ALFRED CZARNETZKI

EPIGENETIC TRAITS: THE CHANGE OF FREQUENCIES DURING THE NEOLITHIC — BRONZE AGE TRANSITION IN BOHEMIA

INTRODUCTION

If literature can be considered a reliable gauge, then there is a definite trend toward the application of epigenetic traits in the examination of skeletal populations. The term "epigenetic traits" also seems to be the preferred phraseology, probably because the alternatives such as "quasi-discontinuous traits" or "discrete-" or "non-metric traits" either have formal connotations or are ambiguous.

In 1969, while researching Mikulčice material in Czechoslovakia, the author had the opportunity to examine the late neolithic, bell beaker and Aunjetitz material in Slany. The friendly co-operation of Dr. J. Chochol was most important concerning this opportunity.

At that time 38 traits were examined, 30 on cranium and 8 on long bones. The list of traits with which the author is concerned has since been expanded to 60; other researchers are including as many as 500 traits. It is not the purpose of this paper to discuss the pros and cons of the various traits (see Sjøvold and Corruccini). But one should not forget that the data obtained from the various population samples is completely dependent on the material analysed, similar to metric traits.

The sexual determination of skeletal material from prehistoric populations is based on population genetic and not formal genetics. From late neolithic individuals, 12 were males, 10 females, and 11 were not determinable. This last group consisted either of children or such incomplete skeletal rests that the sex could not definitely be determined. 82 individuals were investigated from the bell beaker period, 25 males, 26 females and 33 indeterminable. The main problem in this last category again being the large amount of non-adult skeletons. The Aunjetitz material from Bohemia was sorted into 32 males, 22 females, and 13 indeterminable. It is interesting to note that the Aunjetitz period, although chronologically the youngest, did not contain the majority of individuals. The late neolithic material could not be culturally subdivided, but this is not surprising considering the size of the sample group.

RESULTS

Before beginning with the traits, one aspect should be made very clear. The results of sample population comparisons rely primarily on the initial compiling of the various sample material or groups size; the range of probability and geographic origin are secondary factors. Metopism is probably the most frequently examined trait. Berry & Berry (1967) have, for example, already published distribution curves for this trait. The distribution curves for the samples with which we are presently concerned (*table 2*) clearly established a higher rate of occurrence of this trait in the neolithic and bell beaker females than in the males, the Aunjetitz male — female relationship reversed this distribution. Consequently this cannot be an indication of the feminization of the brow ridge, nor may this trait be considered as a female characteristic. Then historically observed, there has been a continuous regression of the frequency of this trait among females. Based on population genetics, taking only this trait into account, it could be concluded that a continuous change in the gene frequencies, free from external influence, was taking place within the female population during this

TABLE 1 *Discontinuous varying traits of the skull and postcranial skeleton*)*

1	(1)	Metopism
2	(2)	Supra-orbital foramen complete
3	(3)	Supra-orbital sulcus present
4	(4)	Supra-orbital sulcus and frontal foramen present
5	(5)	Coronal ossicle present
6	(6)	Bregmatic bone present
7	(7)	Sagittal ossicle present
8	(8)	Parietal foramen present
9	(9)	Ossicle at the lambda
10		Inca bone present
11	(10)	Lambdoid ossicle present
12		Ossicle at the asterion
13		Parietal notch bone present
14	(11)	Highest nuchal line present
15	(12)	Posterior condylar canal patent
16	(13)	Anterior condylar canal double
17	(14)	Condylar facet double
18	(15)	Pharyngeal tubercle present
19		Precondylar tubercle present
20	(16)	Foramen ovale incomplete
21		Foramen spinosum closed
22		Foramen of Huschke present
23	(19)	Mastoid foramen exsutural
24	(20)	Auditory torus present
25	(17)	Epipteric bone present
26	(18)	Fronto-temporal articulation
27	(21)	Anterior ethmoid foramen exsutural
28	(22)	Posteiror ethmoid foramen present
29	(23)	Accessory infra-orbital foramen present
30	(26)	Palatine torus present
31		Maxillary torus present
32	(24)	Greater palatine foramen double
33	(25)	Lesser palatine foramen missing
34		Mental foramen double
35		Mandibular torus present
36	(27)	Zygomatico-facial foramen present
37	(28)	Proc. margin. zygomat.
38		Upper I1 shovel-shaped
39	(29)	Upper M3 present
40		Lower M3 present
41		Upper M1 Y-fissures
42		Lower M1 Y-fissures
43		Upper M1 5 cusps
44		Lower M1 4 cusps
45		Tuberculum Carabelli
46		Enamel pearls on the molars
47		Lateral bridge of the atlas
48	(31)	Fossa teres of humerus
49	(32)	Fossa pectoralis of humerus
50	(33)	Fossa teres and pectoralis of humerus
51		Septal aperture of humerus
52		Fossa bicipitis of radius
53	(34)	Fac. artic. capit. of femur enlarged
54	(36)	Fossa hypotrochanteric of femur
55		Crista hypotronchanteric of femur
56	(35)	Third trochanter of femur
57		Fac. artic. post. of tibia enlarged
58	(37)	Fossa solei of tibia
59		Squatting facet of tibia
60		Rim distal ventral of tibia retracted

