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Contents

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Condition and directions in the advance of the anthropological investigations in Bulgaria

(Preface)

Y. Yordanov

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

The beginning, the development, the modern conditions, and the perspectives of the anthropological investigations in Bulgaria are discussed. From Acad. Jonas Bassanavichus, through the Department of Anthropology directed by Prof. Dr. Dimiter Kadanov to the nowaday anthropological investigation which are holding up not only in Department of Anthropology at the Institute of Cell Biology and Morphology, but also at other groups of different Universities and Institutes. The basic achievement of the anthropology up-to-now and the perspectives for the future studies in the different fields of the anthropology are treated.

Key words: anthropology, physical anthropology, anthropogenetics, ethnical anthropology, paleoanthropology, tendencies.

The first anthropological investigations in Bulgaria are connected with the name of the Lithuanian physician, scientist Academician Dr. Jonas Bassanavichus, and have already century-old history. At the first middle of the century, numerous anthropological studies are carried out, some of them with national range (Acad. St. Vatev, Acad. M. Popov and others). The organized and systematic anthropological investigations in our country originate from the establishment of the Department of Anthropology at the Institute of Morphology at the Bulgarian Academy of Sciences in 1953, with its first chief – Prof. Dr. D. Kadanov.

At present the most numerous and independent anthropological department in Bulgaria is that one at Institute of Cell Biology and Morphology at the Bulgarian Academy of Sciences. Anthropological investigations are carried out also in: the Department of Zoology and Anthropology of the Biology Faculty at the University of Sofia; the Department of Anatomy and Physiology of Men of the Biology Faculty at the University of Plovdiv; the Department of Sports Medicine at the High Sports School; the Institute of Gerontology of the Medical Academy in Sofia; the Departments of Anatomy in Plovdiv, Varna and Stara Zagora; the Department of General Biology at the Medical Institutes in Sofia,

Varna, Plovdiv; the Departments of Forensic Medicine in Sofia, Pleven and Stara Zagora; the Departments of Medical Genetics in Sofia and Varna; some clinical departments at the Medical Institutes in the country. As for the subject respect, almost all the fields of the physical anthropology without the problems of anthropogenesis are represented in the Bulgarian departments of anthropology. The results are published in Bulgaria and abroad, including some monographic works, and are reported to many national and international congresses, conferences, and symposiums. The results in the scientific works of the Bulgarian anthropologists are of an interest and receive a high valuation both in our country and abroad, which is confirmed by the frequent references from Bulgarian and foreign specialists.

On the basis of the realized scientific achievement of the Bulgarian anthropology, the following directions of its development can be outlined:

I. National programme "Anthropological characteristics of the Bulgarian population." At the present moment, the basic scientific task for the Bulgarian anthropology is to realize the National Programme "Anthropological characteristics of the Bulgarian population", which was approved by the Presidium of the Bulgarian Academy of Sciences, and was financed by the Ministry of Science and High Education. The research group includes scientific workers of the Department of Anthropology at the Institute of Cell Biology and Morphology at the Bulgarian Academy of Sciences, and is supplement with some additional workers by civil contracts. The programme consists of 2 basic parts: 1. Anthropological characteristics of the modern population in Bulgaria; 2. Anthropological characteristics of the ancient population which had lived in the Bulgarian lands (data made from archaeological excavations bone relics). The aims of the National Anthropological Programme are as follows: 1. To be made a complete anthropological characteristic of the modern Bulgarian population (at first of adults – 30-40 years of age), i.e. to be made "an anthropological photograph" at the end of the XX-th century, and this new data to be compared with the data from the beginning and the middle of the century; 2. By the bone relics to be characterized anthropologically the population which had lived in our lands in different epochs – from the Neolith to the Late Middle Ages – taking into account the appearance, the development, and the distribution of the anthropological types and evaluating the global processes in the human evolution.

Realizing the National Anthropological Programme we are to organize an Anthropological Museum and a National Bone-depository in it.

The result from the National Anthropological Programme will help very much the knowledge about different anthropological aspects of the human development in our lands. This big material of representative anthropological data for the modern Bulgarian population will ensure the settlement of a series of problems in the fields of the practical anthropology.

II. Anthropological investigations of morpho-functional anthropological characterization of the modern population in our country. In this field the problems worked out are:

1. Physical development of children and growing up persons. For the realization of this problem some transversal studies (in the future longitudinal ones too) are taken out which are necessary for the investigation of the complex processes of the physical development and the growth from birth to sexual maturation and the connection of them with the different conditions of life and the

social environments. Of a special significancy are also the studies on the relationship between social factors and the coming of puberty in different districts of the country, as well as the interrelationship between the very early and very late coming of puberty and the constitution.

2. Physical development of adults assessed in connection with different factors as: age-sexual, socio-economic and cultural belonging; pshycho-physical specificity of the proffessional engagement; natural-geographic and other economical factors; degree of urbanization and industrialization of the living and birth places; factors which determine the specificity of the old age in our country etc. The results from the anthropological investigations in this field give an optimum volume of data for the characterization of the morpho-functional anthropological status of the modern Bulgarian population; give possibilities for evaluation of the regularities in the physical development of the population in connection with the specific conditions of life and labour; give anthropological data for comparative investigations in time and areas including the evaluation of the processes of acceleration and retardation for the present moment and as a prognosis; ensure a possibility for a documentation and a foretelling of the negative effects in the physical development of man in different unhealthy ecological, professional, etc. factors with a view to eliminating them in time.

3. Practical-anthropological investigations. The picked up anthropological data, representative for different groups of the modern population are of a big practical importance. The data are initial base for the elaboration of the anthropological norms for different periods of the human ontogenesis. It guarantee also the evaluation of anthropological **standards** wanted in the ergonomic-anthropological considered design of different products addressed to the man's labour. In this manner the anthropology like a fundamental science becomes a data source with big socio-health and economical importance for the national economy.

III. Anthropogenetic investigations. The researches in this field divide in two basic groups:

1. Investigations of the inheritance of normal features in man.
2. Medical-genetic studies.

The exposition of genetic fund of the Bulgarian population with respect to normal genetic markers includes both the discovery of new rare blood groups, serum factors, ensyme system and the study of population-genetic processes of the Bulgarian population as a whole, and for separated territories in the country. Another part of the investigations are the connections between some genetic markers, and certain pathology and the population frequency of the markers. In the researches of multiple births, as one of the most actual problems, lay the study of the biology of the multiple births in connection with the social conditions, the intense migration of young people inside the country and abroad, the increase of the children born out of wedlock, the steroid hormones therapy, etc. The twin investigations in Bulgaria must include also the multiple births researches and the use of the second twin method – MZ sets brought up in different conditions. In the field of medical-genetic investigations, the insurance of some conditions for modern citogenetic diagnosis wants a solution.

IV. Medical-anthropological investigations. As an almost new part of the anthropological science, medical anthropology is like an unitive link between anthropology and medicine. The study of forms and sizes variations of human body in norm and in transition between norm and pathology, and the knowledge

of data for the changes in different diseases guarantee both the early diagnosis of the illnesses and the etio-pathogenesis of them. For the needs of the medical anthropology are studied the features of human body in healthy individuals, the specific of their physical development, their constitution and the dermatoglyphic characterization. The manifestation of changes in human body (men with different psycho-physical disorders, chromosome diseases etc.) are examined also. Anthropological markers provoking the corresponding diseases and the transition among norm and pathology in the external features— body form and size and its parts are looking for. A particular part of the medical anthropological investigations are the dermatoglyphic investigations. Both healthy individuals (representative contingent for the Bulgarian population), and persons with different diseases are studied. Here can be joined the examinations for identification – examination for paternity.

The tasks laying before the medical anthropology are:

-1. To make norms for the differentiation between norm and pathology, and to do an interval possition for the medial forms from norm to pathology for children, growing up and adults;

-2. To fix the markers for the early phases of the respective pathology with a view of the prophylaxes in the modern science.

V. Investigations in the field of the ethnic anthropology. The investigations in the field of the ethnic anthropology help the clearing of the mechanism and the way of forming the local populations and the different human races. On the basis of the examination of the population in different regions in Bulgaria are made anthropological characterizations of separate ethnic and ethnographic groups in the view of clearing their ethnogenesis (Turks, Tatars, Bulgarian Mohammedans, Turkish-speaking Bulgarians of the Varna region, Lipovanians, Karakachans, Kapans, Hurtsoj men etc.).

The insufficient anthropological investigations of the modern Bulgarian population connected with the genesis of the folk determine the future tasks of the ethnic anthropology in our country:

-1. Systematic anthropological researches of separate territorial, geographic, ethnographic and ethnic groups of people;

-2. To establish the common ethnical, the regional, and the local features of the modern Bulgarian population.

This investigations will have a considerable meaning in the settlement of a big circle of problems as: – formation and origin of the folks from the Indo-European linguistic community, and the repercution of the historic processes on the anthropological typification of the modern Bulgarian population.

VI. Paleoanthropological investigations. In Bulgaria are carried out systematic paleoanthropological investigations which exceed already the study of a separate necropolies only. The numerous matherials from the archaeological excavations present the anthropological characterization of the population who have lived in our lands during different epochs. The data give a good possibility for copious comparative analysis. From the Neolith to the Late Middle Ages can be traced the dynamics in the development of the basic anthropological types, as well as to be cleared the running of the two epochal processes – brachycephalization and gracilization. The established morphological variations of the archaeological types at the end of the Antiquity and mainly during the Middle Ages enable the searching of their connections with the intense migration processes and the metissation of different tribes and folks.

The race-typological investigations are to be added with new data. The generalization of the different anthropological data about the applying of some ethnic customs, as the unnatural head deformation and the detailed analysis of the symbolic trepanations connected until now only with the Old-Bulgarian ethnos must be examined too.

The accumulated in the last years paleodemographic data give a possibility to be traced the demographic history of the Bulgarian population from the Neolith to the end of the Middle Ages, and to be looked for connections of it with the socioeconomic development, migrations, and some other factors which have had effect upon the history.

Generalized investigations in the field of the paleopathology are also imminent. The signs from different sickly modifications of the bone structure must be summarized by nosological units, and must be examined in differential-diagnostic plan. Both the sickly changes, and the traumatic injuries traced during the times will give interesting additional knowledge about the separate populations and their manner of life and labour.

A special place in the paleoanthropology and in the ethnic anthropology have the odontological investigations. The picked up odontometric and odontoscopic materials add the anthropological characteristics of the investigated population with the specific data about the development of the teeth-jaw apparatus, the different diseases in the times and areas of the country, the subsequent racial-typological features etc.

VII. Investigations in the field of the anthropological plastic reconstruction of the face on the skull. In the laboratory of plastic anthropological reconstruction of face, which exists as an independent group in the Institute of Cell Biology and Morphology – Bulgarian Academy of Sciences, are worked out the basic morphological principles of the method, and are gotten concrete results (scientific publications, plastic and graphic reconstructions, museum exhibits and museum exhibitions). The investigations of the morphology of the human face, respectively of the face skull parts for the needs of the plastic reconstruction will be deepened and extended on the base of the achievement, evaluating the foreign experience and taking into account the technical possibilities of the modern science. The studies will continue turned to slightly studied morphological structures with importance for the external relief of some face interrelations and correlations, to the age changes of the external features etc. The volume of the work of plastic reconstructions will be widened with a view to exhibiting the physical types of the people who have inhabited our lands from the Neolith to the Middle Ages.

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Paleodemographic and paleopathologic data of late antique population of Augusta Trayana

N. Kondova, S. Cholakov

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

Paleoanthropological material from the southern necropolis of the ancient town of Augusta Trayana has been examined. By means of paleodemographic analysis and examination of pathological changes in the bones of 370 individuals (107 children, 33 adolescents, 118 females, and 112 males) the authors study the demographic situation, the frequency of occurrence and the course of some inflammatory, degenerative and infection diseases, as well as the dental – maxillary paleopathology and the traumatic injuries, characteristic of the period and the examined population in particular.

Key words: paleodemography, paleopathology, Late Antiquity, Thracian lands.

The southern necropolis of Augusta Trayana, sited 150 m away from the fortified wall of the ancient town, has been discovered in 1976-77 during rescue excavations in the center of Stara Zagora. Graveplots, stone tombs, vaults and communal graves, 264 in all, dated 2-5 c. A. D, have been studied. The peculiarities of the grave fittings give the base to presume that most of the buried are ordinary town population of Augusta Trayana [4]. Race-type analysis gives stressed superiority of the Southeuropean race stem with 54,4% Mediterranean and 7,2% Protomediterranean race types [3]. That fact, as well as the names on tomb's inscriptions, testify to the presence of compact mass of Thracian population in the Roman town of Augusta Trayana, that has kept some of its ethnical customs up to the Late Antiquity.

The purpose of the present study is to expand the notion of conditions of life and social situation of the population of Augusta Trayana, great administrative center in Roman province Thracia, using paleodemographic analysis and examination of pathologic changes in bone-joint system.

Material and methods

The anthropologic study covers skeletons of 370 individuals: 107 children, 33 adolescents, 118 females, and 112 males. The demographic indices, used as a base

for the present analysis, are calculated by the method of Acsadi and Nemeskeri [1]. The tendencies of demographic processes' course are best revealed in four of them: "relative death frequency" (d_x), "further expected life span" (e_x), "life expectancy" (l_x), and "risk of dying" (q_x).

Paleopathologic data are obtained by macroscopic and X-ray examination of skulls and postcranium skeletons. Odontologic investigation is carried out on 545 dentitions, with 9276 teeth available, including 133 children's dentitions with 1491 milk teeth. Caries frequency (CF), caries intensity (CI), and index of cariosity (IC) are calculated.

Results and discussion

Paleodemography. Demographic processes, directly connected to the social development, reflect not biological events only, but cultural history of any people also. The term "average life expectancy" is defined by UNO as forthcoming duration of life for new-borns (e_0), which for the group investigated is 31,34 years. That index must be carefully interpreted and considered in paleoanthropologic investigations because of the highly varying number of children's skeletons. Child mortality in Augusta Trayana population is 29%, and having in mind the relatively low part of 0-1 year-old children, its real value is probably over 40%, that is, life duration is lower. The index e_{20-24}, being further expected life span of adults, is more reliable. It is expected persons aged twenty to live 24,54 years more, and to reach about 40 years age. Female's life duration is below average level, and 5 years less than male's (27,41 years). Considering the interrelation between sexes, the greater number of males of mature and senile age makes an impression (Fig. 1), and that is a distinguishing feature, characteristic for the Antiquity. There are 47 females to 75 males at the age over 45 in the population studied. The same tendency can be followed on the diagram of relative death frequency: female's curve has two peaks, first maximum at 35 years and the second at the interval 50-55 years (Fig. 2); male's curve forms only one maximum only after 50. The greatest intersex differences are observed at the age of till 40. 46,6% of all the females get into that interval, while the males are 24,10% into it. The variations of the values of q_x index, indicator of risk of dying at definite age for a person, are in support of these data (Fig. 3). The index for males starts to increase not until 40-45 years, while female's index is three times greater at 30-40 years. The difference diminishes gradually in the next age intervals, and after 55 the probability to die is higher for males. That peculiarity is observed for other populations of Antiquity [5] and Middle Ages [6], and reflects a common regularity in demographic processes. Comparing the demographic situation in Bulgarian lands with that of other European countries, we find conformation of this tendency. The indices for free town population of ancient Rome, are closest to our results, further expected life span (e_{20}) being 25,2 years in average (26,9 for males and 23,4 for females), as can be seen from the published data [1]. Though we could expect higher level of civilization in bigger settlements of the Roman empire, as Augusta Trayana and Abritus on our lands, the results show that the still insufficient development of medicine could not prevent complications in pregnancy and parturition, as well as the heavy, some times epidemically passing, diseases, specific for the childhood. These are the main reasons for higher mortality of young females and of high child mortality not only in early

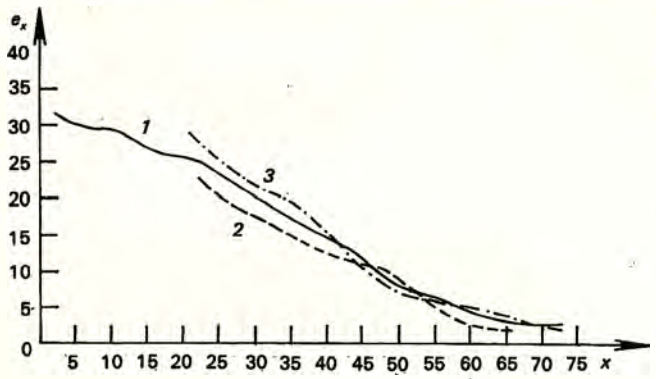

Fig. 1. Further expected life span
1 – 00+♂♂+♀♀; *2* – ♀♀; *3* – ♂♂

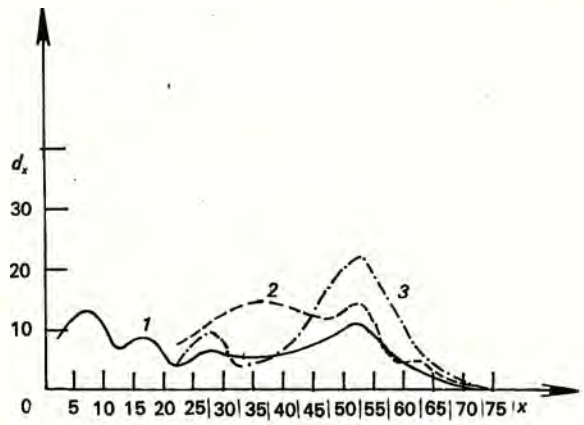

Fig. 2. Relative death frequency in various age intervals
1 – 00+♂♂+♀♀; *2* – ♀♀; *3* – ♂♂

childhood, but in the interval between 5-9 years too. 47% of all the children at the age of 0-14 years get in that interval. Life expectancy (l_x) confirms these data – only 51,89% of the population have reached 30 years.

