases in the size of bowls, but the imposition of higher taxes raised prices and made it desirable that the rate at which a bowlful was consumed be decreased, incidentally prolonging the pleasure of the smoker - hence, smaller bore sizes.

Stem thickness, by itself is an unreliable index of age. In the first place, the thickness, or, really, the thicknesses, of a stem fragment is a fortuitous circumstance depending, in large measure, upon the position between bowl and mouthpiece which it originally occupied. In the older pipes, virtually all stems tapered from a relatively great thickness near the bowl to a very noticeably thinner size near the mouthpiece, so that an old stem might be broken into several sections in which there were very noticeable variations in thickness. In the older pipes the degree of taper from bowl to mouthpiece is often very pronounced. Taper and thickness go hand in hand as functions of stem length in the older pipes. In some of the later pipes taper ceases to be a function of length and becomes just an incidental aspect of the appearance of the whole stem. In these pipes it is often extremely difficult, if not impossible, to determine from what area between the bowl and the mouthpiece any given fragment may have been derived.

It should be understood that there was nothing requisite to the manufacture of a clay pipe which made either the length of the stem or the degree of its taper mandatory in order to insure that the pipe would function successfully as an instrument for the smoking of tobacco. Both length and degree of taper are just simple aspects of the way things happened to develop. If anything, both these elements probably stemmed from the general form of the American Indian clay elbow pipes after which the first English pipes were modeled.

Secondly, as advancing technology made possible the production of longer stems, there arose a problem of diminishing strength and increasing fragility, then and even now a detrimental aspect of all clay pipes whose stems are integral parts of the whole, which demanded attention. One partial solution must have been obvious to the early 18th century pipemakers who produced the pipe known as the "alderman" or "yard of clay" with its 18" long stem and to the later pipemakers of the early 19th century who manufactured the "church-warden" pipe whose stem ranged from 24" to 28" in length: i.e., reduction in the diameter of the bore in order that the walls of the stem might be thicker and, therefore, the strength of the stem increased. Other pipemakers who made pipes whose stems were considerably shorter but nevertheless plagued with the same problem of fragility quickly played "Follow the Leader." Thus, length of stem, in addition to some of the economic factors and fancies of the buying public mentioned in an earlier paragraph, played a role in the gradual reduction of bore size. In general, it may be assumed that if a short length of thin pipe stem has a large bore, the fragment probably occupied a position near the mouthpiece of an older pipe. Conversely, if a length of thin stem has a bore of small size, the fragment probably came from a later pipe and its former position in the original stem is insecure.

It should now be clear that only when stem thickness is synthesized with other factors may it be an index of age. The bore diameter of the short, thin Buck site stem fragment is a large 8/64ths inch. It is most probable that the specimen was broken from a mid-17th century pipe at a point close to the mouthpiece.

Conclusions

1. The indicated shape of the Buck site bowl from which the fluted fragment was broken precludes the possibility of its manufacture in England at the middle of the 18th century but does allow the possibility that it could have been made early in the 19th. However, the total absence of similar elementally fluted bowls from American excavations definitely datable between 1650-1750 provides sufficient evidence for not assigning such early date to the Buck site fragment. It appears far more probable that excavation of similar bowls from such sites as Old Fort Niagara (1726-1815) and the John Deere Blacksmith Shop (1837-1847) provides far more reliable indices of the most reasonable dating of the Buck site specimen. If this premise be accepted, then it is most likely that the fragment reached the site as the chance discard of some transient or some farmer many years after active habitation of the site ceased, as was postulated for several pipe fragments which occurred in the original assemblage from the presumed midden area of the site.

2. It may be recalled that in the original collection of pipe evidence from the Buck site were found 29 (10% of the total number of stem fragments) stem sections whose bore diameter measured 8/64ths inch. This number of examples was judged sufficient to indicate hesitant habitation beginning about 1665. The finding of an additional fragment having the 8/64ths bore diameter only serves to strengthen the postulation.

