A synopsis of the physical anthropology of the corded ware complex on the background of the expansion of the Kurgan cultures

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Abstract

Morphometrical data of human skeletal material from Eastern and Central Europe, of the period 4000 b.c. to 1800 b.c. (c. 5000-2500 B.C.), are elaborated with the aid of multivariate methods. A synoptical picture is presented describing biological affinities between the cultural groups concerned. The affinities are interpreted on the background of the geographical distances. "Old Europe" cultures are confronted a) to their local and chronological successors, and b) to populations living in, or originating from, Eastern Europe, in order to work out - on the background of current theories on Indo-Europeanization and the expansion of Kurgan cultures - the biological elements potentially implied in the formation of the Corded Ware complex. The question of the phenotypical variability of the latter is investigated with respect to time and space (expansion); its biological incidence on the autochthonous populations (substratum) is analyzed. In parallel, the Corded Ware complex is confronted to the Bell Beaker complex, especially as to their morphological and cultural antagonism. The great lines can be summarized as follows. [...]
A SYNOPSIS OF THE PHYSICAL ANTHROPOLOGY OF THE CORDED WARE COMPLEX ON THE BACKGROUND OF THE EXPANSION OF THE KURGAN CULTURES

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"Old Europe" cultures are confronted a) to their local and chronological successors, and b) to populations living in, or originating from, Eastern Europe, in order to work out — on the background of current theories on Indo-Europeanization and the expansion of Kurgan cultures — the biological elements potentially implied in the formation of the Corded Ware complex. The question of the phenotypical variability of the latter is investigated with respect to time and space (expansion); its biological incidence on the autochthonous populations (substratum) is analyzed. In parallel, the Corded Ware complex is confronted to the Bell Beaker complex, especially as to their morphological and cultural antagonism.

The great lines can be summarized as follows. Initially, two biological and geographical blocks were present: in Western Europe, the homogenous complex of "Old Europe" populations; in Eastern Europe the Neolithic substratum and the quite different Kurgan groups. The biological effect of the expansion of the Kurgan traditions is evident in the regions adjacent to the North Pontic area, but it is fading out progressively with increasing distance from this center.

The Corded Ware complex s.l. is biologically heterogeneous. The local groups of the core area (Central Germany, Czechoslovakia, Poland) form a very homogeneous block, issued from the local "Old Europe" substratum and persisting until Aunjetitz at least. This block shows no biological affinities to the Ukrainian Kurgan populations. There is no evidence for physical presence of Kurgan tribes in this area. Indo-Europeanization of Northern Europe could be explained by indirect Kurganization, i.e. by invasion of previously Kurganized neighbor groups.

The final phase of the European Neolithic is marked by the sudden appearance of two fast and far expanding cultural assemblies: the Bell Beaker and the Corded Ware complexes. In various respects both of them are involved in severe archaeological controversy: their origin, the modalities of their expansion and their impact on local substratum — biological and cultural — raise questions that have encountered an extraor-
dinary variety of tentative answers.

As to the understanding of their history, in the recent years some real progress has been achieved concerning the former (Glockenbecher symposium Oberried, 1974; Lanting and van der Waals, 1976; Gallay 1979), whereas for the latter — the Corded Ware complex — the general historical reconstruction is arrived at a dead end (1), despite of the fact that the knowledge on the local and regional level is steadily increasing.

Physical anthropology has been solicited repeatedly (Gimbutas 1980; Schwidetzky 1978a, 1978b) to "referee" in this apparently unresolvable dispute and to intervene by forwarding biological arguments that are likely to contribute to a better understanding of these problems. As a matter of fact, physical anthropology has — potentially — an important role to assume in the reconstruction of "prehistoric" history: it has to complement cultural history (the evolution, in time and in space, of immaterial components — religious, aesthetical, technological) with a skeleton of factual history (the chronological succession of political events resulting from physical interaction between human groups standing behind these ideas). It has to intervene notably in the apparently endless debate of "diffusionism vs. migration" and to give insight into the modalities of cultural expansion by a comparative analysis of the biological properties of the cultural and geographical groups involved in the process under study.

Independently of the question, whether physical anthropology — at the present time — is able or not to undertake this fascinating task with reasonable chances of success, it is necessary to explain, at the outset of this study, the anthropological point of view of the situation we have to deal with. In order to give a contrasted picture, it is useful to come back to the Bell Beaker, the antagonist of the Corded Ware complex in Central and Western Europe.

To put it very bluntly, the Bell Beaker and the Corded Ware complexes can be regarded as being two very unlike twin brothers. Twin brothers, because they are partly contemporaneous, because partly they occupy the same regions and because both are brought in connection with Kurgan culture

(1) See introductions of Häusler (1969) and Schwidetzky (1978a).
dynamism (Wave III; Gimbutas 1980); but unlike because of their physical type: Bell Beaker peoples — at least the ones in the center of their stronghold in Central Europe — have a very strongly expressed and unmistakable morphological individuality (usually tagged with the shorthand label of “planoc-<ipitinale Steilköpfe”), which constitutes an excellent marker of their biological penetrance on the substratum across the vast area they have spread.

