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ANTHROPOLOGICAL ASPECTS IN THE GENETICS OF HUMAN DEVELOPMENT

Heterosis as one of the factors of child growth and development

Our epoch is demographically characterized by a general disintegration of isolated population groups and by widening the circle of the marrying couples. A. Serra and A. Soini (1959) showed that in three North Italian provinces the share of marriages from the circle of close relatives dropped from 6,17 % between 1903—1923 to 3,72 % in 1926—1931 and to 1,85 % in 1933—1953. The index of close blood-relationship dropped in France between 1926—1930 and 1950—1958 more than two-and-a-half times (J. Sutter, J. Goux, 1962). These figures show the growth of genetic versatility of the population, caused by neglecting religious, race and caste bans on contracting matrimony, and also due to mass migration of the population in connection with wars and with the colonization of new territories. After World War II e.g. in Szczeczin (Poland) only 2.7 % of the original inhabitants remained, most of the new settlers came from West and Central Poland. On contracting matrimony in the newly settled town the common origin of the bridegroom and bride played no decisive role. In 1950 only 15 % of the newly-wed couples came from near villages (within a circle of 10 km); by 1962 their proportion dropped to 7 % (N. Wolański, 1970).

Profound demographic changes occurred during the colonization of the American Continent by Europeans. The mass migration from European countries led in North America to the mixing of numerous groups of originally isolated populations.

The changes in the character of marital relations between new colonists were profoundly studied by J. Hulse, (1957), on the example of Swiss colonists from the Ticino (Tessin) Canton, settling parts of California. Though most young colonists of Swiss origin married girls from their own Canton, only one-third of them married girls from their former villages in Europe. At the same period in Switzerland two-thirds of matrimonies were contracted between the inhabitants of the same village. Probably Hulse's observations can be applied also to colonists from other countries, and let us propose that this law holds good not only for the 20th century, when it was discovered in the USA, but also for the previous centuries. The results of these shifts in the structure of the population were ascertained by James Gent already in 1869. The merit of this British anthropologist consists in describing the whole complex of changes in the physical development of the population — called acceleration of the development. Americans are of higher stature than their European ancestors. The time of growth and development of the North Americans is shorter, but their birth rate has dropped. J. Gent, the discoverer of acceleration, was unable to explain this new phenomenon satisfactorily. Scientists tried to tackle this problem repeatedly at the beginning of the century, but it still remains to be 'the biological puzzle of the 20th century'. There were numerous hypotheses trying to explain the acceleration through improved alimentation, better health conditions of the infant population, influence of the proces of urbanization and many other environmental influences typical for the contemporary society. Many researchers, however, consider acceleration as a result of a breach of former very limited circle of conjugal unions and of contracting mixed, so-called heterolocal marriages (see also V. V. Bunak, 1968).

Already F. Engels wrote in his Origin of Family, Private Property and State: 'There is no doubt that the nations in which blood-relationship was limited were developing quicker and more thoroughly than the nations in which marriage between brothers and sisters became an obligatory rule' (translation from the Russian edition. Moscow, 1970, p. 31).

It follows from the above quotation that on speaking of brothers and sisters F. Engels did not have in mind direct blood-relatives, but also genetically more distant kinship and his ideas are proved also by the results of modern research. According to the observation of Hulse (1957) the offspring of exogamous marriages is of higher growth than the offspring of endogamous ones. E. Schreider (1969) showed statistically significant and very convincing correlations between indexes of blood-relationship in the population of a series of French departments and between the average bodylength values in various age groups.

Manifestations of heterosis in the growth and development of children and adolescents were clearly established, however the essence of the phenomenon and the conditions influencing it positively have not been explained. The extension of the circle of conjugal unions does not lead necessarily to heterosis. J. Trevor (1953) studied the results of racial crossing of man and in his huge material he did not come across the heterosis phenomenon. The body dimensions of children born from international marriages can exceed the body dimensions of children born to parents of the same nationality, this, however, is explained by the admixture of high growth components, and it serves as an example of hybridization without heterosis.

Neither the transition from relative endogamy to exogamy within a single national group is always accompanied by heterosis.

According to V. Ferák et col. (1970) at the present period the body weight of school children in the rural districts of Slovakia is in no way connected with the fact whether their parents come from the same village or from different villages. Body dimensions of the adults (over 17 years), however, reflect this fact. The average body length of men of endogamous and exogamous origins reached 174.2 cm and 176.2 cm, of women 161.4 cm and 162.9 cm. J. Penrose (1955) tried to explain the causes of the absence of heterosis in a number of cases. In his view one of the conditions for heterosis is the necessity of a certain degree of genetic similarity of parents. Now, if we come back to the observations of V. Ferák and coll. (1970), we can say that there is a striking absence of any similarity in parents whose children have not reached 17 years of age, while in the older generation they still preserved the necessary degree of homozygosity. Heterosis appears probably in a certain optimal case of homozygosity. This assumption can be verified by comparing the body dimensions of people born in couples with different grades of exogamy. N. Wolanski et coll. (1969) based their work on Polish data, comparing the body dimensions of children of 4, 8 and 16 years wit hregards to the distances between the birthplaces of their parents.

TABLE 1 *Body length of children from Szczeczin (Stettin) with regards to the geographical distance between the birth-places of the parents (according to Wolański and col.)*

Distance between the birth-places (in km)	Age and sex of the children					
	4 years		8 years		16 years	
	boys	girls	boys	girls	boys	girls
0—10	103.8	102.2	128.7	126.7	170.6	160.4
11—50	104.2	104.8	125.8	126.0	173.1	161.0
51—100	104.6	103.3	127.5	122.6	173.5	161.2
101—300	103.9	103.6	127.5	126.2	173.2	161.1
301 and more	104.3	103.7	128.6	126.6	171.1	161.5

They presumed that with the increase of the distance the grade of exogamy is also increasing. The increase of exogamy was accompanied by comparatively large increases in body length and by the increase of the chest circumference *(Table 1)*. This trend went on up to a certain exogamy grade, then its further increase led to the elimination of the heterosis effect. Wolanski et coll., however, did not arrive to this conclusion, and the data they published do not allow statistical evaluation.

MATERIALS AND METHODOLOGY

For verifying the presumption that development acceleration appears only at an optimum level of mixing of the population, as stated by one of us (B. A. Nikityuk, 1972), V. I. Filippov realized in the summer of 1971 a series of anthropometric researches studying 806 Ukrainian boys and girls 4—7 year-old born and bringing up in the kindergartens of the town of Verkhovtsevo and in the surrounding villages in the Dniepropetrovsk Region.

The parents and in the most cases also the grandparents of the studied children were born in the Dniepropetrovsk Region. As to their social background the group was quite homogenous: 97.85 % of the parents were collective farmers and farm labourers and 2.15 % — white-collar farm specialists.

During the research we measured also the standing and sitting height of the children with the help of a wooden anthropometer. The children were also weighed (on medical weighing machines). Part of the research was also the measuring of the circumference of their chests and heads (with a cm tape), of the width of their shoulders and of the pelvis, transverse and antero-posterior diameter of the chest, longitudinal and transverese diameter of the head, facial breadth and morphological height of the face (sliding calipper), strength of the hand (with a hand dynamometer).

For groups subdivided according to sex, age and exogamy grade we calculated the arithmetic means of the body dimensions, the standard quadratic deviations and variation coefficients with the errors of