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Note: Credit for the development of data in regard to the pipe factory at Pamplin, Virginia, is gladly shared by the author with the following persons who have been of inestimable assistance to him: Dr. John C. Ewers, United States National Museum, who first noted, in 1953, Pamplin pipes on sale in the community store at the Fort Peck Indian Reservation, Montana; Miss Wilsie Thornton, Pamplin, who, in the late 1950's, discovered, in the cellar of what had been, many years earlier, her father's general store, several barrels of handmade clay pipes made by the women in the general area around Pamplin and accepted by her father as payment in kind for sugar, flour, cloth and other household necessities; Mrs. Bess Mattox, Pamplin, cousin of Miss Thornton, who assisted in recovery of the pipes, pursued many lines of investigation in regard not only to the

hand-made country pipes but also the circumstances leading to the establishment and operation of the Pamplin Smoking Pipe and Manufacturing Company, willingly shared her findings with the writer, and furnished him with examples of the several types of country-made pipes; Mr. Edward Chappell, Farmville, Virginia, who pursued investigation of the Pamplin factory, did much documentary research in the Appomatox County Court House, excavated a dump area near the pipe kiln, and furnished to the writer representative samples of the factory-made pipes; and to Mr. Howard MacCord, Richmond, Virginia, who personally made several attempts to elicit information from the surviving last president of the Pamplin Smoking Pipe and Manufacturing Company who, most regrettably, proved himself 100% uncooperative.

PROBLEMS IN THE RELATION OF "FLINT" TOOLS TO THEIR GEOLOGICAL PLACE OF ORIGIN.

ELWOOD S. WILKINS, JR.

INTRODUCTION

The correct equation of lithic material with source is extremely important in documenting contact or movements of ancient peoples. This is not easy. Local materials are often mismatched with a source several hundred miles distant. Much confusion is due to close resemblances among secondary chalcedonies.

Chalcedony, being cryptocrystalline quartz, is microcrystalline silica. In the case of samples of local, Delaware Chalcedony Complex, scattered disperse inclusions (in trace to very low amounts) of other minerals occur as impurities. The most significant impurities in chalcedonies are limonite [$FeO(OH).nH_2O$] and goethite ($HFeO_2$). Other minerals, such as magnetite ($FeO.Fe_2O_3$), chromite ($FeO.Cr_2O_3$), ilmenite ($FeO.TiO_2$), other hydrous ferric oxides, hematite (Fe_2O_3), pyrites (FeS_2) and various complex silicates (containing iron with one or more other metals) may be present.

The term chalcedony has been used in a very narrow sense. H. G. Richards (1) notes that the terms flint, jasper, chalcedony and chert are much confused in the literature. He claims that the terms are synonomous and that all should be called "cryptocrystalline quartz". However, he then suggests the usual classification based on color. Earlier mineralogists (including S. F. Gordon (2)) state that chalcedony is transparent or translucent at thin edges and had a waxy luster. Colors given are white, gray, blue, pale brown to dark blue and black. Gordon lists carnelian, chrysoprase, prase, agate and moss agate as chalcedonies with specific colors, appearances and physical properties. He lists jasper as red, brownish, ocher yellow and opaque. Flint is gray, smoky brown or brownish black and with a subvitreous luster. Dana (3) gives the luster of chalcedony as nearly that of wax, transparent or translucent, of a white, grayish, blue, pale brown to dark brown or black color. Carnelian, prase, chrysoprase and agate are listed as chalcedonies. Flint is somewhat allied to chalcedony, but opaque, and dull luster, usually gray, smoky brown or black. Jasper is an impure opaque colored quartz: commonly red, also yellow, dark green and grayish blue.

