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THE ORIGIN OF THE "PALESTINIAN" BICHROME WARE*

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INTRODUCTION

During the decade bridging the year 1930, a repertory of bichrome pottery appeared from excavations in Palestine¹, Cyprus² and coastal Syria³. The Bichrome Ware, as the pottery was called, was dated to the Late Bronze I Period, but may have appeared earlier. Major notice was called to this ware in the publication by Petrie in 1931 of his excavations at Tell el-'Ajjul and since then they have been the object of detailed study. The complex arguments concerning their evolutionary associations will be summarized presently but, for the moment, we only point out that the pottery has been considered indiginous to Palestine or Syria.

W. A. Heurtley in his article, "A Palestinian Vase Painter of the Sixteenth Century B.C."⁴, which appeared in 1939, concludes that most, if not all, of the Bichrome Ware was the product of one artist whom he called the "Tell el-'Ajjul painter"⁵. He reasoned that the painter began working in Megiddo and later moved to Tell el-'Ajjul, on the southern coast of Palestine. "... he seems to have soon established himself in the South, whence examples of his work were exported to other parts of Palestine, to Syria, and eventually

* Work performed under the auspices of the U. S. Atomic Energy Commission.

to Cyprus"⁶. Heurtley further states that "There is a uniformity about the Cyprus group which suggests that they formed part of a single consignment, and the form of the jugs can be explained by supposing that they were especially designed to satisfy the Cypriot tastes"⁷. (See map.) Claire Epstein, in her book, Palestinian Bichrome Ware, criticized Heurtley's conception of a one-man school analogous to those of the 5th and 4th century Greek vase paintings. She also dismisses Heurtley's theories regarding the migration of the hypothetical painter by disqualifying his stratigraphic analysis of Megiddo⁸.

The present report falls into two domains: (1) the assignment of provenience of these wares by a method which is independent of stylistic criteria, and (2) a new appraisal of their stylistic associations and antecedents. It will be shown that the best examples of these wares, and the large proportion of all specimens sampled, were made in Cyprus. At the time that the first detailed studies of this pottery repertory were made, attention was already called to abundant stylistic affinities with Cypriot Wares. However, certain inhibitions against attributing them to actual Cypriote origin were in vogue and have persisted. A re-examination of these premises shows that they are unnecessary or are, in fact, contrary to evidence.

ANTECEDENTS AND ASSOCIATION OF THE BICHROME STYLE

The detailed studies of the Bichrome Style by Heurtley⁹ and by Epstein¹⁰ both emphasize a complex pattern of stylistic influence which includes major elements of typical Cypriote wares. The two authors disagree in important aspects of interpretation, but each finds reasons to fit these wares into a Syro-Palestinian setting. The appearance of Cypriote shapes and decorations in Bichrome pottery is simply taken as an instance of strong external influence.

We turn first to an issue which has beclouded the consideration of this repertory as part of a local Cypriote sequence. The Bichrome Ware is wheel-made and it is commonly accepted that the potter's wheel was not used in Cyprus as early as the Late Bronze Age. This premise has led to difficulties in interpreting other pottery styles excavated in Cyprus as well. Some major Cypriote styles of this period such as White Slip and Base Ring, do indeed seem to be almost exclusively hand-made, but others are represented by both techniques of pottery making. There are copious references for the appearance of wheel-made Cypriote styles such as Whited Painted, Plain White, Black Slip, Black Lusterous, Red Slip, and Plain Ware in the same context with hand-made forms (see, for example, Tomb 10 in Enkomi¹¹). Sometimes, in the comments on the two types, attention is called to distinctions in "workmanship" which give added reason to label the wheel-made varieties as "imports". We have not examined extensive collections of parallel varieties in juxtaposition but, from what we have seen, the differences seem no greater than one would expect from different techniques employed by different potters.

An examination of Cypriote tomb inventories shows that the wheel-made variety is often more plentiful than the hand-made counterpart. In Enkomi Tomb 2, Dikaios¹² reports 8 specimens of Black Slip Ware, all wheel-made. Noteworthy and curious is the fact that Plain Ware is often exclusively wheel-made. Thirty-five specimens were found in Tomb 2¹³ and 118 pieces in the large assemblage of Tomb 10¹⁴, but no reference is made to hand-made Plain Ware from these tombs.

The large quantity of wheel-made vessels caught the eye of Westholm: "The comparatively large number of foreign wares in this tomb is worthy of

notice, especially as most of the classes are represented by several vases¹⁵." Dikaios reports that among the pottery from Enkomi, there are many wares which he considers foreign only because the wheel technique was not used in Cyprus at that time. "The problem is to explain this apparent similarity of the pattern with that on the White Slip I Ware. The alternatives are: I. that the original development of the White Slip I pattern owed to some extent its inspiration to these imported wares; II. that the Syro-Palestine makers of the latter had been influenced by the White Slip I which was exported from Cyprus¹⁶."

A voluminous catalogue of wheel-made pottery of Cypriote styles is available in the excavation reports concerned with the period in question and will not be summarized further here. It is enough to add that the authors of these reports are sometimes plainly uneasy in describing all as imports to Cyprus. Our sole purpose in mentioning this subject is to reduce inhibitions toward considering the Bichrome repertory as native to Cyprus in prelude to the presentation of positive evidence.

In comparing Bichrome pottery with Cypriote wares, it is convenient to use the White Painted sequence because shapes and decorative motifs can be discussed together. In the White Painted sequence many vessel shapes persisted throughout the bronze age; new forms were added and older ones diminished in numbers only to be revived again. The exact chronology of these wares is not without dispute but it is likely that the Bichrome style is contemporaneous with White Painted V and they seem to appear at the closing phase of the Middle Bronze (MB) or Middle Cypriot (MC) period¹⁷.

The forms encountered in the Bichrome repertory appear in large numbers among the White Painted vessels with one notable exception which will be

mentioned below. This is not so for the relation of Bichrome Ware to traditional MB forms of the Syro-Palestinian milieu where a number of dominant Bichrome forms are missing. To be sure, the distinction is made less clear by the appearance of wheel-made pottery along with and related to White Painted V. When these are all assigned to mainland provenience, this automatically establishes on the mainland a considerable corpus of typical Cypriote styles from which the Bichrome shapes could have been derived. Although a comprehensive discourse on stylistic affinities might be illuminating, we shall only present a couple of examples to illustrate the kinds of problems which arise and then expand briefly on stylistic affinities.

The tankard in a distinctive form is prominent in the White Painted sequence but is missing in this form among late MB pottery of the mainland. It does appear in the Bichrome style with shape and elements of decoration similar to the White Painted counterpart. The small differences might be ascribed to the tastes of the respective potters and technical demands of the respective modes of construction. This would appear to be a point in evidence for the Cypriote origin of the Bichrome style. If one is following the thesis that Bichrome Wares are Palestinian, the tankard may be explained as a form inspired by Cypriote contacts or deliberately made for the Cypriote market. On the basis of a single example, it is manifestly difficult to take a dogmatic stand on either side of the issue.

By the same token, the krater in Bichrome style can be treated either as a piece of positive evidence or an awkward singularity. This shape is well known in the Palestinian corpus, but not in Cyprus. In support of the Palestine-centered thesis, the krater is a familiar and congenial form to adapt to the

Bichrome style; for those who want these wares to emanate from Cyprus, the krater is a convenient form to adopt for wheel-construction or was deliberately made for the Palestinian market, not only in the Bichrome style but in the White Painted as well. We do find wheel-made kraters of the White Painted V tradition in Cypriote tombs, such as Milia Tomb 10¹⁸.

