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THE POPULATION OF ZALAVÁR A PROBLEM IN CRANIAL VARIATION

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Variation within living human populations can be fruitfully studied by using genetic traits, especially of the blood, and mathematical methods recognizing isolation, inbreeding, population structure, etc. Such approaches cannot be applied to fossil populations. Nevertheless we have been rather free with assumptions and estimates as to internal variability of these, often from inspection alone and without statistical controls. (In fact, confidence as to variability seems to have been greatest when material was poorest: Skhul, Ofnet, Krapina and others.) More generally, it seems to have been assumed that variability, in skeletal morphology, would be least when populations were most isolated and most homogeneous in origin, and the reverse. But we do not know this from fact, and we really do not know enough to expect it theoretically. We still know almost nothing about the real outcome of "mixtures", after more than a century of examining European "races".

In this paper I wish to look at these questions by presenting a little material on three series of European crania studied by myself as part of a more general work (Howells 1973). These are an early medieval series from *Zalavár* in western Hungary, another early medieval series from Oslo, and one representing recent centuries from the small village of Berg in Carinthia. These series should represent communities which were, respectively, very cosmopolitan and heterogeneous in origin (Zalavár), fairly cosmopolitan and much less heterogeneous (Oslo), and extremely local and parochial (Berg). There is of course no objective basis for these characterizations other than their histories. Each series is represented by about 50 crania, in good condition, of each sex.

The series from the Zalavár cemeteries, in the Anthropological Section of the Natural History Museum in Budapest, were studied through the kindness of Drs. *Nemeskéri* and *Tóth.* They were excavated by the former, who also studied them in detail (Acsádi, Harsányi, Nemeskéri 1962) and guided me in estimating sex and selecting specimens, as well as giving me the history of the cemeteries. I wish to thank *Dr. Nemeskéri* warmly once again for his help. Zalavár was a Frankish protectorate in vassalage to the Bishop of Salzburg, following the Avar period and the Frankish wars, at the beginning of the 9th century. The crania used are from the cemeteries of the chapel and the castle, the latter probably having a particularly heterogeneous ethnic composition but the whole being made up of surviving elements of (with some Avars?) Romanized Germans, Slavs, and Franks.

The Oslo series, also medieval, was drawn principally from graveyards of relatively early parishes, when the population was probably less cosmopolitan than it later became. That from Berg derives from the charnel house in a small mountain village; it was acquired by VON LUSCHAN who believed that it must represent almost the entire village population over several centuries ending with the 19th. From the indications, it would be hard to find a more localized group, similarly restricted in contact and in outbreeding, for which a large number of skulls was available.

Finding objective means of stating the relative variability within a series of crania, in some reliable figure, is not easy. The obvious way is to look at the standard deviations — the basic estimate of dispersion — in various measurements. Such figures for our populations are given in full in my main study (HOWELLS 1973). However, it is very difficult to see any trends in them; in addition, there is the problem of sampling fluctuation in rather small samples like these, which makes the comparisons unsatisfactory.

I have chosen instead some other standard deviations. In the study, the whole set of male crania (17 populations) was subjected to a factor analysis, and 18 orthogonal factors were developed which seem to correspond well to morphological realities. Factor scores were computed for each skull, and means and standard deviations of them found for each population. These factor scores have several advantages. They are independent and uncorrelated, so that their dispersions should not correspond for internal reasons (as they might between related direct measurements of the forehead, for example). They are in nearly standard form (i. e., with a mean of zero and a standard deviation of nearly 1.00). And being multivariate measures, they should be more normally distributed than ordinary measurements. The standard deviations for our three