TABLE 2

Body length (cm) of boys differing by the grade of exogamy

Age (in years)		Distance between the birth–places of the parents				
		0—10	11—50	0—15	16—50	51 and more
4	N	22	28	26	24	50
	M ± m (M)	99.0 ± 0,26	102.6 ± 0.72	99.3 ± 0.28	102.5 ± 0.91	102.8 ± 0.72
	σ ± m (σ)	1.22 ± 0.18	3.89 ± 0.51	1.50 ± 0.20	4.50 ± 0.65	5.14 ± 0.51
	V ± m (V)	1.23 ± 0.18	3.79 ± 0.50	1.51 ± 0.20	4.39 ± 4.63	5.00 ± 0.50
5	N	23	22	25	20	55
	M ± m (M)	107.3 ± 0.53	108.8 ± 0.95	107.3 ± 0.51	108.8 ± 0.93	109.5 ± 0.76
	σ ± m (σ)	2.58 ± 0.38	4.52 ± 0.68	2.58 ± 0.37	4.52 ± 0.71	5.53 ± 0.55
	V ± m (V)	2.40 ± 0.35	4.06 ± 0.61	2.40 ± 0.33	4.06 ± 0.64	5.05 ± 0.50
6	N	31	30	37	24	39
	M ± m (M)	111.6 ± 0.80	114.3 ± 0.54	111.8 ± 0.60	114.0 ± 0.74	114.7 ± 0.47
	σ ± m (σ)	4.80 ± 0.61	3.45 ± 0.39	3.89 ± 0.45	3.70 ± 0.53	2.94 ± 0.33
	V ± m (V)	4.30 ± 0.54	3.01 ± 0.33	3.47 ± 0.40	3.24 ± 0.45	2.56 ± 0.28
7	N	25	35	33	27	40
	M ± m (M)	123.5 ± 0.97	124.6 ± 0.80	123.6 ± 0.78	124.5 ± 0.50	122.5 ± 0.82
	σ ± m (σ)	4.89 ± 0.68	4.97 ± 0.57	4.50 ± 0.55	2.61 ± 0.35	5.23 ± 0.59
	V ± m (V)	3.96 ± 0.56	3.90 ± 0.46	3.64 ± 0.44	2.09 ± 0.28	4.35 ± 0.43

the indicated indexes. The reliability of the differences between arithmetic means and variation coefficients was assessed in keeping with the size of the exceeding of their difference of the quadratic root from the sum of the quadrates of the errors (t). The difference was considered reliable if $t > 1.96$, with a probable error below 5 %.

As a model for the evaluation of the levels of endo- and exogamy and thus of the level of homo- and heterozygosity of the population, we applied a model used also by N. Wolański et coll. taking into the distance between the birthplaces of the parents. We approved three variants of this model — the division to three groups seemed to us more suitable than the five groups used by N. Wolański.

1. 0—10 km, 11—50 km, 51 km and more,
2. 0—15 km, 16—50 km, 51 km and more,
3. 0—24 km, 25—74 km, 75 km and more.

The first and second variants of the model were used for the analysis of the body length of the boys in standing position. *(Table 2).*

The data of *Table 2* are very close to the results of N. W o l a ń s k i et coll. *(see Tab. 1)* and demonstrate a statistically reliable increase in the body length of boys in keeping with the increasing distance between the birthplaces of their parents. The drop in body length, foretold by us in cases when the optimum heterozygosity rate was overcome-it was found only in 7 year-old boys reaching 2.0 cm at $t = 2{,}0$ (2nd variant of the model).

The partial confirmation of the hypothesis did not satisfy us. As a basis for further procedure the third variant of the model was chosen. For the evaluation of the exogamy grade of the groups which had been detached we calculated the percentage of the frequency of the origin of all four grandparents from the same village, three grandparents from the same village, two grandparents from the same village and all four grandparents from four various villages.

In children whose parents came from villages up to 24 km apart, in 90 % of all cases three to four grandparents were born in the same village. Only in 4 % of all cases came the grandparents of these children from four different villages. Let us call these children endogamic (or endogames) (0 grade of exogamy).

Children whose parents came from villages 25—74 km apart have in 74 % of all cases two grandparents from one village. In 16,0 % of all cases all four grandparents come from different villages. Let us consider these children as exogamic children (or exogames) of 1st grade.

Finally the children whose parents came from villages and towns more than 75 km apart in 57.0 of

TABLE 3 *Variants of the origin of grandparents of the children with regards to the distance between the birth-places of their parents*

Distance between the birth-places of the parents (km)	4 grand-parents from the same village	3 grand-parents from the same village	2 grand-parents from the same village	4 grand-parents from various villages
0—24	70.0 %	20.0 %	6.0 %	4.0 %
25—74	7.0 %	3.0 %	74.0 %	16.0 %
75 and more	0	0	43.0 %	57.0 %

TABLE 4

Body length (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	$M \pm m(M)$	98.50 ± 0.28	101.0 ± 0.72	104.3 ± 0.43	100.0 ± 0.78	102.1 ± 0.82	100.8 ± 0.78
	$\sigma \pm m(\sigma)$	1.58 ± 0.20	4.08 ± 0.51	2.62 ± 0.30	4.51 ± 0.56	4.69 ± 0.57	4.70 ± 0.55
	$V \pm m(V)$	1.60 ± 0.21	4.00 ± 0.50	2.51 ± 0.29	4.51 ± 0.56	4.59 ± 0.56	4.66 ± 0.55
5	N	30	33	30	35	40	32
	$M \pm m(M)$	106.2 ± 0.66	109.2 ± 0.64	109.5 ± 0.71	108.7 ± 0.82	109.0 ± 0.80	111.1 ± 0.66
	$\sigma \pm m(\sigma)$	3.63 ± 0.47	3.67 ± 0.45	3.90 ± 0.50	4.84 ± 0.57	5.06 ± 0.56	3.72 ± 0.46
	$V \pm m(V)$	3.41 ± 0.44	3.36 ± 0.41	3.50 ± 0.43	4.45 ± 0.53	4.64 ± 0.51	3.34 ± 0.42
6	N	40	32	30	38	30	30
	$M \pm m(M)$	112.0 ± 0.54	114.6 ± 0.79	115.4 ± 0.78	117.2 ± 0.81	112.6 ± 0.47	116.1 ± 0.94
	$\sigma \pm m(\sigma)$	3.43 ± 0.38	4.49 ± 0.56	4.30 ± 0.55	5.01 ± 0.57	2.60 ± 0.33	5.18 ± 0.67
	$V \pm m(V)$	3.62 ± 0.40	3.91 ± 0.49	3.71 ± 0.48	4.18 ± 0.47	2.30 ± 0.29	4.46 ± 0.58
7	N	31	38	33	38	36	30
	$M \pm m(M)$	122.7 ± 0.61	119.1 ± 0.96	126.0 ± 0.28	127.9 ± 0.99	122.2 ± 0.87	121.9 ± 0.89
	$\sigma \pm m(\sigma)$	3.41 ± 0.43	5.88 ± 0.69	1.61 ± 0.20	6.09 ± 0.70	5.20 ± 0.61	4.87 ± 0.63
	$V \pm m(V)$	2.77 ± 0.35	4.93 ± 0.58	1.27 ± 0.15	4.76 ± 0.54	4.25 ± 0.50	3.99 ± 0.51

TABLE 5

Trunk length of children (cm) differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	$M \pm m(M)$	56.0 ± 0.30	57.5 ± 0.46	59.1 ± 0.37	56.6 ± 0.50	57.5 ± 0.62	57.2 ± 0.44
	$\sigma \pm m(\sigma)$	1.63 ± 0.21	2.60 ± 0.32	2.26 ± 0.26	2.85 ± 0.35	3.58 ± 0.44	2.66 ± 0.31
	$V \pm m(V)$	2.91 ± 0.38	4.53 ± 0.57	3.82 ± 0.45	5.03 ± 0.63	6.22 ± 0.77	4.61 ± 0.54
5	N	30	33	30	35	40	32
	$M \pm m(M)$	60.2 ± 0.42	61.6 ± 0.27	61.1 ± 0.64	60.9 ± 0.50	60.0 ± 0.44	61.4 ± 0.42
	$\sigma \pm m(\sigma)$	2.34 ± 0.30	1.54 ± 0.19	3.49 ± 0.45	2.98 ± 0.36	2.76 ± 0.31	2.37 ± 0.30
	$V \pm m(V)$	3.88 ± 0.50	2.50 ± 0.31	5.71 ± 0.74	4.89 ± 0.58	4.60 ± 0.51	3.85 ± 0.48
6	N	40	32	30	38	30	30
	$M \pm m(M)$	63.0 ± 0.42	63.0 ± 0.68	63.5 ± 0.29	64.5 ± 0.37	62.6 ± 0.56	64.0 ± 0.57
	$\sigma \pm m(\sigma)$	2.69 ± 0.30	3.87 ± 0.48	1.59 ± 0.20	2.26 ± 0.26	3.05 ± 0.39	3.15 ± 0.41
	$V \pm m(V)$	4.26 ± 0.48	6.14 ± 0.77	2.50 ± 0.32	3.50 ± 0.40	4.87 ± 0.63	4.92 ± 0.63
7	N	31	38	33	38	36	30
	$M \pm m(M)$	67.0 ± 0.36	65.3 ± 0.54	69.0 ± 0.51	68.1 ± 0.56	66.7 ± 0.45	66.3 ± 0.52
	$\sigma \pm m(\sigma)$	2.00 ± 0.25	3.36 ± 0.38	2.91 ± 0.36	3.48 ± 0.40	2.89 ± 0.34	2.85 ± 0.37
	$V \pm m(V)$	2.89 ± 0.37	5.14 ± 0.59	4.21 ± 0.52	5.10 ± 0.59	4.33 ± 0.51	4.29 ± 0.55

cases had all four grandparents from different villages and in 43 % of cases they had two grand parents from the same village. Let us call these children exogames of the 2nd grade.

