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Early Farmers from El-Badari: Aboriginals or "European" Agro-Nostratic immigrants to the Nile Valley? Craniometric affinities considered with other evidence

Abstract

The appearance of agriculture in the Nile Valley occurs some two thousand years after its emergence in Europe and the Near East. It has been suggested that migrants brought farming and the Afro-Asiatic language family into the Nile Valley, after the dispersal of speakers of the Nostratic language grouping, whose region of origin has been postulated to be southern Europe. The issue of migration is explored by a multivariate phenetic analysis of crania of farmers from the district of el-Badari, site of the earliest agriculture in Upper Egypt. Comparison samples are from Europe and tropical Africa based on the results of previous work, in which the morphometric pattern of epipaleolithic crania from the region affiliated with non-elongated tropical African groups. UPGMA and neighbour joining clustering algorithms were generated from matrices of Mahalanobis distances, and an analysis undertaken of the order of intra-group distances between each of the series. The sample from el-Badari is found to be more broadly similar to the tropical African series, while not being identical. These results are not supportive of population replacement or major migration with genetic swamping from Europe, as an explanation for the emergence of agriculture in the Nile Valley. The conclusions based on the morphometric analysis, receives some additional support from archaeological and linguistic evidence.

Generally, less emphasis is now placed on substantial population migration or replacement as an explanation for culture change in "prehistory ." One notable exception to this development is to be found in theories addressing the

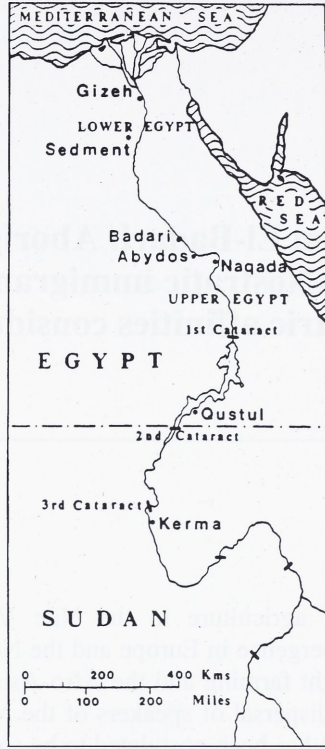


Fig. 1. Location-map el Badari

spread of agriculture, especially in Europe (see demic diffusion in Ammerman & Cavalli-Sforza 1984; Sokal et al. 1991). Similarly, it has also been suggested that migrants from Europe spread farming, along with a Nostratic language branch (ancestral Afro-Asiatic), into the Nile Valley (Barbujani & Pilastro 1993). This view can be called the agro-Nostratic hypothesis. 'Nostratic' is the name given to any of several versions of a hypothetical genetic linguistic macro-grouping consisting of several well accepted language families (see Ruhlen 1991). Extensive European colonization of, or migration into northwest Africa, the Nile Valley, and greater northeastern Africa in the late Pleistocene or early Holocene was once suggested by biological anthropologists (see e.g. Seligman 1930; Coon 1965). It is implied in much genetic and non-specialist work in which suprasaharan Africa is somehow transported to "Eurasia"; such a perspective denies indigenous in situ evolution and culture to Suprasaharan and Saharan

Africa. It in effect de-Africanises a part of Africa due to outmoded non-evolutionary theories, and the inability to accept African biocultural variation.

There are two reasons, both based on archaeological evidence, for considering mass migration as a factor in explaining the appearance of food production in the Nile Valley. First, the emergence of agriculture in the Nile Valley does occur nearly two thousand years after its establishment in Europe and the Near East (Hassan 1988). Second, the core domesticates found in the Nile Valley are the same as in Europe and the Near East: wheat, barley, ovacaprines, and cattle; these are not generally believed to have had the appropriate wild progenitors in Africa, with the exception of cattle (Wendorf et al. 1987, Wendorf & Schild 1994; but see Clutton-Brock 1989 for a different view on cattle). The geographical pattern of early horticulture in the Nile Valley is not inconsistent with this migration thesis. The oldest documented food production sites are in northern (Lower) Egypt and date from 5200 BCE to 4600 BCE (Hassan 1988; Kobusiewicz 1992; Wetterstrom 1993). Evidence for agriculture is next attested further south, in el-Badari, a district in northern upper Egypt, and dates to approximately 4400-4000 BCE; the associated lithics, pottery and other artifacts constitute the "Badarian," the first defined unit in the predynastic cultural sequence which shows continuity with dynastic Egypt (Arkell & Ucko 1965; Hoffman 1988; Hassan 1988).