Paleopathology. Proof of different disease's dissemination are the morphologic changes of bones. Degenerative-distrophic processes, inflammations, traumatic injuries, as well as some common diseases, have left specific traces on the skeletons. Spondyloarthrosis changes are discovered in 12% of adult individuals (Fig. 4) that are the most often diagnosed disease of the group of chronic degenerative processes [2]. Light and middle heavy forms of course are prevailable. X-ray grams show congestions at the edges of vertebrae, converting in osteophates. The deformations of small joints, formation of bone clamps, ossifying of longitudinal ligaments and knitting of neighbour vertebrae are more rare. The heavy arthrosis changes of big joints are rather exceptions, being most often consequence of traumatic injuries. That is the case with chronic deformation osteoarthrosis coxae, developed after heavy injuries fracture of both cruris bones (Fig. 5).

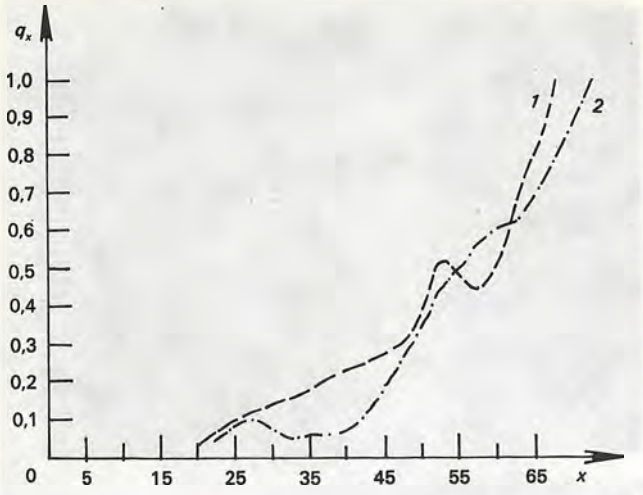

Fig. 3. Risk of dying in various age intervals
1 – ♀♀; *2* – ♂♂

Fig. 4. Chronic deformation spondyloarthrosis

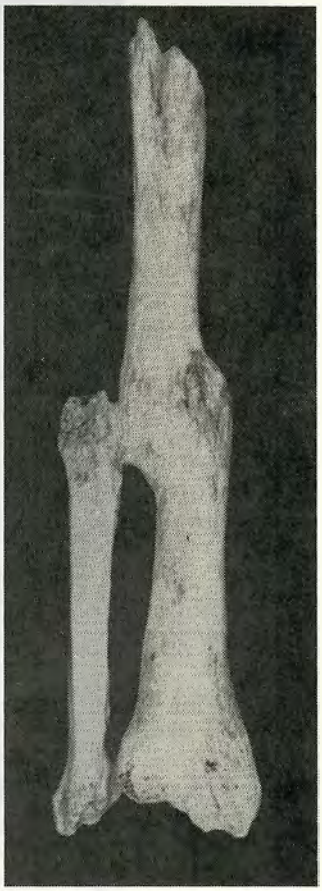

Fig. 5. Complicated fracture of cruris bones

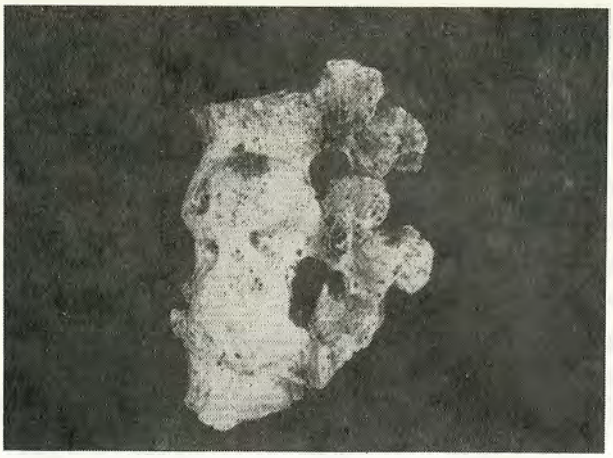

Fig. 6. Chronic tubercular spondylitis

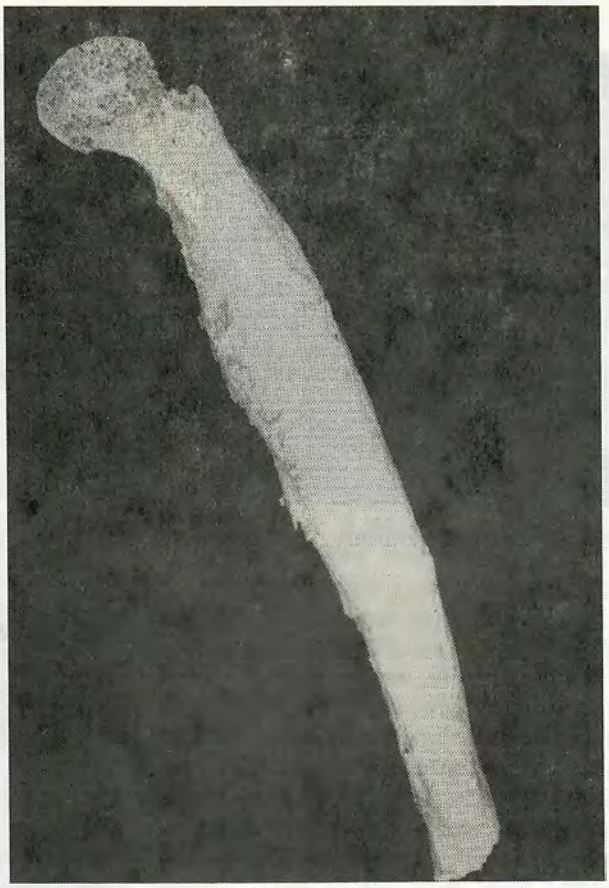

Fig. 7. Chronic osteomyelitis

Fig. 8. Tumour-like formation in skull bones

Inflammable processes, causing specific changes in bone structure, must be mentioned as a separate group. Tubercular-spondylitis and chronic osteomyelitis are found as separate cases (Fig. 6, Fig. 7). Chronic post traumatic periostitis are more frequent. In some cases arthrosis changes of big and small joints are combined with inflammable process and have heavier course, causing deformations and ancilosis.

Osteohondrom of femoral bone and osteom of ribs, tumour-like formations are diagnosed. The X-ray data for a case of forbregmatic tumour formation with irregular form (Fig. 8) give indication for a malignant process.

The traces of skull-brain traumae are not frequent. Only two cut injuries are penetrating in depth, not showing healing, being the probable cause of death (Fig. 9).

Except for the described disease changes, observed in paleoanthropological studies the investigation of population of Augusta Trayana gives information about some more rare diseases too. The high frequency of symmetric orbital

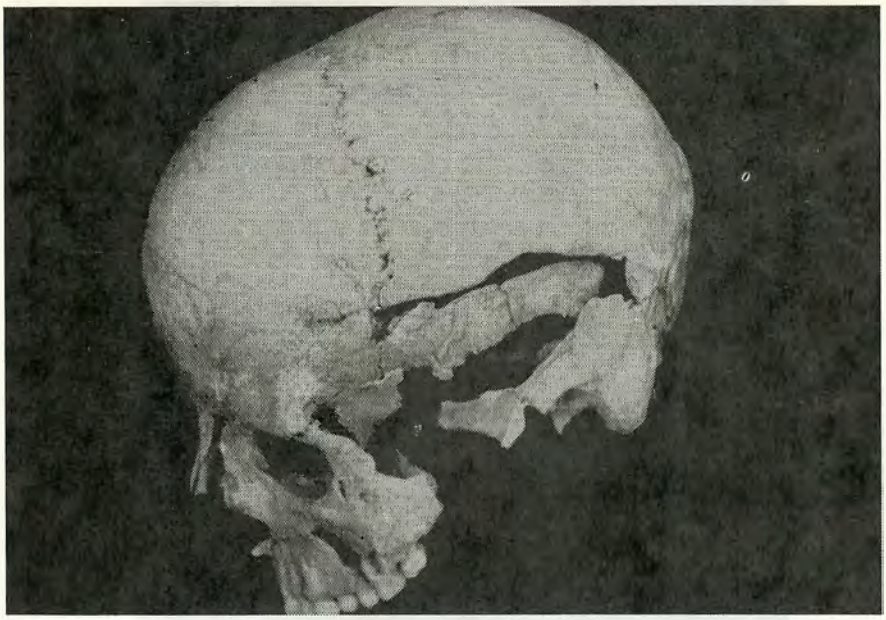

Fig. 9. Traumatic lesions in parieto-accipital region of skull

osteoporosis – 10 cases, half of which are in second and third stage of development – cribra orbitalia porotica, cribra orbitalia trabecularis, is notable. These morphologic changes indicate serious illness – congenital haemolytic anaemias of talassemia type – having lethal end between 14 to 18 years.

Another characteristic peculiarity is the presence of data about outbreak of an epidemic. Detail investigation of grave fittings, communal graves (containing 5 and more skeletons) and the mass tomb (more than 40 buried) discounts war battles and big fires as a reason. Age-sex structure of the studied individuals corresponds to demographic structure of the population – 37% children, 35% females and 27% males. That data, as well as the lack of traces of violent death, guide to assumption of heavy epidemic disease that struck the population of Augusta Trayana near the end of 5 c. A. D.

Tooth-maxillary paleopathology. The population studied is notable for relatively high cariosity – CF = 50,24, CI = 7,17 and IC = 3,60. The caries is met in milk teeth in early childhood yet. Caries damages of constant teeth appears in children yet, and gradually increase with age. The quik development of carious process is typical of the population studied (Table 1). Half of the carious teeth are roots, and in one third complications in tooth adjoining tissues exist (granulomatous lesions and cysts). Anomalies in teeth number and situation, as well as maxillar fractures, are rare in the dentitions studied.

Conclusions

1. The results of paleodemographical and paleopathological study give information of relatively good living standard of the population.

Table 1. Stomatological status of skulls from Augusta Trayana's necropol. Permanent teeth

Age group	Sex	Total number of skulls	Available teeth	Teeth lost post mortem	Teeth lost ante mortem	Tartar	Alveolar atrophy	Tooth abrasion	Superficial caries	Medium profound caries	Profound caries	Roots	Carious teeth	Skulls with carious teeth	Granulomatous lesions	Cystous lesions	Ideal amount of teeth	Actual amount of teeth	Caries intensity	Caries frequency	Index of cariosity	Archaeological dental index
Infans II	—	77	838	142	—	0,09	—	—	5	1	—	—	6	6	—	—	980	980	0,72	7,79	0,06	85,81
Juvenis	—	45	985	281	—	0,65	—	—	5	3	1	—	9	7	1	—	1266	1266	0,91	15,55	0,14	77,80
Adultus	♀	68	1526	573	70	1,27	1,51	1,68	52	11	12	15	90	39	12	—	2169	2099	5,90	57,35	5,90	72,70
	♂	38	885	294	36	1,35	1,51	1,67	19	11	10	17	57	21	14	—	1215	1179	6,44	55,26	3,56	75,06
Maturus	♀	75	1430	635	331	1,50	2,61	3,26	22	31	34	89	176	56	53	5	2396	2965	12,31	74,67	9,19	69,25
	♂	82	1737	590	297	1,47	2,55	3,37	36	19	33	85	173	58	51	14	2624	2327	9,96	70,73	7,04	74,64
Senilis	♀	13	179	60	177	1,54	2,96	3,88	1	1	2	19	23	19	12	1	416	239	12,85	76,92	9,88	74,89
	♂	14	205	86	157	1,53	2,68	3,93	—	2	4	18	24	10	11	2	448	291	11,71	71,43	8,36	70,45
Total		412	7785	2661	1068	1,09	1,56	1,93	140	79	96	243	558	207	154	22	11 514	10 446	7,17	50,24	3,60	74,53

2. The development of demographic processes obeys a general tendency, common for Late Antique and Middle Age population in whole Europe.

3. The high frequency of symmetrical orbital osteoporosis, connected to congenital haemolytic anaemias, is a characteristic peculiarity.

4. The population of the Roman town of Augusta Trayana has been struck by heavy epidemic disease in the end of its existing.

5. Paleodemographic and paleopathologic study of Augusta Trayana's population reflects the demographic situations in Thracian lands in the end of Antiquity and, in fact, represents a stage of demographic history and social development of the population living on the territory of contemporary Bulgaria.

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A new approach for assessment of asymmetry in paleoanthropological material

A. Nacheva

Institute of Cell Biology and Morphology,
Bulgarian Academy of Sciences, Sofia

An original method for assessment of asymmetry in paleoanthropological material is given. The informative possibilities of this method are shown on the results of its applying to published metrical data for long bones [5].

Key words: paleoanthropology, long bones, asymmetry.

The enrichment and detailing of information, got by studying anthropological bone remains, are of great importance for the reconstruction of morphologic characteristics of ancient people, and for getting some knowledge on their ontogenesis. The anthropological bone remains are mainly studied for: sex and age determination; morphologic characterization on the base of scopic and metric data; description and documentation of pathologic finds. The skull bones are studied metrically in details, while in the postcranial bone material, the lengths of the long bones, are measured only, in order to determine the hight of the individuals [1, 3, 7]. However, rich biometric information, which could be used as a base of reason-consequens analysis of age-sex differences through the different ontogenesis stages of population in near and remote past, remains uncollected and unstudied [5].

The metric bilateral differences of the pair long bones are relatively less studied. The results published concern mainly the crossed asymmetry in lengths of: humerus, which is right dominant, and radius, which is left dominant [4, 5]. That statement is based on rending an account of the direction of the metric dominance only, while the size of asymmetry remains without discussion. One of the most important reasons for neglecting it, is probably the lack of objective base for comparison of the differences between right and left values in pair features, whose main dimensions are of different orders. For example, bilateral difference of 2 mm does not show high asymmetry for a feature with main dimension over 500 mm, but it is significant for a feature with main dimension less than 50 mm.

There have been published attempts for objectifying the comparative assessment of bilateral differences on bone remains and living population, by initiating different indices, but they all provide comparison on intergroup level, as they use mean values [2, 6]. Rubrications, based on the data of these indices, do not render an account of the size of the feature's asymmetry shown, even at the group level. For example, there are three possibilities for Duncker's index: when the index is 0 there is no asymmetry, when it is +1 rightside asymmetry presents and, when it is −1 leftside asymmetry presents.

The results of our investigations (using our method) on asymmetry in different social-professional groups of contemporary population, show that the features of morphologic body asymmetry possess high ecosensitivity and give rich information about intersex and interage differences [8]. This results give us the base for seeking similar information in bone material, having in mind that any successful attempt for its enrichment would be of great importance for the paleoanthropological studies.

The purpose of the present work is to study the applicability and informativeness of our method for comparative assessment of asymmetry in paleoanthropological material.

Materials and methods

Published metric data of bilaterally studied long bones from ancient slavic necropolis in Czechoslovakia, dated IX century, are used in this investigation [5]. The publication of these authors gives extensive metric material about the base pair long bones of adult individuals of both sexes in four age groups from 20 to 60 years. There are bilateral data for: humerus, radius, ulna, femur, tibia, and fibula bones for sufficiently great number of individuals, shown in Tables 1 and 2 respectively. At the same time the possibility for comparative assessment of asymmetry, on the base of the absolute differences between right and left dimensions of the features, is summarized in the only conclusion about the asymmetry. The cited authors establish that: "...The long bones of the upper limbs, in mean values, are longer at the right side, and on contrary, the long bones of the lower limbs, in mean values, are longer at the left side..." [5].

Our method is based on introducing nondimensional standardized indices of asymmetry, named "Units of Asymmetry" (UA). They provide objective comparative assessment of the size of the manifested asymmetry on individual, group and intergroup levels, independent on the primary feature's value or dimension. UA are calculated easily and quickly. They are the differences between 100 and the percentage ratio of right and left values of the features. UA are positive when right dominance is present and negative, when left dominance is present.