**) The english terminology was taken from Finnegan and Faust and the latin terminology has been applied to those traits which could not be translated.*

time, while a formal genetic orientation would assume an advanced reduction of the additive gene effect. Based on the aforementioned reverse occurrence of the trait between males and females, the female threshold value, in relation to the total variability, would be increased while that of the males, decreased. From these observations one could further assume a constant tendency toward displacement of the values of the hereditary factors responsible for metopism. Then, according to population genetics, a continuous evolution could be postulated, in spite of the three, clearly separate cultural phases. Just one good look at the sample material is needed to realize that this could never be maintained, then the majority of the metopic skulls fall within the neolithic period, followed by the Aunjetitz, and finally the bell beaker. The most distinct epigenetic distance, based on metopism, was established between the late neolithic and bell beaker and Aunjetitz individuals showed the least distance. In order to establish the general as well as the specific trends of the complex mechanics of frequency, each trait would have to be investigated in a similarly extensive fashion. This sort of undertaking can very easily go too far, especially since no definite correlation between the various epigenetic traits has, as yet, been established. Hence the remainder of this research will be restricted to the generalized distances within and among the group samples. But the sex- determination will be continued in order to maintain a control over the purely theoretical possibility that the gene flow could occur exclusively among females or males, or indiscriminately among both.

The generalized distances published by G r e w a l l (1962) have been computed to handle inter- as well as intraspecific distances *(see table 3)*. The late neolithic samples are conspicuous because of their especially high intraspecific variability; the female interspecific variability is correspondingly unusual. This is more likely due to the general neolithic population variability (C z a r n e t z k i, unpublished), than to any peculiarity of these particular samples. It may, therefore, be assumed that a more unified gene pool was shared by the bell beaker and Aunjetitz people.

A comparison of all three of sample groups susbstantiates the findings based on the metopic trait: the greatest divergence again occurring between the neolithic and bell beaker populations and the least between the bell beaker and Aunjetitz groups. Further support was obtained when a "criss-cross" comparisons of each of the male sample populations with each of the female sample populations resulted in this same sequence of divergence; the males, when considered among themselves, reiterated this sequence. Provided that a continuous evolution was taking place, then a divergency in this

TABLE 2

	Frequency of metopism					
	Late neolithic		Bell beaker		Aunjetitz	
	abs.	%	abs.	%	abs.	%
♀	6/1	16,7	20/1	5,0	20/1	5,0
♂	7/0	0,0	21/1	4,8	29/4	13,8
sex indet.	9/4	44,4	25/2	8,0	12/1	8,3
TOTAL	22/5	22,7	66/5	7,5	61/6	9,8