One approach, although limited, with which to explore the possibility of migration in earlier times, is through analysis of craniometric affinities. Previous studies have not specifically addressed the immigration of farmers from Europe into the Nile Valley. However, Brace et al. (1993) find that a series of Upper Egyptian/Nubian epipalaeolithic crania affiliate by cluster analysis with groups they designate "Sub-Saharan African", or just simply "African" (from which they incorrectly) exclude the Maghreb, Sudan and the Horn of Africa), while post-Badarian southern predynastic and a late dynastic northern series (called "E" or Gizeh) cluster together, and secondarily with Europeans. In the primary cluster with the Egyptian groups are also remains representing populations from the ancient Sudan and recent Somalia. Brace et al. (1993) seemingly interpret these results as indicating a population "relationship" from Scandinavia to the Horn of Africa although the mechanism for this is not clearly stated; they also state that the Egyptians had no "relationship" with "Sub-Saharan" Africans, a group that they nearly treat (incorrectly) as monolithic, although sometimes seemingly including Somalia which directly undermines aspects of their claims. "Sub-saharan" Africa does not define/delimit authentic Africanity.

The later dates, specific domesticates, and lack of local wild antecedents make a case for food production having been largely (but not wholly) derivative in the Nile Valley from the Near East; and these observations, coupled with the

interpretations found in some linguistic and human biological studies, allow for considering the possibility of large-scale migration into the Nile Valley in the immediate post epipalaeolithic period. Here we present a narrowly focused study of early Badarian crania, designed to explore the question of Nostratic population replacement, or migration into the Nile Valley consonant with the time of the earliest agriculture attested in Upper Egypt. European series are used as the Nostratic representatives, given Europe's proximity to Egypt. The results of the analyses are discussed with findings from archaeology and linguistics in order to assess the likelihood of the agro-Nostratic hypothesis for the Nile Valley.

Materials and Methods

Eight series were used in this analysis, including three from Europe and four from tropical Africa (Table 1). European and non-Nile Valley African groups are used as comparative material based on Brace et al.s (1993) comments on the affinities of an Upper Egyptian/Nubian epipalaeolithic series. Twenty-five male Badarian crania were culled from a larger series (n~60) housed at the Duckworth laboratory, Cambridge University. The sample size was optimized using reasonable estimation techniques Howells (1973).

The subject was approached from an exploratory perspective, using different variable sets and techniques to examine the structure of the data. Analyses were carried out using fifteen and eleven metric variables (Table 2). Anatomically, the variables were chosen in order to represent the major embryological areas of the skull, in a balanced fashion, and for their likely genetic basis (see Keita 1988). The smaller set eliminates measurements that cross the major developmental regions of the cranium and/or which have less demonstrated heritability. The number of variables was selected to maximize biostatistical validity, and conforms to findings which indicate that this is likely best achieved when the variable set is numerically smaller than the number of cases (individuals) in the smallest sample (see Sjøvold 1975; Van Vark 1976; Corruccini 1978). Also no simple ratios, proportions or indices were used in order to be consistent with the best practice advocated by biomathematicians. The Mahalanobis distance technique only makes use of the unique contribution of each variable because it in effect eliminates correlations between variables, unlike Penrose or Euclidean distances.