More recently, mineralogists (4, 5, 6, 7) have divided cryptocrystalline silica into two general classes: fibrous and granular. This distinction cannot usually be made without microscopic aid. Chalcedony is a general name applied to fibrous varieties, according to Hurlbut (4). It is to be more specific, brown to gray, translucent, with a waxy luster. Color gives rise to other varieties; carnelian, sard, chrysoprase, agate, bloodstone, onyx, and agatized wood. Flint is a granular variety, somewhat like chalcedony in appearance, but dull or dark in color. Jasper is a granular cryptocrystalline quartz, usually colored red from hematite inclusions.

Archaeologists use the term chalcedony for a material that has a waxy or semi-waxy luster, is transparent or translucent, and practically colorless. However, in our local area, within the same waxy nodule, every mixture occurs. There

may be large areas that are almost colorless, yellow or brown, and black. It seems incongrous to label different parts of the nodule by different mineral names (Chalcedony, jasper and flint) when they are color varieties. It might be better to call them all chalcedonies and use color for descriptive purposes. The term jasper should be used for dull, heavily pigmented, brown, cryptocrystalline silica pigmented by iron salts. (8).

One of the most helpful discussions of the cryptocrystalline silicas is that by Frondel (7)., p. 170-171. ". . . Many of the recognized types stem from times of antiquity, and almost all antedate the application of the petrographic microscope and of x-rays as descriptive tools. Their distinction is based on secondary, gross characters, particularly the color, as determined by physical admixture, and on the mode and scale of their geological occurrence. Additional factors are the distribution of the color, the fracture and texture, and visible inclusions of other minerals.

"Following general and long established usage, the name chalcedony is restricted, as the main variety, to fibrous quartz that is relatively light colored, without appreciable admixture of foreign material and without gross color banding, and that occurs in small masses as crusts, cavity fillings, and the like. Most of the fine-grained types of quartz that have been distinguished by given names, including agate, carnelian, flint, and chert, basically are aggregates of fibrous quartz, for which the term chalcedonic silica is appropriate, and in a sense are variants of chalcedony. In addition, some of the fine-grained types of quartz are found on microscopic examination to be composed of granular rather than fibrous quartz. Novaculite and much of what is called jasper and prase are of this nature, as is at times some of the normally fibrous material classed under specific names on the basis of color or other non-textural factors."

However, there is one good insight that delivers us from this morass of a terminological mess. It is the distinction between a mineral and a rock.

The Classification of silicas as rock types.

Charles F. Wray (9) in his petrographic study of New York lithic materials, has been unable to untangle classic definitions of the quartz-family minerals into any natural classification or order. He believes that the terminology is a gordion knot that cannot be untied but must be cut. In cutting the knot, he goes back to fundamental distinctions that hold throughout mineralogy and chemistry. These involve the basic difference between a mineral and a rock, a chemical and a material.

Wray proposes that there is a mineral called chalcedonite. It is a perfectly pure and homogeneous chemical made up of cryptocrystalline silica, its crystals are interlocked and intergrown, of such small size that they cannot be resolved under the microscope. Probably no pure chalcedonite exists in nature, but it could be readily synthetized or segregated. The material which archaeologists call chalcedony is the closest approximation to chalcedonite. Its crystalline fragments are so tiny that chalcedonite (a solid) can only be distinguished from a glass (a liquid) by the technique of x-ray diffraction, which shows the geometrical patterns in which atoms are locked together by valence bonds into a fixed lattice of molecules within a solid.

Lithic materials are mainly rocks, just as most of the substances used in industry are materials. Minerals and chemicals are pure or purified ingredients. Chalcedonite is one of the minerals mixed with other minerals to form a rock. A mineral is a pure chemical, a rock is a mixture made up from particles of several or many different minerals. All flints, cherts, chalcedonies (or whatever you call them) are rocks; chalcedonite is but one constituent of rocks.

"Flints" or chert are not quartz; quartz is a grossly crystalline silica mineral, containing no chalcedonite. This is the first major distinction, that between quartz and chalcedonite, distinct mineral species. "Flints" and cherts are rocks and not minerals, because they are mixtures of several mineral species. If we turn to the terminology for rocks instead of looking for mineral distinctions, we can handle silicas. They are no more difficult than granites or gneisses or schists, where there are continuous spectra of mineral mixtures forming so many gradients in a rock series that we are often at a loss for a valid name.