Notwithstanding the vacillations of the preceding discussion, an examination of the full repertory of Bichrome shapes reveals a very close relationship to Cypriote traditions and in most respects the shapes are alien to MB Palestine. The Bichrome Ware jugs bear a striking resemblance to the White Painted III and IV jugs¹⁹ as does the tankard already mentioned. The shape of the tankard, divested of the tankard handle, is also virtually identical with White Painted vessels given such other names as amphora and jar. The nearly-hemispherical bowl with horizontal handle found in Bichrome Wares has a long tradition in Cypriote pottery, preceding, within, and following the MC period. It is probable that the Cypriote White Slip I milk bowl and the Monochrome bowl, as well as the Bichrome bowl, can trace their ancestry to the Cypriote White Painted forms which preceded them. An engaging Cypriote ceramic form which goes back to White Painted III is the zoomorphic quadruped and this is also represented in Bichrome decoration.

With respect to decorative styles in the Bichrome repertory, most vessels were painted solely in geometric patterns involving a variety of motifs. Some vessels are heavily covered with designs but most present an uncluttered appearance and all are orderly and neatly drawn. The metope arrangement is common, as are pendant, horizontal and crossed lines. Crosses, crossed-hatching and checkerboard forms are also commonly worked in between horizontal bands or as design elements in the metope dividers.

In the Cypriote White Painted sequence, there is, of course, an unbroken tradition of decorated pottery employing a wide array of geometric elements arranged in a variety of patterns. The artists had a predilection for covering all parts of the vessels but, particularly in latter phases of the sequence, some of the vessel shapes are less profusely painted. Among the design motifs, one finds all of those which appear in the Bichrome style. Such simple and freely-rendered motifs as the cross-lined pattern are virtually indistinguishable in the two types of ware.

Decorated pottery does appear in the MB Palestinian setting but not pervasively, and the different elements of design are quite limited. Although Heurtley was convinced that the Bichrome style arose and developed in Palestine, he did not look at local traditions of vase decoration for the inspiration. Above all, he refers to the import of Cypriote White Painted Ware "which precipitated a revival of vase painting in Palestine, long overdue ..." ²⁰ Cyprus, on the other hand, had a long-standing tradition of painted pottery, stretching to the Neolithic time ²¹.

We are inclined to say that stylistic analysis, as applied both to shapes and decorations, points conclusively to a Cypriote origin of the Bichrome style. As such, this repertory would be the culmination of the Cypriote White Painted tradition. However, we feel it prudent to use the stylistic evidence more cautiously and merely assert that these criteria do not argue against Cypriote origin in any substantial way. The reason for this cautious approach is that the Bichrome repertory embodies much which is distinctive, hence innovative. Under such circumstances, there is too much latitude available for speculating as to which features could only have arisen in a

particular setting. Nowhere is this difficulty posed more clearly than in deciding what can be learned from a design motif which has not yet been discussed.

It has already been mentioned that most Bichrome vessels are decorated with purely geometric patterns, but the most eye-arresting feature of the repertory is the frequent incorporation of elegantly but simply rendered birds, fish, caprine figures, and bulls. Much effort has been expended in trying to find antecedents of this pictorial style. From our viewpoint, the sources of inspiration remain obscure and the ancient artists who chose to use this motif could have practiced their art in one place as well as another. The style is clearly innovative within either a Cypriote or Syro-Palestinian setting and it seems fruitless at this juncture to speculate on what provided the stimulus.

If we compare large Bichrome assemblages as those from 'Ajjul and Milia, there seem to be no gross differences which would shed light on what was the center of origin. Although no statistical work was undertaken, it seems that the Palestinian sites did not yield more Bichrome Ware than Cyprus. If anything, more has been found in Cyprus than in Palestine. Significantly, the Bichrome Ware always occurs in the Syro-Palestinian sites alongside the typical Cypriote pottery of the same period. In Cyprus, however, they do not appear with Palestinian pottery unless one so classifies the wheel-made wares of Cypriote styles.

Any discussion of a pottery repertory would be incomplete without consideration of the chronological setting in which it appeared. However, from what has been learned about the Bichrome Ware to date, there is little which

points unequivocally to its place of origin. The subject is certainly worthy of further study as there are important unanswered questions on the evolution of this style and its relationship to other wares.

In Palestinian sites, the beginnings of the Bichrome repertory have been generally placed in LBI. The Late Bronze I period is assigned by Amiran²² to the years 1570-1410 B.C., Kenyon puts it between the Ahmosis campaign against Southern Palestine (1570/1565) and the Tuthmosis III battle of Megiddo (1481 B.C.)²³. Schaeffer places the period from 1600 to 1450 at Ras Shamra²⁴. With few objections, this repertory is said to have started in this period and dwindled substantially by its close. Attempts to trace the development of the style have thus far not been very rewarding. Heurtley²⁵ divided the Megiddo Bichrome vessels into two groups, one of which he took to represent the fully developed Bichrome art, and the other its somewhat cruder beginnings. Epstein²⁶ has questioned the stratigraphy and from her conclusions it would seem to us just as reasonable to say that the cruder category is a contemporary or even posterior copy of the finer ware.

Although stratigraphic information is available from Cypriote sites, little has been done deliberately to reconcile the findings with Palestinian chronology. Åström²⁷ reported Bichrome Ware in Trench 9 at Kalopsidha at a level corresponding with the beginning of the Late Cypriote period which has been dated approximately 1600/1575. Within the uncertainties of absolute chronology, it is only possible to state that the Trench 9 Bichrome sherds appear to be at least as early as comparable ware in Palestinian sites. At Enkomi, Dikaios²⁸ found Bichrome Ware in a Level I context which again dates to the beginning of LCI. At Milia, the story is much the same. Attention should

also be called to hand-made Bichrome sherds in Kalopsidha Trench 9. These were found in the same context as the wheel-made variety and are noted by Aström as "probably an imitation of the contemporary Bichrome Wheel-made Ware of Late Cypriote I, if not a forerunner of it"²⁹.

The remainder of this report will be concerned with laboratory analysis of pottery fabrics aimed at determining provenience by this independent method. The Bichrome Ware was chosen by one of us (Michal Artzy) for study, as a suitable and interesting pottery group for this approach. Compared with many pottery repertories, this group is compact and relatively discrete geographically and temporally. Above all, it seemed beset with questions as to exactly where it was made. The stylistic homogeneity bespoke a localized production but we had no preconceived notion where the centers might be among the available options. The only insight, not available to others who might approach this problem, came from some previous analyses in our laboratory of other Cypriote wares which indicated that wheel-made pottery found in Cyprus need not have been imported.

ORIGINS OF POTTERY - Methodology

Clays, which become ceramics upon firing, are transformation products from the weathering of certain common types of rocks. The chemical composition of the clay may be expected to reflect that of the parent rock, but in clay formation there also take place chemical fractionations which will be sensitive to the particular environmental conditions. The question of interest here is whether clays from one source are chemically distinguishable from all others; if so, there would be available a chemical "fingerprint" which would reveal the provenience of pottery.

There are a number of different clay types which are well known in the science of clay mineralogy but each of these is widely distributed and their identification could not be of much aid in provenience studies. The necessary condition for success in provenience studies is that each category contains subtle differences which can be discerned and related to different places. The discreteness of a chemical fingerprint depends upon the amount of detail which is obtained; in the present context, the details must come from the breadth of the array of elements which display different chemical properties. Since the great majority of the elements present in rocks and clays are present only in the parts-per-million range, the most desirable methods of analysis are those which are sensitive to such low levels.