RESULTS

Body length. The data in Tab 4. show that compared with children of the same age and sex children of exogamic grade 1 (further exogames I) are taller than endogamic children and children of the 2nd exogamous group (briefly exogames II). The increase of body length from endogames towards exogames I and the drop in body height from exogames II were 5.8 cm ($t = 11.4$) and 2.0 cm ($t = 2,4$) in four old-year boys, 3,3 cm ($t = 3,4$) and 0,5 cm ($t = 0,5$) in five year-old boys, 3,4 cm ($t = 3,6$) and 2,8 cm ($t = 3,1$) in six year-old boys, 3,3 cm ($t = 3,3$) and 3,8 ($t = 3,3$) in seven year-

TABLE 6

Body weight (kg) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	15.8 ± 0.18	16.9 ± 0.34	18.2 ± 0.24	15.8 ± 0.44	16.2 ± 0.39	17.0 ± 0.46
	σ ± m (σ)	1.01 ± 0.13	1.94 ± 0.23	1.54 ± 0.18	2.47 ± 0.31	2.22 ± 0.27	2.73 ± 0.32
	V ± m (V)	6.39 ± 0.82	11.4 ± 1.42	8.52 ± 0.99	15.6 ± 1.91	13.6 ± 1.67	16.0 ± 1.88
5	N	30	33	30	35	40	32
	M ± m (M)	17.5 ± 0.30	18.2 ± 0.37	18.3 ± 0.32	19.1 ± 0.51	19.5 ± 0.39	19.4 ± 0.45
	σ ± m (σ)	1.60 ± 0.21	2.11 ± 0.25	1.77 ± 0.23	3.03 ± 0.30	2.48 ± 0.28	2.57 ± 0.32
	V ± m (V)	9.20 ± 1.18	11.5 ± 1.42	9.67 ± 1.25	16.7 ± 1.99	12.7 ± 1.42	13.3 ± 1.66
6	N	40	32	30	38	30	30
	M ± m (M)	21.0 ± 0.33	20.9 ± 0.39	19.9 ± 0.30	21.8 ± 0.31	20.5 ± 0.50	22.3 ± 1.32
	σ ± m (σ)	2.07 ± 0.23	2.22 ± 0.28	1.65 ± 0.21	1.92 ± 0.22	2.74 ± 0.35	6.71 ± 0.86
	V ± m (V)	9.85 ± 1.11	10.5 ± 1.14	8.29 ± 1.06	8.76 ± 1.00	13.3 ± 1.72	30.0 ± 3.86
7	N	31	38	33	38	36	30
	M ± m (M)	24.3 ± 0.23	22.7 ± 0.50	27.1 ± 0.82	25.2 ± 0.81	24.4 ± 0.89	24.0 ± 1.00
	σ ± m (σ)	1.32 ± 0.17	3.15 ± 0.36	4.72 ± 0.58	4.98 ± 0.57	5.36 ± 0.64	5.54 ± 0.71
	V ± m (V)	5.43 ± 0.69	14.3 ± 1.64	17.4 ± 2.14	19.8 ± 2.95	21.9 ± 2.58	23.0 ± 2.96

TABLE 7

Chest circumference (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	53.1 ± 0.28	52.8 ± 0.98	55.0 ± 0.41	51.2 ± 0.44	53.3 ± 0.39	53.4 ± 0.40
	σ ± m (σ)	1.53 ± 0.20	5.55 ± 0.69	2.52 ± 0.29	2.52 ± 0.32	2.23 ± 0.27	2.39 ± 0.28
	V ± m (V)	2.88 ± 0.37	10.5 ± 1.31	4.58 ± 0.53	4.92 ± 0.62	4.18 ± 0.52	4.45 ± 0.52
5	N	30	33	30	35	40	32
	M ± m (M)	55.5 ± 0.40	53.8 ± 0.54	56.1 ± 0.27	53.9 ± 0.54	56.9 ± 0.39	54.6 ± 0.37
	σ ± m (σ)	2.32 ± 0.28	3.12 ± 0.38	1.48 ± 0.19	3.21 ± 0.38	2.44 ± 0.28	2.10 ± 0.26
	V ± m (V)	4.18 ± 0.51	5.79 ± 0.71	2.64 ± 0.34	5.95 ± 0.71	4.28 ± 0.48	3.84 ± 0.48
6	N	40	32	30	38	30	30
	M ± m (M)	56.9 ± 0.39	57.0 ± 0.39	56.6 ± 0.40	57.2 ± 0.38	57.0 ± 0.42	58.7 ± 0.86
	σ ± m (σ)	2.45 ± 0.27	2.23 ± 0.28	2.16 ± 0.28	2.30 ± 0.28	2.33 ± 0.30	4.70 ± 0.62
	V ± m (V)	4.35 ± 0.48	3.91 ± 0.49	3.81 ± 0.42	4.12 ± 0.48	3.91 ± 0.50	8.00 ± 1.03
7	N	31	38	33	38	36	30
	M ± m (M)	60.5 ± 0.45	58.4 ± 0.43	63.1 ± 0.82	59.2 ± 0.72	60.2 ± 0.60	59.0 ± 0.65
	σ ± m (σ)	2.50 ± 0.32	2.63 ± 0.30	4.72 ± 0.59	4.46 ± 0.52	3.61 ± 0.42	3.55 ± 0.46
	V ± m (V)	4.13 ± 0.52	4.50 ± 0.52	7.48 ± 0.94	7.32 ± 0.88	5.98 ± 0.70	6.00 ± 0.77

old boys. In girls the statistically reliable increase of body length from the endogames to exogames I. reached 2.6 cm ($t = 2.1$) at the age of 6 years and the drop in body langth from exogames I towards exogames II reached 6.0 cm at $t = 4.5$ at the age of 7 years. In five year-old girls the body length is increasing from exogames I towards exogames II by 2.4 cm at $t = 2.1$.

The variability of body length in 4 year-old boys increases from endogames towards exogames I and from these to exogames II. However, in six year-old boys in the transition from exogames I to exogames II the variability of body length is dropping. In girls of all age categories and in five year-old boys the level of variability does not depend on the division of the children into groups 0, I or II.

Trunk length. The trend of longer trunk in exogames I compared with endogames and exogames

TABLE 8

Antero-posterior diameter of the chest (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	12.4 ± 0.12	12.2 ± 0.17	12.7 ± 0.10	12.2 ± 0.13	12.6 ± 0.14	12.4 ± 0.10
	σ ± m (σ)	0.67 ± 0.08	1.00 ± 0.12	0.64 ± 0.07	0.75 ± 0.09	0.86 ± 0.10	0.60 ± 0.10
	V ± m (V)	5.41 ± 0.69	8.19 ± 1.02	5.03 ± 0.58	6.14 ± 0.76	6.82 ± 0.84	4.83 ± 0.57
5	N	30	33	30	35	40	32
	M ± m (M)	12.7 ± 0.15	12.6 ± 0.14	13.3 ± 0.14	12.8 ± 0.13	13.2 ± 0.12	12.8 ± 0.12
	σ ± m (σ)	0.90 ± 0.11	0.85 ± 0.10	0.81 ± 0.10	0.78 ± 0.09	0.76 ± 0.08	0.70 ± 0.09
	V ± m (V)	7.08 ± 0.91	6.74 ± 0.83	6.09 ± 0.78	6.09 ± 0.72	5.75 ± 0.64	5.46 ± 0.68
6	N	40	32	30	38	30	30
	M ± m (M)	13.6 ± 0.15	12.9 ± 0.10	13.3 ± 0.16	13.2 ± 0.12	13.6 ± 0.17	13.3 ± 0.13
	σ ± m (σ)	0.95 ± 0.10	0.62 ± 0.08	0.88 ± 0.11	0.77 ± 0.09	0.96 ± 0.12	0.72 ± 0.09
	V ± m (V)	6.98 ± 0.78	4.80 ± 0.60	6.61 ± 0.85	5.83 ± 0.66	7.05 ± 0.91	5.41 ± 0.69
7	N	31	38	33	38	36	30
	M ± m (M)	14.0 ± 0.11	13.5 ± 0.11	14.5 ± 0.14	13.8 ± 0.10	14.4 ± 0.18	13.5 ± 0.14
	σ ± m (σ)	0.64 ± 0.08	0.73 ± 0.08	0.81 ± 0.09	0.67 ± 0.07	1.07 ± 0.12	0.78 ± 0.10
	V ± m (V)	4.57 ± 0.58	5.40 ± 0.61	5.59 ± 0.68	4.85 ± 0.55	7.43 ± 0.87	5.74 ± 0.74