The Corded Ware people on the other hand, are of a very common, ubiquitous, morphotype, that is encountered in large parts of Europe, since Early Neolithic through all the subsequent periods.

So, at first sight, the two main protagonists of the terminal phase of the Central European Neolithic raise very specific problems concerning the reconstruction of their biological and cultural origin: the Bell Beaker people — although being perfectly traceable on their expansion across Central and Western Europe (Gerhardt 1978; Menk 1980a) — are too “exotic” and can hardly be attached to any preexisting population in Europe, whereas the Corded Ware people — being too indistinctive with respect to their biological surrounding — are difficult to judge as to their biological and cultural connections, forwards and backwards in time, and across space.

These unfavorable starting conditions — discouraging at a first glance — make our problem even more challenging; and I think that physical anthropology, at present, is nevertheless likely to make major contributions to the historical reconstruction of the Corded Ware complex and — possibly — of the process of Indo-Europeanization of Central and Northern Europe. Three reasons must be evoked to justify our optimism:

1. Physical anthropology has undergone profound modifications — practically a complete substitution — of its methodology of data elaboration. This is a direct consequence of the introduction of digital computers. Their essential impact is not to do usual work faster and with less effort, but to give new incentives to conceptual imagination, methodological creativity and transdisciplinary thinking, which altogether permit to undertake much more widely conceived studies, based on much more in-detail information, and to reach a much higher level of data integration and interpretation. This evolution has started in the late sixties and, after the time-consumming phase of build-
ing up the new infrastructure (program libraries, data banks), and of accumulating the experience to handle it, it begins now to yield.

Now, as it has overcome its severe methodological shortcomings (that were responsible, in the last decades, for its stagnation and even involution), physical anthropology has now its most urgent problems on the material side: more skeletal material is needed, with more, better and more reliable morphometrical data, and with an exhaustive chronological, cultural, economical, etc. background description. This claim addresses to anthropologists and archaeologists, together with scientists of other branches involved in archaeology.

2. Taking into consideration its renewed potential, physical anthropology can now pretend to play more than a junior role aside of archaeology in the reconstruction of prehistoric events. The time is ripe for intensified interdisciplinarity, and archaeologists should seek collaboration of physical anthropologists, to start with at the time of fieldwork, if possible.

Cultural dynamism, as studied by archaeology on the basis of the material remainders found in the human settlements and necropolises, cannot make abstraction of the underlying factors of population biology and history, as (to be) investigated by physical anthropology. It is important to focus attention on biological Man — the bearer of culture — and not only on the physical relics he has left. Besides the classical problem of “diffusionism vs. migration,” there are other important biological aspects, such as demography, populational health status, ecological equilibrium, etc., which, taken altogether, can not only contribute to a better understanding of the modalities of cultural dynamism, but also of its causality.

3. Archaeology also has done very interesting progress as to new, large scale framework conception. Very appealing theories have been proposed, like the one on Indo-Europeanization as seen in connection with the expansion of Kurgan culture (Gimbutas 1961; 63; 73; 80). Such theories must be welcomed because — even if they might go too far in some details — they catalyze research on its way to converge towards a more complete and more realistic conception of prehistory. First: they express the feeling that prehistoric archaeology has pushed “culture atomization” too far (i.e. splitting of cultural entities into small and ephemeral local groups). Second: by giving much
importance to non-material components of culture (religion; social and "political" behavior) — components that archaeologists frequently refrain from giving more than marginal consideration — such theories might contribute to motivate prehistorians to adopt new perspectives, approaching the ones used in historic research (where the non-material aspects are seizeable through the written records). Third: they provide an interesting background and an extremely useful framework to physical Anthropology for the reconstruction of large parts of the biological history of recent Mankind.

Objectives

The Corded Ware Complex has an extremely vast extension, comprising many geographical subgroups and cultural "associates." A useful and comprehensive compilation of the anthropological and archaeological problems has been given by Schwidetzky (1978a). This study also presents some very clear-cut conclusions — with which we widely agree — as to the morphological heterogeneity of the Corded Ware Complex (when considered in its widest sense), and to the apparent lack of morphological affinity to Kurgan culture populations. This is of particular interest in connection with the controversy about the origin of the Corded Ware complex and, thence, of the modalities of the process of Indo-Europeanization.

Is it necessary, for a realistic understanding of its genesis, to take into consideration any human migration — and if so, what can be said as to their extent (geographical, demographical)? — or can it be fully explained with a model of cultural diffusionism?

What can be said about its own cultural and biological dynamism? To what extent is the expansion of Corded Ware cultural traditions accompanied by movements of human groups (small units or entire populations)?

At any rate, whatever the problems are, it is insufficient to consider the Corded Ware complex only within a biologicocultural context as delimited by its own geographical extension: it is essential to consider it on a (sub)continental level by integrating it into the phenomenon of Indo-Europeanization (immaterial aspects: ideological, linguistical, social), and by confronting it with the expansion of the Kurgan cultures (physical aspects: technoculture, human physical type).