Mahalanobis distances were calculated using the SAS statistical package (SAS Institute 1992). The resulting matrices were manipulated to explore the place of the Badarian series in relationship to the others. This was carried out in two ways. A sequential display, called a distance hierarchy (Keita 1983), was constructed by placing in order of progressive dissimilarity, all other series from

Table 1. Cranial series used

<u>Designation</u>	<u>Locale</u>	<u>Number</u>
Berg	Hungary	56
Bushman	Southern Africa	41
Dogon	Mali	47
Norse	Norway	55
Teita	Kenya	33
Zalavar	Hungary	53
Zulu	South Africa	55
Badarian	Upper Egypt	25

Table 2. Variables

<u>15 set</u>	<u>11 set</u>
Glabella-occipital length	same
Basinasion length	same
Basibregma height	--
Maximum cranial breadth	same
Bizygomatic breadth	same
Biauricular breadth	same
Minimum cranial breadth	--
Basion-prosthion length	same
Upper facial height	same
Nasal height	same
Orbit height	--
Orbit breadth	--
Nasal breadth	same
Bimaxillary breadth	same
Cheek height	same

Table 3A. D² matrix 11 variables

from POP	Berg	Bushman	Dogon	Norse	Teita	Zalavar	Zulu
Berg	0						
Bushman	23.59377	0					
Dogon	19.48910	8.17140	0				
Norse	5.15374	18.18366	18.21260	0			
Teita	23.52637	11.20639	8.65231	13.49573	0		
Zalavar	3.99291	15.33975	13.78928	0.90011	10.78592	0	
Zulu	23.24636	10.64561	3.94152	15.41540	3.78664	12.26495	0
Badarian	21.69216	6.13146	9.88218	13.27768	6.00010	9.68540	7.60615

Table 3. D² matrix 15 variables

from POP	Berg	Bushman	Dogon	Norse	Teita	Zalavar	Zulu
Berg	0						
Bushman	36.74497	0					
Dogon	38.28162	19.26284	0				
Norse	10.78136	29.98679	33.56878	0			
Teita	34.78863	17.64547	12.55126	18.67868	0		
Zalavar	9.37956	28.01987	28.56992	5.13509	19.00213	0	
Zulu	44.92925	21.57363	8.90887	31.64631	9.43921	23.68180	0
Badarian	28.72911	12.51195	12.85704	18.79617	8.33989	13.19330	10.47652

each one of the groups. This summation device facilitates the assessment of samples' relative similarities to each other, and provides one view of the overall structure of the taxonomic matrix. It facilitates seeing the most similar pairs of series. Cluster analyses were also performed using algorithms for the unweighted pair group method using arithmetic means (UPGMA) and neighbour joining (NJ) methods (Kumar et al. 2001). Both approaches are used because different clustering techniques are notorious for yielding different results using the same

data. An exploration using multiple approaches is more likely to lead to useful conclusions and the generation of new hypotheses.

Results

The Mahalanobis distances between all of the series were unlikely to be due to chance at the five percent level, with nearly all having lower probability values (usually $p < 0.001$). An examination of the distance hierarchies reveals the Badarian series to be more similar to the Teita in both analyses, and always more similar to all of the African series than to the Norse and Berg groups (Table 3, Fig. 2). Essentially equal similarity is found with the Zalavar and Dogon series in the eleven variable analysis, and with these and the "Bushman" in the one using fifteen variables.

11 Variables

Badarian: Teita, Bushman<Zulu<Zalavar, Dogon<Norse<Berg
 Berg: Zalavar<Norse<Dogon<Badarian<Zulu, Teita, Bushman
 Bushman: Badarian<Dogon<Zulu<Teita<Zalavar<Norse<Berg
 Dogon: Zulu<Bushman, Teita<Badarian<Zalavar<Norse<Berg
 Norse: Zalavar<Berg<Badarian, Teita<Zulu<Bushman, Dogon
 Teita: Zulu<Badarian<Dogon<Zalavar<Bushman<Norse<Berg
 Zalavar: Norse<Berg<Badarian<Teita<Zulu<Dogon<Bushman
 Zulu: Teita, Dogon<Badarian<Bushman<Zalavar<Norse<Berg

15 Variables

Badarian: Teita<Zulu<Zalavar, Dogon, Bushman<Norse<Berg
 Berg: Zalavar<Norse<Dogon<Bushman, Badarian<Zulu<Teita
 Bushman: Badarian<Dogon<Zulu<Teita<Zalavar<Norse<Berg
 Dogon: Zulu<Teita<Badarian<Bushman<Zalavar<Norse<Berg
 Norse: Zalavar<Berg<Teita<Badarian<Zulu<Bushman<Dogon
 Teita: Zulu<Badarian<Dogon<Norse, Zalavar<Bushman<Berg
 Zalavar: Norse<Berg<Badarian<Zulu<Teita<Dogon<Bushman
 Zulu: Dogon<Teita<Badarian<Zalavar<Bushman<Norse<Berg

Fig. 2. Distance hierarchies.