TABLE 9

Transverse diameter of the chest (cm) ofchildren differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	13.2 ± 0.17	13.0 ± 0.21	13.4 ± 0.13	12.9 ± 0.17	13.2 ± 0.15	13.4 ± 0.15
	σ ± m (σ)	0.98 ± 0.13	1.20 ± 0.15	0.84 ± 0.09	0.98 ± 0.12	0.88 ± 0.10	0.92 ± 0.10
	V ± m (V)	7.32 ± 0.95	9.22 ± 1.15	6.23 ± 0.72	7.59 ± 0.94	6.66 ± 0.81	6.11 ± 0.72
5	N	30	33	30	35	40	32
	M ± m (M)	13.6 ± 0.11	13.8 ± 0.12	14.2 ± 0.14	13.8 ± 0.23	14.2 ± 0.14	14.0 ± 0.23
	σ ± m (σ)	0.62 ± 0.08	0.70 ± 0.08	0.82 ± 0.10	1.41 ± 0.16	0.89 ± 0.09	1.30 ± 0.16
	V ± m (V)	4.54 ± 0.59	5.07 ± 0.61	5.77 ± 0.74	10.2 ± 1.21	6.26 ± 0.70	9.28 ± 1.16
6	N	40	32	30	38	30	30
	M ± m (M)	14.2 ± 0.08	13.9 ± 0.23	15.0 ± 0.21	14.9 ± 0.17	14.5 ± 0.22	14.8 ± 0.19
	σ ± m (σ)	0.56 ± 0.06	1.31 ± 0.16	1.16 ± 0.15	1.05 ± 0.12	1.25 ± 0.16	1.05 ± 0.13
	V ± m (V)	3.94 ± 0.44	9.42 ± 1.18	7.73 ± 1.00	7.04 ± 0.80	8.62 ± 1.11	7.09 ± 0.91
7	N	31	38	33	38	36	30
	M ± m (M)	15.7 ± 0.25	15.0 ± 0.16	16.0 ± 0.26	15.0 ± 0.24	16.2 ± 0.20	15.9 ± 0.19
	σ ± m (σ)	1.40 + 0.18	1.00 ± 0.14	1.54 ± 0.18	1.52 ± 0.17	1.22 ± 0.14	1.09 ± 0.14
	V ± m (V)	8.91 ± 1.13	6.66 ± 0.78	9.62 ± 1.18	10.1 ± 1.15	7.53 ± 0.88	6.85 ± 0.88

II was observed in all age and sex groups. *(Table 5).*

The increase of the trunk length from endogames to exogames I and its drop from exogames I to exogames II reached 3,1 cm (t = 6,4) and 1,6 cm (t = 2,2) in four year-old boys, 2,0 cm (t = 3,2) and 2,3 cm (t = 3,1) in seven year-old boys. In seven year-old girls the trunk length in exogames I exceeded that of the endogames by 2,8 cm (t = 3,6) and in the exogames II it was 1,8 cm shorter than in the exogames I.

The variability of the length of the trunk has no exact dependence on the grade of exogamy. In 4—6 year-old boys and in 5 year-old girls the variation coefficients in exogames II are higher than in exogames I or in endogames. In six year-old girls the variability of the length of the trunk in

TABLE 10

Shoulder-breadth (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy					
		0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	$M \pm m(M)$	22.5 ± 0.08	23.0 ± 0.26	23.3 ± 0.07	22.5 ± 0.21	22.7 ± 0.16	23.0 ± 0.19
	$\sigma \pm m(\sigma)$	0.45 ± 0.05	1.47 ± 0.18	0.42 ± 0.05	1.19 ± 0.15	0.93 ± 0.11	1.18 ± 0.14
	$V \pm m(V)$	1.99 ± 0.26	6.39 ± 0.79	1.80 ± 0.21	5.28 ± 0.66	4.00 ± 0.50	5.13 ± 0.60
5	N	30	33	30	35	40	32
	$M \pm m(M)$	24.2 ± 0.20	24.4 ± 0.20	24.5 ± 0.15	24.5 ± 0.28	24.5 ± 0.24	24.7 ± 0.22
	$\sigma \pm m(\sigma)$	1.12 ± 0.14	1.14 ± 0.14	0.81 ± 0.10	1.69 ± 0.20	1.54 ± 0.17	1.27 ± 0.16
	$V \pm m(V)$	4.62 ± 0.60	4.67 ± 0.58	3.30 ± 0.42	6.89 ± 0.82	6.28 ± 0.70	5.14 ± 0.64
6	N	40	32	30	38	30	30
	$M \pm m(M)$	24.6 ± 0.18	25.9 ± 0.24	26.2 ± 0.26	25.7 ± 0.16	25.7 ± 0.26	25.5 ± 0.46
	$\sigma \pm m(\sigma)$	1.44 ± 0.13	1.34 ± 0.17	1.43 ± 0.18	0.99 ± 0.11	1.44 ± 0.18	2.53 ± 0.33
	$V \pm m(V)$	4.63 ± 0.52	5.17 ± 0.65	5.45 ± 0.70	3.85 ± 0.44	5.60 ± 0.72	9.91 ± 1.28
7	N	31	38	33	38	36	30
	$M \pm m(M)$	27.9 ± 0.20	26.8 ± 0.19	29.6 ± 0.34	27.2 ± 0.23	27.7 ± 0.18	27.0 ± 0.45
	$\sigma \pm m(\sigma)$	1.10 ± 0.14	1.23 ± 0.14	1.98 ± 0.24	1.41 ± 0.16	1.05 ± 0.12	2.49 ± 0.32
	$V \pm m(V)$	3.90 ± 0.50	4.58 ± 0.52	6.69 ± 0.82	5.18 ± 0.59	3.79 ± 0.45	9.22 ± 1.10

TABLE 11

Pelvis breadth (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy					
		0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	$M \pm m(M)$	17.5 ± 0.10	17.3 ± 0.21	18.7 ± 0.20	17.0 ± 0.15	17.2 ± 0.11	17.6 ± 0.20
	$\sigma \pm m(\sigma)$	0.57 ± 0.07	1.22 ± 0.15	1.25 ± 0.14	0.87 ± 0.18	0.66 ± 0.08	1.21 ± 0.14
	$V \pm m(V)$	3.25 ± 0.41	7.05 ± 0.88	6.68 ± 0.77	5.11 ± 0.63	3.83 ± 0.47	6.90 ± 0.81
5	N	30	33	30	35	40	32
	$M \pm m(M)$	18.2 ± 0.17	18.5 ± 0.11	18.4 ± 0.20	18.2 ± 0.28	18.4 ± 0.15	18.5 ± 0.17
	$\sigma \pm m(\sigma)$	0.91 ± 0.11	0.66 ± 0.08	1.15 ± 0.14	1.67 ± 0.19	0.97 ± 0.10	0.97 ± 0.12
	$V \pm m(V)$	5.00 ± 0.64	3.56 ± 0.43	6.25 ± 0.80	9.17 ± 1.09	5.27 ± 0.58	5.24 ± 0.65
6	N	40	52	30	38	30	30
	$M \pm m(M)$	18.0 ± 0.12	19.1 ± 0.27	19.2 ± 0.21	19.5 ± 0.20	19.3 ± 0.18	20.0 ± 0.46
	$\sigma \pm m(\sigma)$	0.82 ± 0.09	1.55 ± 0.19	1.17 ± 0.15	1.25 ± 0.14	1.01 ± 0.13	2.56 ± 0.33
	$V \pm m(V)$	4.55 ± 0.51	8.11 ± 1.01	6.09 ± 0.77	6.41 ± 0.73	5.34 ± 0.68	12.8 ± 1.65
7	N	31	38	33	38	36	30
	$M \pm m(M)$	20.4 ± 0.16	19.8 ± 0.21	21.0 ± 0.36	20.3 ± 0.27	21.1 ± 0.28	19.9 ± 0.22
	$\sigma \pm m(\sigma)$	0.94 ± 0.11	1.34 ± 0.15	2.12 ± 0.26	1.67 ± 0.19	1.73 ± 0.20	1.24 ± 0.16
	$V \pm m(V)$	4.65 ± 0.59	6.76 ± 0.77	10.0 ± 1.23	8.30 ± 0.95	8.19 ± 0.96	6.28 ± 0.80

exogames I and II is lower than in endogames. In the rest of the cases the variability level in all three groups remains the same.