In the present paper the Corded Ware complex will be recon-
sidered therefore, within an extended reference framework, comprising for each region studied, representatives of: a) the local substratum; b) Corded Ware (and/or contemporaneous group); c) the chronological successors. With the aid of some relatively advanced biostatistical methods, biological arguments will be worked out in order to provide archaeologists with quantitative arguments to support — or discard — some of their hypotheses a) concerning the history of the Corded Ware complex, and b) concerning the implications of the Kurgan culture expansion in general, as currently considered (Gimbutas 1980).

Material

The material used in this study consists exclusively of cranio-metrical data (26 variables: 11 measurements of the cranial vault, 9 of the face and 6 indices), observed on adult individuals belonging to one of the cultural, chronological or geographical units listed hereafter (tab. 1). Out of a total of 2,265 individuals responding to these selection criteria, 1,842 were retained for further study; the remainder had to be discarded because of undeterminable sex or because of very poor state of conservation. All these data were collected in the literature and are stored now in the ADAM Databank (2), together with much more other osteometrical data of other periods and other areas.

The 26 craniometric parameters retained here represent a maximum common basis between Western European and Russian craniometry. It must be mentioned that Western European craniometry — for some understandable reasons (Menk 1978:25) — has undergone a regrettable atrophy. The Russian technique, in contrast, has retained some extremely valuable measurements concerning the morphology of the face, which are highly relevant as to the important problem of detection of mongolid interference. These measurements had to be omitted here because they have no counterpart in the data collected according to the Western technique.

The material retained in this study concerns seven geographical regions that are particularly relevant for our purpose. It would have been interesting to include other regions, and to

(2) ADAM (Anthropological Acquisition and Management) is a fully computerized Data Bank for interdisciplinary research in historical and prehistoric anthropology (Menk 1979, 1980b).
Tab. 1. List of samples

<table>
<thead>
<tr>
<th>Region, culture</th>
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1. **GERMANY**
   - Central Germany
     - **LINEAR** Linear Pottery 89 (Bach 1978)
     - **CORD-GDR** Corded Ware 58
     - **BELL-GDR** Bell Beaker 54 (Gerhardt 1953)
     - **AUN-GDR** Aunjetitz 52 (Ullrich 1972)
     - Upper Rhine/Switzerland
       - **CORD-RH** Corded Ware 23 (+ Gerhardt, Strahn 1975)

2. **CZECHOSLOVAKIA**
   - **CORD-CS** Corded Ware 34
   - **BELL-BOH** Bell Beaker (Bohemia) 32
   - **BELL-MOR** Bell Beaker (Moravia) 42
   - **AUN-BOHE** Aunjetitz (Bohemia) 127
   - **AUN-MORA** Aunjetitz (Moravia) 102

3. **LOWER AUSTRIA**
   - **AUN-AU** Aunjetitz 24
   - **HAINBURG** Hainburg 124
   - **GEMEINLE** Gemeinlebarn 61

4. **POLAND**
   - **FUNNEL-B** Funnel Beaker 49 (not restricted to Poland)
   - **CORD-POL** Corded Ware 28
   - **ZlOTA** Złota 24
   - **Zlota/Corded** 39
   - **Mierzanowice** 31

5. **ROMANIA**
   - **STA-CRIS** Starčevo-Criş 11 (insufficient sample)
   - **GUMELNIT** Gumelnita 10 (insufficient sample)
   - **RUSSE** Russe 53
   - **CERNA VODA** Cernavoda 9 (insufficient sample)
     - **Globular Amphora** 17 (also from Poland)

6. **RUSSIA (Northwest)**
   - **CORD-PRU** Corded (East Russia) 17 (partly Poland)
   - **BOAT-AXE** Estonian Boat-Axe 10
   - **FATJANOVO** Fatjanovo 52
   - **COMB** Combed Ware 20
   - **COMB-PIT** Comb-pit marked ware 77
   - **SIB.NEOL** Siberian Neolithic 12
   - **AFANASEV** Afanasjevo 34
   - **ANDRONOV** Andronovo 32

7. **RUSSIA (Southwest)**
   - **DNIEPR-DO** Dnieper-Donets 236
   - **SR.STOG 2** Srednj Stog II 12 (cultural attribution uncertain)
   - **DREVNEJA** Drevnejamnaja 31
   - **KATAKOMBA** Catacomb 63
   - **SRUBNAJA** Srubnaia 82
   - **TRIPOLO-3** Cucuteni (3) 27
   - **GORO-H-F** Gorodsk-Horodiștea-Foltești 22 (partly Romanian)
   - **USATOVO** Usatovo (2) 16
proceed — within the regions retained — to a more differentiated geographical subdivision; unfortunately this is not possible yet because of the lack of sufficient material. It is worthwhile, however, to notice that these samples constitute an extremely wide morphological spectrum, which covers practically the whole range of variability of post-paleolithic Europe. This fact will reveal to be of great practical importance for the interpretation of morphological group differences. With the aid of some partly new methods it will permit to reach a superior level, in the sense that affirmative conclusions can be drawn on a quantitative basis.