The system of analysis adopted for these studies involves neutron activation which can be applied with sensitivity and accuracy to many trace elements. For pottery analysis, only about 100 mg. are used and this may be removed from any part of the sherd. The method has been discussed in detail in other publications³⁰ and will not be described here. The manner in which the

analytical data are applied to a study of pottery provenience does require brief discussion in order to make intelligible that which follows.

From each site pertaining to a particular problem, one endeavors to select a substantial number of sherds which, based upon archaeological criteria, may reasonably be expected to be of local manufacture. In the ideal case, the collection from each site will show chemical homogeneity and be different from all others tested. Some of the complexities which can arise will become apparent when the results of the present study are presented.

Returning to the ideal case, one can compute for each chemical element the mean value encountered and the spread of values which is given in usual statistical terminology by the standard deviation from the mean for the sherds in the group. The array of mean values and standard deviations for all of the diagnostic elements becomes the chemical profile or fingerprint for this group. The question of whether any sherd found anywhere belongs to this group can, in principle, be answered by simple statistical analysis. It must be stated that one cannot judge ahead of time the adequacy of sampling necessary to justify the statistical analysis, but judgment does develop as the study progresses. Quite obviously, the more facets of a particular problem which are taken into consideration, the surer one can be of the interpretation.

ORIGINS OF THE BICHROME WARE

In presenting the results which follow, we are faced with multi-dimensional comparisons: comparisons between pottery of the same style from different sites, different styles from the same site, and ancillary evidence from sites not directly associated with the Bichrome Ware. This will have to be done sequentially and not entirely in the order suggested in the previous discussion of an "ideal" provenience investigation. A substantial fraction of the analytical data obtained in this study will not be presented in this report. Some of the omitted results provide useful embellishment to points which will be made and other pertain to intriguing side issues for further investigation. These will have a proper place in a lengthier report which will go beyond the few simple points we set out to make here.

Tell el-'Ajjul and Milia Main Groups. The two largest assemblages of Bichrome Ware analyzed came from two sites: 54 pieces from 'Ajjul and 39 from Milia³¹. From the 'Ajjul Bichrome, a single chemical group was made up of 36 pieces; and from Milia, 27 pieces were placed in a single group. Discussion of the pieces which are not included in these two groups will be presented in later sections.

In Table 1 are presented the statistical data on 18 elements showing the mean values and standard deviations for a group as indicated. Attention is called to the first two columns for the moment. It would appear that the Bichrome Ware groups from 'Ajjul and Milia are indistinguishable within the statistical dispersions (and this is the case) although for statistical clarity one should compare each sherd individually with a group rather than group with group. For ease in visualization, some of the data of Table 1 are

displayed in bar-graph form in Fig. 1 where the top of each bar relates to the mean value, and the hatched zone is the extent of the dispersion in standard-deviation form. At this point we only conclude that the Bichrome Ware groups from 'Ajjul and Milia are so much alike in chemical composition that they very likely have the same provenience.

The other two columns of Table 1 and bars of Fig. 1 pertain to two small groups of "local wares" from 'Ajjul and Milia, respectively. It is seen that the group from Milia agrees rather well in composition with the Milia and 'Ajjul Bichrome Ware, whereas the group of plain ware from 'Ajjul is vastly different. These added considerations expand the conclusions: (1) All of the Bichrome Ware thus far discussed came from the same place. (2) If we must choose between Milia and 'Ajjul, the place is clearly Milia.

We should say something at this point about the nature of the plain wares from Milia and 'Ajjul; why they are so few in numbers, and how sure one can be that they represent local manufacture at the respective sites.

The five sherds from 'Ajjul were wheel-made and typical of Middle/Late Bronze styles. They were excavated by Petrie along with the Bichrome assemblage and were obtained for sampling at the Rockefeller Museum in Jerusalem. Unfortunately, it was not possible to obtain surface sherds or clays directly from the site. In order to be better satisfied that the composition encountered is indeed local to that area we shall presently compare these with materials from other sites in the southern coastal region of Israel which had already been analyzed in conjunction with other problems.

The small group of eight pieces from Milia have a different story. They were selected from a somewhat larger number of wares from Milia because they

were from hand-made vessels of unquestionable Cypriote shape and decoration, and because the compositions agreed fairly closely with those of the Bichrome Ware. This latter reason may seem of questionable objectivity and should be explained.

When we analyzed pottery from sites on the eastern plain of Cyprus such as Milia, Enkomi and Kalopsidha, we did not find single chemical groups which embraced all of the specimens from the respective sites. Instead, a considerable number of groups appeared which are chemically quite similar to each other but readily discernible by our system of analysis. Because of the number and similarity of such groups we are inclined to believe that this region has a considerable number of places from which the ancient potters drew their clays, and that these sources share a similar geochemical history. In short, the Bichrome Ware thus far mentioned is chemically similar to a number of pottery groups from the eastern plain of Cyprus, and matches very closely with this particular group of eight sherds from Milia. We shall compare some of these other groups presently.

Pottery of southern coastal Israel. As already mentioned, we are somewhat dissatisfied with the use of only five 'Ajjul plain ware sherds to represent local materials. Consequently, we shall compare the 'Ajjul plain wares with pottery drawn from three other sites in the region: Deir el-Balach which lies 6 km south of 'Ajjul, Tel Ashkelon which is about 25 km to the north and Tel Ashdod 15 km still further north. (See map.)

The data on these four sites are shown in Table 2 along with the 'Ajjul Bichrome group from Table 1 for comparison. The data for a selected group of elements are also shown in Fig. 2 in bar-graph form. It is seen,

first of all, that the four sites from southern coastal Israel have much in common although there are differences between them. These distinctions should be compared with the gross differences which all have from the 'Ajjul Bichrome group which we take to come from eastern Cyprus. Note for example, the elements Ta, Sc, Cs, Cr and Hf, among others.

The fact that typical local potteries from three sites to the north and south of 'Ajjul all look similar to the small collection of local 'Ajjul wares gives one added confidence that these do indeed represent local manufacture. It should be emphasized that the evidence presented in Table 2 only shows that it is highly unlikely that the 'Ajjul Bichrome Ware was made locally. The crucial point concerning their provenience is that they do agree with pottery from eastern Cyprus.

Pottery of eastern Cyprus. As was done in the preceding section for several sites in southern coastal Israel, one can compare pottery groups from a number of sites in eastern Cyprus to provide circumstantial evidence that the small reference group from Milia is local to that area. For the sake of brevity, the data to support this contention will not be presented here. An examination of the available data reveals a greater diversity of clay sources in this area but again they all share many characteristics in common. Because of the complexity encountered, however, we do not find it prudent to assert at this stage that the 27 specimens of Bichrome Ware were made specifically at Milia. This issue will likely be clarified in the course of further work and in the more detailed examination of voluminous data already taken on Cypriote pottery. We wish to emphasize that we do not doubt that the Bichrome Ware is from eastern Cyprus but rather that there are local details about which we are not completely satisfied.

It was mentioned earlier that 39 specimens of Bichrome Ware from Milia were analyzed and the 27 of these were placed in a single chemical group for comparison with the group of 36 specimens from 'Ajjul. Brief mention will now be made of the other 12 pieces from Milia. These could be placed into several small groups which are discerable from the main group and from each other. However, all of these are very likely also from eastern Cyprus because they have the same chemical pattern as the main group and the many similar groups of other wares mentioned in the preceding paragraph. This subject will be further developed in the following section of this report.