Body weight. As we can see in Table 6 in 4 and 7 year-old boys the body weight is increasing from endogames towards exogames I and from exogames I to exogames II it is dropping. The increase and drop in four-year old boys are 2.4 kg ($t = 8.0$) and 2.0 kg ($t = 4.4$) and in seven year-old boys 2.8 kg ($t = 3{,}3$) and 2,9 kg ($t = 2{,}4$). In five year-old boys the body weight is increasing from endogames towards exogames II by 2,0 kg at $t = 4{,}0$. In six year-old boys the body weight is dropping from endogames towards exogames I (by 1,1 kg at $t = 2.4$) while in exogames I and II it remains approximately on the same level.

In seven year-old girls body weight is increasing from endogames towards exogames I (by 2,5 kg at

TABLE 12

Head circumference (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N M ± m (M) σ ± m (σ) V ± m (V)	30 50.4 ± 0.08 0.45 ± 0.06 0.89 ± 0.11	32 49.2 ± 0.22 1.27 ± 0.16 2.58 ± 0.32	27 51.1 ± 0.08 0.48 ± 0.06 0.93 ± 0.11	32 49.9 ± 0.23 1.33 ± 0.17 2.66 ± 0.32	33 50.5 ± 0.24 1.41 ± 0.17 2.79 ± 0.34	36 49.7 ± 0.22 1.30 ± 0.15 2.61 ± 0.30
5	N M ± m (M) σ ± m (σ) V ± m (V)	30 51.2 ± 0.22 1.21 ± 0.16 2.36 ± 0.30	33 49.4 ± 0.22 1.27 ± 0.16 2.57 ± 0.31	30 50.9 ± 0.27 1.48 ± 0.20 2.92 ± 0.36	35 50.1 ± 0.24 1.40 ± 0.17 2.79 ± 0.33	40 51.5 ± 0.21 1.32 ± 0.12 2.56 ± 0.28	32 50.1 ± 0.20 1.16 ± 0.14 2.31 ± 0.28
6	N M ± m (M) σ ± m (σ) V ± m (V)	40 51.6 ± 0.23 1.44 ± 0.11 2.78 ± 0.31	32 50.7 ± 0.27 1.51 ± 0.12 2.97 ± 0.37	30 51.3 ± 0.20 1.11 ± 0.14 2.15 ± 0.27	38 50.8 ± 0.19 1.15 ± 0.13 2.26 ± 0.25	30 50.7 ± 0.27 1.49 ± 0.19 2.93 ± 0.37	30 50.7 ± 0.19 1.04 ± 0.14 2.05 ± 0.26
7	N M ± m (M) σ ± m (σ) V ± m (V)	31 51.8 ± 0.21 1.16 ± 0.15 2.24 ± 0.28	38 50.8 ± 0.22 1.36 ± 0.16 2.67 ± 0.30	33 52.0 ± 0.22 1.27 ± 0.16 2.44 ± 0.30	38 51.4 ± 0.19 1.15 ± 0.13 2.23 ± 0.25	36 52.0 ± 0.21 1.26 ± 0.15 2.42 ± 0.28	30 51.0 ± 0.26 1.45 ± 0.19 2.87 ± 0.37

TABLE 13

Head length (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N M ± m (M) σ ± m (σ) V ± m (V)	30 16.9 ± 0.06 0.35 ± 0.04 2.04 ± 0.26	32 16.2 ± 0.11 0.66 ± 0.08 4.08 ± 0.51	37 17.1 ± 0.04 0.29 ± 0.03 1.79 ± 0.20	32 16.3 ± 0.15 0.85 ± 0.10 5.22 ± 0.65	33 16.9 ± 0.02 0.14 ± 0.01 0.82 ± 0.10	36 16.4 ± 0.07 0.46 ± 0.05 2.19 ± 0.25
5	N M ± m (M) σ ± m (σ) V ± m (V)	30 16.8 ± 0.04 0.25 ± 0.03 1.46 ± 0.18	33 16.5 ± 0.10 0.62 ± 0.07 3.73 ± 0.45	30 17.1 ± 0.11 0.62 ± 0.08 3.68 ± 0.47	35 17.0 ± 0.09 0.59 ± 0.07 3.48 ± 0.40	40 17.1 ± 0.09 0.60 ± 0.06 3.50 ± 0.55	32 16.6 ± 0.09 0.54 ± 0.06 3.26 ± 0.40
6	N M ± m (M) σ ± m (σ) V ± m (V)	40 17.2 ± 0.13 0.84 ± 0.09 4.86 ± 0.54	32 16.6 ± 0.11 0.64 ± 0.08 3.86 ± 0.48	30 17.2 ± 0.14 0.80 ± 0.10 4.64 ± 0.59	38 17.3 ± 0.08 0.53 ± 0.06 3.06 ± 0.35	30 17.1 ± 0.11 0.61 ± 0.07 3.55 ± 0.45	30 16.8 ± 0.08 0.48 ± 0.06 2.85 ± 0.36
7	N M ± m (M) σ ± m (σ) V ± m (V)	31 17.2 ± 0.11 0.62 ± 0.07 3.63 ± 0.45	38 16.8 ± 0.10 0.67 ± 0.07 3.96 ± 0.45	33 17.2 ± 0.12 0.71 ± 0.08 4.13 ± 0.50	38 17.0 ± 0.09 0.61 ± 0.06 3.60 ± 0.41	36 17.4 ± 0.10 0.63 ± 0.07 3.60 ± 0.42	30 16.9 ± 0.13 0.76 ± 0.09 4.47 ± 0.57

$t = 2,6$) and from endogames to exogames II — in five year-old girls — by 1,2 kg at $t = 2,1$. In four-year old girls the body weight of the exogames I is lower than in endogames (by 1,1 kg at $t = 2,0$).

The variability of body weight is increasing in exogames II compared with the group of endogamous children. This phenomenon was observed in all age and sex groups, with the exception of four year-old girls and five year-old boys.

CHEST CIRCUMFERENCE

We can see in Table 7 that the groups of 4 and 7 year-old boys of exogames I have larger chest circumference than the endogames and exogames II of the same age. The difference in the value of this dimension totalled: in four-year old between exogames I and endogames — 1,9 cm at $t = 3,8$, between exogames I and II and 1,7 cm at

TABLE 14

Greatest head breadth (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	14.1 ± 0.04	13.7 ± 0.09	14.3 ± 0.08	13.7 ± 0.08	14.0 ± 0.12	13.9 ± 0.09
	σ ± m (σ)	0.25 ± 0.03	0.52 ± 0.06	0.52 ± 0.06	0.45 ± 0.05	0.73 ± 0.06	0.56 ± 0.06
	V ± m (V)	1.76 ± 0.22	3.87 ± 0.48	3.65 ± 0.42	3.27 ± 0.40	5.20 ± 0.64	4.02 ± 0.47
5	N	30	33	30	35	40	32
	M ± m (M)	14.4 ± 0.13	13.9 ± 0.06	14.6 ± 0.12	13.7 ± 0.07	14.5 ± 0.07	13.9 ± 0.10
	σ ± m (σ)	0.73 ± 0.09	0.35 ± 0.04	0.66 ± 0.08	0.46 ± 0.05	0.45 ± 0.05	0.60 ± 0.07
	V ± m (V)	5.08 ± 0.65	2.54 ± 0.31	4.47 ± 0.57	3.38 ± 0.40	3.08 ± 0.34	4.28 ± 0.53
6	N	40	32	30	38	30	30
	M ± m (M)	14.5 ± 0.08	14.4 ± 0.07	14.5 ± 0.10	14.1 ± 0.05	14.6 ± 0.09	14.2 ± 0.09
	σ ± m (σ)	0.56 ± 0.06	0.45 ± 0.05	0.57 ± 0.07	0.38 ± 0.04	0.53 ± 0.06	0.55 ± 0.07
	V ± m (V)	3.84 ± 0.42	3.13 ± 0.39	3.90 ± 0.50	2.35 ± 0.26	3.60 ± 0.46	3.85 ± 0.49
7	N	31	38	33	38	36	30
	M ± m (M)	14.2 ± 0.02	14.4 ± 0.09	14.5 ± 0.08	14.1 ± 0.07	14.5 ± 0.08	14.0 ± 0.10
	σ ± m (σ)	0.12 ± 0.01	0.57 ± 0.06	0.50 ± 0.06	0.47 ± 0.05	0.51 ± 0.06	0.56 ± 0.07
	V ± m (V)	0.85 ± 0.10	3.95 ± 0.46	3.44 ± 0.42	3.55 ± 0.38	3.51 ± 0.41	3.96 ± 0.51