Chalcedonite is the mineral that forms the ground of most "flints". If a pure cryptocrystalline silica is nearly pure, with a fibrous appearance and only scattered impurities, transparent to light gray to green to blue to pale yellow to orange to red in color, it is a rock called chalcedony.

If it is full of small quartz crystals or voids, giving it a matte and non-glassy surface on a break, with a granular appearance, we consider it a chert. Chalcedonite mixed with resolvable quartz crystals or voids but with little dark mineral admixture is translucent: it is a chert.

Other rocks made up mostly of silica have other mineral impurities. If a chert is stained yellow, brown, red, or green by the various salts of iron which are not crystalline but which form a cloud-like tissue of colloidal particles suspended in chalcedonite, it is a jasper. Jasper is a variety of chert, but it takes its color from mineral constituents which are missing in true chert.

Rocks consisting of chalcedonite intermixed with crystals of black opaque mineral are likewise of a granular texture because of included crystals. They are opaque, giving us another rock-type which we call flint. The ground of flint is chalcedonite, which is cryptocrystalline and therefore appears superficially fibrous under the microscope because of its infinitely fine grain size. Intermixed with it in flint is a large proportion of grossly-crystalline minerals of heavy metals, so that its macroscopic structure appears granular.

Thus, Chalcedonite, quartz and other minerals making up a cryptocrystalline

silica-rich rock are each minerals, pure minerals. If a rock is almost all chalcedonite and is translucent with a glassy surface, it is chalcedony. If it is largely chalcedonite but includes much quartz or voids, it is a chert. If it is a chert but is colored by cloudy, flocculent inclusions of colloidal hydrated iron salts, it is a jasper. If a rock which would be a chert or jasper is filled with tiny crystals of dark heavy metal minerals, such as chromium-iron oxides, it is opaque and is a flint. Some chalcedonies, the simplest of this series in their gross composition, present serious difficulties in determining the cause for particular colors, due to dissolved trace elements.

Additional work must be done in classifying the intergrades between chalcedony and jasper which occur abundantly in both the Delaware Chalcedony Complex and the Pennsylvania Jasper localities.

Eastern Chalcedonies.

Most of the heat experiments have been made with samples from three groups of chalcedonies. These are the jaspers, chalcedonies and cherts of eastern Pennsylvania; jaspers, cherts, flints and chalcedonies which cluster about Newark, Delaware; chalcedonies, cherts and jaspers of Dinwiddie County, Virginia. They represent three natural geological units or formations of quite different geological age. They are conformable formations, produced by the same geological and chemical process.

Small outcrops of Pennsylvania Jasper are known at five locations within the area of the Hardiston Quartzite Formation of probable Precambrian age. They have been seen in section only at Vera Cruz (10) in Lehigh County. Thin beds of jasper and flint underlying a thin limonite bed represent a fossil soil profile preserved on remnants of an ancient land surface inclosed within the Hardiston. The silica layers have been shattered and faulted by earth movements at several different times. Cracks have healed, cavities filled, and surfaces crusted with secondary chalcedony.

The Delaware Chalcedony Complex, of Cretaceous age, includes extensive exposures of Newark Jasper, Cecil Black Flint, and Broad Run Chalcedony in Delaware, Chester and Lancaster Counties, Pennsylvania; New Castle County, Delaware; and Cecil and Harford Counties, Maryland. A bewildering variety of secondary chalcedonies (grown in veins and voids and upon blocks) is found in each locality, often associated with crusts of semi-opal (Hyalite).