'Ajjul Bichrome and other groups from eastern Cyprus. In the preceding discussions, attention was focused on a group of 36 pieces of Bichrome Ware excavated at 'Ajjul out of 54 which were analyzed. We shall now take up some of the remaining 18 specimens which did not fit within the larger group and at the same time provide emphasis for the complexities alluded to.

Among a considerable number of distinguishable pottery groups from eastern Cyprus was a group of 13 Black Slip sherds from Milia, all wheel-made. A number of the chemical elements of this group are substantially different from the Milia pottery of Table 1 but the general pattern is the same. The significance of this group in the present context is that 3 pieces of Bichrome Ware from 'Ajjul matched this Black Slip group from Milia.

In the past, these Black Slip wares would have been termed "imports" because they were wheel-made. For us, they represent one of a considerable number of similar clay sources from eastern Cyprus. There would be nothing unusual in the inference that the potters who made these wares selected their clays from the same source as was used for some of the wheel-made Bichrome Ware.

Another specimen of Bichrome from 'Ajjul matched a group of 7 white Painted IV, V sherds from Kalopsidha. Bichrome Ware from this site has been reported by Aström³² but none has been analyzed by us.

Two other pieces from 'Ajjul were considerably different in composition from everything which has been discussed so far. Their analytical data are shown in Table 3 and Fig. 3 under the headings AJU 10 and AJU 35. These have been singled out for illustration partly because they can be related to a different part of Cyprus and also to show how single sherds may be related to a group. They are compared with a group of 10 pieces of hand-made Black Slip and Red-on-Black wares from Paleoskoutella (in the Karpos) and, for contrast, the group of Milia Bichrome Ware from Table 1 is also entered. It is seen that AJU 10 and AJU 35 are very much like the group from Paleoskoutella and greatly different from that from Milia. Eighteen elements are listed in Table 3 and a single sherd is statistically a member of a group if two-thirds of the elements fall within one standard deviation. Comparison will show that AJU 10 and AJU 35 fit nicely into the group from Paleoskoutella. The region around Paleoskoutella, therefore, also seems to be one in which Bichrome Ware was made and one is reminded that considerable numbers of Bichrome vessels came to light in the neighboring site of Nitovikla³³.

Finally, we shall just mention that several other Bichrome pieces from 'Ajjul have been shown to be of likely Cypriote origin even though, as yet, we do not have the exact groups with which to fit them. This leaves just 6 pieces of Bichrome Ware from 'Ajjul from the 54 analyzed which will be considered next.

'Ajjul locally-made Bichrome. The 6 Bichrome pieces which we term "locally-made" cannot be specifically assigned to 'Ajjul partly because we do

not have adequate numbers of local wares with which to compare them (see Tables 1 and 2). One piece of Bichrome does fit very well with the reference group of 5 pieces of plain ware from 'Ajjul; the others are somewhat different.

After finding that six Bichrome sherds were of Palestinian (if not specifically 'Ajjul) origin, we consulted our description notes and photographs to see if anything distinguished them visually. A summary for the six pieces follows: one of is a biconical jar, another a flat plate decorated with an unusual pigment and with no known parallel in Bichrome repertory, a krater sherd with unique bird head (duck-like rather than the graceful ibis), two sherds with a very soft clay and one for which we have no photograph or notes.

It would be rash, perhaps, to assert that all of these specimens are atypical of the Bichrome repertory and on this basis to class them as imitations. Arguments of this kind are sometimes unsatisfactory in that they presuppose fixed boundaries of style, workmanship, and firing conditions, beyond which a vessel is excluded. What can be said about these six pieces is that a couple of them are singular among everything yet seen and that others are atypical in one respect or another.

Bichrome Ware from other Palestinian sites. Attention has been focused on 'Ajjul because from here came the largest number of pieces which we analyzed. It turned out that the assemblage presented a concise picture of provenience in which all specimens but a few could be clearly traced to Cypriot origin. More subjectively, the assemblage was also characterized by stylistic homogeneity in the sense that there is little doubt that the vast majority of the pieces fit clearly within the pottery repertory with which we are concerned.

Samples thus far taken from other sites are relatively few in number. The results will be presented in abbreviated form, in part because they do not

constitute a reasonable sampling, but also because a broad issue has arisen about which concise answers cannot be given at present. This issue has to do with the relation between Bichrome Ware and decorated LB Palestinian pottery some of which is painted in two colors. The question has already been dealt with by Amiran³⁴ in considering which among these may be taken as styles derived from the Bichrome and which should be properly placed within that repertory. Indeed, Heurtley³⁵ divided the Megiddo two-color pottery into two classes which he ascribed to an 'early' and 'late' phase of the Bichrome style. Although his chronology was shown by Epstein³⁶ to be faulty, it does not follow that there are no distinctions which might be correlated temporally. For the present, we believe that there are still questions of typology and chronology which cannot be answered satisfactorily.

Beth-El. Six pieces from this site were analyzed, all of which appeared to be good examples of Bichrome Ware. Five of these had compositions indistinguishable from the large groups from Milia and 'Ajjul and are classed by us as imports from eastern Cyprus. One piece was grossly different and is clearly unlike any of the large numbers of specimens analyzed from Cyprus. It is also vastly different from the compositions we associate with southern coastal Israel.

Lachish and Tell el-Hesi. Only 3 samples of Bichrome Ware from Lachish and 1 from Tell Hesi were analyzed and all were of eastern Cypriote composition.

Tel Mor. This site, on the sea coast a short distance north-west of Tel Ashdod, was a seaport settlement and is characterized by large numbers of imported wares among the pottery finds³⁷. The sherds that were sampled were

small and much effaced through weathering, consequently the identification as Bichrome Ware was quite uncertain for a number of them.

Two or three fragments which could conceivably be two-colored, hence Bichrome, are probably not of Cypriote origin but the provenience is not yet known. Nine others, for which the identification varied from "certain" to "uncertain", could be fitted among the three reference groups from Cyprus already mentioned.

Megiddo. This is an important site for the problem at hand if for no other reason than that it figured prominently in the early studies of Bichrome Ware by Heurtley and by Epstein. Here we encounter in full force the problem previously discussed, that is, what boundaries to place on the Bichrome repertory.

Among the pieces analyzed from Megiddo were found a substantial number which are as clearly of Cypriote origin as those from 'Ajjul and the other sites. There were also a number of pieces with two-color decoration which are not of Cypriote composition and agree in composition with other decorated and undecorated vessels from Megiddo. These are likely to be of local manufacture although this issue has not yet been settled on the basis of the analyses so far made. In the light of these analytical results on the two-color wares it will be necessary to re-examine typological features to see if there are any added reasons to consider these as a group apart.

SUMMARY

The data presented here, both chemical and typological, point to eastern Cyprus as the source of the "Palestinian" Bichrome Ware. Probably, it would be incorrect to assert that every piece of pottery which is reasonably classified as Bichrome Ware was made in Cyprus; nevertheless, the vast majority of those analyzed can be traced to Cyprus and of these the preponderance came from the region around Milia.

The stylistic antecedents of the Bichrome Ware are readily at hand within the long tradition of Cypriote painted wares. Although the Bichrome repertory contains some innovative features, most of the vessel shapes and design motifs bear a striking resemblance to those of the White Painted sequence of the Middle Cypriote Period.