TABLE 15

Facial breadth (cm) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	11.3 ± 0.06	11.0 ± 0.09	11.6 ± 0.07	11.0 ± 0.08	11.2 ± 0.16	11.2 ± 0.08
	σ ± m (σ)	0.34 ± 0.04	0.55 ± 0.06	0.45 ± 0.05	0.50 ± 0.06	0.94 ± 0.11	0.53 ± 0.06
	V ± m (V)	3.00 ± 0.38	5.00 ± 0.62	3.87 ± 0.44	4.54 ± 0.56	8.39 ± 1.03	4.73 ± 0.55
5	N	30	33	30	35	40	32
	M ± m (M)	11.2 ± 0.08	11.1 ± 0.05	11.6 ± 0.08	11.1 ± 0.08	11.5 ± 0.09	11.1 ± 0.09
	σ ± m (σ)	0.47 ± 0.06	0.31 ± 0.03	0.46 ± 0.05	0.50 ± 0.05	0.59 ± 0.06	0.53 ± 0.06
	V ± m (V)	4.19 ± 0.54	2.79 ± 0.34	3.96 ± 0.51	4.50 ± 0.53	5.13 ± 0.57	4.77 ± 0.59
6	N	40	32	30	38	30	30
	M ± m (M)	11.5 ± 0.04	11.5 ± 0.06	11.6 ± 0.07	11.4 ± 0.07	11.5 ± 0.12	11.5 ± 0.11
	σ ± m (σ)	0.31 ± 0.03	0.37 ± 0.04	0.43 ± 0.05	0.44 ± 0.05	0.70 ± 0.09	0.64 ± 0.08
	V ± m (V)	2.69 ± 0.30	3.21 ± 0.40	3.70 ± 0.47	3.94 ± 0.45	6.08 ± 0.78	5.56 ± 0.71
7	N	31	38	33	38	36	30
	M ± m (M)	11.9 ± 0.06	11.5 ± 0.09	12.0 ± 0.06	11.5 ± 0.07	11.9 ± 0.05	11.6 ± 0.08
	σ ± m (σ)	0.38 ± 0.04	0.60 ± 0.06	0.38 ± 0.04	0.44 ± 0.05	0.33 ± 0.03	0.45 ± 0.05
	V ± m (V)	3.19 ± 0.40	5.21 ± 0.59	3.19 ± 0.39	3.82 ± 0.43	2.72 ± 0.32	3.87 ± 0.49

$t = 3.0$; at the age of 7 years — between exogames I and endogames — 2.6 cm at $t = 2.8$, between exogames I and II 2.9 cm at $t = 2.9$. at the age of 5 years the chest circumference is increasing in boys from endogames towards exogames II by 1.4 cm at $t = 2{,}5$. In girls we observed statistically significant differences only at the age of 4 years: the chest circumference in exogames II is larger than in exogames I by 2,2 cm at $t = 3{,}7$.

In five cases out of eight the dimension variability in exogames II was larger than in endogames or exogames I.

Antero-posterior diameter of the chest. It follows from Table 8 that this chest dimension is increasing from endogames towards exogames I: in five-year old boys by 0,6 cm at $t = 3{,}0$, in seven-year old boys by 0,5 cm at $t = 2{,}8$, and in girls of the

TABLE 16

Morphological facial height (cm) of children, differing by the degree of exogamy

Age in years		Degree of exogamy					
		0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N	30	32	37	32	33	36
	M ± m (M)	8.10 ± 0.04	8.00 ± 0.06	8.10 ± 0.03	7.90 ± 0.06	8.20 ± 0.05	8.00 ± 0.07
	σ ± m (σ)	0.24 ± 0.03	0.34 ± 0.04	0.20 ± 0.02	0.39 ± 0.04	0.30 ± 0.03	0.44 ± 0.05
	V ± m (V)	2.96 ± 0.37	4.25 ± 0.53	2.46 ± 0.28	4.93 ± 0.61	3.65 ± 0.44	5.50 ± 0.64
5	N	30	33	30	35	40	32
	M ± m (M)	8.40 ± 0.08	8.30 ± 0.14	8.70 ± 0.09	8.40 ± 0.08	8.70 ± 0.07	8.40 ± 0.07
	σ ± m (σ)	0.44 ± 0.05	0.81 ± 0.09	0.50 ± 0.06	0.51 ± 0.06	0.49 ± 0.05	0.44 ± 0.05
	V ± m (V)	5.23 ± 0.67	9.75 ± 1.20	5.74 ± 0.70	6.07 ± 0.72	5.63 ± 0.62	3.20 ± 0.40
6	N	40	32	30	38	30	30
	M ± m (M)	8.80 ± 0.08	8.60 ± 0.07	8.80 ± 0.17	8.50 ± 0.06	8.80 ± 0.06	8.60 ± 0.08
	σ ± m (σ)	0.56 ± 0.06	0.45 ± 0.05	0.98 ± 0.12	0.41 ± 0.04	0.34 ± 0.04	0.48 ± 0.06
	V ± m (V)	6.36 ± 0.71	5.23 ± 0.65	11.1 ± 1.43	4.82 ± 0.55	3.86 ± 0.49	5.57 ± 0.75
7	N	31	38	33	38	36	30
	M ± m (M)	9.00 ± 0.07	8.60 ± 0.08	9.00 ± 0.07	9.00 ± 0.08	9.10 ± 0.07	8.60 ± 0.07
	σ ± m (σ)	0.40 ± 0.05	0.52 ± 0.05	0.45 ± 0.05	0.52 ± 0.05	0.44 ± 0.05	0.42 ± 0.05
	V ± m (V)	4.44 ± 0.56	6.05 ± 0.69	5.00 ± 0.61	5.77 ± 0.66	4.84 ± 0.57	4.87 ± 0.62

same age by 0,3 cm at t = 2,0. No real differences were found between exogames I and II.

The variability of the antero-posterior chest diameter in the groups divided according to age, sex and exogamy, remained usually on the same level. In seven-year old boys an increase of variability of this dimension from the endogames towards exogames II was observed at t = 2,7, while in four-year old girls the variability was dropping from the endogames towards exogames II at t = 2,9.

Transverse diameter of the chest. As it follows from Table 9 this dimension is increasing from endogames towards exogames I (by 0.6 cm at t =3.3 in five-year old boys, by 0.8 cm at t = 3.5 in six-year old boys, by 1.0 cm at t = 3.7 at six-year old girls) and from exogames I to exogames II (by 0.5 cm at t = 2.2 in four-year old girls and by 0.9 cm at t = 3.0 in seven-year old girls).

The variability of the transverse diameter of the chest in boys remained on the same level, with the exception of six-year old boys where we observed an increased variability of this dimension from the endogames towards exogames I at t = 3,4. In girls we observed an increase of variability in the age group of the five-year old from the endogames towards exogames I at t = 3,8, and in the seven-year old girls there was an increase of variability from endogames to exogames I at t = 2.4, and a drop of variability from exogames I to exogames II at t = 2.2.

Shoulder-breadth. As it follows from Table 10 the shoulder-breadth is increasing from endogames towards exogames I (by 0,8 cm at t = 8,0 in four-year old boys, by 0.3 cm at t = 5.0 in five-year old boys, by 1,6 cm at t = 5,0 in six-year old boys and by 1,7 cm at t = 5,6 in seven-year old boys). We observed a drop in this dimension from exogames I to exogames II in four-year old boys (by 0,6 cm at t = 3,5) and in seven-year old boys (by 1,9 cm at t = 4,4). In girls we found practically no differences between endogames, exogames I and exogames II in this dimension.

The variability of the shoulder-breadth from endogames towards exogames I in boys remained practically the same, wih the exception of seven-year old boys, where we observed an increase of variability of this dimension from the endogames towards exogames I at t = 2,8. In the transition from exogames I to exogames II we found an increase of variability in 4 and 5-year old boys at t = 4.1 in both cases. In 7-years old there was a drop of variability at t = 3.1. In girls there were no differences in this dimension between endogames and exogames I, in the transition from exogames I to exogames II, however, we observed an increase of variability (in the age groups of 6 and 7-years at t = 4,5 and t = 3,0).