Table 1

Standard deviations of factors scores

1. táblázat. A faktorok szórásai

Factor*	Populations — *Populációk*		
	Zalavár	Norwegian	Berg
1. Facial forwardness	0.98	1.15	1.04
2. Sagittal cranial length	1.01	1.07	1.35
3. Vault breadth	0.79	0.89	1.18
4. Facial height	1.12	0.92	1.14
5. Upper face breadth	0.86	0.75	0.84
6. Midfacial size	0.74	1.00	0.87
7. Orbit horizontal profile	0.97	0.90	1.01
8. Interorbital prominence	0.82	0.91	0.89
9. Nasalia, prominence	1.01	0.93	1.13
10. Interorbital breadth	1.00	1.11	0.96
11. Subnasal flatness	1.06	0.97	1.00
12. Prognathism	1.10	0.84	1.01
13. Malar size	0.98	0.91	0.84
14. Frontal bone length	0.97	1.06	1.12
15. Frontal flatness	0.94	1.00	0.98
16. Parietal size	0.93	1.03	1.02
17. Occipital curvature	0.90	1.04	1.13
18. Occipital size	0.97	0.98	0.93
Means — *Középértékek*	0.953	0.970	1.024

* *Faktorok:* 1. faciális előreugrás, 2. sagittális koponyahossz, 3. boltozatszélesség, 4. arcmagasság, 5. a felső arc szélessége, 6. a középarc nagysága, 7. orbitális horizontális profil, 8. interorbitális kiemelkedés, 9. nasalia, kiemelkedés, 10. interorbitális szélesség, 11. subnasalis laposság, 12. prognathia, 13. a járomív nagysága, 14. a homlokcsont hosszúsága, 15. homloki laposság, 16. parietális nagyság, 17. occipitális görbület, 18. occipitális nagyság.

European populations (male series only) are given in Table 1. (These figures do not appear in the general report on the crania). The means of the 18 standard deviations for each of the three groups are also given; averaging them is legitimate, since they are on the same scale.

The figures indicate that, in their distribution on the factors, the Zalavár skulls vary no more than the others, and in fact rather less, with Berg having the highest absolute figures, and being the highest of the three in many factors. Where variation is indicated to be extreme, the results are in fact reasonable. For example, Berg is unusually variable in the factor of "sagittal cranial length" as well as "vault breadth"; and these skulls are probably affected by a higher degree of accidental occipital flattening, and thus of fluctuation in skull length and breadth, than other series. Accordingly, goodness of the figures used, as estimators of variation, is supported. Two high figures for Zalavár may be interesting: the factors of "subnasal flattening" and "prognathism", since subnasal flatness and *lack* of prognathism are characters of Mongoloid peoples in my major study; possibly some slight Avar presence in survivors is involved.

But this is speculation. As far as these figures go, Zalavár, though historically complex in the origin of the population, seems to be no more variable than the others, a major North European community and a relatively isolated, probably inbred, mountain village. The case of the last may not be surprising; contrary to the ready assumption that such villages would be homogeneous, genetic homozygosity may actually be expected to produce extreme variants more often in them than in cosmopolitan groups. This is not well known empirically in the case of man, but in fact such inbred communities do *not* give signs of reduced variability (Howells 1966).

Another question might follow: was the Zalavár population general and amorphous in cranial form, or more strongly defined? That of Berg could probably be called "Alpine" in traditional terms, and that of Oslo "Nordic", again speaking broadly (Berg was somewhat broader in forehead and face, with a mean cranial index of 82 for the two sexes; the other two populations converged on an index of 76 or 77).

Simple comparison of mean figures for 70 different measurements and angles (let alone indices) is an impossible way to judge likenesses; for this reason and to analyze form, these and other populations in the study cited were subjected to multiple discriminant analysis (Howells op. cit.). Use of the mean function scores allows plots to be made of two, or even three, of such general measures at the same time, and these show Zalavár to be very close to the Norwegian population. A generalized distance using many functions at once shows the same thing, but has some limitations. The graphs below are a further method of plotting the relative positions, in fuller form, by a technique suggested by Andrews (1972).