Results and discussion

The mean values of the right and left dimensions of the features studied – grouped in decades – taken from the publication cited, and the absolute differences between them and the corresponding UA, computed additionally by us, are presented in Table 2. The combined data for all the period

Table 1. Metrical data of bilaterally investigated long bones commonly for 20-60 years of age

Features	Men					Women				
	n	$\bar{X}_r$	$\bar{X}_l$	dif.	UA	*n*	$\bar{X}_r$	$\bar{X}_l$	dif.	UA
Humerus	158	333,4	329,5	3,9	1,2	97	303,2	300,2	3,0	1,0
Radius	116	250,9	248,9	2,0	0,8	74	227,1	225,1	2,0	0,9
Ulna	44	270,7	268,9	1,8	0,7	32	245,0	243,1	1,9	0,8
Femur	223	458,3	460,2	1,9	−0,4	167	416,2	417,1	0,9	−0,2
Tibia	166	375,5	377,2	1,7	−0,5	130	341,3	341,6	0,3	−0,1
Fibula	13	367,8	366,6	1,2	0,3	9	334,6	336,0	1,4	0,4

Table 2. Metrical data of bilaterally investigated long bones – in decades

Features	Indicators	(20-30) – I age group		(30-40) – II age group		(40-50) – III age group		(50-60) – IV age group	
		♂	♀	♂	♀	♂	♀	♂	♀
Humerus	*n*	15	16	29	33	70	41	44	7
	$\bar{X}_r$	336,3	304,3	332,4	299,1	331,1	307,8	336,8	307,4
	$\bar{X}_l$	332,7	300,3	328,5	297,3	326,8	301,9	333,4	304,3
	dif.	3,6	4,0	3,9	1,8	4,3	5,9	3,4	3,1
	UA	1,1	1,3	1,2	0,6	1,3	2,0	1,0	1,0
Radius	*n*	6	14	21	22	54	28	35	10
	$\bar{X}_r$	252,0	227,4	252,2	224,5	249,9	229,4	251,5	226,2
	$\bar{X}_l$	247,0	226,5	250,3	222,2	248,0	227,2	249,7	223,4
	dif.	5,0	0,9	1,9	2,3	1,9	2,2	1,8	2,8
	UA	2,0	0,4	0,8	1,0	0,8	1,0	0,7	1,2
Ulna	*n*	3	5	7	11	20	10	14	6
	$\bar{X}_r$	278,7	242,6	264,0	243,0	268,7	247,8	275,8	246,0
	$\bar{X}_l$	273,3	243,2	262,0	241,2	267,9	245,2	272,9	243,2
	dif.	5,4	−0,6	2,0	1,8	0,8	2,6	2,9	2,8
	UA	2,0	−0,2	0,8	0,7	0,3	1,1	1,1	1,2
Femur	*n*	19	32	32	46	101	63	71	26
	$\bar{X}_r$	453,1	416,9	455,5	412,1	457,3	418,0	462,3	418,1
	$\bar{X}_l$	455,5	417,7	458,1	413,2	458,9	418,9	464,3	418,6
	dif.	−2,4	−0,8	−2,6	−1,1	−1,6	−0,9	−2,0	−0,5
	UA	−0,5	−0,2	−0,6	−0,3	−0,3	−0,2	−0,4	−0,1
Tibia	*n*	16	22	21	43	78	50	51	15
	$\bar{X}_r$	366,4	340,9	375,9	336,8	373,1	344,5	382,1	343,7
	$\bar{X}_l$	369,8	341,9	377,5	337,5	373,5	344,7	383,1	342,7
	dif.	−3,4	−1,0	−2,6	−0,7	−0,4	−0,2	−1,0	1,0
	UA	−0,9	−0,3	−0,4	−0,2	−0,1	−0,1	−0,3	0,3
Fibula	*n*	1	–	3	3	5	5	4	1
	$\bar{X}_r$	355,0	–	359,0	320,7	363,8	340,8	382,5	352,0
	$\bar{X}_l$	350,0	–	358,7	320,7	362,2	341,6	382,3	354,0
	dif.	5,0	–	0,3	0,0	1,6	−0,8	0,2	−2,0
	UA	1,4	–	0,1	0,0	0,4	−0,2	0,1	−0,6

from 20 to 60 years are presented in Table 1. As it is can be seen from the data in Tables 1 and 2, and even more clearly, from their graphic expression for humerus and femur, taken as examples, at Fig. 1, one could hardly derive richer information, using only the absolute values of right and left dimensions of the features and their differences than that of the authors cited, i. e. that the humerus

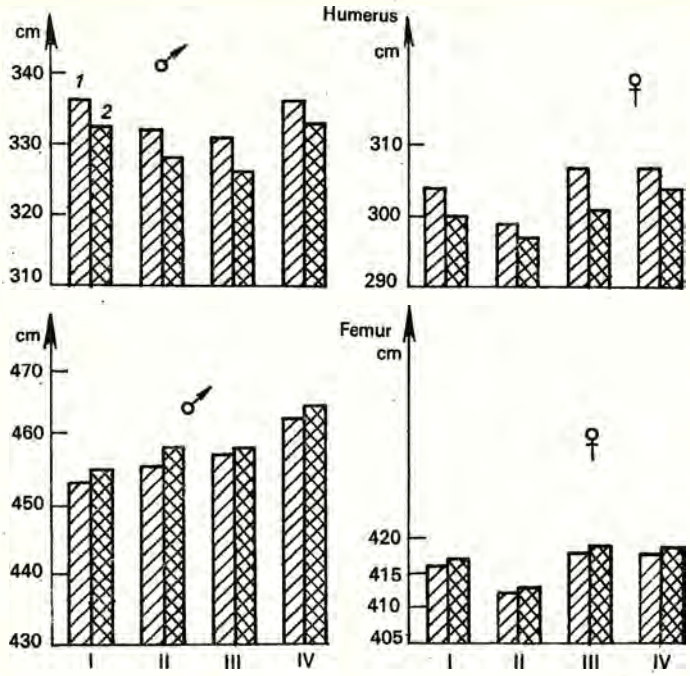

Fig. 1. Manifestation of asymmetry, expressed by absolute right/left values of features
1 – right; *2* – left
I age group – 20-30 years; II age group – 31-40 years; III age group – 41-50 years: IV age group – 51-60 years

is right dominant and the femur is left dominant. In order to compare the informativeness of the absolute values of the bilateral differences and the proposed standartized indices of asymmetry – UA, their values are juxtaposed in Table 3. The juxtaposition in the first part of Table 3 shows, for example, that UA, equal to 2, corresponds to different absolute differences: for the humerus – 5,9 mm, for the ulna – 5,4 mm, and for the radius – 5,0 mm. On the other hand, 5 mm absolute difference for the fibula corresponds to 1,4 UA, and so on. The second part of Table 3 illustrates that absolute differences of 2 mm for the femur, ulna, and fibula correspond to different asymmetry, expressed in UA equal to 0,4, 0,8 and 0,6 respectively.

That data give convincing grounds to accept that UA objectify the comparative assessment of asymmetry manifestations, giving the possibility to analyse the size of asymmetry for different features, independently on their main dimensions. When studying the bone material, UA give rich additional information. The long bones of the upper limb for both sexes reveal higher asymmetry than that of the long bones of the lower limb, during the whole period (20-60 years) (Fig. 2). Anyway, the intersex differences are more distinct for the asymmetry of the long bones of lower limb for which the women have comparatively smaller UA. The fact, that men's fibula show rightside asymmetry, that is laterality different from their known leftside stereotype, and UA showing that the established rightside asymmetry is significant, is of interest too. The women's fibula show the known leftside asymmetry of the lower limb (Fig. 3). The UA values give more detailed and richer information when following the age

Table 3. Comparison between UA and absolute value of right – left differences of some investigated features

	UA	Differences, mm
I	2,0	5,9 (Humerus – women, III age gr.) 5,4 (Radius – men, I age gr.) 5,0 (Ulna – men, I age gr.)
	1,4	5,0 (Fibula – men, I age gr.)
	1,1	3,6 (Humerus – men, I age gr.) 2,9 (Radius – women, IV age gr.) 2,6 (Radius – women, III age gr.)
	0,6	2,6 (Femur – men, II age gr.) 2,0 (Fibula – women, IV age gr.) 1,8 (Humerus – women, II age gr.)

	Differences, mm	UA
II	2,0 (Femur – men, IV age gr.)	0,4
	(Radius – men, II age gr.)	0,8
	(Fibula – men, IV age gr.)	0,6

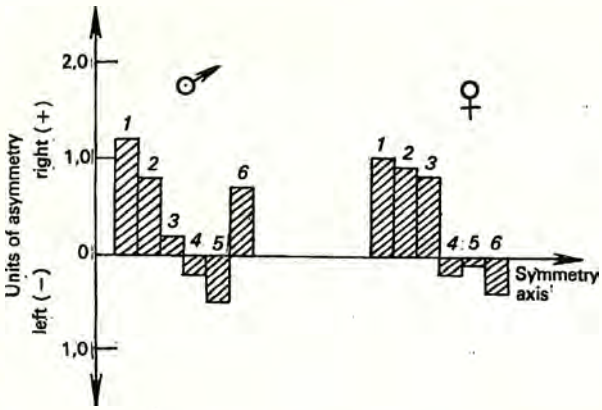

Fig. 2. Manifestation of asymmetry, expressed by UA commonly for 20 to 60 years
1 – humerus; *2* – radius; *3* – ulna; *4* – femur; *5* – tibia; *6* – fibula

dynamics of asymmetry. The data about long bones studied show that, also for the bone material the size of asymmetry occurs to be a characteristics of higher ecosensitivity, while laterality remains relatively constant for all the age groups of the period studied. Each of the bones studied shows specific tendency of asymmetry size dependence on age and sex. The asymmetry for men's humerus increases gradually up to 50 years. That is, during the active labour period of men, and after that decreases. Such a tendency is not observed for women. The manifestation of asymmetry for radius shows enhanced sex dimorphism – asymmetry decreasing with age for men, and on contrary for women – chronologically increasing. The tendency for the ulna is similar. This type of reactivity is evidently in connection with the functional engagement of the upper limb, typical

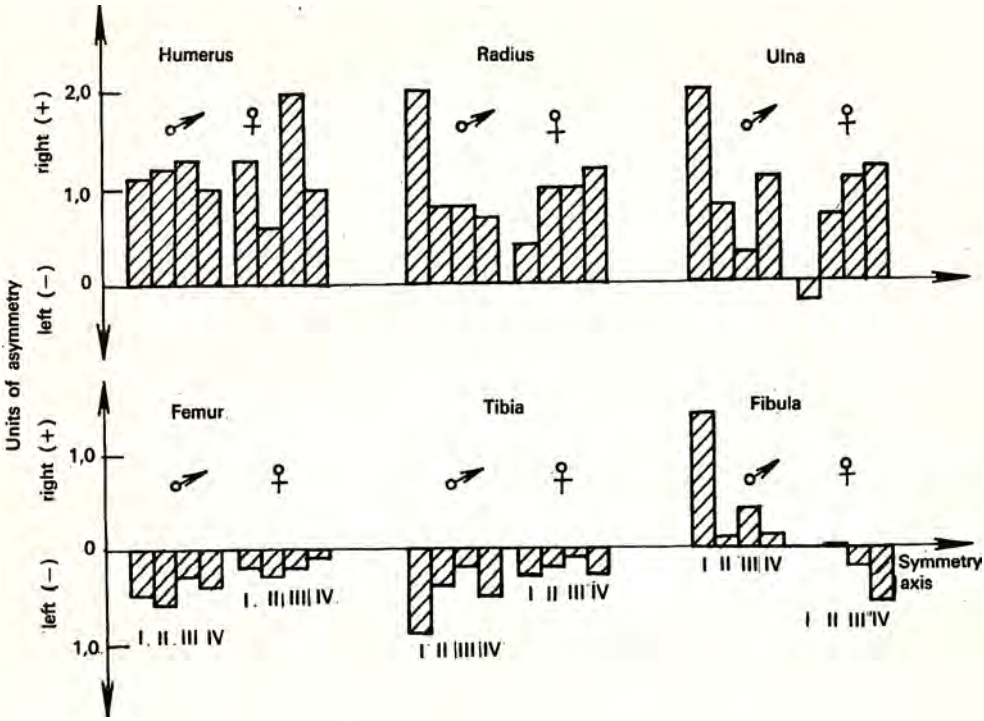

Fig. 3. Manifestation of asymmetry, expressed by UA – in decades
I age group – 20-30; II age group – 31-40; III age group – 41-50; IV age group – 51-60

for both sexes. The leading role of the humerus for asymmetry manifestation is determined by stronger physical efforts of arm and shoulder men's muscles. For the women the manipulation is usually finer and with less physical efforts so the asymmetry manifestation is determined by ulnar and radial muscles. A tendency for decreasing the asymmetry with age is traced for the long bones of the lower limb for both sexes. That enhances the significant functional dependence of the asymmetry size once again. Fibula shows specific interage differences in asymmetry manifestations with the age, being rightside and decreasing for men, and – leftside and increasing for women.

Conclusions

1. Information with rich biological content for long bone asymmetry is achieved by using our method of assessment. This information is much more objective, extensive and detailed comparatively to the only conclusion about the asymmetry given in the paper cited.

2. The established specific intersex and interage differences in asymmetry manifestations of the long bones studied show that the asymmetry is a biometric characteristic with great information possibilities and can be used as a model for tracing some of the changes occurring in man's morphological characteristic during the different stages of ancient people's ontogenesis in paleoanthropological studies.

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Anthropological data about the population from the West Rhodopes

L. Kavgazova, Zl. Filcheva

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

900 men and 1076 women from the three territorial groups of the West Rhodopes constituted the subject of the study. In the analysis 13 anthropological features were included. All three anthropological types established by us among the population from the West Rhodopes enter the composition of the modern Bulgarian people and formed on a very old local anthropological Balkan substrate.

Key words: anthropological types, Dinaric type, Pontic type.

The present work is dedicated to the anthropological study of the Bulgarian-Mohammedans from the West Rhodope region. The interest to the anthropological composition of this population is determined by its population-demographic structure which has been formed under the influence of its confessional isolation. According to the studied of Iv. Georgieva and D. Moskova [4] the Bulgarian-Mohammedans from West Rhodopes are characterized with endogamous conjugal ties but excluding marriages reaching the third-cousin degree. Because of the endogamy this marital structure bears the features of a biological population in which specific for the region anthropological types have been formed. This fact determines also the great interest to the investigation on the anthropological types from an historical-ethnographic Rhodope district in a better preserved and more ancient form. As a whole the Rhodopes are poorly studied in an anthropological respect. Partial investigations with an ethnogenetic purpose have been carried out by M. Popov [6], P. Boev at al., L. Hristova [8]. These investigations contribute significantly to the construction of wholesome anthropological characteristics of the Rhodope population.

The region of the West Rhodopes stretches from the Mesta river valley to the West to the Vurbitza river to the East [5]. In the monography of M. Popov [6] a total of 150 males and 48 females from various districts of the West Rhodopes have been studied: Assenovgrad – 31 males, Smoljan – 78 males and 48 females, Zlatograd – 35 males, Devin – 1 man, Ardino – 5 men.

The aim of the present study is: 1) By a statistically significant number of persons investigated to make morphological characteristics of the studied West Rhodope population and to trace the territorial changeability of the racial-diagnostic features among the population of three territorial groups – a south-west one (Dospat-Trigrad), southern one (Smiljan) and the south-east one (the region of the village of Startsevo), 2) Definition of certain typical of the Bulgarian-Mohammedans from this region anthropological types.

Materials and methods

900 men and 1076 women from the three territorial groups of the West Rhodopes constituted the subject of the study. 415 men and 462 women were investigated from the Dospat-Trigrad region from the Smiljan one – 382 men and 491 women and from the region of Startsevo village– 103 men and 123 women. The studied contingent comprises predominantly farmers and small owners. The age of the individuals under study is between 25 and 50 years. In the processing of the anthropological material from the West Rhodopes was used the population approach. Its application in the anthropological survey of contemporary population renders the opportunity for the use of the anthropological results as an historical source since the population represents the lowest level of racial classification. In the present work an attempt is made for transition in the following degree of racial classification – the separation of the typical of the region studied anthropological types or a group of populations. This stage of the processing of the anthropological material is of great importance in the restoration of ethnical community history entering the composition of these anthropological types or groups of population.

The anthropological studies in the West Rhodopes were performed after the conventional anthropological methods [2, 6] observing the basic principles of the ethnogenetic investigation. In the anthropological study of the West-Rhodope population the geographical factor was used as a binding link between anthropology and ethnographic systematics. In the comparative-population approach the method of Penrose and of the combination polygons for summed comparison of the groups [1, 7] was used. In the analysis 13 anthropological features were included (8 presented with their absolute values and 5 indexes) and 6 scopic features as well.

Results and discussion

The data from the investigation of the head, the face and the visual evaluation of the morphological features which are not susceptible to measurment are presented in Tables 1-7. The mathematical characteristics of each feature give the possibility to get an impression of the averaged anthropological peculiarities for each territorial group. The data summed up for the three territorial groups from the West Rhodopes compared to the data of M. Popov [6] for the total Bulgarian population are presented in Table 2. The results from the investigation of the scopic features are presented in Tables 3-7 and the comparative data about certain scopic features between the summarized West-Rhodope population and the total Bulgarian one are presented in Figs 1 and 2. The greater percent of the dark hairs and with greenish-brown eyes among the studied West Rhodope

Table 1. Statistical parameters of the measured features in the groups under study

Features	Sex	Dospat-Trigrad region $n♂=425$, $n♀=462$			Smiljan region $n♂=382$, $n♀=491$			Startsevo $n♂=103$, $n♀=123$		
		$\bar{x}$	s	m	$\bar{x}$	s	m	$\bar{x}$	s	m
Head length (mm)	men	190,97	11,65	0,57	186,29	6,37	0,32	190,05	5,87	0,58
	women	181,48	6,49	0,30	176,26	5,82	0,26	179,77	5,60	0,50
Head breadth (mm)	men	155,26	9,56	0,47	158,42	5,44	0,28	147,17	5,14	0,51
	women	149,21	5,65	0,26	150,11	5,24	0,24	141,53	4,73	0,43
Bizygomatic breadth (mm)	men	141,67	11,78	0,58	141,14	5,24	0,27	134,02	5,95	0,59
	women	134,88	5,69	0,26	132,54	4,82	0,22	128,77	4,88	0,44
Mandibular width (mm)	men	110,61	9,43	0,46	108,78	6,70	0,34	105,76	5,80	0,57
	women	102,92	8,13	0,38	101,57	5,20	0,23	100,24	5,04	0,45
Morphological height of face (mm)	men	124,20	9,06	0,44	124,35	6,31	0,32	125,19	6,36	0,63
	women	115,06	5,83	0,27	113,38	5,48	0,25	113,90	5,59	0,50
Nose height (mm)	men	56,96	5,12	0,25	54,94	3,58	0,18	54,31	3,51	0,35
	women	53,16	4,10	0,19	50,28	3,45	0,16	48,81	3,58	0,32
Nose width (mm)	men	34,44	3,50	0,17	34,99	2,88	0,15	34,65	2,70	0,27
	women	31,84	2,87	0,13	31,62	2,55	0,12	31,97	2,52	0,23
Cephalic index (%)	men	81,30	3,80	0,19	85,04	3,90	0,20	77,53	3,44	0,34
	women	82,22	3,50	0,16	85,16	3,87	0,17	78,80	3,48	0,31
Morphological face index (%)	men	87,67	5,21	0,26	88,10	5,01	0,26	93,48	5,72	0,56
	women	85,31	4,80	0,22	85,54	4,92	0,22	88,55	5,05	0,46
Mandible-zygomatic index (%)	men	78,08	4,50	0,22	77,07	4,05	0,21	78,84	4,57	0,45
	women	76,30	3,90	0,18	76,63	3,97	0,18	77,86	4,07	0,37
Transversal-cephalofacial index (%)	men	91,25	3,60	0,18	89,09	3,70	0,19	91,10	3,54	0,35
	women	90,40	3,40	0,16	88,30	3,60	0,16	90,93	3,41	0,31
Height-width nose index (%)	men	60,46	5,90	0,29	63,69	6,98	0,36	64,13	7,08	0,70
	women	59,89	5,40	0,25	62,89	6,58	0,30	65,81	6,99	0,63
Body height (cm)	men	169,09	5,20	0,26	165,47	5,29	0,27	170,83	7,43	0,74
	women	158,13	5,50	0,26	150,72	5,14	0,23	157,91	5,53	0,50

population compared to the data of M. Popov [6] makes a definite impression. In Figs 3 and 4 the results from the comparison of the territorial groups among themselves and with respect to the total Bulgarian population are presented. Summing up the results from the analysis of the statistical parameters of the measurement and scopic features for the population from the three territorial groups certain peculiarities can be differentiated thus defining the corresponding anthropological type.