Some groups are represented by very small, and therefore insufficient, samples. Much endeavour must be invested in the future to mobilize additional osteological material. Considerable quantities are “hibernating” in collections all over the world and, before soliciting the archaeologists to be more open-minded to collaboration, physical anthropologists should first make an effort on their own to make “their” material available for information exchange.

Methods

Multivariate methods were used to assess the biological affinities between the 39 groups described above. These methods (3) are at present the most appropriate ones to work out the type of quantitative information that archaeology needs for genetical reconstruction of population history and for modeling of culture dynamics.

The procedure carried out can be broken down into four phases which are outlined very concisely hereafter.

Simplification of raw data

The initial data (group means of 26 craniometric parameters) were submitted to principal component analysis. The essential features of this method can be summarized as follows. The raw data, heavily affected by undesired redundancy, are transformed into new, artificial variables (or factors), which express the whole information in a very convenient form: a) condensation of the essential information in a small number of interpretable

(3) For further details concerning multivariate methodology see Howells (1975) and Menk (1975).
factors; b) differential weighting of the initial parameters according to their real contribution to overall variability; c) elimination of redundance.

Computation of morphological intergroup distances

This is the principal step towards an objective assessment of biological group affinities. The morphological, or phenotypical (4) distance between two groups is the euclidean distance separating the group centroids in the principal components hyperspace. It sums up, in one figure, all 26 partial differences between two groups on the level of the raw data; all redundance being eliminated and each one of the initial parameters being weighted according to its importance as to population differentiation. Such a distance coefficient can be considered, therefore, as a neutral expression of the biological relationship existing between two groups. It is unaffected of any prejudice and exempt of any subjective valorization such as one would ineluctably introduce if one were trying to operate instead with the usual notions of “similarity” and “dissimilarity”.

This distance coefficient is computed for each pair of groups which eventually results in a table (distance matrix) containing, in our case, 39 x 39 = 1521 distance coefficients.

Simplification of the distance matrix

It is obvious that such a huge distance matrix, in its numerical form, is of very little practical help for interpretation of population history. Further reduction is needed to work out the basic structure of group affinities.

Numerical taxonomy provides the necessary tools for this step. Indeed, a distance matrix can very profitably be converted into a graphical representation — a dendrogram — that depicts in a readily assimilable way the nature of the relationship between all pairs of groups (see figs. 1 and 3).

Comparison between biological and geographical distances

In order to give additional information contributing to a meaningful interpretation of the bio-cultural phenomena that might have occurred during the time-span under study, it

(4) Phenotypical distances — computed on the basis of quantitative data on skeletal morphology — can reasonably be assumed to reflect genetical differences between groups.
appears useful to confront the biological distances to the distances separating the groups in the geographical space. Indeed, more insight can be obtained for a realistic explanation of the modalities of cultural expansion.

Figures 4 to 9 show the relation between these two distance types with respect to some “key groups”; the latter being located at the origin of the reference axes of the plot (fig. 4).

The procedures defined above (except step 4) were executed in three independent runs: the first two on the two sexes taken separately, and the third on the two sexes taken together (after standardization of the raw data). Initial data for these analyses were the group means, computed from all individuals presenting at least one of the 26 variables chosen for this study. Lacking means, or means based on an insufficient number of observations, were replaced by estimations obtained by iterative regression (Menk 1975). It must be emphasized here that the data analysis, as outlined above, is deliberately thought to be a very general approach, aimed to work out the basic lines of the biological history of human groups in Eastern and Central Europe. Further studies — for which the methodology is ready — must be devoted to internal populational problems, such as demography (Hassan 1979) and morphological intra-variability.

Results

General overlook of Physical Anthropology of Europe during Neolithic

In an earlier study (Menk 1975) we have presented an overall synthesis of the phenotype relationships between the cultural groups of the European Neolithic, as assessed by physical anthropology, by means of cranial morphology. It might be useful, at the outset of the considerations on Corded Ware and Kurgan cultures, to give a brief outline of some results that are interesting in the particular context of this study.

Despite the fact that some important complexes — such as Bell Beaker, Corded Ware, and Early Bronze Age cultures — were taken as entities with no further local subdivision, and that Kurgan groups were omitted, the essential elements concerning the settlement and the local evolution of European Neolithic populations are clearly demonstrated in the dendrogram (fig. 1).

Two main clusters are present, each one showing a time-
Fig. 1. – General synopsis of Physical Anthropology of prehistoric Europe (Mesolithic until Early Bronze Age). After Menk 1975.
relevant substructure:
A: Western cluster representing essentially “Old Europe” populations, introduced in Europe during Early Neolithic.
  A1: true “Old Europe”: Cardium Impresso, Linear Pottery and their cultural successors during Middle Neolithic until Early Bronze Age (Lagozza, etc.).
  A2: essentially recent groups, including some with Bell Beaker influence.
  A3: “Old Europe” groups, fully gracilized.
B: Eastern cluster, including Mesolithic representatives.
  B1: residual cluster containing groups that show direct or indirect Kurgan influence.