The Virginia group is best known at the Williamson Site, a major Paleo-Indian station in Dinwiddie County, Virginia. The material ranges from partial silica pseudo-morphs after hornblende gneiss through white and cream cherts, yellow and brown jaspers to glassy white, yellow and blue chalcedony. It is of unknown age, but like the other groups, the silica deposits have been formed upon a Precambrian country rock. All three groups are lateritic silicas, products of one sequence of geological conditions and chemical processes.

The silica beds underlie masses of limonite boxworks, both layers representing soil zones formed by lateritic weathering. Under moist tropical climates, on low lying landscapes which are too flat to suffer mechanical erosion and which carry a high water table, limonitic laterites are often formed. Water and organic acids percolating downwards through the soil and rock mantle carry colloidal particles of iron and clay minerals. These become concentrated below the water table, forming a hardpan which may ultimately become a thick rock-like laterite.

Silica is hydrated and transported as a gel and is then concentrated as opal in the zone below the laterite. Silica and iron salts displace other minerals in the zone of deposition. These zones may become relatively pure and concentrate beds of opal and goethite. The opal becomes chalcedony and goethite becomes limonite with later dehydration.

Where bedrock subjected to lateritic weathering is an ultrabasic (ultramafic) lava or metamorphic, it contains abundant sources of iron and silica. Extensive deposits of "flints" and iron ores may result. Where the parent rock is an acid, porous, iron-deficient rock such as the Hardiston Quartzite, long ages of weathering have removed a thick zone of rock leaving very thin layers of chalcedony and limonite in the zones of deposition. At Vera Cruz, the limonite is less than six inches thick, the jasper and flint beds less than three feet.

The Problems of Ohio Chalcedony.

Huge deposits of chert and chalcedony at Flint Ridge, Licking County, Ohio, represent a marine chert which poses many problems. Cherts were deposited on the sea floor as a secondary bed of silica gel, dehydrated to opal and finally to chert. This chert is but one facies of a wider Silurian stratigraphic unit made up of limestones in some areas, shales in others. Each facies represents the product of contemporary but different conditions ofdeposition on various parts of the sea floor.

Bedded marine "flints," like laterite "flints," were the result of specific geological and physiographic conditions. When a land-mass has been eroded down almost to sea level, mechanical erosion ceases and run-off water carries almost no clay, sand or other detritus. Erosion of soils and of mantle rock has become a process of chemical alteration. Silica gel is carried in the run-off water, and is brought into the sea where it forms pure sedimentary deposits of silica.

The modern world contains no peneplain, no area where erosion has proceeded to this stage. However, during the dry season, tropical rivers carry little clay but contain large amounts of silica gel. Marine "flint" beds represent a more extreme stage of peneplantation and tropical weathering, and generally mark the limit of greatest peneplantation in a stratigraphic column. The Kanawha Flint of West Virginia is our most spectacular example of a marine "flint."

The Flint Ridge chert itself consists of three facies, horizontally-separated

areas of different silica varieties. The first is a cream colored fossiliferous chert filled with tiny voids. It occurs in thick strata and forms the bulk of the deposit. It is readily identifiable by its specific microflora and microfauna, and specimens found hundreds of miles away can be equated with this formation. The second variety is chalcedony with the color and transparency of skimmed milk, sometimes with cloudy pink zones. It was a favored material for large knife blades during Adena and Hopewell times. It is massively-bedded but jointed, and can be obtained in very large blocks. Its diatom content sometimes serves to identify it.

The third variety, found in a few small areas near the edges of the chert deposit, is a multi-colored chalcedony. It contains no micro-fossils. In thin section, it is found to consist of a chalcedonite ground, the particles too small to resolve under the microscope, with tiny double-terminated quartz crystals scattered through it. Pennsylvania Jasper has the same composition, but is distinguished from most Flint Ridge Chalcedony by curd-like clouds of limonitic dust which are everywhere in the Pennsylvania Jasper.