In view of the virtual certainty that the wheel-made Bichrome Ware was made on Cyprus, it seems no longer necessary to classify other pottery of the period as imports to Cyprus solely because they were made on the potter's wheel. Consequently, deductions which have been based upon wheel-made wares of White Painted, Black Slip, Plain Ware and other styles should be re-examined.

The acceptance of Cypriote provenience for the Bichrome Ware also brings into focus some issues concerning the typological extent of the repertory and the chronology associated with any stylistic divisions which can be made. The possibility now exists for distinguishing between Bichrome Ware and LB Palestinian Painted Ware which is sometimes termed "Bichrome" because it may be painted with two colors. In the southern sites which were destroyed by Ahmosis, Bichrome Ware appeared before the destruction, and this also points to an earlier date than that at which we believe the LB Painted Ware belongs. Obviously, these tentative conclusions call for a careful re-examination of stratigraphic information and for chemical analyses of a larger array of pottery of these periods.

ACKNOWLEDGEMENTS

We wish to thank Mrs. Helen Michel, Miss Susanne Halvorsen, David Gok and Duane Mosier of the Lawrence Berkeley Laboratory for their contribution to the analysis presented in this paper.

We are indebted to Prof. Einar Gjerstad and the Mediterranean Museum of Stockholm for making available a large collection of pottery excavated in Cyprus by the Swedish Cyprus Expedition and helping us locate the pottery we needed in the museum's collection. Among the specimens sampled are Bichrome Ware and reference materials reported here. We also wish to acknowledge the kind cooperation and helpful comments extended by Dr. Vassos Karageorghis, Director of the Department of Antiquities, Republic of Cyprus.

Most of the Tell el-'Ajjul pottery was sampled at the London Institute of Archaeology and we thank Prof. Peter Paar for making them available to us. Similarly, wares from Megiddo were sampled at the Oriental Institute of Chicago.

Pottery from a number of sites in Israel were made available to us with the kind cooperation of the Israel Department of Antiquities and the staff of the Rockefeller Museum. The assistance of Mrs. Ruth Peled in locating materials and giving aid in sampling is gratefully acknowledged. We also thank Dr. Moshe Dothan for permitting us to examine the large assemblage from Tel Mor and to take samples, some of which are reported here.

FOOTNOTES

* Work performed under the auspices of the U. S. Atomic Energy Commission

- (1) Sir Flinders Petrie, Ancient Gaza II (London, 1932)
- (2) A. Westholm, "Some Late Bronze Tombs at Milia", Quarterly of the Department of Antiquities in Palestine, VIII (1939), 1-20
- (3) C. Schaeffer, Missions en Chypre 1932-1935 (Paris, 1936), 49
- (4) W. A. Heurtley, "A Palestinian Vase Painter of the Sixteenth Century B.C.", Quarterly of the Department of Antiquities in Palestine, VIII (1939), 21-34
- (5) Ibid., 32
- (6) Ibid., 33
- (7) Ibid., 34
- (8) Claire Epstein, Palestinian Bichrome Ware (Leiden, 1966)
- (9) Heurtley, op. cit.,
- (10) Epstein, op. cit., See also: C. Epstein, "Bichrome Wheel-made Tankards from Tell el-'Ajul", Palestine Exploration Quarterly 1961, 137-143 and C. Epstein, "Bichrome Vessels in Cross Line Style", Palestine Exploration Quarterly 1965, 42-53
- (11) P. Dikaios, Enkomi Excavations 1948-1958 I (Mainz am Rhein, 1969-1971), 389
- (12) Ibid., 345
- (13) Ibid., 336-347
- (14) Ibid., 357-394
- (15) Westholm, op. cit., 8
- (16) Dikaios, op. cit., 226
- (17) Paul Aström, Excavations at Kalopsidha and Ayios Iakovos in Cyprus, Studies in Mediterranean Archaeology Vol. II., (Lund, 1966), 60
- (18) Westholm, op. cit., 2

- (19) For examples of the Cypriote White Painted Ware see: Paul Åström, Middle Cypriote Bronze Age (Lund, 1957); For a detailed comparison between the Bichrome Ware and the White Painted Ware see: Michal Artzy, Brandeis University Ph.D. dissertation (Ann Arbor, 1972)
- (20) Heurtley, op. cit., 34
- (21) Åström, op. cit., 206
- (22) Ruth Amiran, Ancient Pottery of the Holy Land (Jerusalem, 1969), 124
- (23) K. M. Kenyon, "Palestine in the Time of the Eighteenth Dynasty", Cambridge Ancient History, fasc. 69
- (24) Claude F. A. Schaeffer, Stratigraphic Comparée (London, 1948), 559
- (25) Heurtley, op. cit., 27
- (26) Epstein, Palestinian Bichrome Ware, 21
- (27) Åström, op. cit., 51
- (28) Dikaios, op. cit., 442
- (29) Åström, op. cit., 60
- (30) I. Perlman, F. Asaro, "Pottery Analysis by Neutron Activation", Archaeometry, Vol. 13, part 2, 1971; I. Perlman, F. Asaro and H. Michel, "Nuclear Applications in Art and Archaeology", Annual Review of Nuclear Science, Vol. 22, 1972; V. Karageorghis, F. Asaro and I. Perlman, "Concerning Two Mycenaean Pictorial Sherds from Kouklia (Palaepaphos), Cyprus", forthcoming issue of Archaeologische Anzeiger
- (31) For the sake of brevity, we are not identifying separately these and other specimens which were analyzed. We shall provide to anyone who is interested our inventory identifying each piece and where it is presently located, references to those which have been published, and a notation as to the chemical group in which each fits.

- (32) Åström, op. cit., 60
- (33) Einar Gjerstad, The Swedish Cyprus Expedition I (Stockholm, 1937), 317f
- (34) Amiran, op. cit., plate 46
- (35) Heurtley, op. cit., 27
- (36) Epstein, Palestinian Bichrome Ware, 20
- (37) Moshe Dothan, "Tel Mor", Entziklopedia le-Khakirot Archiologiyot be-Eretz-Yisrael II (Massada, 1970), 586

Table 1. Comparison of Bichrome Ware from Tell el'Ajjul and Milia, and other wares from these sites.

	Aju. Bichr. (36 pieces) M±σ	Mla. Bichr. (27 pieces) M±σ	Aju. Plain (5 pieces) M±σ	Mla. Handmade (8 pieces) M±σ
Fe(%)	5.54±0.23	5.87±0.21	4.31±0.27	5.00±0.50
Ta	0.691±0.034	0.734±0.025	1.355±0.127	0.658±0.066
Sc	22.08±0.92	23.50±0.65	13.95±0.71	20.83±2.56
Co	30.54±1.78	31.33±3.19	17.21±1.09	27.13±2.94
Cs	4.70±0.50	4.71±0.43	1.13±0.49	3.59±0.63
Cr	351±68	346±31	116±14	346±62
Hf	2.95±0.21	3.23±0.17	9.74±1.02	2.97±0.29
Th	7.05±0.46	7.34±0.54	8.27±0.88	6.81±0.78
Ni	251±21	276±21	48±11	229±19
Rb	95±25	84±17	34±10	63±16
La	21.2±1.2	20.3±2.1	33.2±1.2	20.7±1.9
Lu	0.319±0.019	0.325±0.025	0.433±0.040	0.320±0.019
U	2.56±0.92	1.82±0.17	2.38±0.71	2.48±0.77
Ti(%)	0.420±0.034	0.457±0.033	0.577±0.037	0.454±0.031
Mn	973±99	984±172	855±26	1076±94
Na(%)	1.076±0.187	1.116±0.177	0.648±0.100	1.202±0.213
Al(%)	6.85±0.39	7.08±0.31	5.34±0.24	—*
Ca(%)	9.8±1.7	6.2±1.7	6.9±0.7	9.9±2.6

The numbers for the respective elements are group mean values (M) and the standard deviations (±σ). All are in units of parts-per-million unless designated "(%)".