Physical Anthropology of the Corded Ware Complex and the Kurgan cultures

General outline of cranial morphology

A first synoptical view of the structure of morphological relationship between the groups submitted to this study is given in fig. 2. This scattergram — showing the 39 samples plotted according to the two most significant principal components — gives a quite meaningful summary, although it contains only about half of the total information. It represents in a well differentiated manner all the essential anthropological elements intervening in the historical scenario of this study:
1: “Old Europe” substratum: meso-dolichocranic, leptomorphic, gracile and rather small as to general size.
2: Bell Beaker Complex: brachycranic, meso-eurymorphic, medium in size.
3: Kurgan groups and associates: mesocranic, mesomorphic facial components (rather low orbitae, but tendency toward narrow nasal aperture), rather big in size.
4: Ukrainian neolithic substratum: extremely large in size and extraordinary robust; dolicho-mesocranic, eurymorphic (very low orbitae and rather broad nose: “Palaeo-Europid,” “Cromagnid”).

This schematic layout of a wide score of representatives of prehistoric Europids (5) shows a cleavage of European humanity into two spheres which — before the onset of Kurgan “radi-

(5) On the basis of the available cranial measurements the mediterranid and the nordid types are not easy to be distinguished.
Fig. 2. — General synopsis of cranial morphology of the material used in this study. 39 groups plotted in function of the first and the second principal components (representing 52% (36.5% and 15.5% respectively) of total information (26 craniometric variables)).
ation" — were sharply differentiated and isolated: on one hand Western Europe with its typical mediterranid and nordid (6) stock of “Old European” civilisations and, on the other hand, Eastern Europe with its prevailing cromagnid morphotype, as represented by the Dnieper-Donets culture; the only mediterranid (and mediterranean) representative east of a line Vistula-Pruth being the Tripolye/Cucuteni culture. Then, as a consequence of the upheaval having occurred during the transitional phase between final Neolithic and Early Bronze Age, two new entities emerge: a) the brachymorphic Bell Beaker people located astride of the continental (and morphological) cleavage mentioned before, and b) the lepto-dolichomorphic Corded Ware/Aunjetitz Complex as a sub-unit of the “Old Europe” morphotype.

Attention must be paid, however, to the fact that this graphical representation is based on the group centroids (general averages), which means that no account is given of intrapopulational variability for which the two spheres would certainly show some non-negligible overlap. But, in despite of these oversimplifying side-effects of this rather straightforward representation, the fundamental elements of biological, cultural, geographical and historical structuration of Europe are clearly demonstrated, and the introduction of additional information is not likely to bring any major modification of this picture.

**Cluster Analysis: static interpretation**

The dendrogram (fig. 3) — depicting the group affinities on the basis of morphological intergroup distances, computed on the total information — gives full confirmation of the structures outlined above. It splits into two main clusters showing the biological bipolarity — Eastern and Western — as mentioned before. As the present study is aimed to work out the biological incidence of the Kurgan cultures, it seems logical to start the interpretation of the dendrogram at the “lower” end.

**The Eastern Cluster (B)**

This cluster splits into two sub-units, representing the neo-

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(6) All 39 groups are definitely Europid, except Afanasjevo that features for the — contested — Okunevo subgroup some mongolid traits in the facial skeleton (Debetz 1973, p. 159).
Fig. 3. — Dendrograph summarizing the structure of biological affinities between 39 groups; based on phenotypical distances in a 10-dimentional principal component hyperspace. X-axis: level of affinity. Y-axis: limited interpretability; rotation of some “forks” — as indicated by arrows — would produce more meaningful neighborships.
lithic substratum: Dnieper-Donets (7) of the Ukraine (branch B1) and the core of the Kurgan complex (branch B2: Drevnejamnaja, Srubnaja, Catacomb cultures), surrounded by some geographical neighbors (Afanasjevo, Andronovo, Western Siberian Neolithic), and by some potential cultural and/or biological associates (Central Russian Comb-pit Pottery culture, – East Baltic Boat-Axe culture, Cernavoda (8)).

The Western Cluster (A)

This cluster too, subdivides into two historically relevant sub-clusters: “Old Europe” substratum (A1) and “intruders” (A2).

The Old Europe sub-cluster (branch A1) features practically all of the true “Old Europe” representatives (9) (Linear Pottery, Cucuteni, Gumelnita/Karanovo VI) and — witnessing the persistence of this stock — some later groups of the transition period (Zlota, Mierzanowice). In addition to this, we find half of the Corded Ware/Aunjetitz-conglomerate in this sub-cluster: local Corded groups from Central Germany and from Czechoslovakia, and Aunjetitz groups from Bohemia and Lower Austria (the population from the site of Gemeinlebarn clearly fits into the Aunjetitz type). Corded Ware people from Southwest Germany and Switzerland, however, represent a differentiated group (local variety of migrants according to Gerhardt and Strahm, 1975; Strahm 1979; Schwidetzky 1972; Sangmeister and Gerhardt 1965). The Comb-marked Pottery is only very loosely attached to this sub-cluster (low level of similarity). The affiliation of the Bohemian Bell Beaker to the “Old Europe” cluster is a striking example of an artefact due to

(7) There is a problem concerning the cultural attribution of the sample named “Srednj Stog II”. The skeletal material used in this study comes exclusively from the site of Kapulivka; according to its authors (Zinevich and Kruts 1968, p. 14), the archaeological material found in association with the skeletons speaks more in favor of an appurtenance to Srednj Stog II than to Dnieper-Donets. As to the human type, the skeletons belong, without any doubt, to the Dnieper-Donets populations.