TABLE 3

Distances of the 38 Epigenetic traits

		Late neolithic				Bell beaker				Aunjetitz			
		female	male	indet.	total	female	male	indet.	total	female	male	indet.	total
Late neolithic	female		0,909+	1,213++		0,051–	0,231–	0,570+		0,162–	0,145–	0,962+	
	male			0,771+		0,950++	0,831++	1,450++		0,979++	0,675+	0,744+	
	indet.					1,131++	0,944++	1,286++		1,388++	0,954++	0,643+	
	total								0,146+				0,141+
Bell beaker	female						0,144–	0,347+		0,057–	0,150–	0,795++	
	male							0,485++		0,101–	0,174–	0,657+	
	indet.									0,424+	0,500++	0,841++	
	total												0,093+
Aunjetitz	female										0,140–	0,822++	
	male											0,527+	
	indet.												
	total												

order could not have been anticipated (see Berry & Berry 1967 for further data concerning an Egyptian series). Interestingly enough, it was the female samples which reversed this curious order, i.e. the more contemporary samples displayed lesser degrees of divergence.

DISCUSSION

It appears as though the first change in the frequency of the female gene flow took place, either during or shortly after the bell beaker period. A change, which according to the above information, affected the total gene flow and must have been the result of external influence. The cultural-historical opinions concerning the innovations in the bell beaker period add substance to this conclusion. The proximity of the late neolithic and bell beaker females as opposed to the proximity of the late neolithic and Aunjetitz males might have resulted from the displacement of the values responsible for the development of the different epigenetic traits during the bell beaker period. It could then be inferred that an intermingling of the bell beaker people among the Aunjetitz inhabitants influenced the gene pool of the latter. This would, in turn, explain the aforementioned similarities between the late neolithic and Aunjetitz groups, and remain in complete accord with cultural-historical thinking. However, it should not be forgotten that this must not necessarily have been the case. A somewhat oversimplified summary of the above would then suggest that during the bell beaker period the majority of Bohemian immigrants were males; obviously bearing another gene pool. The new intercourse between the immigrants and the indigenous neolithic Bohemians changed the gene frequency and correspondingly, the gene pool. The examined sample population from the Aunjetitz period contained hereditary factors from the original population which had been altered enough far the source of this influence to be reconstructed. Whether this represented a resettling or merely a migration of the bell beaker peoples cannot be answered within the realm of the present analysis.

It is hoped that this paper has offered some more insight into the possibilities that epigenetic traits can provide when interpreting, reconstructing, and differentiating population, and the importance of determining the sexes of the individuals for an analysis of prehistoric material.

ACKNOWLEDGEMENT

Dr. J. Chochol must be especially thanked for the possibility to examine the material upon which this paper is based. Also Cathleen Prudek for her translation of the original German text and this English manuscript.

LITERATURE CITED

BERRY A. C. & BERRY R. J. (1967): Epigenetic variation in human cranium. — *J. Anat. 101, 361—379.*

BERRY R. J.: The biology of non-metrical variation in mice and men: In: The skeletal biology of earlier human populations. *(Brothwell, D. R. edit.) — Pergamon Press, London 1968.*

BERRY A. C.: The Use of Non-metrical Variations of the Cranium in the Study of Scandinavian Population Movements. 1974.

CORRUCCINI R. S.: An Examination of the Meaning of cranial discret traits for human skeletal biological Studies. *Am. J. Phys. Anthrop. 40, 425—445, 1974.*

CZARNETZKI A.: Anthropologie der hessischen Steinkammergräber. Eine Studie zum morphologischen Vergleich menschlicher Populationen aus dem Neolithikum. *(Unpubl.)*

FINNEGAN M., FAUST M. A.: Bibliography of human and nonhuman non-metric variation. *Research report number 14 — University of Massachusetts 1974.*

GREWALL M. S. (1962): The rate of genetic divergence of sublines in the C57BL stain of mice. — *Gen. Res. 3, 226—237.*

SJOVOLD T.: Some Aspects of physical Anthropology on Gotland during Middle Neolithic Times: In. Janson G. O.: Gotlands mellanneolitiska gravar. *Stockholm 1974, 176—211.*

Alfred Czarnetzki,
Institute of Anthropology and Human Genetic
74 Tübingen, West Germany