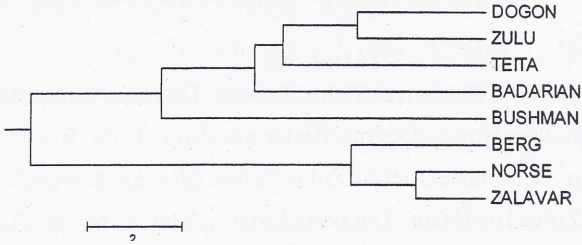
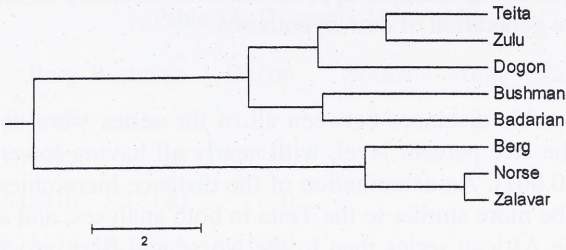


Fig. 3. UPGMA dendrograms: 11 and 15 variables.

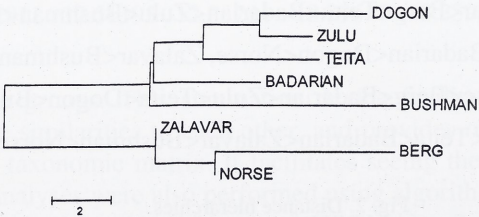
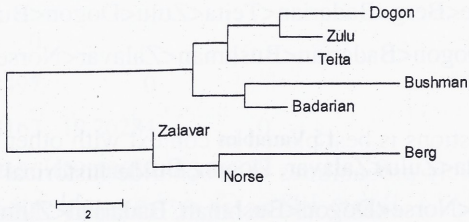


Fig. 4. Neighbor joining dendrograms: 11 and 15 variables.

The Badarian series clusters with the tropical African groups no matter which algorithm is employed (Fig. 3 and 4). The clustering with the "Bushman" can be understood as an artifact of grouping algorithms; it is well known that a series may group into a cluster that does not contain the series to which it is most similar (has the lowest distance value). An additional twenty dendrograms were generated using the minimum evolution algorithm provided by MEGA (not shown). In none of them did the Badarian sample affiliate with the European series. In additional analyses the "Bushman" series was left out; the results were the same (not shown).

It is interesting that the distance hierarchies and cluster analyses show the European series to always be closer to each other than any is to anyone of the African series, and to have generally lower distance values between themselves than did the African groups. Also the individual European series are not consistently found to be more similar to one particular African series, or similar in the same order.

Discussion

The results are not supportive of European agriculturalists colonizing el-Badari in the early to mid-Holocene. The Badarian series evinces greater phenetic affinity with the tropical African comparative groups, and notably the east African Teita. This affinity is relative, and not to be taken as indicating identity. This finding can only be interpreted as showing a particular broad similarity in the morphometric space circumscribed by the particular groups used. The Badarians were a local Saharo-Nile Valley population, based on archaeological and other data (see below). Phenetic affinity assessed in the exploration of historical questions is best placed in context with other information that in toto indicates the likely probabilities of a bonafide historical connection (see Dutta 1984; Harrison 1984; Rouse 1986). Chance resemblance, parallelism and micro-convergence may also be possible explanations for biological similarity.