(8) The Cernavoda sample represents one of the most heterogeneous groups of this study. This fact could reflect — to some extent — Kurgan influence (Wave I; Gimbutas 1980), but this explanation is not fully ascertained. Other possible reasons to explain this heterogeneity: small size of the sample; problems of internal chronology of the material (Necrasov, pers. comm.).

(9) The Starcevo-Grój sample is another “unsatisfactory” case. The material, too scarce, is heterogeneous from the geographical and chronological point of view.
insufficiently accurate cultural and chronological attribution of skeletal material (undoubtedly Aunjetitz people) (10).

The “intruder” sub-cluster (branch A2) also subdivides into two highly significant units: Bell Beaker (A21) and “Kurganized Old Europeans” (A22). Whereas the former — pure-bred Bell Beaker (Gerhardt 1978; Menk 1979) from the core area of their subsequent diffusion (Central Germany, Moravia; Hainburg representing an Early Bronze Age survivor, perhaps a residual stronghold in a surrounding dominated by the Aunjetitz culture) — are obviously of extraneous origin, the latter (A22) are predominantly “Old European” as to their biological composition.

Biological “Kurgan” admixture (Wave II, according to Gimbutas 1980) can reasonably be admitted for the following South-Eastern groups: Usatovo 2, Globular Amphora culture, and Gorodsk-Horodîștea-Foltești. More comment will be given later.

For the North-Eastern and North-Central European groups there is probably no direct biological “Kurgan” admixture: East Prussian Corded Ware represents a local variety: “Old Europe” stock differentiated by microevolution (isolation). Fal'janovo must be interpreted as a migrant of Western (Corded Ware) origin. The Moravian and Central German Aunjetitz groups are affiliated to this cluster, rather than to the one of the remnant Aunjetitz groups, because — as a consequence of sampling difficulties (separation of Late Bell Beaker and Early Aunjetitz) — they contain some early material “contaminated” by Bell Beaker elements (Gerhardt 1953). The transition phase from Bell Beaker to Aunjetitz culture in Central Europe would merit a detail study. A satisfactory explanation is still to be found for the contradictionary biological and cultural evolution: there seems to be a cultural continuity from Bell Beaker to Aunjetitz (Gallay 1980), but a complete rupture as regards the local human stock.

(10) The Bohemian Bell Beaker sample (N = 32) contains 11 individuals from the site of Polepy, dated Bell Beaker/Aunjetitz. These 11 individuals, representing a homogeneous (hyper)dolichocranic group (1 ultra-, 5 hyper-, 3 dolichocranic, 2 mesocranic), are likely to be predominantly Aunjetitzians, rather than Bell Beaker people.
Dynamic interpretation of group affinities

In order to get additional elements for a consistent interpretation of biological and cultural history, the biological intergroup distances — on which the whole interpretation has been based up to now — were compared to the geographical distances that separate the cultural groups in space (11).

In the graphs following hereafter, the N-1 groups are shown as to their geographical and biological closeness to the nth group — the reference group. The latter being situated in the origin of the X/Y-coordinate system (12). Fig. 4 gives further explanations on these graphs.

According to the aims of this study, the following groups were selected for this additional analysis, and will serve consequently as reference groups: Dnieper-Donets, Drevnejammaja, Linear Ceramic, Bell Beaker, Corded Ware (the last three all from Central Germany).

Implantation of Kurgan populations in the Ukraine

Fig. 5, with the Dnieper-Donets culture as reference group (representing the substratum of Middle and Late Neolithic of the Ukraine), is clearly partitioned into four biologically and historically relevant complexes: a) Eastern Europid; a) Kurgan core; b) “Old Europe”; c) Kurganized “interface” between a) and b). With its very large gap between the substratum and the Kurgan groups, this figure suggests a complete population substitution: the morphological type encountered in the Dnieper-Donets culture representing the upper extreme robusticity of the Europid spectrum vanishes at the end of Neolithic without leaving any trace (13). This means, of course, that migration of the Kurgan people must have set on earlier, from some area farther East (Southern Soviet Central Asia, probably with some North Caucasian influence Majkop culture (Sulimirski 1970:

(11) The geographical distances between the groups were computed between the barycenters of the geographical distribution of the skeletons used in this study (for each skeleton we have the geographical coordinates in the Data Bank).

(12) The scaling on the X- and Y-axes is given in terms of ranks of the distances (as opposed to absolute distances, expressed in kilometers). This numerical transformation provides better readability of the graphs: it avoids “crowding” in the region around the origin, and produces some concentration in the region opposed to the origin.