The colored chalcedonies are highly jointed or brecciated, so that it is difficult to find a piece as large as one's fist. The cleft surfaces are generally coated with quartz crystal or limonitic crusts. Because it was not available in large pieces, it was infrequently used for bifacial knife blades. However, the Hopewell culture favored colored chalcedonies for small blade tools ("flake knives") and most Ohio Hopewell cores and blades are of the brilliant varicolored stone. Thus local collectors call the creamy chalcedonies "spearpoint material," the multicolored chalcedonies "core material."

The genesis of the colored chalcedonies is obscure. They do not appear to be vein chalcedonies but rather to have been deposited secondarily very slowly at the edge of an area of silica deposition. Some blocks, when broken, are found to have a nucleus of soft, decayed limestone. Thus they may represent secondary chalcedonies formed very soon after the massive beds of cream colored silica were deposited. They probably show a wider range of colors than any other single chalcedony. Two specific color variants, unfortunately rare, have never been seen in any other chalcedony. One is "Robin's Egg Blue," the other a rich violet subtly flecked with red. Some brown zones are colored by inclusions of iron salts, but most samples show no mineral inclusions visible under the microscope, and the coloring ions seem to be in solution in the silica. Concentrations of trace metals may produce much of the coloration.

Many individual pieces of colored Flint Ridge Chalcedony may be confused with chalcedony from other sources, but large samples should be distinguishable because no other formation shows as much range in coloration. Studies of the petrography and of the geological structure of the Flint Ridge deposits have not progressed to the point where we can identify colored chalcedonies with certainty or describe their genesis.

The Local Problem: the Effect of Heat.

In the Delaware area, the main problem is this. Chalcedony vein-fillings in Cecil Black Flint (pigmented with magnetite-chromite inclusions) and a few chalcedony nodules from the Broad Run Valley (New Garden Township, Chester Co., Pa.) and also from the Heath Farm, Cecil Co., Md., resemble some chalcedony from Flint Ridge, Ohio, from the Williamson Site, Dinwiddie Co., Va., and from the jasper exposures of eastern Pennsylvania (Lyons, Macungie, Vera Cruz, Durham and Longswamp). Heating makes identification with sources more difficult. Persons knowledgeable in allocation of exotic chalcedonies are unable to correctly sort both unheated and heated specimens (which were selected for their treacherous appearance).

It should be pointed out that all local chalcedonies (as well as those from Berks and Lehigh Counties, Pa.) respond to the effects of heat by changing color. The materials from the Williamson Site and Flint Ridge, having sparse iron salt curds, do not all respond. It should also be noted that, although all of the Delaware Chalcedony Complex chalcedonies respond to the effects of heat, only a few examples resemble unheated samples from other sources.

The Effect of Heat Under Oxidizing Conditions.

It is the effect of heat upon the limonite and goethite with which we are at present concerned. This has been studied through experiments extending over the past ten years. Other iron compounds play a minor role. Literature search has confirmed that limonite [yellow ocher - $FeO(OH).nH_2O$] loses its combined water to become the much more highly-colored hematite (red ocher-Fe_2O_3). Other hydrous ferric oxides, such as goethite, also lose their water to become hematite. Experiments have shown that a temperature of about 250°C. (482°F.) is sufficient to completely alter limonite to hematite.

When chalcedony is not heated too rapidly, its form is apparently not altered. Too rapid heating causes chalcedony to split apart and "pot-lid," due to rapid generation of steam from combined and adsorbed water. Jaspers, having much limonite, crumble through innumberable steam explosions. As a result, many heated jaspers resemble shattered pieces of hematite.

Limonites vary from yellowish to dark-brown. The colors which they impart depend upon the fineness of ocreous particles and upon the amount present. The color of a pigment becomes lighter as the particle size decreases. The color of the Delaware Chalcedony Complex chalcedonies varies from white to yellow, brown and black.

The Effect of High Temperature and Reducing Conditions

When heated under oxidizing conditions as in an open fire, the Delaware Chalcedonies take on a reddish color, depending upon the amount and kind of iron min-

erals present. Under reducing conditions, and at very high temperatures, other reactions occur. Hematite is reduced to a more stable, black compound, magnetite ($FeO.Fe_2O_3$). This heat transformation can be carried out most readily in the center of a very hot fire using corn cobs as fuel. The heat is usually sufficient to cause incipient fusion of the surface, forming a glass.