'Aju. Plain' is a group of typical MB/LB Plain Ware from Tell el'Ajjul.

'Mla. Handmade' is a group of hand-made White Painted and Plain Wares from Milia.

* At the time these wares from Milia were analyzed, aluminum was not measured.

Table 2. Comparison of Tell el-'Ajjul Bichrome and Plain Wares from Table 1 with pottery groups from Deir el-Balach, Tel Ashkelon and Tel Ashdod.

	Aju. Bichr. (36 pieces) M±σ	Aju. Plain (5 pieces) M±σ	Balach (8 pieces) M±σ	Ashkelon (20 pieces) M±σ	Ashdod (110 pieces) M±σ
Fe(%)	5.54±0.23	4.31±0.27	4.26±0.25	3.97±0.17	3.75±0.22
Ta	0.691±0.034	1.355±0.127	1.258±0.064	1.280±0.056	1.340±0.064
Sc	22.08±0.92	13.95±0.71	13.32±0.80	13.09±0.52	12.47±0.65
Co	30.54±1.78	17.21±1.09	18.21±1.27	17.39±1.14	16.77±0.99
Cs	4.70±0.50	1.13±0.49	1.6±0.3	1.8±0.2	1.7±0.2
Cr	351±68	116±14	102±11	113±7	121±7
Hf	2.95±0.21	9.74±1.02	9.03±1.05	11.92±0.97	14.16±1.17
Th	7.05±0.46	8.27±0.88	7.56±0.53	7.66±0.38	8.03±0.45
Ni	251±21	48±11	46±11	57±14	42±14
Rb	95±25	34±10	52±14	56±10	57±7
La	21.2±1.2	33.2±1.2	30.2±2.0	30.1±1.4	30.1±1.5
Lu	0.319±0.019	0.433±0.040	0.397±0.024	0.434±0.018	0.463±0.027
U	2.56±0.92	2.38±0.71	1.62±0.18	1.89±0.22	1.94±0.12
Ti(%)	0.420±0.034	0.577±0.037	0.557±0.031	0.629±0.032	0.691±0.038
Mn	973±99	855±26	891±58	754±40	776±46
Na(%)	1.076±0.187	0.648±0.100	0.624±0.116	0.688±0.096	0.666±0.035
Al(%)	6.85±0.39	7.08±0.31	5.66±0.41	5.43±0.24	5.25±0.30
Ca(%)	9.8±1.7	6.9±0.7	6.4±1.2	7.7±1.2	6.3±0.7

(continued)

Table 2 (continued)

The numbers in this table are defined in Table 1.

'Balach' refers to a group of 8 Plain Ware vessels from Deir el-Balach.

'Ashkelon' refers to a group of 20 Philistine sherds from Tel Ashkelon.

'Ashdod' refers to a group of 110 sherds from Tel Ashdod, mostly Philistine.

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Table 3. Comparison of Milia Bichrome (from Table 1) with a group of hand-made ware from Paleoskoutella and two single sherds from Tell el-'Ajjul.

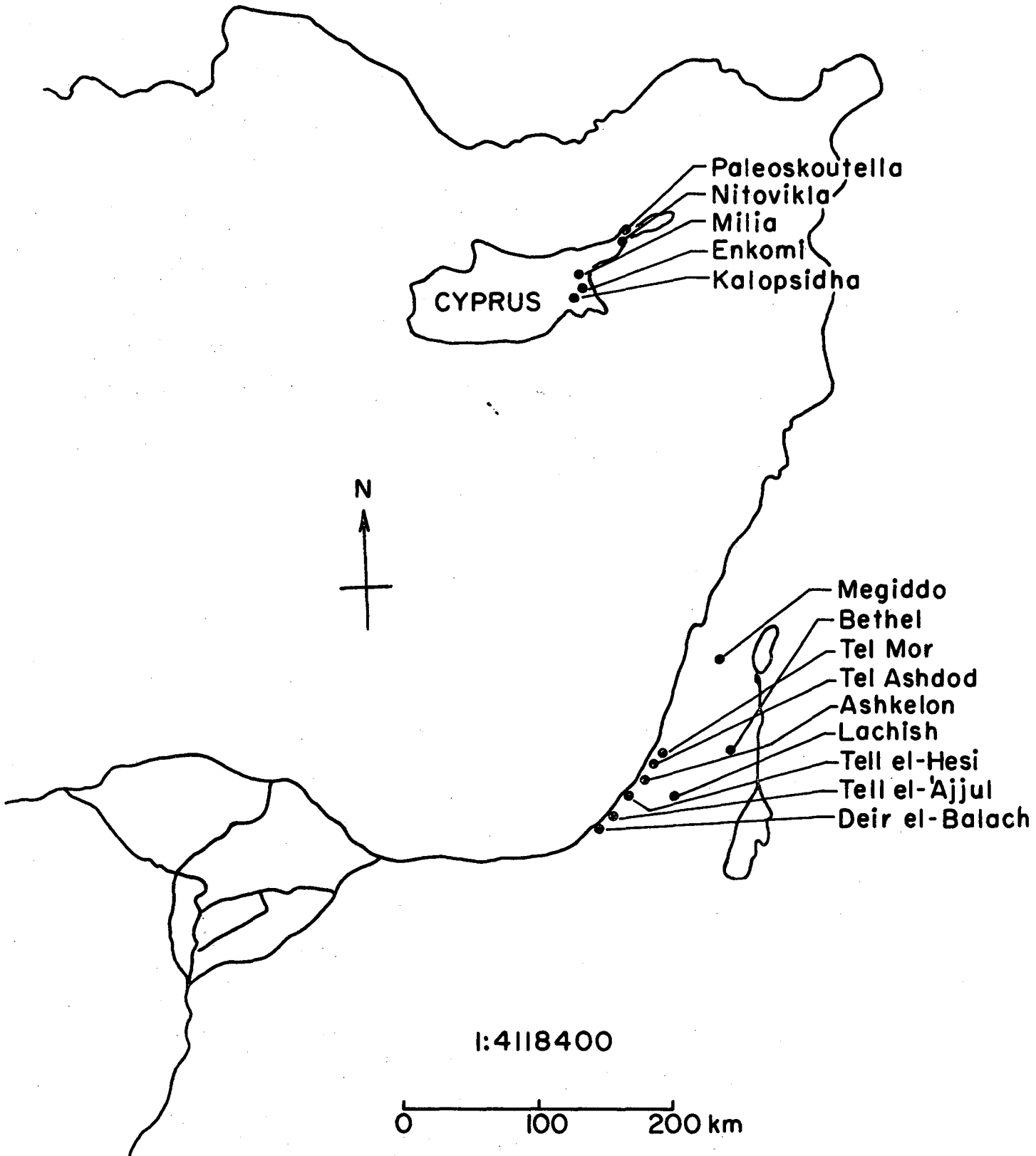
	Mla. Bichr. (27 pieces)	Paleoskoutella (10 pieces)	AJU 10 (single sherd)	AJU 35 (single sherd)
Fe(%)	5.87±0.21	5.21±0.21	5.17	5.50
Ta	0.734±0.025	1.258±0.061	1.204	1.252
Sc	23.50±0.65	19.15±1.11	19.09	18.83
Co	31.33±3.19	24.64±1.65	24.28	25.53
Cs	4.71±0.43	7.38±0.88	7.10	7.12
Cr	346±31	189±15	199	169
Hf	3.23±0.17	5.02±0.29	4.76	5.18
Th	7.34±0.54	12.60±0.52	11.64	12.83
Ni	276±21	140±19	147	129
Rb	84±17	125±39	130	133
La	20.3±2.1	36.9±3.1	34.1	38.6
Lu	0.325±0.025	0.422±0.025	0.367	0.403
U	1.82±0.17	2.97±0.08	2.63	3.12
Ti(%)	0.457±0.033	0.527±0.031	0.463	0.494
Mn	984±172	1446±173	1358	1340
Na(%)	1.116±0.177	1.093±0.211	0.929	0.901
Al(%)	7.08±0.31	7.66±0.68	7.87	7.59
Ca(%)	6.2±1.7	6.2±2.3	6.2	4.5