Breadth of pelvis. The data in Table 11 show that within the same age and sex groups there are no differences in the pelvis breadth between the endogames and exogames I and II. The only exception is the group of four-year old boys, where exogames I have 1.2 cm broader pelvis than the endogames (t = 5.0), and there is a drop in this dimension from exogames I towards exogames II, reaching 1.5 cm at t =6.2.

In six year-old boys in exogames I the pelvis is 1,2 cm broader at t = 7,0 than in the endogames.

In three cases out of eight the variability in exogames I was higher than in endogames, in two

TABLE 17

Hand strength (kg) of children differing by the grade of exogamy

Age in years		Degree of exogamy 0		I		II	
		Boys	Girls	Boys	Girls	Boys	Girls
4	N M ± m (M) σ ± m (σ) V ± m (V)	30 8.20 ± 0.44 2.43 ± 0.31 29.6 ± 3.81	32 5.60 ± 0.29 1.68 ± 0.21 33.2 ± 4.15	37 9.20 ± 0.40 2.47 ± 0.28 26.7 ± 3.10	32 6.00 ± 0.42 2.42 ± 0.30 40.3 ± 5.03	33 7.60 ± 0.29 1.71 ± 0.21 22.5 ± 2.76	36 5.60 ± 0.30 1.85 ± 0.21 33.0 ± 3.88
5	N M ± m (M) σ ± m (σ) V ± m (V)	30 9.50 ± 0.29 1.63 ± 0.21 17.1 ± 2.20	33 8.00 ± 0.40 2.31 ± 0.28 28.8 ± 3.55	30 10.0 ± 0.45 2.51 ± 0.32 25.1 ± 3.23	35 7.70 ± 0.37 2.24 ± 0.26 29.0 ± 3.44	40 10.1 ± 0.34 2.21 ± 0.24 21.8 ± 2.44	32 8.20 ± 0.40 2.32 ± 0.28 28.2 ± 3.52
6	N M ± m (M) σ ± m (σ) V ± m (V)	40 11.2 ± 0.21 1.33 ± 0.14 11.9 ± 1.40	32 10.6 ± 0.31 1.78 ± 0.22 16.8 ± 2.13	30 10.0 ± 0.24 1.35 ± 0.18 13.5 ± 1.74	38 11.2 ± 0.34 2.12 ± 0.24 18.9 ± 2.17	30 12.5 ± 0.50 2.78 ± 0.35 22.2 ± 2.86	30 10.4 ± 0.57 2.89 ± 0.37 27.7 ± 3.58
7	N M ± m (M) σ ± m (σ) V ± m (V)	31 14.7 ± 0.35 1.99 ± 0.25 13.5 ± 1.71	38 11.7 ± 0.32 1.98 ± 0.22 16.8 ± 1.92	33 15.0 ± 0.50 2.92 ± 0.35 12.8 ± 1.58	38 12.0 ± 0.24 1.51 ± 0.17 12.5 ± 1.43	36 13.2 ± 0.35 2.15 ± 0.25 16.2 ± 1.90	30 12.2 ± 0.43 2.45 ± 0.31 20.0 ± 2.58

cases in exogames II it was lower and in one case it was higher than in exogames I.

Head circumference. The results of Table 12 show that this dimension in boys is increasing from endogames towards exogames I at the age of six years by 0,7 cm at t = 7,0 and at the age of five years is dropping by 0,3 cm at t = 2,7. From exogames I towards exogames II the head circumference is decreasing at the age of four years by 0,6 cm at t = 2,7 and is increasing at the age of five years by 0,6 cm at t = 6,0; at the age of 6 and 7 years the given characters remain on the same level. In girls-exogames I the head circumference is increasing compared with endogames: at the age of 4 and 5 years by 0,7 cm at t = 2,2 in both groups, at the age of 7 years by 0,6 cm at t = 2,1. During the transition from exogames I to exogames II no substantial changes were observed in the head circumference of the girls.

The variability of the head circumference does not show any exact dependence on the grade of exogamy, neither in boys, nor in girls. The only exception are boys at the age of 4 years, whose variability is increasing during the transition from exogames I to exogames II by 1,9 % at t = 5,5, and 6-year old boys whose variability is dropping during the transition from endogames to exogames I by 0,6 % at t = 2,1.

Head length. As it follows from Table 13 this dimension is increasing from endogames towards exogames I (by 0,2 cm at t = 2,8 in four-year old boys, by 0,3 cm at t = 2,7 at five-year old boys, by 0,5 cm at t = 3,8 in five-year old girls and by 0.7 cm at t = 2.8 at six-year old girls and is dropping from exogames I to exogames II (by 0,2 cm at t = 4,0 in four-year old boys, by 0,4 cm at t = 3,0 in five-year old girls, by 0,5 cm at t = 5,0 in six-year old girls).

The variability of the head length in five-year old boys is increasing from endogames towards exogames I by 2,2 % at t = 4,5. From exogames I to exogames II the variability is dropping in four-year old girls by 3,0 % at t = 4,3. In other age and sex groups the variability of the head length remains practically on the same level.

Greatest head breadth. The data in Table 14 show that boys-exogames I have a larger transverse diameter of the head than boys-endogames at the age of 4 years (by 0.2 cm at t = 2.5) and at the age of 7 years (by 0,3 cm at t = 3,0). When comparing girls-endogames and girls-exogames I we observed a drop in the transverse diameter of the head — in five-year old by 0.2 cm at t = 2.0 (and in six- and seven-year old by 0,3 cm at t = 3,0 in both cases).

From exogames I towards exogames II the greatest head breadth usually remains the same. The only exception are the four-year old boys, whose transverse diameter of the head dropped by 0,3 cm at t = 2,1.

The variability of the greatest head breadth increased from endogames to exogames I in four- and five-year old boys by 1,9 % at t = 4,1 and by 2,6 % at t = 5,9. In other cases no real changes have been observed, either in boys nor in girls. The variation coefficients from exogames I towards exogames II were increasing in four-year old boys (by 1,6 % at t = 2,0) and in six-year old girls (by 1,5 % at t = 2,6).

Facial breadth. It follows from Table 15 that facial breadth is increasing from endogames towards exogames I in four-year old boys by 0.3 cm at $t = 3{,}0$ and in five-year old boys by 0,4 cm at $t = 4{,}0$. From exogames I towards exogames II this dimension is decreasing by 0,4 cm at $t = 2{,}3$ in four-year old boys. In other age and sex groups no significant differences were observed.

The variability of the facial breadth in the age and sex groups divided according to the grade of exogamy remained usually on the same level. There was an increase of variability of this dimension from exogames I towards exogames II in four-year old boys by 4.5 % at $t = 4.0$, in six-year old boys by 2.4 % at $t = 2.6$. In girls the variation coefficients increased from endogames towards exogames I by 1.7 % at $t = 2.5$ in the age of five years, and from endogames to exogames I they dropped by 1.4 % at $t = 2.0$ at the age of seven years.

Morphological facial height. The data of table 16 show that five-year old boys and seven-year old girls have a greater morphological facial height in exogames I than in endogames: the difference is 0.3 cm at $t = 2.5$ and 0.4 cm at $t = 3.6$. In other groups there are no significant differences.

The variability of the morphological facial height increased in six-year old boys from the endogames towards exogames I by 4,7 % at $t = 2{,}9$, and dropped from exogames I towards exogames II by 7,2 % at $t = 4{,}9$. In five-year old girls the variation coefficient dropped from the endogames to exogames I, and from exogames I to exogames II by 3,7 % at $t = 2{,}6$ and by 2,9 % at $t = 2{,}8$. In other groups the variability remained practically on the same level.

Hand strength. As we can see in Table 17 no differences were found in this character between various exogamy grades. In six-year old boys there is a certain drop in the hand strength from endogames towards exogames I by 1.2 kg at $t = 4.0$. In four and seven-year old boys the hand strength is decreasing from exogames I to exogames II by 1.6 kg ($t = 3.0$) and 1.8 kg ($t = 3.0$), but in six-year old boys this character is increasing under equal conditions by 2.5 kg ($t = 4.4$). The hand strength of girls in various exogamy-grade groups remains practically the same.

The variation coefficients of the hand strength of five-year old boys are increasing by 8,0 % at $t = 2{,}1$ from the endogames towards exogames I. From exogames I towards exogames II they are dropping (in six-year old boys by 8,7 % at $t = 2{,}6$), or are increasing (in six- and seven-year old girls by 8,8 % at 2,1 and by 7,5 % at $t = 2{,}5$).