The anthropological type of the population from the south-west territorial group (Dospat-Trigrad one) displays the following characteristics: height – above the average, brachycephaly, a greater bizygomaticum width compared to the other two territorial groups and the total Bulgarian one but with a smaller medium morphological height (mesoprosope), with a more pronounced mandibular width comparatively high and medium wide nose, with a straight convex profile. The hairing of the beard and the breasts is over the average. The pigmentation (hair, eyes) is transitory – from darker variants close to the Mediterranean anthropological types to considerable depigmentation (the eyes).

Table 2. Comparative data about the statistical parameters of the West Rhodope population and total Bulgarian population

Features	Sex	West Rhodopes $n♂=900$, $n♀=1076$			Total Bulgaria, after Popov [6] $n♂=5749$, $n♀=2152$		
		$\bar{x}$	s	m	$\bar{x}$	s	m
Head length (mm)	men	188,88	9,15	0,30	189,02	6,69	0,09
	women	178,90	6,09	0,18	180,29	5,63	0,12
Head breadth (mm)	men	155,68	7,60	0,25	153,78	6,26	0,08
	women	148,74	5,36	0,16	149,90	5,53	0,12
Bizygomatic breadth (mm)	men	140,57	8,93	0,30	139,63	5,76	0,08
	women	133,11	5,21	0,16	132,43	5,66	0,12
Mandibular width (mm)	men	109,28	7,99	0,27	108,62	5,83	0,08
	women	102,00	6,60	0,20	101,91	5,16	0,11
Morphological height of face (mm)	men	124,38	5,19	0,17	126,84	6,54	0,09
	women	114,16	4,88	0,15	118,52	5,96	0,13
Nose height (mm)	men	55,80	4,35	0,14	58,25	3,93	0,05
	women	51,35	3,76	0,11	56,53	3,65	0,08
Nose width (mm)	men	34,70	3,16	0,10	33,72	2,45	0,03
	women	31,75	2,69	0,08	31,34	2,27	0,05
Cephalic index (%)	men	82,46	3,80	0,13	81,30	4,40	0,06
	women	83,17	3,67	0,11	83,23	3,78	0,08
Morphological face index (%)	men	88,52	5,19	0,17	90,81	5,29	0,07
	women	85,78	4,88	0,15	89,53	5,36	0,11
Mandible-zygomatic index (%)	men	77,74	4,32	0,14	77,89	3,95	0,05
	women	76,63	3,95	0,12	77,13	4,06	0,09
Transversal-cephalofacial index (%)	men	90,32	3,64	0,12	91,04	3,66	0,05
	women	89,50	3,49	0,11	88,44	3,78	0,08
Height-width nose index (%)	men	62,25	6,51	0,22	58,23	5,59	0,07
	women	61,94	6,15	0,19	55,75	5,15	0,11
Body height (cm)	men	167,75	5,54	0,18	170,90	6,11	0,08
	women	154,72	5,34	0,16	160,38	5,46	0,12

Table 3. Colour of the skin of the population from the studied groups

Group	Sex	White (1)		Swarthish (2)		Swarthy (3)		Medium score
		n	%	n	%	n	%	
Dospat-Trigrad region	men	380	92,01	32	7,75	1	0,24	1,08
	women	440	95,89	19	4,11	–	–	1,03
Smiljan region	men	307	81,43	66	17,51	4	1,06	1,20
	women	455	92,86	33	6,73	3	0,41	1,08
Startsevo	men	87	84,47	16	15,53	–	–	1,16
	women	121	98,37	2	1,63	–	–	1,02

The percent of the bright eyes (with greenish-brown and bright) is greater than the average. For the southern territorial group (the Smiljan one) the more typical morphological features are as follows: medium height, brachycephaly, a cross diameter considerably higher in comparison with the other territorial groups,

Table. 4. Colour of the eyes of the population from the studied groups

Group	Sex	Dark (1-4)		Mixed (5-8)		Blue (9-12)		Medium score
		n	%	*n*	%	*n*	%	
Dospat-Trigrad region	men	154	37,11	176	42,41	85	20,48	1,83
	women	158	34,35	238	51,74	64	13,91	1,80
Smiljan region	men	94	24,61	229	59,95	59	15,44	1,91
	women	180	36,66	254	51,73	57	11,61	1,75
Startsevo	men	24	23,53	70	68,63	8	7,84	1,84
	women	48	39,02	65	52,84	10	8,14	1,69

Table. 5. Colour of the hair of the population from the studied groups

Group	Sex	Blonde (A-O)		Dark (P-Y)		Reddish (I-VI)		Medium score
		n	%	*n*	%	*n*	%	
Dospat-Trigrad region	men	24	5,78	388	93,50	3	0,72	,95
	women	18	3,90	439	95,02	5	1,08	,97
Smiljan region	men	9	2,36	372	97,38	1	0,26	1,98
	women	21	4,28	464	94,50	6	1.22	1,97
Startsevo	men	1	0,97	101	98,06	1	0,97	2,00
	women	3	2,44	117	95,12	3	2,44	2,00

Table 6. Shape of the hair of the studied groups

Group	Sex	Straight soft (b)		Medium wavy (c)		Big wavy (d)		Small wavy (e)		Medium score
		n	%	*n*	%	*n*	%	*n*	%	
Dospat-Trigrad region	men	280	67,63	103	24,88	30	7,25	1	0,24	2,32
	women	401	86,80	52	11,25	9	1,95	—	—	2,15
Smiljan region	men	282	74,21	56	14,73	37	9,74	5	1,32	1,12
	women	406	82,69	59	12,02	25	5,09	1	0,20	1,22
Startsevo	men	71	68,93	20	19,42	10	9,71	2	1,94	1,45
	women	100	81,30	11	8,94	6	4,88	6	4,88	1,33

Table 7. Shape of the nose of the studied groups

Group	Sex	Concave (1-5)		Straight (6-10)		Convex (11-15)		Medium score
		n	%	*n*	%	*n*	%	
Dospat-Trigrad region	men	7	1,69	215	51,93	192	46,38	2,45
	women	43	9,31	297	64,28	122	26,41	2,17
Smiljan region	men	15	3,93	249	65,18	118	30,89	2,27
	women	52	10,59	348	70,88	91	18,53	2,08
Startsevo	men	3	2,91	74	71,85	26	25,24	2,22
	women	16	13,01	88	71,54	19	15,45	2,02

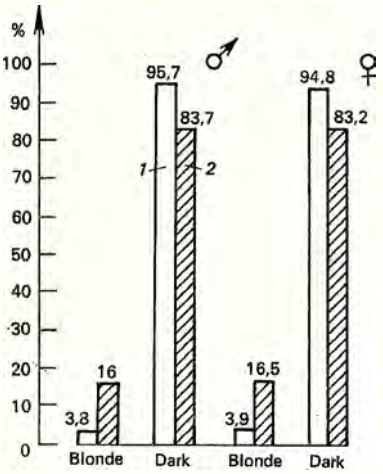


Fig. 1. Comparative data about the hair colour
1 – West Rhodopes; *2* – total Bulgaria, after Popov [6]

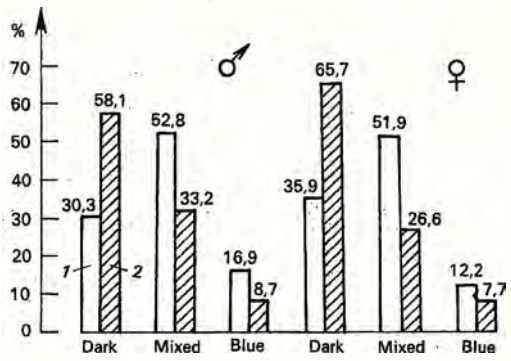
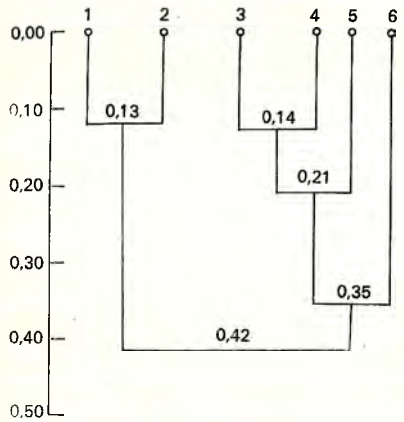


Fig. 2. Comparative data about the eyes colour
1 – West Rhodopes; *2* – total Bulgaria, after Popov [6]



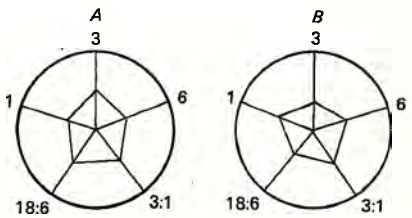


Fig. 3. Morphological distance between the studied territory groups and the total Bulgarian population, after Popov [6]

Fig. 4. Polygonic graphs showing the variation of morphological traits between West Rhodopean population (*A*) and total Bulgarian population (*B*), after Popov [6]

comparatively well expressed bizygomaticum width and moderately pronounced mandibular width. The face is of medium width and height. The nose dimensions are of medium value, the straight forms of the profile being prevalent. In this group also the mixed hues of the eyes are predominant while the hair are mainly dark-brown. The population from the south-east territorial group has the following anthropological characteristics: tall, but with the smallest value of the cross diameter of the head both with respect to the other two groups and to the total Bulgarian population, mesocephaly. In comparison to the other two territorial groups the face is much more narrow and elongated, hyperlepto-

prosopes. The nose profile is a straight one-compared to the other two groups with the smallest number of convex forms while in women the concave ones are also found. The eyes are predominantly of transitory pigmentation (with greenish-brown eyes) and less dark, the skin is white and the hair-brownblack. The hairing of the breasts and the beard is above the average tending to strong.

From the comparative analysis of the morphological peculiarities of the population from the three territorial groups from the West Rhodopes it is seen that there exists a clearly expressed proximity, but a certain variability as well.

In the population from the two territorial groups – the south-west one (Dospat-Trigrad) and the southern one (Smiljan) two variants can be differentiated among the anthropological types with pronounced brachycephaly. The first one is closer to the Dinaric anthropological type, and the second – to the Alpic or bright brachycephalic "central-european" type [3]. The morphological peculiarities of the anthropological type established among the population of Startsevo village district is related to Pontic anthropological type [9].

According to the investigations of M. Popov [6] all three anthropological types established by us among the population from the West Rhodopes enter the composition of the modern Bulgarian people and are formed on a very old local anthropological Balkan substrate.

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Differences and degree of identity between certain face dimensions

Y. Yordanov, Br. Dimitrova

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

By means of classical anthropometry 108 grown-up individuals of the male sex and 112 – of the female one aged 18-32 years, students, have been investigated. The following facial dimensions were taken: interpupillary distance, nose width, distance between the apexes of the maxillar canines, height of theear, width of the left eye-lid slit, the height between Glabella-Subnasale and the height between Gnathion-Labrale superius. The results obtained are statistically processed. After the analysis of the identity and the differences between the mean values of the analyzed sizes and the distribution of the differences according to the prevalence of the given dimension, the authors draw the conclusion that the identity and the differences among these facial dimensions can be used as an objective guide in the solution of certain practical tasks of anthropology.

Key words: anthropometry, facial dimensions, identity.

The interrelationship between definite constant anatomical sizes in the facial part of the skull (human face respectively) is known for quite a long time now [1, 3, 6]. It can be traced beginning from the canons of the old masters of fine art. Michelangelo Buonaroti was the first in 1493-1494 to take as a module the physiognomical height of the face which he divided into three equal parts with parallel to the horizontal plain lines [3]. This was accepted also by other famous authors from the Middle Ages such as Leonardo da Vinchi, Albrecht Dürer etc.

The purpose of the present study is to look for the degree of identity and the differences between some of the face dimensions in grown-up individuals with regard to application in anthropology – the method of plastic anthropological reconstruction of the head by the skull [4, 5, 9].

Material and methods

108 individuals of the male sex and 112 of the female one aged 18-32 years have been investigated by the classical anthropological method (9). The following dimensions limited by the points have been taken (Fig. 1):

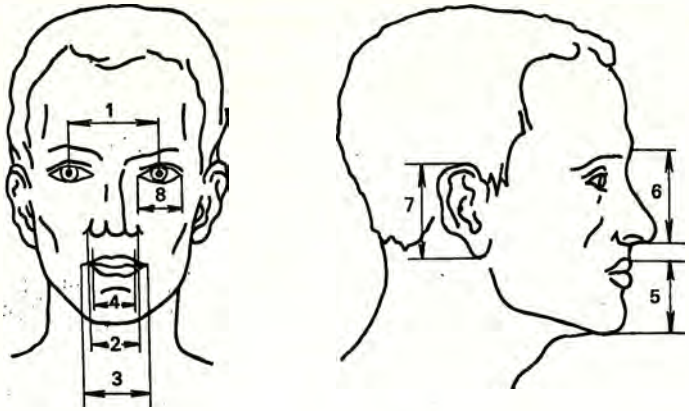


Fig. 1. Anthropometrical points and dimensions

1. Centrum pupillae dex. – centrum pupilae sin. (interpupillary distance),
2. Alare – Alare (width of nose),
3. Cheilion – Cheilion (width of mauth slit),
4. Distance between the apexes of the upper canines,
5. Labrale superius – Gnathion,
6. Glabella – Subnasale,
7. Supraaurale – Subaurale (height of the ear),
8. Ektokanthion sin. – Entokanthion sin. (width of the left eye-lid slit).

Identity as well as differences were sought between the eight dimensions as follows:

1. Interpupillary distance – Cheilion – Cheilion,
2. Cheilion – Cheilion – Labrale superius – Gnathion,
3. Interpupillary distance – Labrale superius – Gnathion,
4. Alare – Alare – Apexes of $\frac{3}{3}$,
5. Alare – Alare – width of the left eye lid slit,
6. Glabella – Subnasale – height of the ear.

For each dimension the medium value with the basic parameters (Table 1) has been calculated. The recorded differences are distributed into three groups: with absolute identity (difference = 0); with the first dimension greater

Table 1. Statistical characteristics of 8 facial dimensions in grownups of both sexes (♂ n – 108; ♀ n – 112)

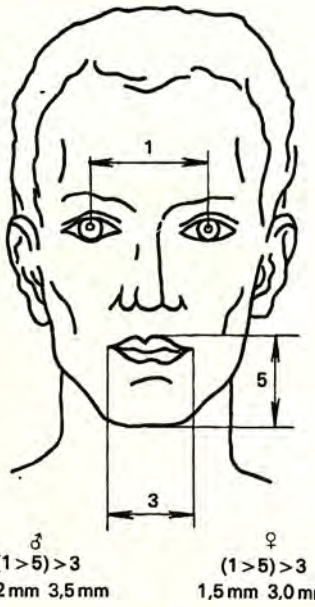
Dimensions	Females			Males		
	x	σ	m	x	σ	m
1. Interpupillary distance	54,4	3,6	0,3	57,9	4,0	0,4
2. Alare-Alare	32,2	2,3	0,2	36,2	2,8	0,3
3. Cheilion-Cheilion	49,9	2,7	0,3	53,9	3,2	0,3
4. Apexes $\frac{3}{3}$	33,7	2,0	0,2	35,0	2,4	0,2
5. Labrale sup.-Gnathion	52,9	3,8	0,4	57,4	4,8	0,5
6. Glabella-Subnasale	65,6	3,8	0,4	69,8	4,6	0,4
7. Height of the ear	60,5	3,3	0,3	65,2	3,9	0,4
8. Width of the eye-lid slit	32,2	2,6	0,4	34,1	2,3	0,3

(difference +) greater second dimension (difference −). The groups are differentiated separately for both sexes. The differences are presented for each group by an ordinary arithmetic mean in mm and their frequency and distribution – in an absolute number and in percent.

Results and discussion

The mean values of the face dimensions (Table 1) are greater in the individuals from the male sex, which a regular consequence of sexual dimorphism. In the following three groups of sizes a degree of identity can be sought; interpupillary distance, width of the mouth slit; height Gnathion-Labrale superius; width of the nose; apexes of 3|3, width of the eye-lid slit; height of the auricle, height Glabella-Subnasale.

For the first group of dimensions (No 1, 3, 5) the interpupillary distance is with greatest value and with the lowest one is the width of the mouth slit (Fig. 2). The height between Gnathion and Labrale superius takes the intermediate position between them. The difference for the individuals of the male sex is 0,2 mm between the size No 1 and No 5, i. e. a practical identity exists. In the individuals from the female sex the difference is 1,5 mm for these dimensions. The width of the mouth slit is closer in value to the height Gnathion-Labrale superius. The differences between these dimensions are 3,5 mm for the males and 3,0 mm for the females respectively. The mean values from this group show a similarity the



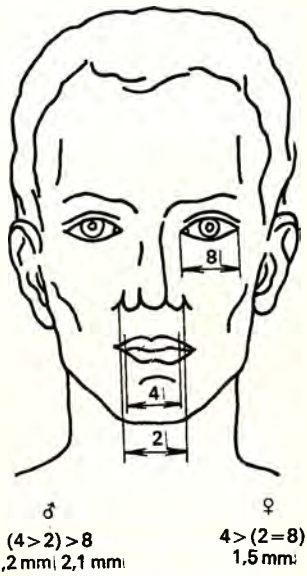


Fig. 2. Differences between the dimensions: interpupillary distance, Gnathion-Labrale superius, and width of the mouth slit

Fig. 3. Differences between the dimensions – width of nose, width of the eye-lid slit and distance between the maxillar canines apexes

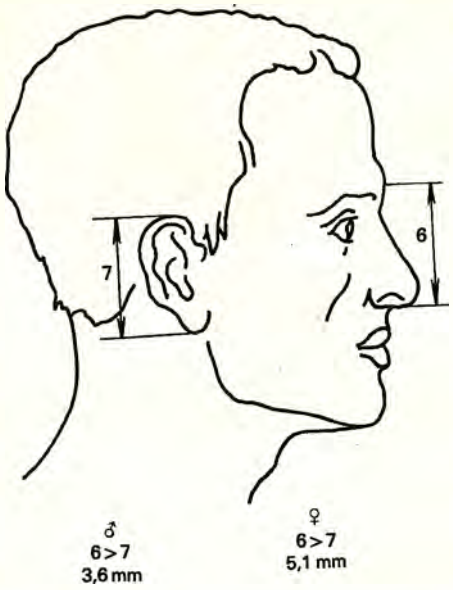


Fig. 4. Distances between the dimensions Glabella-Subnasale, height of the ear

differences between them being insignificant. This shows that they can be used in practice without possessing the qualities of cannons or absolute dependencies.