W. F. Hillebrand and G. E. F. Lundell (12) caution exceeding a temperature of 1200°C. when heating ferric oxide. Above that temperature, it is reduced to magnetite, which no amount of heating can re-oxidize to ferric oxide. H. Warth (13) noted that when aluminum and ferric oxides are heated together at a high temperature the iron is decolorized and a white product is obtained. This may explain the formation of white veining (and/or mottling) that is observed in Cecil Black Flint. A dark-red to black, over all color, is produced under conditions of very high temperature and reducing atmosphere. Artifacts made from Delaware Chalcedonies, and especially chalcedony artifacts tnat have been treated in this manner, are distinct varieties. At tne same time they represent a puzzle as to their identity and source of material. Artifacts of Delaware, Pennsylvania and Virginia material showing this effect have been collected. Most are Broad Spear Points in the Dismal Swamp Collection of B. C. McCary and in collections of the Pennsylvania Historical and Museum Commission.

Description of Colors.

Colors of unheated and heated chalcedonies are best described by means of the Munsell Color Charts (14). Their use is recommended for the color description of all lithic material whenever possible. By this means a standard description is given that anyone can find on a like chart. This is more accurate than the use of arbitrary and inconsistent color description.

The color range of Delaware Chalcedonies varies after heating. In an oxidizing atmosphere, it ranges from pink to dusky-red and dark-red (and in a few cases) it is a reddish-gray; due, no doubt, to the presence of magnetite or chromite. Pastel-green casts have been noted in thin vein fillings. Heat does not alter them. They may be due to iron silicates. Under high temperature and reducing conditions, reddish-gray to black color is produced. Effects of heat on one particular sample of chalcedony is collated with standards from the Munsell Color Charts in the following table:

Unheated	Heated under oxidizing conditions	Heated under reducing conditions and at a high temp.
10YR 5/4 Yellowish-Brown	10R 3/3 Dusky-Red	10R 2/1 Reddish-Black

Vein chalcedonies from Lyons, Macungie and Vera Cruz show some color changes like Delaware materials. Others produce pastel tones that are due either to iron minerals not present in Delaware materials, or to other metals. Materials from the Williamson Site and from Flint Ridge bear a striking resemblance to each other in color and quality of material. They respond to heat in a similar way. Both of these materials may produce a rainbow of hues, when selected specimens with tones ranging from almost white to a light brown, are heated.

Similar pastel colors are produced when the weathered and whitened skin of Broad Run Chalcedony is heated. This chalky skin is caused by voids in the rock due to the solution of silica and other minerals by weathering. This suggests that at least some of the white coloration of other chalcedonies may be due to the presence of light-scattering voids or crystals. Complex silicates, such as those of aluminum, may also account for some background colors that are unaffected by heat.

Colors other than reds are produced. These may be due to trace elements also found in chalcedonies from Lyons, Vera Cruz and Macungie.

Flakes, spalls, and artifacts which show the effect of heat upon part of the specimen, with the balance unaltered, are known everywhere. Some have been heated just enough to give a red skin and then subsequently worked. This has removed the red surface in patches, revealing the original color underneath. Artifacts collected in the Dismal Swamp area by B. C. McCary (probably made of the same material as that of the Williamson Site) and artifacts in the collections of the Pennsylvania Historical and Museum Commission, include a minority, all Broad Spear Points, that show this effect. Both collections also include specimens that have been heated sufficiently to change their color throughout.

The Natural Colors of Chalcedony.