DISCUSSION

Let us have a look at the final table, showing the dependence of the body dimensions of children upon the grade of their exogamy (*Table 18*).

The analysis of *Table 18* shows that in four-year old boys all the followed dimensions increase from the endogames towards exogames I with the exception of the antero-posterior and transverse dia-

TABLE 18. *Statistically reliable changes in body dimensions of children at the transition from one exogamy grade to other*

Age (in years)		Boys		Girls	
		0—I	I—II	0—I	I—II
4	Growth	1, 2, 3, 4 7, 8, 9, II, 12, 13	—	7	4, 6, II
	Drop	—	1, 2, 3, 4, 7, 8, 9, II, 12, 13, 14	3, 12	—
5	Growth	1, 5, 6, 8, 10, 11, 12	3, 7	7, 8	I
	Drop	7	—	9	8
6	Growth	1, 6, 12, 13	14	1, 6, 8	—
	Drop	3, 9, 14	1	9	8
7	Growth	1, 2, 3, 4, 5 9, 12	—	1, 2, 3, 5	6
	Drop	—	1, 2, 3, 4, 12, 14	9	1, 2, 10

NOTE:

1 — body length, — 2 — trunk length, 3 — body weight, 4 — chest circumference, 5 — antero-posterior diameter of the chest, 6 — transverse diameter of the chest, 7 — head circumference, 8 — head length, 9 — greatest head breadth, 10 — morphological facial height, 11 — facial breadth, 12 shoulder breadth, 13 — pelvis breath, 14 — hand strength.
O, I, II — grades of exogammy.

meters of the chest, morphological facial height and hand strength. Most of the body dimensions drop from exogames I towards exogames II — with the exception of the antero-posterior and transverse diameter of the chest and of the morphological facial height. In four-year old girls we observed an increase of body dimensions from endogames towards exogames I and from exogames I to exogames II in one and three characters out of the 14. In five-year old boys seven body dimensions increased from endogames towards exogames I (Table 18). In five-year old girls from endogames to exogames I the circumference and head length increased, and from exogames I to exogames II the head length dropped. In six-year old boys from endogames to exogames I the body length, transverse diameter of the chest, shoulder breadth and the pelvic breadth increased. From exogames I towards exogames II the body length dropped. In six-year old girls from endogames towards exogames I the body length, transverse diameter of the chest and the head length increased. From exogames I towards exogames II the head length decreased. In seven-year old boys from endogames towards exogames I there was an increase in seven body dimensions *(Table 18).* From exogames I towards exogames II 6 body dimensions decreased. In seven-year old girls from endogames towards exogames

I the body length, the length of the trunk, the body weight and the antero-posterior diameter of the chest increased. From exogames I towards exogames II the body length, the length of the trunk and the morphological facial height dropped.

We can say that there is an increase of body dimensions from endogames towards exogames I and they decrease from exogames I to exogames II — most conspicuously in four- and seven-year old boys and in seven-year old girls.

The analysis of the morpho-functional differences between endogames, exogames I and II enables us to draw the conslusion that in boys body length and shlouder breadth are the most sensitive to exogamy characters *(Table 18)*. For the transverse and anteroposterior diameters of the chest and for the morphological facial height there was increase in the arithmetic means only from endogames towards exogames I. In body weight, transverse diameter and circumference of the head the arithmetic mean is dropping from endogames towards exogames I, and is increasing from exogames I towards exogames II. The hand strength is dropping with the increasing exogamy grade.

In girls the 'waves' of changes from endogames towards exogames I and further towards exogames II are most characteristic for the body length and for the head length (Table 18) — while the greatest head breadth decreased from endogames to exogames I. The decrease of the greatest head breadth with the increasing head length in five- and six-year old girls is a proof of dolichocephalization of exogames I compared with endogames.

Let us have a look at the pecularities of dimension variability in children with various grades of exogamy *(Table 19)*.

The data in *Table 19* show that in four-year old boys the variability from endogames towards exogames I is increasing in body length, chest circumference, greatest head breadth and in the pelvis breadth. The variability is increasing from exogames I towards exogames II in seven body characters *(Table 19)* and is decreasing for the pelvis breadth. In four-year old girls the variability is increasing from endogames towards exogames I in the body weight. The variation dropped from exogames I to exogames II in the head length. In five-year old boys the variation coefficients increased from endogames towards exogames I in the length of the trunk, head length, hand strength and they decreased for the chest circumference. The variation coefficients increased from exogames I towards exogames II in body weight, chest circumference, shoulder breadth and they dropped in the length of the trunk and greatest head breadth. In five-year old girls the variation coefficients increased from endogames toward exogames I in five dimensions (*Table 19*) and they decreased for the morphological facial height. From exogames I to exogames II the variation coefficients decreased in the chest circumference, for the morphological facial height and for the body breadths. The variability increased in six-year old boys from endogames towards exogames I in the trunk length, morphological

TABLE 19 *Statistically reliable changes of the variability of body dimensions of children at the transition from one exogamy grade to the other one*

Age (in years)		Boys		Girls	
		0—I	I—II	0—I	I—II
4	Growth	1, 4, 9, 13	1, 2, 3, 7, 9, 11, 12	3	—
	Drop	—	13	4	8
5	Growth	2, 8, 14	3, 4, 12	2, 3, 6, 11, 13	—
	Drop	4	2, 9	10	4, 10, 13
6	Growth	2, 6, 10	3, 11	2	3, 4, 9, 12, 13, 14
	Drop	7	1, 10, 14	—	—
7	Growth	3, 4, 9, 12, 13	1	4, 6	12, 14
	Drop	1	12	11	6

facial height and transverse diameter of the chest and it dropped in the head circumference. From exogames I towards exogames II the variability increased in body weight, in facial breadth and it dropped in body length, morphological facial height and in the hand strength. In six-year old girls the variability increased from endogames towards exogames I in the trunk length. From exogames I towards exogames II it increased in six body dimensions *(Table 19)*. The variability in seven-year old boys increased from endogames to exogames I in five body dimensions *(Table 19)* and it dropped in body length. The variability increased from exogames I to exogames II in the body length and it dropped in shoulder breadth.

In seven- year old girls the variability from endogames toward exogames I increased in the chest circumference and decreased in facial breadth. From exogames I towards exogames II the variability increased in shoulder breadth, in hand strength and decreased in the transverse diameter of the chest.

We can say that the variability of characters is in most cases increasing with the increasing grade of exogamy. In four-year old boys and six-year old girls the main changes of variability occur at the transition from exogames I to exogames II and in seven-year old boys — at the transition from the endogames to exogames I.

Our presumption was proved by the results of this research; i.e. the growth of the grade of exogamy to a certain level stimulates the growth and development of the children, however, after crossing this level the heterosis effect drops. The chosen criterion of exogamy degree as follows from the information on the grandparents proved apt. This explains our results which N. Wolanski and coll. were unable to achieve.

The increase of variability of the characters with the increase of the grade of exogamy is natural since the development of variability depends on the staff of the groups — and in the more uniform group (endogamous) it is lower, while in the group of mixed character (exogamous groups) it is higher. The obvious character of the 'wave' is also natural (the increase and following drop of the character from endogames towards exogames I and then towards exogames II) in boys compared with girls. From the literature we know very well that females are more resistant towards various influences than males. As to age differences in the display degree of the 'wave' we explain the obvious manifestation of this phenomenon at the ages of 4 and 7 years by activation of the growth processes at these ages. Village children of the Upper Dnieper District in the Dniepropetrovsk Region show a so-called semi-growth jump, it will be, however, the subject of a special paper.

CONCLUSIONS

1. The comparison of pre-school age children of endogamous and exogamous origin shows that the intensity of the growth processes in children with slight exogamy (Ist grade) is higher for most body dimensions than in the endogames or in children with the obvious exogamy (IInd grade).

2. In boys the 'wave' character of the changes of body dimensions from endogames towards exogames I, then to exogames II is more conspicuous than in girls. In boys this phenomenon is most perceptible at the age of 4 and 7 years, in girls at the age of seven years.

3. The phenomenon of the 'wave' changes of characters in boys is most conspicuous in the body length, shoulder breadth, in girls in the body length and in the head length. In the groups of five- and six-year old girls the transition from endogamy to the first grade of exogamy is accompanied not only by the increase of the head length, but also by the decrease of the greatest head breadth resulting in dolichocephalization.

4. The variability of the dimensions increases with the increasing grade of exogamy. In boys this process is most conspicuous at the ages of 4 and 7 years, in girls at the age of 6 years.

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