This uses a function, f defined as,

$$f_x(t) = x_1/\sqrt{2} + x_2 \sin t + x_3 \cos t + x_4 \sin 2t + x_5 \cos 2t \ldots$$

extended to as many dimensions, or values for x, as are used. The value of f is computed for different values of t, along the horizontal scale. This is actually an old mathematical idea: it constitutes an orthogonal *Fourier* series, and the values of f do not vary infinitely but repeat themselves with a period of 2π;

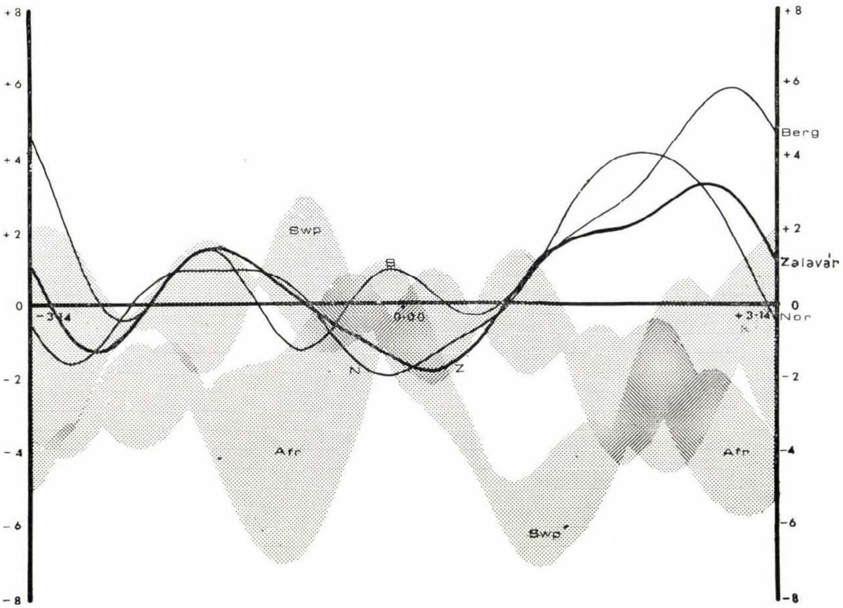

Fig. 1. Multidimensional plot using means of 10 discriminant function scores. Zalavár, Norwegian and Berg series are shown as individual plot lines; African and Pacific series are each shown as shaded zones. Male cranial series.

1. ábra. Tíz többszörös diszkriminancia függvény átlag pontsorának többdimenziós ábrázlása. A zalavári, a norvég és a bergi sorozatokat egyéni pontsorokként, az afrikai és a pacifikus (Swp) sorozatokat mint árnyékzónákat ábrázoljuk. Férfi koponyaszériák.

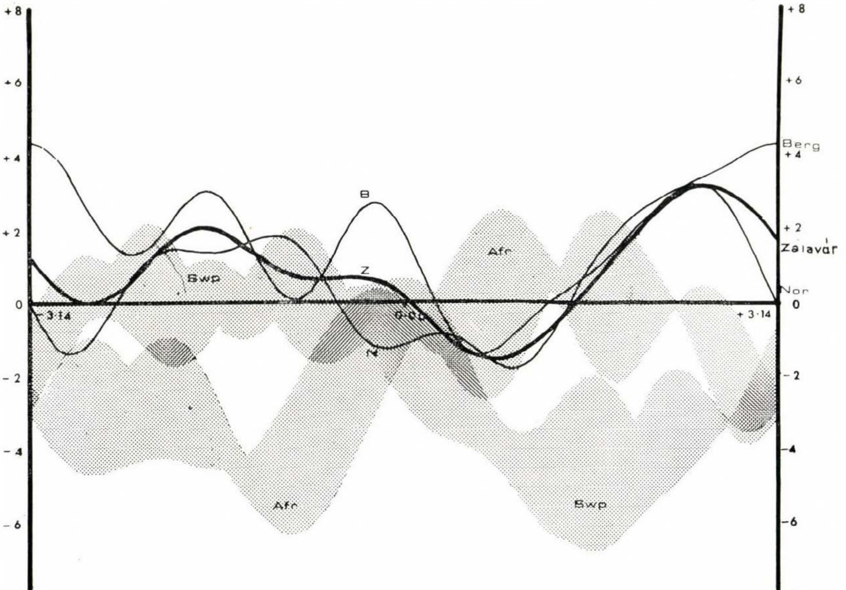

Fig. 2. Same as figure 1. Female series.
2. ábra. Lásd az 1. ábrát. Női sorozatok.

consequently the range of values used for t is taken as —3.14 to +3.14 ($-\pi$ to $+\pi$).