The numbers in this table are defined in Table 1.

"Paleoskoutella" refers to a group of 9 Black Slip and 1 Red-on-Black sherds, all hand-made, from Paleoskoutella.

"Aju 10" refers to a single fragment from Tell el-'Ajjul which is probably Bichrome but could not be clearly identified.

"Aju 35" refers to a single sherd of Bichrome.



CYPRUS

- Paleoskoutella
- Nitovikla
- Milia
- Enkomi
- Kalopsidha



- Megiddo
- Bethel
- Tel Mor
- Tel Ashdod
- Ashkelon
- Lachish
- Tell el-Hesi
- Tell el-'Ajjul
- Deir el-Balach

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FIGURE CAPTIONS

Fig. 1. The bars represent mean values for the indicated pottery groups; the hatched zone on each is \pm the standard deviation for the group. The value for each element is in units of parts-per-million unless designated "%".

'Ajjul Bichr.: A group of 39 pieces of Bichrome Ware excavated at Tell el-'Ajjul; 'Ajjul Plain: A group of 5 pieces of MB/LB typical local ware.

Milia Bichr.: A group of 27 pieces of Bichrome Ware excavated at Milia; Milia Hand-made: A group of 8 pieces of hand-made Cypriote wares typical of the period.

Fig. 2. The bars and hatching have the same meaning as in Fig. 1. The bars designated 'Ajjul Bichr and 'Ajjul Plain are repeated from Fig. 1.

Balach: refers to a group of 8 Plain Ware vessels from Deirel-Balach.

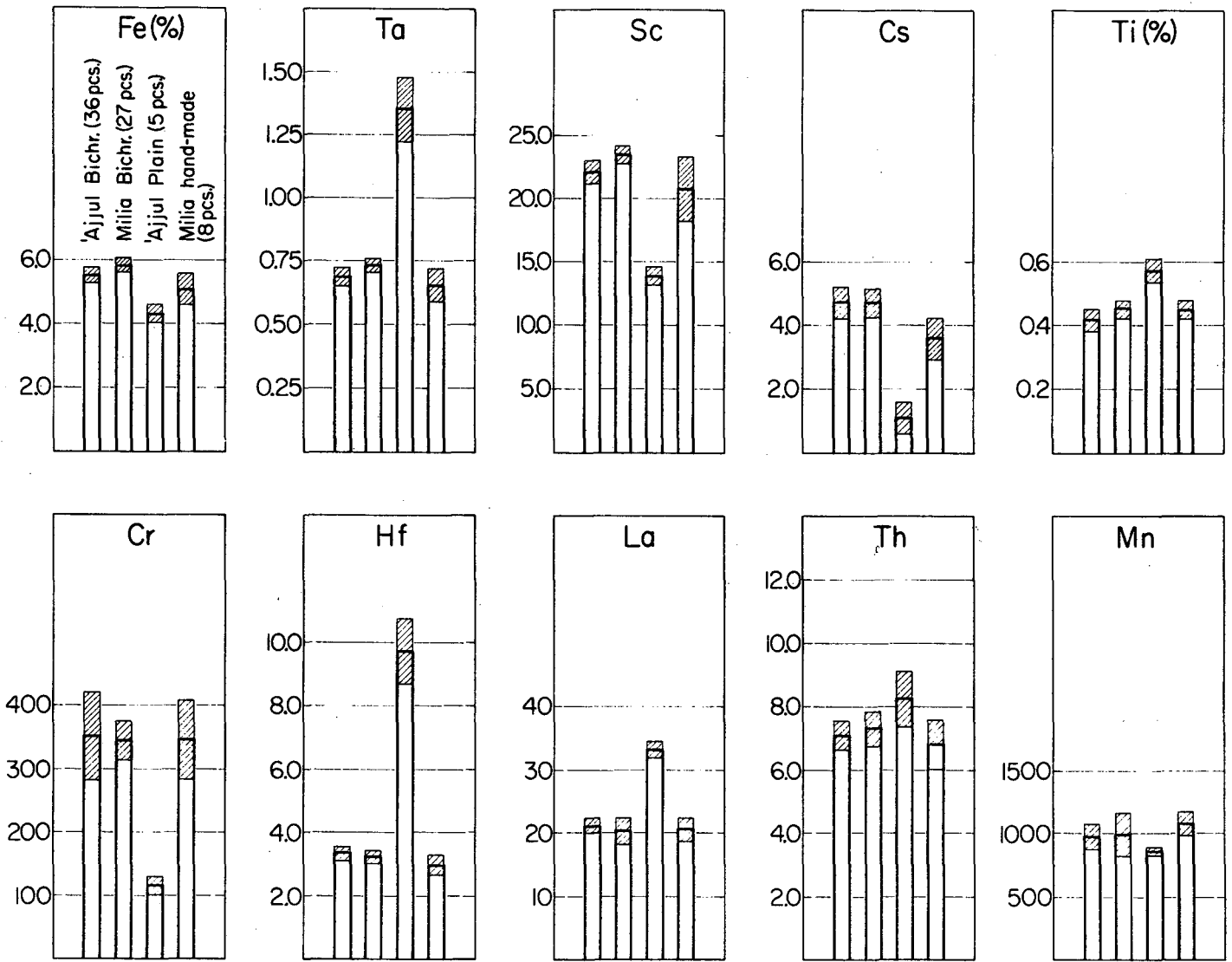
Ashkelon: 20 Philistine sherds from Tel Ashkelon.

Ashdod: 110 sherds from Tel Ashdod, mostly Philistine.

Fig. 3. The bars with hatching have the same meaning as in Fig. 1. The bars designated Milia Bichr. are repeated from Fig. 1. Paleoskoutella refers to a group of 9 Black Slip and 1 Red-on-Black sherds, all hand-made, from Paleoskoutella.