(13) Concerning the apparent persistence until Srednij Stog II see note 6.
Fig. 4. — Biological vs. geographical distances.
A: biological identity of two groups of the same area. For consistent dynamic interpretation time must be taken into consideration.
B: migration; splitting of a population (or random convergence).
C: substitution of a population; intrusion.
D: Dissimilarity increasing with geographical distance (genetic drift, etc.).
ANTHROPOLOGY OF THE CORDED WARE COMPLEX

130; Gimbutas 1961: 199). There is no evidence permitting to derive them from the Central Russian neolithic substratum (the hunting and fishing Comb-pit Pottery people) to whom the Kurgan people show remarkable morphological similarity, however.

Kurgan radiation

Fig. 6 — with the Drevnejamnaja (Jamna) culture serving as reference group — shows two zones, the first one being imbricated in the second: a) the Kurgan core and b) potential “Kurgan satellites,” the imbrication giving a graphical expression of biological Kurgan admixture: Usatovo, Gorodsk-Horodiștea-Foltești, East Baltic (Estonian) Battle-Axe, and Globular Amphora cultures.

As opposed to this Kurgan complex, we find the “Old Europe” sphere and — in between, as a transitional unit — the Bell Beaker groups and other groups being marked, to a variable degree, by their influence.

In opposition to each one of these three entities we observe the Ukrainian neolithic substratum. Thus, this graph (fig. 6) gives a particularly interesting picture of the biological composition of Neolithic and Metal Age Humanity in Eurasia.

The following groups merit some special comment. The Fat’ianovo-Balanovo group, morphologically and culturally (Sulimirski 1970: 196) very close to the North-Central European Corded Ware groups, must be considered as a direct offshoot of the latter, having completely supplanted, by massive migration, the local Central Russian substratum (Comb-pit marked Pottery culture).

Another interesting case must be noticed here: the Estonian Battle-Axe culture. There is a very close phenotypical relationship between the three groups: Kurgan, Comb-pit Pottery, and Battle-Axe cultures (see also fig. 3). This brings physical anthropology in a delicate situation, i.e. to infer genetical links from phenotypical similarity, in a case where there are two potential ancestors: Kurgan and Comb-pit marked Pottery cultures. The similarity between the latter two must be considered either as being fortuitous (morphological convergence), or as reflecting some common early Central Russian substratum.

Cernavoda: this group — the chronological attribution of some of its skeletal material being currently reconsidered
Fig. 6 - Biological vs. geographical distances: Reference group: Drevnjakultana (Lamz) culture.
ANTHROPOLOGY OF THE CORDED WARE COMPLEX

(Necrasov, personal communication) — appears in a "neutral-ized" position between Kurgan and Old Europe. Nevertheless, the presence of individuals of the "Kurgan" type is positively attested (Necrasov 1979). This group remains thus to be re-examined; one of the principal questions must be of demographical nature, i.e. to estimate the proportion of intruders with respect to the substratum.

"Old Europe" continuity in East-Central Europe

Fig. 7, with central German Linear Pottery in the origin of the graph, shows basically the same facts as explained above, but in a graphically reversed order. The morphological persistence of this stock is clearly demonstrated: it is first documented by the Linear Pottery group, and it continues all the way through time, from Early Neolithic until Bronze Age (Aunjetitz) — with a short "intermezzo" staged by the Bell Beaker in Central Germany and in Czechoslovakia.

It must be stressed that most of the neighboring local Corded Ware groups fit perfectly into this pattern. The exceptions will be explained below.

Bell Beaker intrusion

The intrusive character of the Bell Beaker groups ("pure-bred" only; the particular case of the Bohemian group has been mentioned earlier) appears strikingly in fig. 8. Although being brought in relation with Kurgan Waves II and III (Gimbutas 1979), it must be stressed that this very peculiar human type has no particularly close biological affinities to the Kurgan populations. The problem concerning its geographical origin (homeland) beyond the North-Balkanic region of the Baden-Vučedol culture (for which the presence of this human type seems to be ascertained) remains open (Anatolia: Kalicz; Caucasus: Machnik, personal communication).

Heterogeneity of the Corded Ware complex (s.l.)

The bunch of geographical and cultural variants belonging to or brought in relation with, the Corded Ware complex (s.l.) splits into three categories (see figs. 2, 3, 9), each one with its own biological properties and cultural background.

1. Corded Ware core
Fig. 7 - Biological vs. geographical distances. Reference group: Linear potter, culture (Central Germany; Early Neolithic).

Geographical Dist.

Morphological Dist.

Indo-European Studies
Fig. 8 - Biological vs. geographical distances.

Early Bronze Age.
Reference group: Bell Beaker (Central Germany; final Neolithic).

Anthropology of the Corded Ware Complex
ANTHROPOLOGY OF THE CORDED WARE COMPLEX

The samples attributable to the core defined hereafter are: the local Corded Ware groups of Central Germany, Czechoslovakia, Poland and, as an offshoot, Fatjanovo.

A relatively well delimited area, comprising Central Germany, Poland and Czechoslovakia is inhabited by a remarkably homogeneous and autochthonous populace which — abstraction being made of the episodic appearance of the Bell Beaker people in the very same region — has held this territory since the Early Neolithic. Within the biological sphere of “Old Europe,” to which they undoubtedly belong, Corded Ware people represent a somewhat “modernized” variety, characterized by a trend, away from the “archaiostenodolichomorphic” type, towards more eurymorphism. This detail could be of some interest (see below).