The dimensions of the second group (No 2, 4, 8) have little differences among themselves (Fig. 3). For the individuals of the female sex a complete coincidence is recorded between the nose width and the width of the eye-lid slit. This value is by 1,5 mm lower than the distance between the apexes of the maxillar canines. In the individuals from the male sex the nose width is of greatest value of all three

Table 2. Distribution in percent of the differences between eight facial dimensions in grownups of both sexes (♂ n – 108, ♀ n – 112)

Dimension	Females							
	difference 0		difference +			difference –		
	n	%	n	%	$\bar{x}$	n	%	$\bar{x}$
1. Interpupillary distance Cheilion-Cheilion	9	8,1	89	79,5	+6,0	14	12,5	−2,3
2. Cheilion-Cheilion – Labrale sup. – Gnathion	8	9,1	23	20,5	+3,5	81	72,3	−5,7
3. Interpupillary distance Labrale sup.-Gnathion	9	8,1	61	55,0	+5,0	41	36,9	−5,1
4. Alare-Alare – apexes of 313	12	10,7	21	18,8	+2,8	79	70,5	−3,4
5. Alare-Alare – width of the left eye-lid slit	5	9,1	20	36,4	+3,0	30	54,5	−3,3
6. Glabella-Subnasale – height of the ear	8	7,2	90	81,1	+6,7	13	11,7	−2,8

dimensions. The distance between the apexes of the canines is by 1,2 mm smaller and so is the width of the eye-lid slit by 2,1 mm. Practically the distance between the apexes of the maxillar canines, can serve as an objective guide in the determination of the nose width and the width of the eye-lid slit and vice-versa.

The third group is related to the height of the ear and the height between Glabella and Subnasale (Fig. 4). This relationship has been manifold investigated [7, 8]. In our results the ear height is smaller than the other distance by 3,6 mm for the males and by 5,1 mm for the women. This confirms the standpoint about the comparatively smaller auricle in female individials.

The brief analysis of the data in Table 1 shows the proximity and the differences between the mean values of the dimensions and outlines the global tendency for identity or difference. The gathering in groups of the differences according to the prevalence of one or the other dimension (Table 2) underlines the individual picture. In the males there is an absolute identity of some of the dimensions (difference = 0) from 1,9% to 15,7% and in women this is in the limits of 7,2% – 10,7%, i. e. the cases of identity of the dimensions are more frequent in male individuals. This, however, contradicts the common view that the woman's face is more regularly and more symmetrically shaped.

From the distribution of the differences in the first group of dimensions (the first 3 in Table 2) it is seen that they are in limits from 2,3 to 6,0 mm.

The interpupillary distance is greater than the width of the mouth slit in 79,5% of the females and in 73,1% for the males and is greater than the height between Gnathion and Labrale superius in 55,0% and 48,6% respectively. This determines also the reverse frequency of the differences between the width of the mouth slit and the height between Gnathion and Labrale superius – 72,3% for the females and 75,9% for the males.

In the second group (4 and 5 in Table 2) is seen that the width of the nose is greater than the distance between the apexes of the maxillar canines in 18,8% for the females and in 57,4% for the males, and is also bigger than the eye-lid slit width in 36,4% and 65,4% respectively. This distribution emphasizes once again the already noted greater nose width in the individuals of the male sex.

Males							
difference 0		difference +			difference −		
n	%	n	%	$\bar{x}$	n	%	$\bar{x}$
16	14,8	79	73,1	+6,0	13	12,0	−3,0
2	1,9	24	22,2	+4,6	82	75,9	−5,9
10	9,8	52	48,6	+5,8	45	42,1	−6,0
17	15,7	62	57,4	+3,4	29	26,9	−2,6
6	10,9	36	65,4	+3,7	13	23,7	−3,2
11	10,2	85	78,7	+6,6	12	11,1	−4,1

The height of auricle is smaller than the Glabella-Subnasale distance in 81,1% for the female and in 78,7% for the males. The differences are of comparatively great value of 6,6 – 6,7 mm. This can be partly explained with the difficulty in the precise determination of the Glabella point in the region between the eye-brows in the living individual.

Summing up the analysis of the results obtained a conclusion can be drawn that the degree of identity established and the differences between some of the basic facial dimensions can successfully be used as an objective guide in solving some practical tasks of anthropology.

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Movement of the hand in persons of both sexes during 21-30 years of age

V. Lilova, S. Tornjova-Randelova

Institute of Cell Biology and Morphology,
Bulgarian Academy of Sciences, Sofia

The goniometric features of the hand (dorsal flexion, volar flexion, abduction, adduction, supination and pronation) were studied in 250 men and 250 women in age from 21 to 30 years, divided into 5 groups according to age and sex. Sex and age differences were established. The age 24 years is a "limit" after which limitation in the hand movement begins.

Key words: goniometry, wrist joint, dorsal flexion, volar flexion, abduction, adduction, supination, pronation.

The hand of man is the main organ for the realization of his multiple working and living activities. Studies of the hands' morphofunctional characteristics, including changes in its movement, are of significant importance. Similar studies on the age changes of the movement of the hand, foot and head at 10 years interval have been carried out in our country [3, 4, 5].

The aim of the present study is to search for age and sex differences in the movement of the hand, but at a 2 years interval.

Material and methods

The goniometric characteristics of the hand in 250 men and 250 women 21 to 30 years of age were studied. The persons were divided into five age-groups I (21-22 years), II (23-24 years), III (25-26 years), IV (27-28 years) and V (29-30 years). The movement of the hand was characterized by the following goniometric characters: dorsal and volar flexion, abduction and adduction, pronation and supination, fulfilled from a standardized situation and measured at the level of the wrist joint (Fig. 1). An originally constructed device for three-dimensional goniometry was used [2]. The investigation was carried out according to the methods proposed by Мутафов, Торньова [1]. The main biostatistical characteristics ($\bar{x}$, S, $S_{\bar{x}}$, V) were determined for each age group and in both sexes. The measured units were

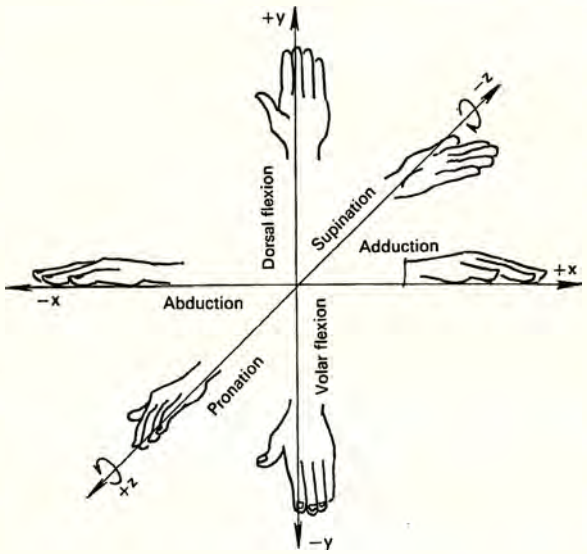

Fig. 1. Scheme of goniometrical indicators of the hand

degrees of angle determined with an allowance of 0,1°. The direction and volume of the age changes were also traced by the computed interage index (IAI) of change [3].

Results and discussion

The values of the three-dimensional goniometry, represented as volume of movements are highest in the second age group (23-24 years) for both sexes (Fig. 2). This holds true for the whole volume of abductional-adductional movements and of flexional and rotational movements. Second, the age group I (21-22 years) comes and in the last place is the oldest age group (29-30 years) for men and the age group IV (27-28 years) for women. The limitations in the volume of the abductional-adductional movements are most distinctly expressed in the last three age groups (25-26, 27-28, 29-30 years).

The finding is similar also for the six separate goniometric features (Tables 1 and 2). An exception is only observed for the abduction movement in both sexes and for the pronation in men, where the age group I (21-22 years) has the highest values. The higher values for the adduction and supination in the age group II (23-24 years), however, compensate this and the total volume of abductional-adductional and rotation movements remains highest in that same group II (23-24 years), as it already has been pointed out.

Consequently, the changes in the goniometric characters of the hand in both sexes form two general groups: the first one (21 to 24 years) is characterized with higher values; in the second one (25 to 30 years) decreasing of the hands' movement is observed. However, the differences between the separate age groups are negligible (Fig. 2).

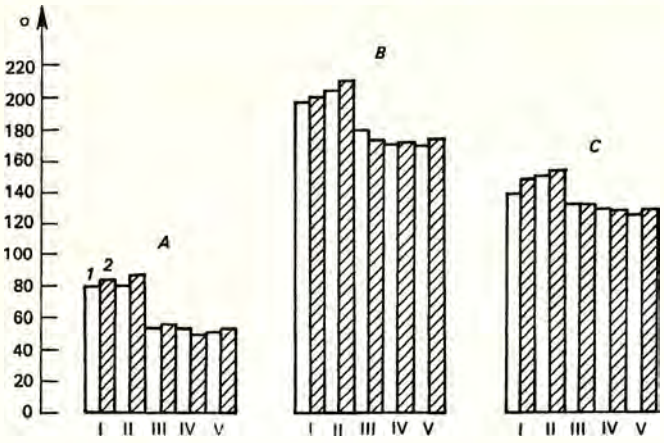

Fig. 2. Volume-movements of the hand
A – abductive-adductive movements; *B* – rotary movements, *C* – flexional movements
1 – men; *2* – women
I–V – age-sex groups

Table 1. Biostatistical characteristics of the goniometrical indicators of hand – men

Features	21-22*	23-24	25-26	27-28	29-30	21-22	23-24	25-26	27-28	29-30
		Adduction					Abduction			
$\bar{x}$	37,94	40,12	21,32	21,34	19,24	42,72	41,46	32,70	33,82	33,00
S	7,82	8,99	5,72	8,45	6,47	8,35	7,50	9,20	10,20	12,06
$S_{\bar{x}}$	1,11	1,27	0,81	1,20	0,92	1,18	1,06	1,30	1,44	1,70
V	20,61	22,41	26,83	39,60	33,63	19,54	18,09	28,13	30,16	36,54
IAI		+5,74	−46,86	+0,09	−9,84		−2,95	−21,13	+3.42	−2,42
		Supination					Pronation			
$\bar{x}$	149,52	159,66	141,62	137,82	140,26	50,64	45,18	39,62	36,86	33,38
S	16,72	18,99	16,97	16,22	16,99	14,33	14,44	13,06	11,24	14,16
$S_{\bar{x}}$	2,36	2,68	2,40	2,29	2,40	2,02	2,04	1,85	1,59	2,00
V	11,18	11,89	11,98	11,77	12,11	28,30	31,96	32,96	30,49	42,42
IAI		+6,78	−11,30	−2,68	+1,77		−10,78	−12,31	−6,97	−9,44
		Dorsal flexion					Volar flexion			
$\bar{x}$	62,74	63,98	60,84	59,78	58,60	78,04	83,56	72,00	71,52	71,14
S	9,50	11,95	14,11	11,91	10,67	8,68	9,80	9,97	10,10	12,20
$S_{\bar{x}}$	1,34	1,69	2,00	1,68	1,51	1,23	1,39	1,41	1,43	1,72
V	15,14	18,68	23,19	19,92	18,21	11,12	11,73	13,85	14,12	17,15
IAI		+1,98	−4,91	−1,74	−1,97		+7,07	−13,83	−0,67	−0,53

* age groups.

The decrease of the hands' movement after age group II is confirmed also by the negative values of the computed IAI. This is particularly well manifested in the abductional-adductional movements where the index values are as follows: −46,86 for adduction, −21,13 for abduction, for men, and −43,81 for adduction and −21,71 for abduction for women (Tables 1 and 2).

Table 2. Biostatistical characteristics of the goniometrical indicators of hand – women

Features	21-22*	23-24	25-26	27-28	29-30	21-22	23-24	25-26	27-28	29-30
	Adduction					Abduction				
$\bar{x}$	40,26	42,36	23,80	21,96	22,10	43,50	43,26	33,84	29,72	31,10
S	8,24	9,24	11,63	7,34	7,38	10,28	9,82	12,49	11,35	9,88
$S_{\bar{x}}$	1,16	1,31	1,64	1,04	1,04	1,45	1,39	1,77	1,60	1,40
V	20,47	21,81	48,86	33,42	33,39	23,63	22,70	36,91	38,19	31,77
IAI		+5,22	−43,81	−7,73	+0,64		−0,55	21,78	−12,17	+4,64
	Supination					Pronation				
$\bar{x}$	159,96	164,58	135,0	133,08	134,36	46,36	48,44	43,38	42,48	42,62
S	16,68	18,95	20,51	21,29	16,89	17,19	21,42	15,80	16,75	14,52
$S_{\bar{x}}$	2,36	2,68	2,90	3,01	2,39	2,43	3,03	2,23	2,37	2,05
V	10,63	11,51	15,19	16,00	12,57	37,08	44,22	36,42	39,43	34,07
IAI		+4,85	−17,97	−1,42	+0,96		+4,49	−10,45	−2,07	+0,33
	Dorsal flexion					Volar flexion				
$\bar{x}$	65,54	71,48	59,32	59,74	60,96	81,62	83,16	73,20	70,68	71,12
S	10,47	8,79	11,98	10,10	11,44	8,95	7,87	11,62	12,82	8,99
$S_{\bar{x}}$	1,48	1,24	1,69	1,43	1,62	1,26	1,11	1,64	1,81	1,27
V	15,97	12,30	20,20	16,91	18,77	10,96	9,46	15,87	18,14	12,64
IAI		+9,06	−17,01	+0,71	+2,04		+1,89	−11,98	−3,44	+0,62

*age groups

The intersex comparison of the hand movement shows that it is slightly higher in women, particularly in both younger groups. For the remaining groups no regularity is observed (Fig. 2). The differences thus mentioned are probably due to the well-known fact that the capabilities for movement of joints in women are greater.

Conclusion

Our results suggest that the age of 24 years represents a "limit" after which a more weakly or strongly expressed decrease in the hand movement begins. The appearance of this changes in the goniometric characteristics are probably connected with the period of finishing of the biological development of the individual and particularly of the sindesmological system of the locomotory system as well as a result of the systematic influence of the working and living activities. The detailed elucidation of this problems requires further investigations within broader age limits and in persons of different professional groups.

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An attempt to determine the professional differentiation in anthropometric characteristics of various groups of workers

*A. Nacheva, A. Zhelezarov**

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia
** Group for Mathematical Modelling in Biology, Bulgarian Academy of Sciences, Sofia*

Factor analysis has been applied to metric data of two men groups, practising two types of physical activity: machine-building and office workers. Set of anthropometric features, responsible for the adaptation of the organism to different working conditions was investigated.

Key words: anthropometric characteristic, professional differentiation, factor analysis, mobile features.

The establishment of biological laws governing the system of relations between anthropometric morpho-functional characteristics, exogenic factors and variability is one of the basic problems of the physical anthropology [1, 2, 3, 4].

This paper makes an attempt to discover the differentiation in anthropometric characteristics investigating individuals with different physical activity.

Material and methods

Two models of different physical activity (groups of workers execising two different types of labour – machine-building and office workers) have been used. 108 men from each professional group have been studied, their age varying between 30 and 40 years, everyone having exercised his profession for 10 years. The study included 60 static and functional-dynamic anthropometric features and 7 indices derived on their basis and characterising the asymmetry in the constitution and function of the body and its parts (Table 1).

In order to study the influence of labour as a factor for the professionally determined differentiation in the anthropometric characteristics we applied factor analysis with a subsequent varimax rotation of the factor matrix following Kaiser

Table 1. Investigated features

1. Stature
2. Sitting height
3. Trunk length
4. Upper limb length
5. Arm length
6. Forearm length
7. Hand length
8. Wrist length
9. Finger IIIth length
10. Hand breadth at thumb
11. Hand thickness
12. Spread of the fingers
13. Envelopment of the Ist and IInd fingers
14. Lower limb length
15. Thigh length
16. Leg length
17. Sphirion length
18. Height to the arch of foot
19. Foot length
20. Foot breadth
21. Biacromial breadth
22. Bideltoid breadth
23. Chest depth
24. Chest breadth
25. Chest circumference – pause
26. Chest circumference – in
27. Chest circumference – out
28. Medium chest circumference
29. Respiratory difference 26-27
30. Respiratory difference 26-25
31. Respiratory difference 25-27
32. Bicristal breadth
33. Bitrochanteric breadth
34. Waist circumference
35. Hip circumference
36. Arm circumference contracted
37. Arm circumference relaxed
38. Contractive difference
39. Forearm circumference
40. Thigh circumference
41. Leg circumference
42. Weight
43. Skinfold-triceps
44. Skinfold-biceps
45. Skinfold-forearm
46. Subscapular skinfold
47. Skinfold at the X-th rib
48. Abdominal skinfold
49. Vital capacity
50. Pulse
51. Hand force
52. Hand flexion
53. Hand extension
54. Flexion-extension volume
55. Hand adduction
56. Hand abduction
57. Adduction-abduction volume
58. Hand pronation
59. Hand supination
60. Hand rotation
61. Asymmetry index – height
62. Asymmetry index – upper limb
63. Asymmetry index – lower limb
64. Asymmetry index – circumferences
65. Asymmetry index – skinfolds
66. Asymmetry index – movements – partial
67. Asymmetry index – movements – common

(1952). Maximum number of selected factors was determined using the eigenvalue criterium – the factors with eigenvalues equal or greiter than 1 have been included. For the identification of the different factors we assumed that features having the highest factor loadings which do not participate in other factors as well should be accepted to be the features with taxonomic importance.

Results and discussion

Results from the analysis of the factor matrix of machine-building workers

The factor structure of the anthropometric characteristics of the machine-building workers is determined by 17 factors explaining 79,7% of the variance of the data (Table 2). Remaining unexplained variance is 20,3%.