The plotting gives a visual display of the relations among a number of populations when these are measured by a set of uncorrelated measures, here ten multiple discriminant mean function scores for each population (as taken from HOWELLS 1973). The plots extend what is possible using two or three scores at a time (Figures 1, 2).

To give perspective in the graphs, there are shown bands which respectively include three African populations (Dogon of West Africa, Teita of East Africa, Zulu of South Africa) and three peoples of the Southwest Pacific (Murray River Australians, Tasmanians, Melanesian Tolais of New Britain). The divergence of these bands in pattern indicates the substantial distinctiveness of these two major population groups from one another, as well as from the European series, which are shown as discrete lines (instead of having the enclosed area filled as with the other, this being simply a visual device). The sexes are seen to agree very well in the patterns revealed.

Among the Europeans, it is clear that the Zalavár series, male and female, approximate to the Norwegians very closely. (Berg diverges, but conforms generally to a European pattern distinct from the other two major geographic regions.) To relate this to older methods of making comparisons, I repeat that these graphs are handling, without suppression or distortion, well over 90% of all the information which can be contained in 70 different measurements and angles, displaying it in an objective and reliable way (and one not resting on preconceptions, let us say, as to the basic importance of the cranial index or some other particular trait).

In the outcome, then, the Zalavár population, in spite of the apparent disparity of contributing elements, seems to have settled into a representative European morphology of its period, close to that present in northern Europe; a second look at the components involved suggests that this "Nordic" conformation is not surprising. As to variation, this also cannot be seen as other than the variation of a normal population in equilibrium, as far as we may recognize such a state. That is, though in existence a very few generations, and doubtless still receiving a good proportion of new members, the population was not simply a conglomerate. Whatever is known about its history, it would seem impossible, by any anthropological method, in this period to disentangle in the Zalavár crania "types", "races" or individual variants which might reflect the nature of ancestral groups involved.

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ZALAVÁR NÉPESSÉGE: A KRANIÁLIS VARIÁCIÓ EGY PROBLÉMÁJA

Írta: *Howells, W. W.*

(Összefoglalás)

A zalavári temetőből származó paleoantropológiai anyagot NEMESKÉRI és munkatársai tárták és dolgozták fel. A koponyák egy részét a szerző egy világméretű koponyavariációs tanulmány céljaira újramérte. Kozmopolita jellegei miatt a zalavári populációt itt a megszokottnál magasabb variabilitás jelei szempontjából vizsgálta. Az általános tanulmányozás során faktoranalízist végzett, és a faktorokon minden koponyasorozatot pontozott; a pontozások szórásait, mint a jelen esetben alkalmazható legmegfelelőbb bizonyításmódokat választotta. A zalavári sorozat nem mutat magasabb variációt, mint egy kor tekintetében összehasonlítható, kevésbé kozmopolita norvég középkori sorozat, vagy egy újabbkori elszigetelt osztrák hegyi falu. Tíz többszörös diszkriminancia függvény átlag pontsorának többdimenziós felírása ugyanezekre a populációkra (*Andrews*-módszer) azt mutatja, hogy a zalavári és a norvég populáció morfológiailag nyilvánvalóan nagyon közel áll egymáshoz. A szerző úgy véli, hogy a zalavári populáció olyan elemekből alakult, melyek már eleve sem voltak különösebben elütőek, és melyeknek nagyon kevés idő kellett ahhoz, hogy normális genetikai azonosságot és változékonyságot hozzanak létre.

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