As essential parts of its economical and technocultural package seems to be of local outgrowth too (Sulimirski 1970: 154), this area — together with its human stock — can be admitted to be the base of the Corded Ware complex, cultural and biological.

2. Peripheral groups with strong biological affinity to the Corded Ware core

The East Prussian group (“Baltic Haff culture”) represents such a local variety, morphologically slightly diversified; influence of the local substratum, as admitted by Schwidetzky (1978:260) or by genetical isolation. The case of the Southern Polish mixed Corded Ware (Zlota group) is not of special interest here.

Another group, of considerably more interest, is the westernmost Corded Ware satellite (Southwestern Germany, Switzerland). As mentioned earlier, this group is considered as an early offshoot of Central European origin, thus tracing back probably to the so-called “Einheitshorizont.” Its morphological particularities (14) fit well into this model: as pointed out by Schwidetzky (1978: 260) the archaiostenodolichomorphic phenotype (its characteristics being probably amplified here by genetical

(14) The vicinity of “Rhenan Corded Ware” to “Bell Beaker” is due to an inconvenience inherent to this type of graphs: the distances separating groups are expressed only as to their amount, but not as to their direction. In the present case the two samples have about the same distance to the reference group, but their direction is, of course, diametrically opposite.
isolation) seems to be clearly more frequent in the early phase of the Central German Corded Ware than in the later phase.

3. Peripheral groups with weak biological affinities to the Corded Ware core

The case of the East Baltic Boat-Axe culture has already been discussed above. Two explanations can be considered, a) full "Kurgan" origin, or b) persistence of the Comb-marked Pottery substratum (Schwidetzky 1978:260).

The Ukrainian groups of Gorodsk and Usatovo, from the point of view close to the ("Old European") Cucuteni/Tripolye substratum.

The last group to be taken into consideration is the Globular Amphora culture. It certainly assumes a key-stone function concerning the Kurganization of the Corded Ware complex. For the time being physical Anthropology cannot provide more than a tentative explanation (the skeletal material is still by far too poor to cover the huge area touched by this culture). It seems, however, that in the southern zone of its diffusion (Romania), the presence of individuals of genuine Kurgan type can be attested (Necrasov 1980). As to the northern zone, the biological incidence of the Kurgan radiation is probably fading out, as it does elsewhere. Detail studies remain to be done.

Conclusions

Indo-Europeanization of Central and Northern Europe

Both Kurgan cultures and Corded Ware/Battle-Axe assemblage are incontestably Indo-European. There is no doubt either, that the Indo-European component of the Corded Ware must be derived stringently from Kurgan: there are irrefutable chronological facts proving the anteriority of Indo-European manifestations in Kurgan, and there is no room for polyphyletic hypotheses. Therefore, the problem of the origin of Indo-European traditions, as seen by Sulimirski (1970:155) "... An attempt to combine both ideas by deriving the Corded Ware cultures from the Yamnaya culture proved to be futile ...", is not relevant any further, except for the fact that it underlines the necessity to give more consideration to the immaterial culture in historical reconstruction.

The fundamental question actually is: by which process diffusion or migration — did the transfer of this cultural package take place? It is not to play another round in the game “Diffu-
sionists vs. Migrationalists" (... and to see who can add another point to his score...). The whole relevance of the question situates at the economical, social, ideological and political level: What are the agents of cultural change, and what are its immediate consequences on the populations implied?

From the point of view of physical anthropology, the modalities can be outlined as follows. On the basis of the arguments presented up to here, Indo-Europeanization of northern Europe (i.e. of the Corded Ware culture s.str.) cannot have taken place by a direct invasion of whatever extent of South-Eurasian Kurgan people. As demonstrated by Schwidetzky (in this volume) there are virtually no individuals within the whole sample of German Corded Ware people that would fit, statistically, into the South-Ukrainian Kurgan populations.

Considering the irresistible success of the new Kurgan traditions — whose expansion (as witnessed by the presence of the new human type in the regions adjacent to the North-Pontic steppes) must have been borne by migrations — it seems reasonable to expect similar processes also for the Kurganization of peripheral regions. This further propagation was not carried out by North-Pontic Kurgan tribes, but by previously Kurganized local groups (such as perhaps Globular Amphora sub-groups). Two reasons must be taken into consideration to explain their supposed dynamism and mobility: a) a new thrust from the South-East by a successive Kurgan wave; b) intrinsic motivation due to the "cultural" Kurgan heritage, such as their new, patriarchal, social structure and new ideology involving the glorification of warfare.

Although the following hypothesis would be difficult to corroborate, it is not unreasonable to assume, for the Central European Corded Ware, the arrival of external biological elements, i.e. previously Kurganized groups (hybrids). As mentioned earlier, there seems to exist some morphological difference between early ("Einheitshorizont") and later Corded Ware populations: the disappearance of the "archaic" stenodolichomorphic type and an increased trend towards more eurymorphic forms as possibly vehiculated by these secondary Kurgan groups. Further studies would be necessary to determine whether these tendencies reflect admixture of such Kurganized groups.
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