I. The features participating in factor I identify the factor as a factor determining the body fatness and the massiveness of the body. The instable features of this group are the basic breadths of the body, skinfolds and weight, which are shared by other factors as well. This shows that the physical activity connected with the labour of the machine-building workers has a modelling effect on these features.

Table 2. Factor structure of investigated features (machine-building workers)*

Factors	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings
I	28	0,95	26	0,94	27	0,94	42	0,90	36	0,89	35	0,87	34	0,86
	37	0,86	39	0,83	22	0,82	40	0,81	41	0,81	24	0,74	46	0,73
	48	0,71	32	0,70	23	0,68	47	0,67	21	0,62	33	0,58	45	0,57
	43	0,54	44	0,51	20	0,49	12	0,43						
II	1	−0,92	4	−0,91	14	−0,88	19	−0,75	5	−0,72	2	−0,66	6	−0,64
	16	−0,62	13	−0,60	33	−0,53	12	−0,46	32	−0,41	10	−0,39	21	−0,34
	17	−0,33	42	−0,33										
III	57	−0,90	55	−0,71	56	0,70	60	−0,70	59	−0,65	58	−0,38		
IV	9	−0,95	62	−0,95	15	0,39	16	0,62	63	−0,53				
V	8	0,88	7	0,81	6	−0,52	10	0,35						
VI	18	−0,76	17	−0,60	50	0,60	2	−0,31						
VII	11	0,84	31	−0,40	3	0,38	25	−0,33	40	0,30				
VIII	54	−0,91	52	−0,81	53	−0,58								
IX	67	−0,94	66	−0,93										
X	51	0,67	25	0,42	21	0,30								
XI	29	0,92	30	0,73	31	0,50								
XII	61	−0,82	31	0,31										
XIII	43	−0,61	44	−0,61	47	−0,56	45	−0,52	48	−0,51	46	−0,40	10	0,32
XIV	20	0,31												
XIV	64	0,77	50	−0,39	65	0,30								
XV	49	−0,73	65	−0,54	60	−0,37	59	−0,33						
XVI	13	−0,45	63	−0,43	12	−0,40	21	−0,37						
XVII	38	0,75	3	−0,43	53	−0,33	59	−0,33	60	−0,32	55	0,30		

* For names of features see Table 1.

II. The second factor is identified as factor responsible for the restriction of the length dimensions of the body; as well as the mobile, with respect to factor Ist, breadths of the body and weight. The negative factors loading of all features participating in this factor is enough reason to suppose that the type of labour activity of the machine-building workers has a suppressing influence on the formation of the length dimensions of the body at the expense of its massiveness.

III. Participating with negative factor loading in factor III are abduction-adduction movements of the hand as well as hand rotation. This fact is in conformity with some others our investigations and shows that the greater loading of the hand leads to the restriction of its mobility.

IV. The fourth factor is identified by the asymmetry of the length dimensions of upper and lower limbs; the negative loadings show that the bilateral loading (weight and motion) in the process of labour restricts and suppresses the development of asymmetry in these features.

V. Factor V determines the relatioships between the dimensions of the hand and the forearm; the negative loading of the forearm shows that the internal structuring in the length dimensions of the hand and the forearm develops at the expense of the forearm.

VI. Factor VI consists of the heights of the foot and the negative loadings show that the erect gate and the weight loading are the reason for the lowering of the arch of the foot.

VII. The taxonomic features of factor VII is the thickness of the hand; which depends positively on the character of labour.

VIII. Factor VIII restricts the flexion-extension movements of the hand.

IX. This factor restricts the development of bilateral differences in the mobility of the hand which is probably due to the participation of the left hand in the process of labour.

X. Factor X is the hand force.

XI. This is the factor of the respiratory excursions of the chest.

XII. Factor XII restricts the asymmetry in the body heights.

XIII. This factor restricts the body fatness. The fact that the skinfolds are grouped in a separate group shows the dependence of the distribution of body fatness from the type of labour.

XIV. This is the factor of the asymmetry in circumferences and skinfolds.

XV. The taxonomic feature of this factor is the vital capacity of the lungs.

XVI. This is the factor of the functional features of the hand.

XVII. This factor determines the relationship between the contractive difference and the mobility of the hand.

Results from the analysis of the factor matrix of office workers

The factor structure of the anthropometric characteristics of the office workers consists of 16 factors (Table 3). They explain 82,1% from the variance of the data.

I. The features participating in the first factor identify it as a factor determining the fatness and the massiveness of the body. The mobile features in this group are skinfolds. They have relatively high factor loading and participate in other factors as well. This shows that the distribution and the quantity of body fatness depends on the hypodynamy connected with this kind of labour.

II. The factor is identified by the length dimensions of the body which are relatively stable.

III. This is the factor of the mobility of the hand, determined chiefly by the abduction-adduction movements which form the biomechanical model of the mobility of the hand in the case of labour requiring to physical efforts.

IV. Factor IV is comprised of the partial dimensions of the foot and the hand, having negative factor loadings.

V. This is the factor responsible for the length dimensions of the hand only.

VI. The sixth factor is identified by the respiratory differences of the chest-inhalation.

VII. Factor VII has differentiated skinfolds with negative loadings and some basic functional features such as vital capacity and contractive difference of the arm. The way these features are grouped shows that in order to ensure the necessary vital capacity and functional abilities, the formation of body fatness should be suppressed.

VIII. This is the factor of the supination of the hand.

Table 3. Factor structure of investigated features (office workers)*

Factors	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings	Features	Factor loadings
I	27	0,96	28	0,96	25	0,94	26	0,94	34	0,92	42	0,92	35	0,89
	36	0,89	37	0,87	39	0,86	22	0,85	40	0,83	41	0,83	32	0,82
	47	0,82	24	0,80	23	0,77	48	0,76	46	0,75	33	0,70	45	0,70
	43	0,62	21	0,59	44	0,53	10	0,40	20	0,33	1	0,32	2	0,30
II	5	0,85	4	0,83	16	0,80	14	0,76	1	0,74	19	0,56	2	0,46
	21	0,41	49	0,40	6	0,33	15	0,33	33	0,32	11	0,30		
III	57	0,89	55	0,84	66	0,73	67	0,70	56	0,67	53	0,47	58	0,44
	54	0,40												
IV	12	−0,81	13	−0,81	20	−0,58	10	−0,56	20	−0,50	51	−0,45	49	−0,36
	64	−0,34	6	−0,32										
V	8	0,86	7	0,70	38	0,30								
VI	30	0,82	29	0,72	38	0,41	66	0,35	67	0,33				
VII	44	−0,70	43	−0,57	45	−0,52	38	0,46	49	0,35	47	−0,34	46	−0,33
	48	−0,30												
VIII	59	0,94	60	0,92										
IX	17	0,84	18	0,69	6	0,32								
X	31	0,86	29	0,49	51	0,36	58	0,33						
XI	54	0,78	52	0,75	50	0,56	53	0,39						
XII	9	0,90	7	0,44										
XIII	63	−0,74	64	0,52	58	−0,45	65	0,44						
XIV	62	0,74	53	−0,39	15	0,39								
XV	61	0,75	3	−0,47	15	−0,40								
XVI	11	−0,59	65	0,33	3	−0,32	32	0,30						

* For names of features see Table 1.

IX. The height dimensions of the foot are grouped in this factor.

X. Factor X is identified by the respiratory differences of the chest – exhalation.

XI. This is the factor of the flexion-extension movements of the hand, the hand extension being more mobile (it participates in another factor as well).

XII. Factor XII controls the relationship between wrist and finger IIIth lengths.

XIII and XIV. Both factors have differentiated various features but they could be conditionally identified as factor of asymmetry of lower and upper limbs respectively.

XV. The greatest factor loading in this group of features has the asymmetry index – heights.

XVI. Because of the nonhomogeneous character of the features participating in this factor it is difficult to identify it.

Conclusions

1. The comparative analysis of the factor structures of the anthropometric characteristics of both groups of workers as well as the consideration of the differences in the identification of the factors show that the variability of the organism in the process of labour is carried out through the adaptive-compensatory changes of interrelated in their reactivity mobile features.

2. The mathematical method used to analyse the differentiation in the anthropometric characteristics of groups of individuals having different level of physical activity (in our study different kind of labour) is highly informative and contributes highly to discover biological laws; it has much better performance than the methods used up to now which prove to be inadequate.

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Age changes in weight and skinfolds in women, aged from 21 to 30

E. Lazarova, A. Nacheva

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

211 women, divided into 5 age groups are investigated: I (21-22), II (23-24), III (25-26), IV (27-28), and V (29-30). The weight and six standard skinfolds (four measured bilaterally) are studied. The results show that subcutaneous fat tissue give us an important information about specific changes in organism, characterizing separate age groups in the period from 21 to 30 years.

Key words: anthropology, fat patternings, skinfolds, age changes.

The age of 21 to 30 is determined, according to the common anthropological classification, as an entire ontogenesis period, named first maturity [7]. However, it is known that a large number of anthropometric features, displaying sex dimorphism, manifest specific interage differences [5, 9]. The differences are mainly related to female's reproductive function and often characterize the quality changes in her organism. That provides the reason for more profound and purposive investigations of interage differences, searching for additional criteria for detailing and enrichment of the periodization of ontogenetic development of female organism. Information of that kind could be received from the features of body fatness as: weight and skinfolds, both strongly depending on sex, age and way of living and laboring of person [3, 4, 6, 8, 9].

The purpose of the present work is to investigate the changes of weight and skinfolds in women aged from 21 to 30. The period is chosen to include the time before, during and after the average age of maternity of the Bulgarian woman (24,0 years at 1979-1980), according to the data given in Statistic Annual of Bulgaria, 1981.

Materials and methods

The data for 211 women, random excerpt from complex anthropological-ergonomic investigation of the Bulgarian population, are studied. The contingent is divided in 5 age groups: I (21-22), II (23-24), III (25-26), IV (27-28), and V

(29-30). All the women studied prefer to manipulate with right hand, that is showing dextral functional asymmetry. The following features are studied: weight, skinfold-triceps, skinfold-biceps, skinfold-forearm, subscapular skinfold (all right and left measures), and skinfolds at the X-th rib and at the abdomen (right only measured). The measurements are done with Harpenden caliper. The metric data of the features studied are variation-statistically computed.

The metric change of each feature in the separate age groups is calculated in reference to its value in the first age group (21-22).

Nacheva's method [2, 3] for anthropometric evaluation of body asymmetry is employed to examine the bilateral differences in skinfolds. The relative indices of asymmetry, named Units of Asymmetry, are calculated, their positive values showing rightside and negative values – leftside metric domination.

Results and discussion

Body weight, being integral characteristic of all body components, including the most mobile – subcutaneous fat tissue, shows differences with the age, represented clearly by the formula I<III<V<II<IV (Tables 1 and 2). The weight is highest at 27-28 and smallest – at 21-22. For the rest age groups the weight is relatively equal. The wave type of age differences shows, that the studies age period (21-30) is not homogeneous concerning the body weight and gives an idea of some phasing in its age changes.

The thicknesses of the studied skinfolds show greater lack of homogeneity in that period, each of them having specific age changes. The specificity is underlined by the unchanged female's type of fatness of the body during the whole period. That could be illustrated by the formulae for arranging the skinfolds according to their thicknesses. The skinfolds at the abdomen and at the triceps are thickest, and those at the forearm are thinnest in all the age groups. However, on that common

Table 1. Mean values of the investigated features and their age changes compared to the I age group

Features	Laterality	Mean values					Relatively age changes (%)			
		I***	II	III	IV	V	II/I	III/I	IV/I	V/I
		n=55	n=24	n=34	n=56	n=42				
Weight		59,0	60,8	60,6	61,2	60,7	3,1	2,7	3,7	2,9
Skinfolds										
triceps	r*	18,6	18,0	18,2	18,9	20,8	−3,2	−2,2	1,6	11,8
	l**	18,5	18,3	18,4	19,4	20,7	−1,1	−0,5	4,9	11,8
biceps	r	9,6	10,5	9,4	10,0	11,3	9,4	−2,1	4,2	17,7
	l	9,7	10,8	9,9	10,4	11,5	11,3	2,1	7,2	18,6
forearm	r	8,3	8,0	8,2	8,3	9,2	−3,6	−1,2	0,0	10,8
	l	8,9	8,6	8,6	9,4	10,0	−3,4	−3,4	5,6	12,4
subscapular	r	16,7	17,1	17,1	19,0	19,5	2,4	2,4	13,8	16,8
	l	17,2	17,4	18,1	19,9	20,2	1,2	5,2	15,7	17,4
X rib	r	13,8	14,7	14,6	15,8	16,1	6,5	5,8	14,5	16,7
abdomen	r	21,9	22,2	21,6	23,5	24,1	1,4	−1,4	7,3	10,0

* r – right;
** l – left;
*** I–V – age groups.

Table 2. Formulae of metric domination of subcutaneous fat-thickness in the investigated skinfolds according to the age

Weight		I	<	III	<	V	<	II	<	IV
Skinfolds										
triceps	r	II	<	III	<	I	<	IV	<	V
	l	II	<	III	<	I	<	IV	<	V
biceps	r	III	<	I	<	IV	<	II	<	V
	l	I	<	III	<	IV	<	II	<	V
forearm	r	II	<	III	<	I	=	IV	<	V
	l	II	=	III	<	I	<	IV	<	V
subscapular	r	I	<	II	<	III	<	IV	<	V
	l	I	<	II	<	III	<	IV	<	V
X rib	r	I	<	III	<	II	<	IV	<	V
abdomen	r	III	<	I	<	II	<	IV	<	V

Indications as on Table 1.

Table 3. Units of asymmetry in bilaterally measured skinfolds

Skinfolds	Units of asymmetry				
	I*	II	III	IV	V
Triceps	0,5	−1,6	−1,1	−2,6	0,5
Biceps	−1,0	−2,8	−5,1	−3,8	−1,7
Forearm	−6,7	−7,0	−4,7	−11,7	−8,0
Subscapular	−2,9	−1,7	−5,5	−4,5	−3,5

* I-V – age groups.

Table 4. Formuale of metric domination of subcutaneous fat-thickness according to location of measurements

I (21-22)	→	4r	<	4l	<	3r	<	3l	<	6	<	5r	<	5l	<	2l	<	2r	<	7
II (23-24)	→	4r	<	4l	<	3r	<	3l	<	6	<	5r	<	5l	<	2r	<	2l	<	7
III (25-26)	→	4r	<	4l	<	3r	<	3l	<	6	<	5r	<	5l	<	2r	<	2l	<	7
IV (27-28)	→	4r	<	4l	<	3r	<	3l	<	6	<	2r	<	5r	<	2l	<	5l	<	7
V (29-30)	→	4r	<	4l	<	3r	<	3l	<	6	<	5r	<	5l	<	2l	<	2r	<	7

Indications as on Table 1.

ground, skinfolds at different body parts and areas reveal different dynamics of age changes:

– Skinfolds at the triceps and at the forearm change their thickness in the same way with the age. The thickness is decreasing in II and III groups, and after 27 is increasing significantly;

– Subscapular skinfold and the skinfold at the X-th rib increase successively with age, but according to their relative differences, the increase is more significant (about 3-4 times greater) after 27 years too;

– Skinfolds at the abdomen and at the biceps show interage differences with two modifying moments. The thickness of skinfolds decreases in the period 25-26, and after 27 increases again (5 times for the abdomen skinfold and 2 times for the biceps skinfold).

The data about the bilateral differences in subcutaneous fat thicknesses at the pair body parts and areas underline even more distinctly the age differences in subcutaneous fat distribution (Tables 3 and 4; Fig. 1). All the skinfolds, with

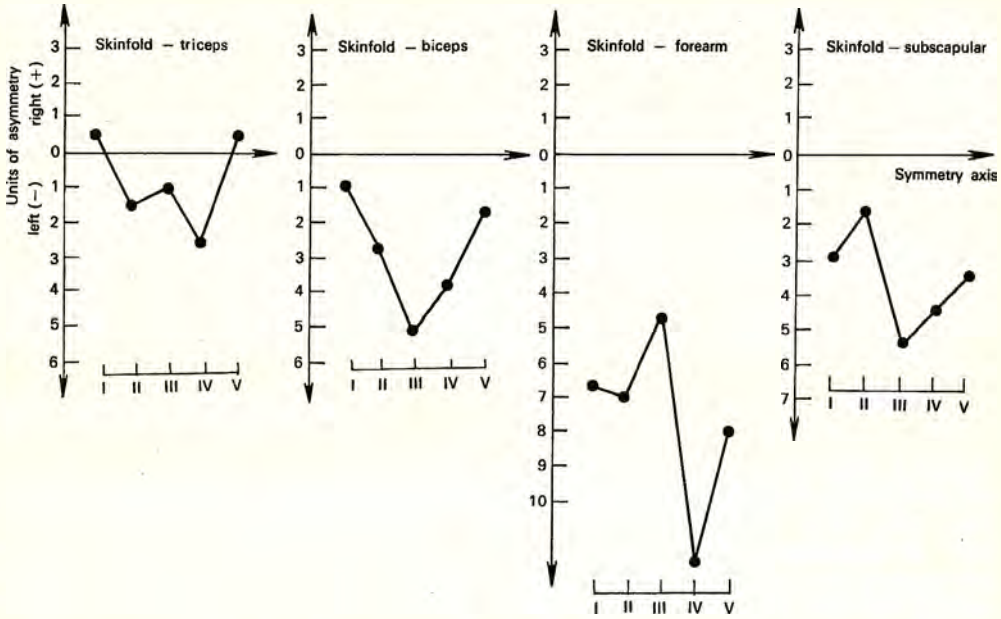

Fig. 1. Manifestation of asymmetry in bilaterally measured skinfolds I-V – age groups

negligible exceptions, are with leftside domination in the period studied. This type of metric asymmetry reflects the dextral functional asymmetry, when the greater physical engagement of the right upper limb, and the connected with it thoracal muscles, leads to changes in muscles/fat ratio, in favour of the actively working muscles. The different grades of functional engagement of muscles in the areas of skinfolds studied, anyway, lead up to metric differences in age changes of the asymmetry shown by them:

– Skinfold at the triceps comes up to be the feature with greatest ecosensitivity, revealing the great functional engagement of the muscles of that area. The asymmetry from slight rightside dominant, in I age group, turns to left side dominant in II, III and IV groups (most strongly expressed in IV group), and then in V group the laterality of asymmetry changes again in rightside dominant. That determines the age of 27-28 as a specific quality stage in sensitivity of subcutaneous fat tissue in the area of triceps;

– The asymmetry of skinfold at the forearm shows that the subcutaneous fat tissue of the forearm has highest ecosensitivity in the V-th age group too;

– The changes in the character of manifestation of asymmetry for subscapular skinfold and skinfold at the biceps occur earlier – in III age group, as leftside asymmetry increases up to 25-26 years and after that consecutively decreases significantly.