In other analyses these early crania from el-Badari have shown a greater resemblance to southern Nile Valley series and some from tropical Africa (including the Horn), than to northern dynastic Egyptians (see e.g. Mukherjee et al. 1955; Keita 1983; 1993). However, these studies were not designed to examine the question of European (Nostratic representatives) migration as the source of early Nile Valley farmers. At another level, the morphometric patterns of Egyptian crania in general, although highly variable, generally exhibit a position intermediate to stereotypical tropical Africans and Europeans in multivariate analyses (see review in Keita 1993). In one study by Howells (1973), the previously mentioned late dynastic northern Gizeh series, which dates to and after the period of historically known incursions from Europe, clusters with

either "Africans" or "Europeans" (the same series used here) depending on method. The matrix of Mahalanobis distances (organized into a distance hierarchy) indicates that this series [Gizeh] was not exclusively more similar to various European or African series for the traits utilized. A careful consideration of these results leads one to consider the issue of variation in Africa, beyond stereotypical racio-typological models and geographical typological thinking (see Hiemaux 1975, Keita 1993, Keita & Kittles 1997, Kittles & Keita 1999).

Simulation studies can also help in assessing the likely probability of ongoing significant migration into the region. Harrison (1984) reports on a model positing a linear array of twenty populations, and for which only sequential migration is allowed; he finds that it would take a neutral gene 500 generations (~10,000 years) at a migration rate of fifty percent (per generation) to reach equilibrium in the populations, thereby rendering them 'similar'. In this simulation movement was modeled as bi-directional in all but the terminal groups. If polygenic craniometric "traits" are considered, and treated as neutral (or 'trivially adaptive') at more realistic rates, with only unidirectional movement, it would take considerably longer to achieve equilibrium, unless there was direct migration to the terminal locale under consideration. Ten thousand years do not separate the epipalaeolithic from the Badarian, or the latter from the subsequent periods in the Nile Valley. (And there is no evidence for direct migration.) Also there would be more than twenty local populations to be considered. Harrison's (1984) simulation results support, indirectly, the findings here, and also the view that Nile Valley craniofacial variation, along with that of Sudan and the Horn of Africa, likely owes more to indigenous microevolution. Their findings of a relative northeast African quadrant-European craniometric similarity more likely reflect various processes and biographies more ancient than wholesale Holocene migration from Europe/Anatolia via a Nostratic-speaking group. This comment would also apply to the broad similarity in molecular genetics of a subset of Nostratic-speaking populations observed by Barbujani and Pilastro (1993). The dendrograms of Brace et al. (1993) would seem to illustrate in the main a facet of indigenous African diversity observed elsewhere: a subset of African series evincing similarity to non-African groups not primarily due to gene flow, analogous to individual Africans (even with the socially-constructed stereotypical "African" morphophenotype) being found throughout mtDNA of trees of world samples. A synthesis of molecular, palaeontological, and ecological evidence indicates that indigenous continent-wide African biogeographical variation should be tremendous (Keita & Kittles 1997, Kittles & Keita 1999).

Non-biological data can profitably be included in this discussion, although biology, language family and culture are not intrinsically linked, or causally related. Information from each category can provide evidence for population

movement and contact in selected circumstances. Collectively, if broadly congruent, data from multiple disciplines can more convincingly make a case for migration (Rouse 1986). The time framework for postulated movement, however, will clearly influence how these different sources of evidence are to be used, and the level of specificity. Given the agro-Nostratic hypothesis, it is of interest to review the results of linguistic studies.

While it is known that languages can be spread by relatively small groups and that communities will sometimes change languages easily (Nichols 1997), language family distributions that date to before expansionist states, empires or ideologies likely reflect more than trivial population movement in relationship to population density. Recent studies in historical linguistics do not support an agro-Nostratic hypothesis which postulates Afro-Asiatic speaking farmers coming into the Nile Valley from Europe. There are several reasons. The date of ancestral Afro-Asiatic is likely to be as much as 15,000 BP (Ehret 1979; 1984; personal communication; Fleming 1974 personal communication), and possibly more. Conservative estimates place the date at 12,000 BP. There is no archaeological evidence for agriculture consonant with these dates. More importantly, reconstruction of ancestral Afro-Asiatic (irrespective of its date) using all of the family's members does not reveal terms for plant or animal domestication (Ehret 1979, 1984, 1995, personal communication). In other words speakers of undifferentiated Afro-Asiatic cannot be shown to have been food producers, but were apparently intensive users of wild grasses. The dates and reconstructions fit with the archeological findings of intensive plant use in the Upper Nile Valley (see Wetterstrom 1993).