We have studied the Delaware outcrops, including a road cut by the Maryland Expressway through the Heath Farm (18 Ce 8) in Cecil Co. Md. This cut exposed the stratigraphy of the jasper and chalcedony in situ. A fresh road cut for the Northeast Extension of the Pennsylvania Turnpike (where it passed through a section at Vera Cruz) (10) did not disclose any red jasper or chalcedony. We have thus noted that red jasper and red chalcedony are not (except carnelian and long-weathered till pebbles or cobbles) natural occurrences in this area. They are the product of accidental or purposeful heating.

A short visit to the Williamson Site did not reveal any material with a natural red color. Specimens collected at this time, as well as specimens in the collection of B. C. McCary, included materials that are altered when heated. Specimens were also collected that have been heated by Indians. Some specimens collected at Flint Ridge respond to heat, giving varied colors, some of which are seen on Flint Ridge Chalcedony tools. These colors may be produced simply by the proper application of heat.

Carnelian, a clear-red, botyroidal chalcedony may occur at all of these locations. Its appearance is distinctive; the only material that could possibly be confused is heated vein-chalcedony.

Conclusions.

It is difficult to distinguish between eastern heated and unheated chalcedonies, and those from mid-western locations.

The microscopy of thin sections and the application of modern analytical techniques (x-ray fluorescence, atomic adsorption, paper chromatography, etc.) for the identification and estimation of trace elements offer better opportunities for relating "flint" tools to their source.

It is recommended that the Munsell Color Charts be used to accurately label colors of lithic materials.

Chalcedony and jasper do not normally occur in matrix in a red color. The use of the terms "red chalcedony" and "red jasper" should be discontinued. In order to properly reflect their history, the terms "heat-reddened," carnelian, "red thermal jasper or chalcedony," or "reddened through long exposure and dehydration of a till pebble or cobble," should be used, according to the genesis of a specific sample.

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INDEX OF PUBLICATIONS, 1933-1965

by Arthur G. Volkman

Since its inception in 1933, the Society has irregularly issued material pertaining to archaeology and ethnology in the State of Delaware.

VOLUME ONE (five numbers) and VOLUME TWO (seven numbers) of the Society's BULLETINS were released in mimeographed form. VOLUME THREE and succeeding issues of its BULLETINS were printed. VOLUME NINE, Number One of March 1958 is the last volume in this series. A new series of successive numbers was set up in the Spring of 1962.

In May, 1940 C. A. Weslager prepared an *Index of Publications*, entitled PAPER No. 2, covering BULLETINS, PAPERS and MISCELLANEOUS PUBLICATIONS issued up to that time. Since that date there has been no additional index, and in view of the significance of the material published in the interim, it was felt a complete, up-to-date index would be desirable.

BULLETINS

THE ARCHAEOLOGICAL SOCIETY OF DELAWARE

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PAPERS

The "Papers" represent a supplementary series of publications, inaugurated in 1939. The "Papers" are numbered consecutively and should be considered separate from "Bulletins." The "Papers" are mimeographed publications with printed covers.

PAPER No. 1 "The Coastal Aspect of the Woodland Pattern as Represented in Delaware." C. A. Weslager

PAPER No. 2 "Index of Publications."

PAPER No. 3 "Excerpts from 'Peter Kalm's Travels.' " With footnotes by C. A. Weslager and Archibald Crozier

PAPER No. 4 "Museum Inventories of Delaware Artifacts." C. A. Weslager, et al.

PAPER No. 5 "Excerpts from Works of HENRY DAVID THOREAU." Edited by A. G. Volkman

PAPER No. 6 "History of the Society." H. T. Pratt

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MISCELLANEOUS PUBLICATIONS

"Indian Towns of the Southeastern Part of Sussex County, Delaware." William B. Marye, 16 pages, printed. (This monograph previously appeared in two parts in the Society's "Bulletin.")

"Indian Land Sales in Delaware," by Leon de Valinger, Jr., with addendum, "A Discussion of the Family Hunting Territory Question in Delaware," by C. A. Weslager.

"Indian Place-Names in Delaware," by A. R. Dunlap and C. A. Weslager.

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