Conclusions

From the results obtained we could generalize that the age changes in the thickness of skinfolds are different from those of body weight in the women studied, aged 21-30.

It is established, that the period, in which the subcutaneous fat tissue shows greatest ecosensitivity, coincides with the period after the average maternity age of Bulgarian women. Most probably, the higher ecosensitivity is a reflexion of the changes, taking place in women's organism during and after the active reproductive phase.

These data give the ground to accept that, after purposeful and representative investigations, the subcutaneous fat tissue provides important information on specific changes taking place in female's organism, characterizing different age subintervals in the period of 21-30 years.

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Age alterations in foot mobility during the puberty

M. Nikolova, S. Moutafov, I. Petrov**

* *Department of Anatomy and Physiology, University of Plovdiv*
Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

The foot mobility has been measured using goniometric traits expressed in angle degrees. Special instruments were used constructed by one of the authors. The subject were 800 children (11-14 years old boys and girls). Age and sex differences were established concerning the foot mobility.

Key words: foot, mobility, goniometry, age and sex alterations.

Introduction

The exact and precise characteristics of foot made by the use of a large number of functional traits is of great importance not only to the theory, but to the medical practice and technology as well.

Investigations of the metric characteristics of foot have been made for a Bulgarian population (25 000 men and women of defferent age) during the period 1960-62. These results laid on the base of the foot standards of Bulgarian population [4, 5, 6, 7, 8]. The knowledge of the functional possibilities of foot and especially of the tibiotarsal articulation movings are of a great importance to the theory and practice. Мутафов et al. [9, 12] using an unique apparatus made functional and dynamic measurements of the head, arm and foot of grown-up Bulgarians [10]. On this base the authors made an analysis of 7 dynamic traits of foot in the tibiotarsal articulation [1, 11]. Similar investigations were carried out in Czechoslovakia and Japan [2, 3].

Studies of children foot concerning their functional and dynamic possibilities are not sufficient, so that was the purpose of our investigation.

Table 1. Biostatistic characteristics of the goniometric parameters of foot (angle degrees)

Characteristic	Abduction max				Adduction max				Extension max				Flexion max				Supination				Pronation			
	11	12	13	14	11	12	13	14	11	12	13	14	11	12	13	14	11	12	13	14	11	12	13	14
Boys																								
$\bar{x}$	46,5	45,3	45,2	45,7	43,9	41,9	42,3	38,8	38,0	40,4	37,3	41,3	42,8	43,1	44,8	42,4	39,1	36,8	35,2	37,1	27,2	28,0	28,1	24,6
σ	8,8	7,7	8,4	8,4	9,5	8,4	10,7	9,1	11,0	11,7	14,3	11,0	12,3	11,6	11,8	12,6	13,9	14,6	12,4	13,5	12,6	13,4	9,7	9,4
m	0,88	0,78	0,85	0,89	0,96	0,85	0,91	0,96	1,07	1,18	1,44	1,11	1,25	1,17	1,19	1,18	1,40	1,33	1,25	1,42	1,12	1,35	0,99	0,99
V_σ	22,6	17,5	19,2	18,1	22,2	20,0	24,2	23,1	28,6	28,6	38,0	26,7	28,8	27,7	29,3	29,1	35,9	39,0	35,0	35,5	46,6	48,0	35,0	37,8
min	27	25	29	24	13	21	15	17	15	11	10	13	18	14	18	18	14	10	10	13	6	6	5	8
max	70	62	65	64	70	66	71	57	65	65	96	62	75	83	73	85	80	85	67	75	89	85	52	55
Girls																								
$\bar{x}$	47,3	47,9	48,6	49,8	45,0	44,1	44,5	41,3	44,2	39,7	40,9	43,2	41,3	43,7	44,2	41,7	39,1	39,7	40,7	39,9	32,9	38,1	32,0	29,5
σ	8,9	8,4	9,3	8,7	9,9	9,3	9,3	8,4	13,5	11,5	11,4	10,5	13,7	13,3	10,9	10,3	12,5	14,5	13,2	13,2	10,7	20,2	12,1	10,6
m	0,89	0,93	0,93	0,86	1,00	0,93	0,93	0,83	0,93	1,31	1,15	1,05	1,35	1,48	1,05	1,02	1,26	1,38	1,33	1,30	1,08	1,23	1,21	1,05
V_σ	19,8	18,2	19,2	18,1	22,3	21,2	21,5	20,7	31,3	30,0	28,5	24,6	33,4	31,0	25,1	25,4	32,4	37,2	33,1	33,2	31,9	35,6	38,2	36,0
min	22	32	22	27	20	18	15	18	20	12	15	18	16	21	18	20	12	10	15	10	10	7	6	6
max	80	78	7,0	76	72	70	67	65	91	80	64	65	84	77	75	68	75	80	84	70	55	99	60	56

Material and methods

The subject were 800 children aged from 11 to 14 years (100 boys and 100 girls in every age group). We took 7 goniometric traits by the use of special instruments constructed by Moutafov and co-workers (Institute of Cell Biology and Morphology, Sofia) – pelmatoangulometer, sedentariometer, and angulometer. The foot mobility in tibiotarsal articulation was analysed by the use of the following goniometric traits: maximum of abduction and adduction, of flexion and extension, and of pronation and supination.

Results and discussion

The data in Table 1 show that the maximum of abduction and adduction is 2°8′ and 2° greater respectively for girls in comparison to the boys. The abduction possibilities of foot for the boys are not changed during the investigated age period, while for girls they increase with age.

The adduction decrease for both sexes and this is more clearly manifested for girls. In comparison to the establishment of Moutafov (16-20 years old boys and girls) our group investigated (11-14 years old children) have 10° greater abduction and adduction. These differences could be explained by taking into account the sample specificities, the greater mobility of foot which is typical of our age group, and a probable secular trend. As for the foot flexion and extension, there is pronounced variability in its mobility for both sexes, although a tendency exists for increasing of foot flexion with age. The extension especially for girls, shows an opposite tendency, i. e. decreases with age. Compared to the data of Moutafov the foot flexion is 2°5′ and 0°6′ lower for girls and boys respectively; the extension is also 12° and 8°6′ lower for girls and boys. The values of supination and pronation are 2°8′ and 6°2′, respectively greater for girls, compared to these for boys.

There is a tendency of increasing of supination possibilities for girls and decreasing for boys up to 13 years. The pronation is variable again. The foot motion has greater functional possibilities for children, than for young boys and girls.

Figure 1 illustrates the sex differences related to given motions and to the whole mobility using the informative opportunities of the "star system" of Maigne. The comparison shows greater mobility of foot for 13 and 14 years old girls.

Conclusions

1. The functional mobility of boy's foot is lower, compared to the girl's one, with an exception of its flexion and extension.

2. The possibilities of abduction and flexion of girl's foot increase with age, whereas the adduction and extension decrease. The abduction possibilities of boy's foot are not altered, but flexion and extension increase with age.

3. The angle dimensions of mobility in the tibiotarsal articulation are higher for 11-14 years old children in comparison to young boys and girls. A possible explanation of these results could not be growth and puberty only, but the secular trend as well.

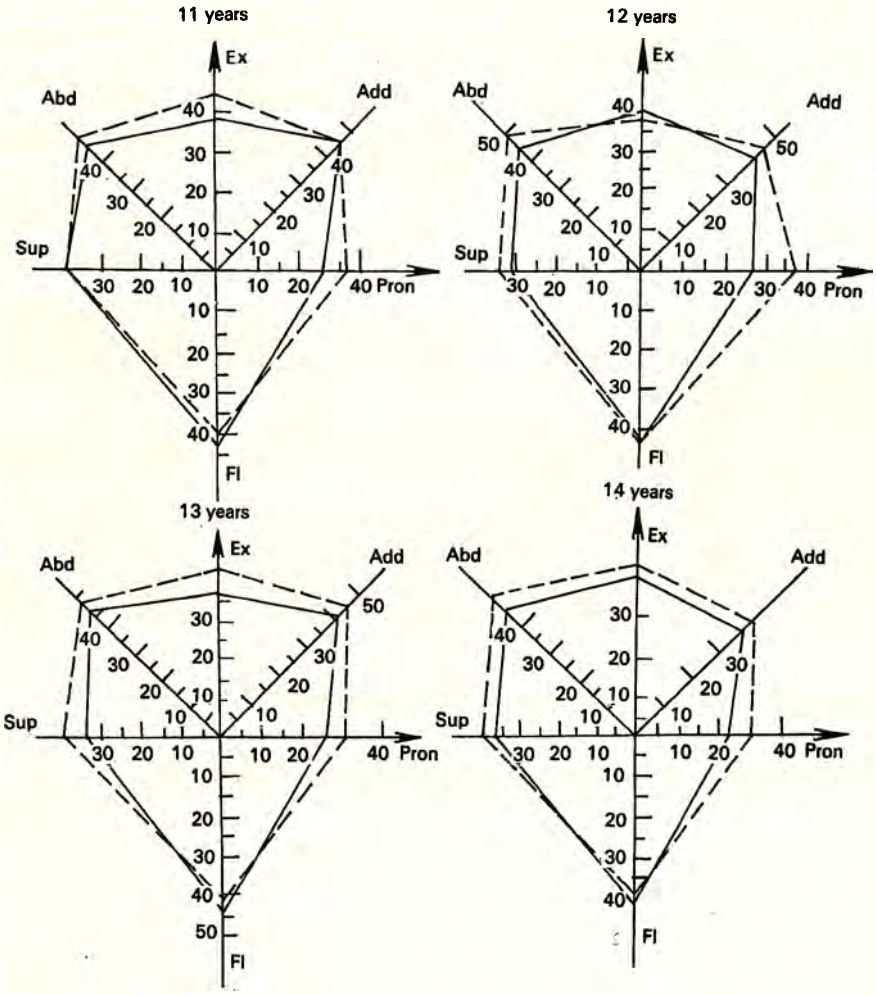

Fig. 1. Changes in the volume of mobility (angle degrees) of foot in relation to the age and sex differences
——— ♂; – – – ♀

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High multiple births in Bulgaria

L. Tzacheva, D. Paskova-Topalova

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

23 triplets, 1 quadruplet and 1 quintruplet from different regions of the country are investigated. The physical development by two global measures – stature and weight are studied up to the end of the 2 years of age, and in comparison with the same measures for singletons. Genealogical analysis of the twin families also is made.

Key words: twins, triplet, quadruplet, quintruplet, physical development, genealogical analysis, stature, weight.

The birth of triplets, quadruplets etc. twin-sets has two different aspects. As biological phenomenon the high multiple birth happens more rarely than the twin birth, but according to our opinion more significant is the genetic aspect of the phenomenon. Mostly, the triplets and quadruplets as a "mixed genetic model" are suitable examinating the complex regularities of the human heredity. The possibilities of zygosoty combinations increase with the number of the partners – for the triplets they are 7, for the quadruplets are much more, etc.

Our twin investigation covers a 25 years period during which are studied 23 triplets, 1 quadruplet and the only quintruplet born not only in Bulgaria, but in the Balkan Peninsula. Some of the children live in Sofia, and other in Plovdiv, Sliven, Kotel, Silistra, Varna, Shumen, Stara Zagora, Kazanluk. The quadruplet is born and live in Kardjally, and the quintruplet in Srednogorie town. In all cases, except the quintriplet, the birth of the twin-sets follow the well known biological regularities of the high multiple birth (without therapeutical intervention). The quintruplet is born after 3 years sterility of the married couple. After that the mother was treated for 2 years with steroids, and the father having oligospermia – for a year. The result of the therapy is the birth of the quintruplet – 2 boys and 3 girls.

The results presented from us are only of triplets etc. whose partners are alive at the moment of the last consecutive study. The number of the children born from high multiple births during the investigated period are much more than the examined from us, which can be seen in Table 1 made on the basis of data from Central Board of Statistics.

Table 1. Type of twins and triplets

Year	Total	♂♂	♂♀	♀♀	♂♂♂	♂♂♀	♀♀♂	♀♀♀
1966	904	288	292	320	2	1	–	1
1967	840	275	254	307	1	–	1	2
1968	956	324	291	337	2	–	1	1
1969	1029	334	336	352	1	1	3	2
1970	972	344	283	339	2	1	2	1
1971	987	351	306	326	1	1	–	2
1972	911	298	264	388	2	1	4	4
1973	987	340	296	332	8	–	–	2
1974	1079	395	328	351	1	–	1	3
1975	1047	377	302	358	3	3	–	4
1976	1058	382	319	354	–	1	2	–
1977	971	309	309	344	4	1	3	1
1978	890	298	271	320	–	–	1	–
1979	858	321	248	283	–	3	3	–
1980	869	287	263	310	1	2	2	4
1981	804	288	219	289	1	2	2	3
1982	965	358	293	318	1	2	–	1
1983	959	347	301	307	1	1	2	–
1984	767	297	216	251	1	1	1	–
1985	607	315	130	159	1	–	–	2
1986	958	341	295	316	–	3	2	1
1987	925	284	294	338	4	1	2	1
1988	922	309	285	321	1	2	1	3

By zygosity the investigated triplets covered nearly all theoretical possibilities of combinations (Fig. 1). The monozygotic triplets are 6 – 2 boy-triplets, and 4 girl-triplets. Greatest is the variety of dizygotic triplets. They are both same-sexed boys or girls, and mixed-sexed in combinations – 2 boys with a girl, and a boy with 2 girls. A three zygotic same-sexed triplet (girls) also is studied (Fig. 2).

The only alive quadruplet in Bulgaria is also threezygotic, mixed-sexed. The boy is from the 1-st zygot, from another zygot is one of the girls, and from the third zygot are the next two girls. The zygosity can be well seen at the photograph (Fig. 3).

The quintruplet born after steroid therapeutics of the both parents is 5 zygotic according to our examination. This diagnosis will be fortified completely in some years when we'll can make more detailed serological investigation. At present only two blood group systems of the children are analysed (Fig. 4).

During the first 2 years of the early childhood the growth and the physical development of the twin-children are examined by the two global measures – stature and weight. Some of the children have been for a short or long time in the neonathological hospitals in Sofia, and the other big towns. At Fig. 5 we present by gestation weeks term the weight of the children from high mutiple births in comparison with the weight of the singletons. This term varies between 33 and 39 gestation weeks, and the degree of prematurity is different for the triplets, quadruplet and quintruplet.

The results from the measurements of stature and weight (some of them are taken in different intervals according to the special conditions) are given in two figures. Figures 6, 7 are for weight and stature at the end of the 1-st, 2-nd years, respectively for singletons and children from high multiple births.

Instead of the different degree of prematurity (for the MZ partners of the quadruplet it's of IV degree) up to the end of the second year of age nearly all the

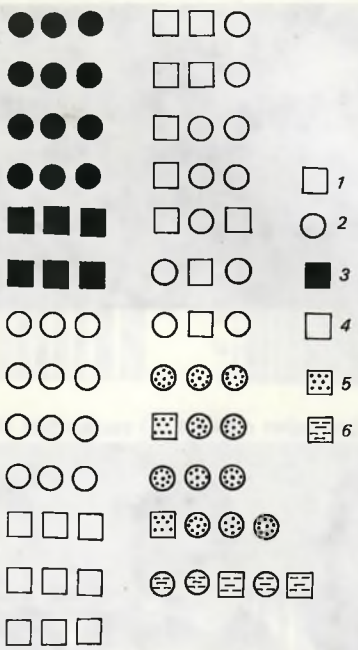

Fig. 1. Type of triplets, quadruplet, quintruplet
1 – boys; *2* – girls; *3* – MZ; *4* – DZ; *5* – TZ; *6* – FZ

Fig. 2. TZ girls

Fig. 3. TZ quadruplet

Fig. 4. FZ quintruplet

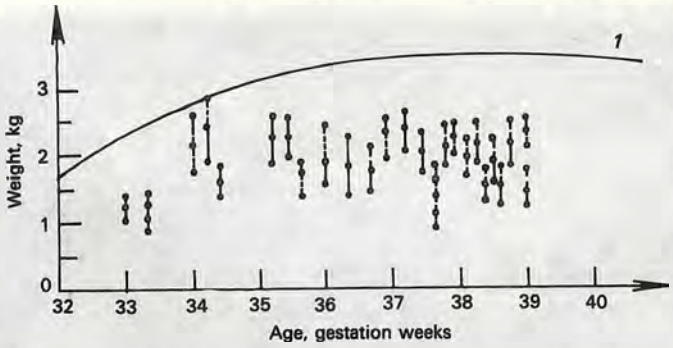

Fig. 5. Comparison between weight of singletons and twins
1 – singletons

twin-children of the high multiple births overtake the singletons by this two measures. The special cares of this children in the hospitals and at home are very important, probably, for their physical development in the first two years of their life.

Family trees of all the triplets, the quadruplet, and the quintruplet are made, and some of them deserve a special examination.

In two cases the mothers of the triplets are twins (Figs 8, 9). The first triplet is MZ-girl-set, and the second – DZ-boy-set.