The evidence is also consistent with Africa being Afro-Asiatic's place of historical differentiation and source of spread (see Greenberg 1966, 1973, Bender 1975; Diakonoff 1981; Ehret 1984; Ruhlen 1991; Blench 1993). The location of ancestral Afro-Asiatic was likely in the northeast quadrant of Africa, in or near the Horn, but also possibly the Sahara, based on the principles of 'greatest diversity' and 'least moves' (cf. Bender 1975 & Ehret 1984, with Nichols 1997). Five of the six branches of this family are only found in Africa (Omotic, ancient Egyptian, Chadic, Cushitic, and Berber). Semitic alone is found in Asia (Greenberg 1973; Diakonoff 1981). Omotic, found only in Ethiopia, has characteristics likely to be relatively similar to those in ancestral Afro-Asiatic. At the time of postulated movement into Africa from Europe (of a Nostratic branch) there is evidence for substantial movement out of Africa, specifically the northern Nile Valley, into the Levant (Bar Yosef 1987). (This archaeological 'signal' may connect the movement of pre-proto-Semitic speakers into the Near East.)

"Culture history" based on linguistics is also not consistent with simple migration and colonization, given the later dates for agriculture in the Nile Valley. It is

substantively significant that the words for the 'foreign' major domesticates in Old Egyptian are not loans from Indo-European (or even Semitic or Sumerian) (Baines, personal communication). Even in early Semitic-speaking Mesopotamian cultures (for which we have written records) some of the words for important domesticates were apparently Sumerian loans (Diakonoff 1981).

The agro-Nostratic hypothesis is also undermined taxonomically. The evidence better supports Afro-Asiatic being a sister, not daughter, of Nostratic (Ruhlen 1991). Dates given for common Nostratic are the same or younger than those assigned to common Afro-Asiatic, making the sibling relationship more plausible if any of these chronologies are valid (cf. Barbujani & Pilastro 1993 and Ehret 1984, Blench 1993). Another issue beyond the scope of this paper is the question of the basic validity of the Nostratic construct, which has not won wide acceptance among historical linguists, due to the problems inherent in linguistic reconstructions of such implied time depths (see Ruhlen 1991, Nichols 1997).

The archaeology of neolithic and predynastic Egypt does not support mass migration from Europe. The earliest evidence for farming in the Nile Valley indicates that local people incorporated Near Eastern domesticates into an indigenous foraging subsistence strategy (Wetterstrom 1993). Settlement patterns and artifacts do not suggest the wholesale settler colonization of the Nile Valley by a community of alien origin. In northern Egypt the earliest sites evincing food production at Fayum and Merimde show some Near Eastern, but not European, influence during the earlier part of the neolithic; chronologically later neolithic artifacts from the same sites indicate a strange regional African (Saharan/Western Desert) influence (Kobusiewicz 1992). The Badarian, in Upper Egypt, is culturally interpretable primarily as a synthesis of indigenous Saharan and Nilotic traditions which incorporated some Near Eastern domesticates perhaps adopted from northern Egypt (Hoffman 1979; Hassan 1988), and apparently did not have a single simple antecedent (Holmes 1989). Kobusiewicz (see this volume) notes sites with Badarian-like pottery, hut older, in the southern eastern Sahara, at a site near the Sudanese border.

Additional analyses using 22 variables (perhaps too many), and including additional material from Sudan, late dynastic northern Egypt (Gizeh), Somalia, Asia and the Pacific islands, showed the Badarian to be most similar to a series from the northeast quadrant of Africa, and then to other Africans.

In summary, and viewed wholistically, the evidence gleaned from linguistic, archaeological, and biological research does not support the migration of Nostratic farmers from Europe to explain either the emergence of agriculture in the Nile Valley, at least in upper Egypt, or the presence of the Afro-Asiatic language family in the Nile Valley and greater Africa. The evidence indicates

early Egypt to foundationally belong to a northeast African biocultural descendant community. Future work will help further clarify issues relevant to the exploration of this subject. These issues include the range of indigenous human variation in the early and mid-Holocene Nile Valley and surrounding regions, the archaeological correlates of migration, and the emergence and development of Afro-Asiatic in the Nile Valley.

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