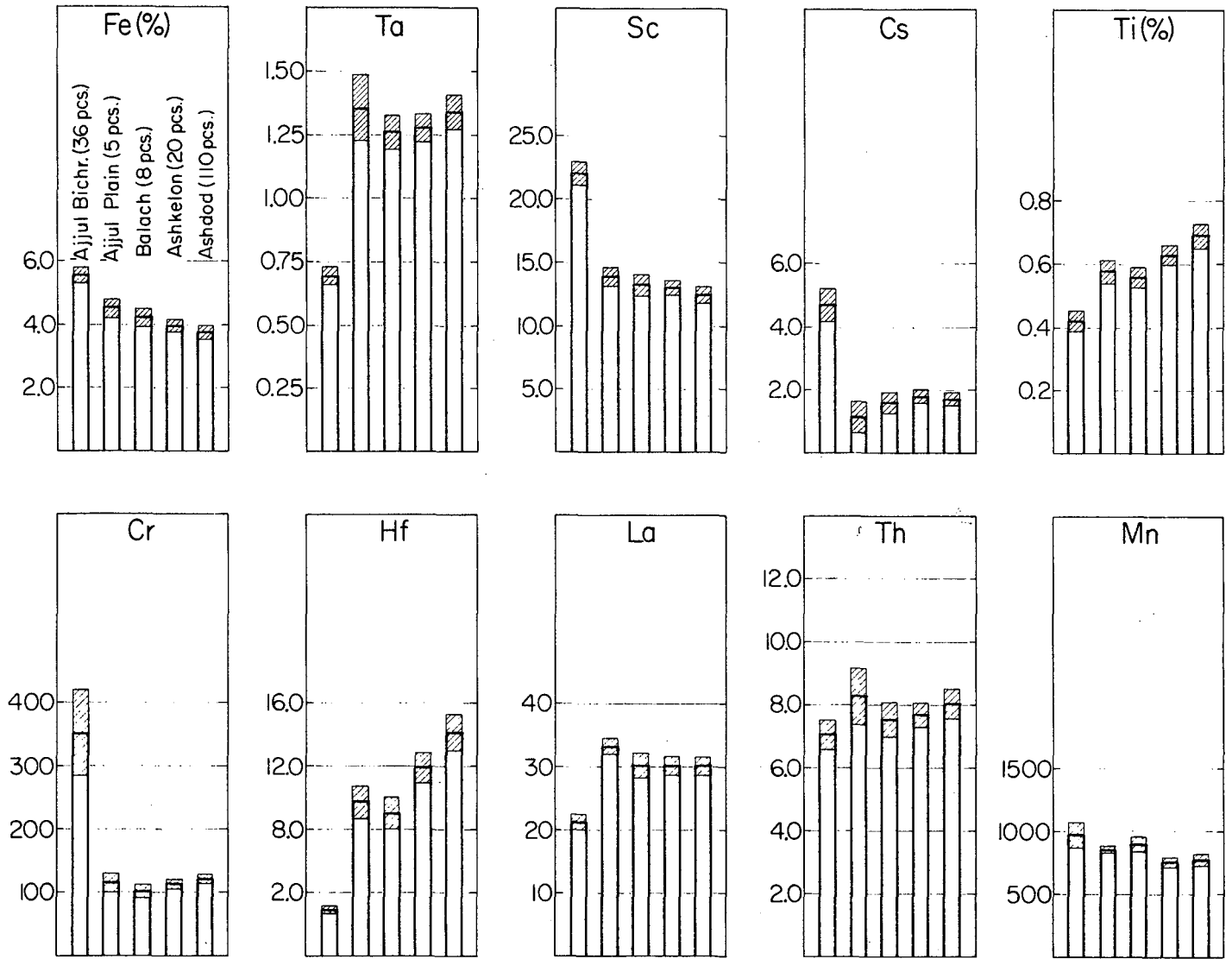
The narrow bars without hatched-zones represent values for individual sherds designated by our laboratory serial numbers:

AJU 10, from Tel el-'Ajjul, in probably Bichrome but could not be clearly identified; AJU 35 is a Bichrome sherd.

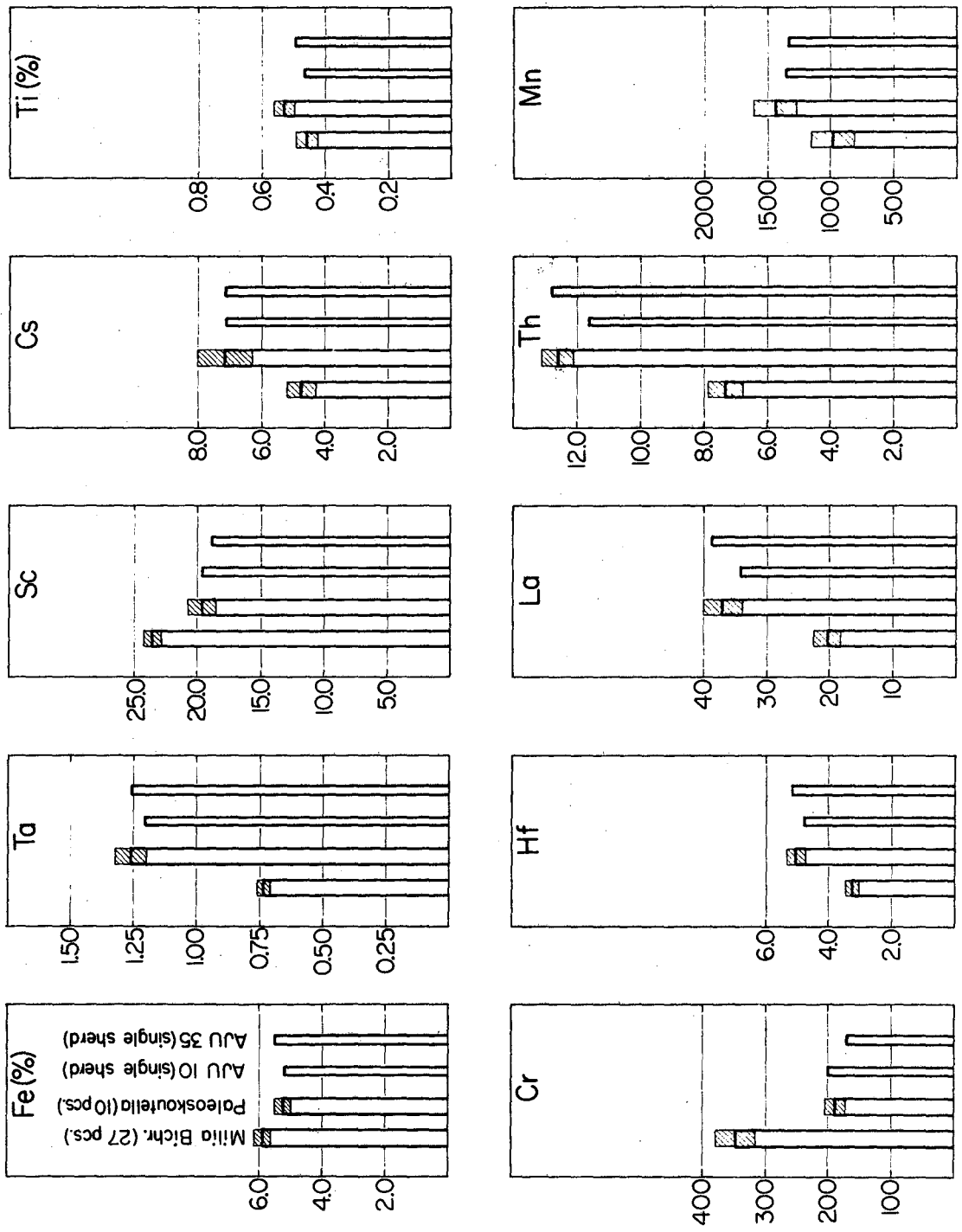


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Fig. 2



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Fig. 3

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