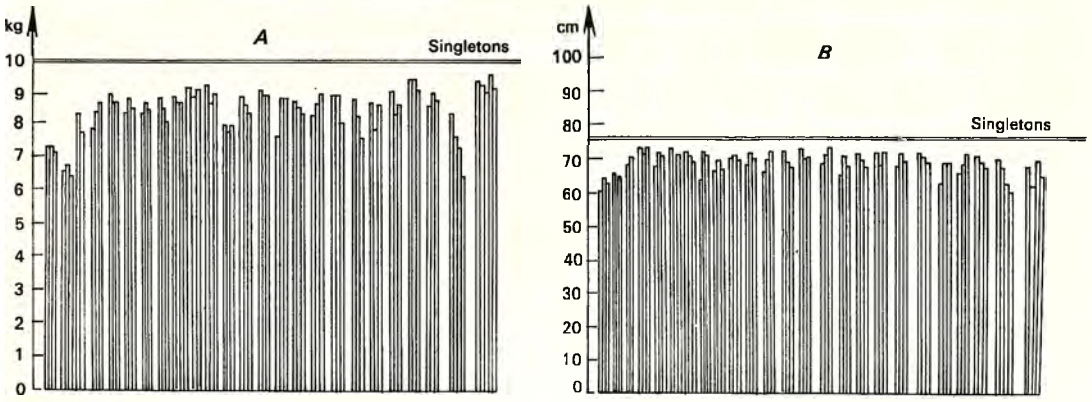

Fig. 6. Comparison of weight (*A*) and stature (*B*) between twins and singletons at the end of the first year of age

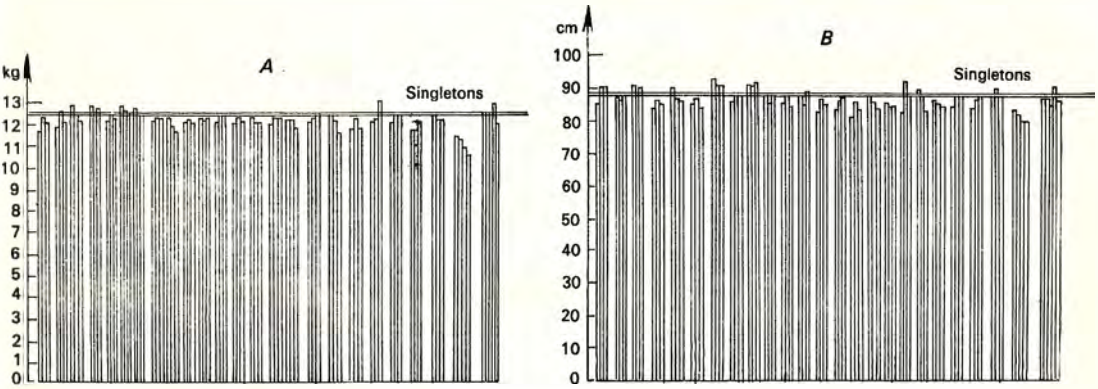

Fig. 7. Comparison of weight (*A*) and stature (*B*) between twins and singletons at the end of the second year of age

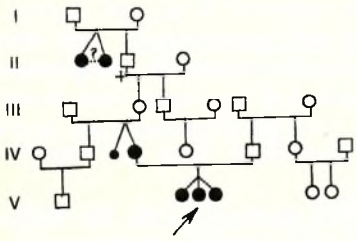

Fig. 8. Family tree of MZ triplet from Sofia

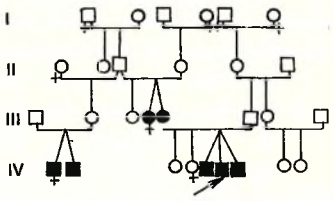

Fig. 9. Family tree of DZ triplet from Silistra

The next family tree shows that the mixed-sexed triplet is born from a second marriage of the father who has also a mixed-sexed twin-couple from his first marriage. The fathers family tree is burdened with two more twin-couples, while for the two wifes we have no data for twinning (Fig. 10).

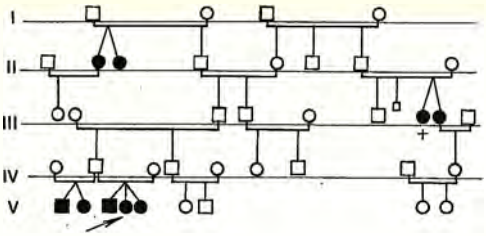

Fig. 10. Family tree of DZ triplet from Sofia

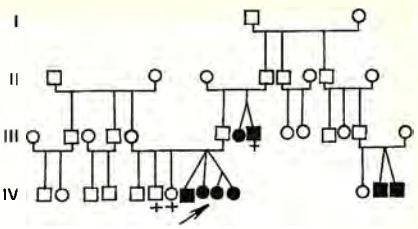

Fig. 11. Family tree of TZ quadruplet from Kardjally

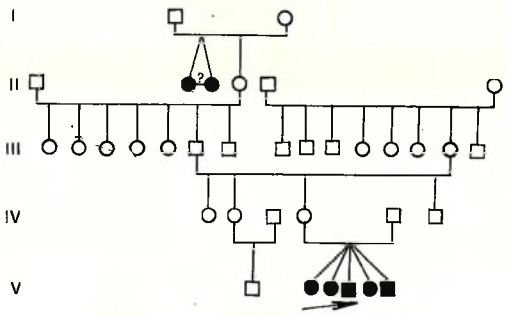

Fig. 12. Family tree of FZ quintruplet from Srednogorie

In the quadruplet family tree can be seen that only in the father's family there are twins (Fig. 11).

On the family tree of the quintruplet instead of the numerous births (the parents are Gipsies) the twinning factor didn't exist (Fig. 12). About the steroid therapy in this case we have spoken already.

At the end we can afford to make the following conclusions:

1. The biological factor of multiple birth in man changes on the one hand with the reduction of the birth-rate, and on the other hand with the antisterility therapeutics.

2. The high multiple birth children in spite of their prematurity, and their smaller measures on birth in many cases under good cares, overtake the physical development of the singletons during the 2-3 years period of their early childhood.

3. The family trees analysis allows to be made two basic conclusions which not all the authors share.

A. The fertility of twinning doesn't decrease.

B. The factor of multiple birth in man isn't connected only with the female sex.

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Cell Biology

Immunomodulating influence of cyclophosphamide and biocarbazine on antitumour immunity of hybridoma bearing mice

Tz. Mihova, D. Nikolova, I. Goranov**

Department of Pathology, Medical Academy, Sofia
** Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia*

A great number of experimental data show that neoplastic growth causes an activation of T-suppressor cells, which does not permit the development of an effective antitumour immune response [4, 8]. On the other hand, the precursors of the T-suppressor cells show a much higher sensitivity to cyclophosphamide (CY) in comparison with the other T-subpopulations and B-cells [5, 6]. T-suppressor cells can be eliminated with relatively low single doses of CY-20 mg/kg – to which the other cells are resistant [7].

Present investigations is an attempt to study the influence of CY and biocarbazine (BC) on the immune response of hybridoma bearing mice.

Key words: antitumour immunity, hybridoma bearing mice, cyclophosphamide (CY), biocarbazine (BC), hybridoma (H).

Material and methods

Animals: BaLb/c mice (240), 3 months old, males and females.
Experimental scheme: The cytostatics have been applied interperitonelly in single doses of 20, 50, 100 and 200 mg/kg 48 hours before tumour transplantation. Cell suspension (10^6 tumour cells/0,1 ml), about 96% vitality has been injected subcutaneously in the abdominal area to each experimental animal. The control group has been injected with tumour cells only.
Animals examination: The latent period (in days) – from implantation to the appearence of a palpable tumour and percentage of "tumour bearing" has been followed.

Tumour growth inhibition test (TGIT) in the percent: *Wc* – means weight of the tumour in the control group on mg; *We* – means weight in experimental animals: $TGIT = \frac{Wc - We}{Wc} \times 100$.

Immunological tests: Quantitative indicate of plaque-forming cells (PFC) in spleen [3] and PFC/10^8 cells.

Indicate of delayed type hypersensitivity on method of Cluman, modified of Bratanov et al. [1].

The histological slides from tumours have been done with hematoxylin and eosin, PAS (Periodic acid-Schiff)-reaction, Gomori and Mallory.

The statistical study has been performed with *t*-criteria of Student-Fisher.

Results and discussion

"Tumour bearing" groups from 90% in control animals to 24% in the pretreated with 20 mg/kg BC and to 38% – with CY animals. This percent is lower with 50 mg/kg dose – for BC is 12% and 15% for CY. Percentage of "tumour bearing" with the highest doses of both cytostatics reaching 40%, but in the animals with 100 mg/kg CY it is lower – 33% (Fig. 1).

The latent period between tumour inoculation and the appearance of a palpable tumour is maximally prolonged by 50 mg/kg dose BC (25 ± 1 day). The latent period is shortened by increasing the dose to 200 mg/kg and for BC it is equal to this in the control group, while for CY it is with two days longer (Fig. 2).

TGIT is highest for both cytostatics with doses of 50 and 100 mg/kg in contrast to the dose of 200 mg/kg, where the influence of the tumour inhibition is minimal (Fig. 3).

Histologically – the tumours have well marked stroma with a reduction in the number of tumour cells. Doses of 50 mg/kg (Fig. 4) and 100 mg/kg BC and CY cause wide field of necrosis.

Data from PFC – test in the spleen disclose, that antibody cells are more markedly increased in animals, prior to treatment with the lower doses of 20 mg and 50 mg/kg BC and CY. Primary humoral immune response to sheep red blood cells (SRBC) is reduced with dose of 100 mg/kg in comparison to the control group (bearing the tumour but not treated). This inhibition is more strongly expressed with the highest dose of 200 mg/kg BC. The statistical study shows a significant difference between the different groups, treated with the same cytostatic. By injecting animals with 20 mg/kg CY the number of PFC in spleen is higher than that of PFC in animals with 100 mg/kg, as is the same for animals treated with 200 mg/kg ($P < 0{,}001$). Similar results have been obtained by PFC/10^8 spleen cells and this indicates reliable difference between the group with 50 mg/kg CY, which shows a higher number of PFC, than this treated with 100 mg/kg ($P < 0{,}05$) and 200 mg/kg ($P < 0{,}001$). In animals treated with lower doses BC the number of PFC is significantly greater than in those treated with high doses. There is statistically a high difference in the number of PFC between the animals with 20 mg/kg BC compared to PFC – with 100 mg/kg and 200 mg/kg (Fig. 5). The number of PFC with a dose of 50 mg/kg BC is higher than that with doses of 100 and 200 mg/kg BC ($P < 0{,}001$).

Micrometric measurement on the induction of contact dermatitis in the control animals and the pretreated mice with BC and CY are introduced in Fig. 6.

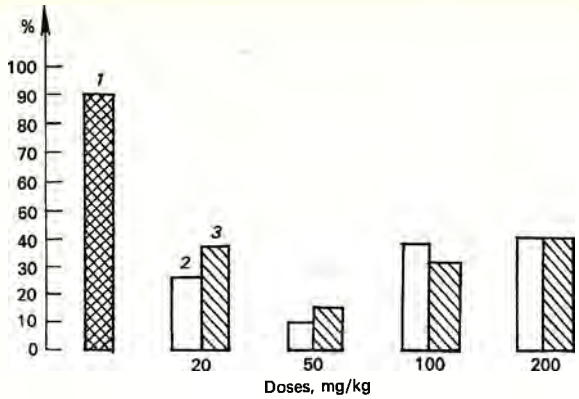

Fig. 1. Effect of cyclophosphamide and biocarbazine on the "tumour bearing" of hybridoma (%)
1 – H; *2* – H+BC; *3* – H+CY

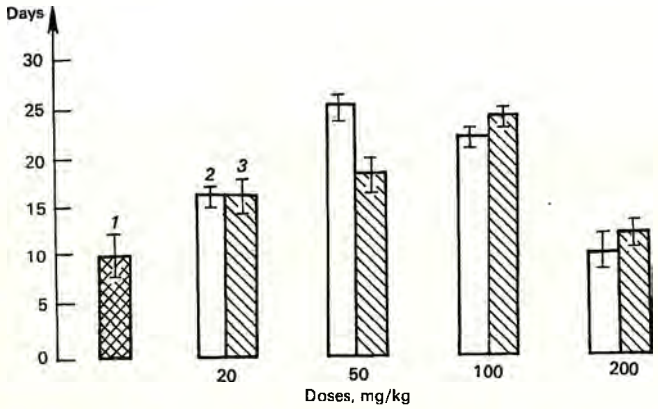

Fig. 2. Effect of cyclophosphamide and biocarbazine on the latent period of hybridoma (days)
1 – H; *2* – H+BC; *3* – H+CY

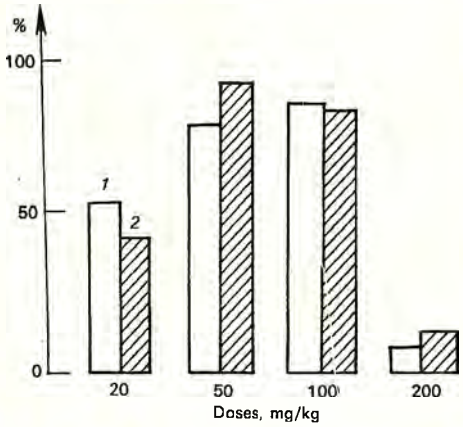

Fig. 3. Effect of cyclophosphamide and biocarbazine on the inhibition of tumour growth (%)
1 – CY; *2* – BC

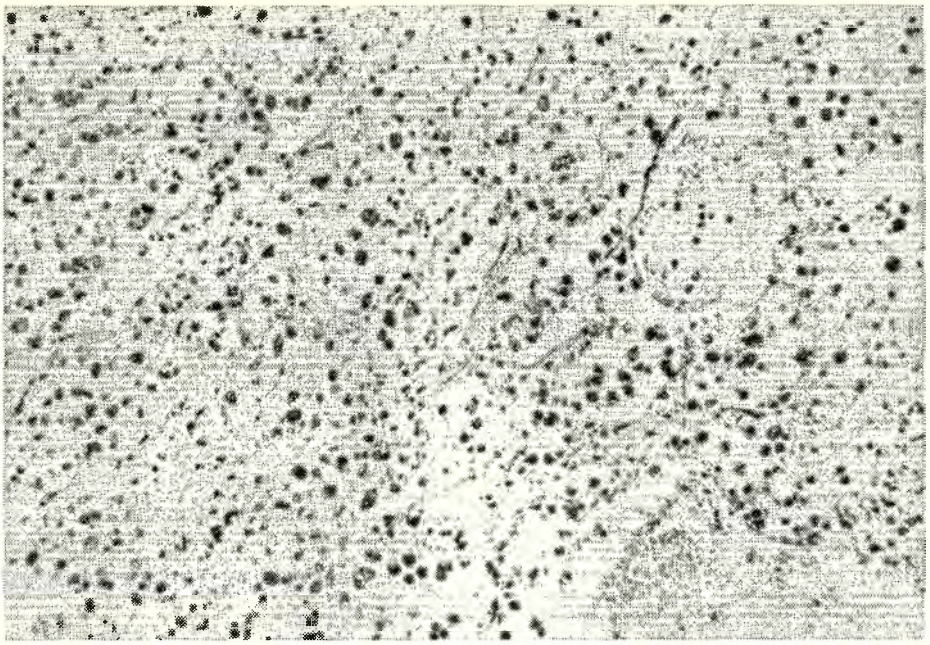

Fig. 4. Hybridoma histological picture demonstrates a reduction of tumour cell number. Necrotic alteration are observed (after a 50 mg/kg BC pretreatment). × 120

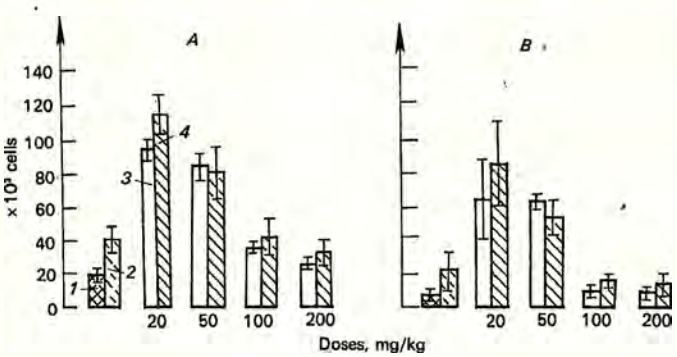

Fig. 5. Influence of cyclophosphamide and biocarbazine on the plaque-forming cells by hybridoma bearing mice

A – PFC per spleen; *B* – PFC per 10^5 spleen cells
1 – control (H); *2* – control (SRBC); *3* – BC+H; *4* – CY+H

It is obvious that all BC and CY doses have an enhancing effect on the delayed type cell-mediated reaction in comparison to the control group. This supports the statistical evaluation for the dose 20 and 50 mg/kg BC and CY and by 200 mg/kg CY. The statistical comparative analysis shows that there is a reliable difference in the values of the low and high doses of the cytostatic (for BC 20 mg/kg with $P<0{,}01$) to 100 mg/kg BC and with $P<0{,}05$ to 200 mg/kg BC. Even with the

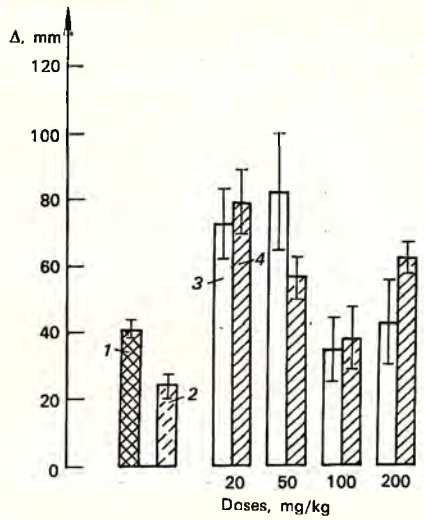

Fig. 6. Effect of cyclophosphamide and biocarbazine on the induction of contact dermatitis by hybridoma bearing mice
1 – control (DNFB); *2* – control (H); *3* – BC; *4* – CY

highest BC and CY doses the cell-mediated immune reaction is more strongly expressed in comparison with the hybridoma control group.

The cytostatics CY and BC are metabolized and are eliminated from organism in the first 5-6 hours. In the present study BC and CY are applied 48 hours before tumour cell inoculation. This totally excludes the immediate influence on tumour cells of the applied cytostatics. Our data for the inhibition effect of CY and BC on the "tumour bearing" and the prolongation of the latent period of hybridoma suggest and induction of the immune response. The low doses – 20 and 50 mg/kg CY and BC, respectively, are more effective, as shown by our results. Similar findings have been reported by Schwartz et al. [7], Capetola et al. [2] for 20 mg/kg CY. They permit the assumption that T-suppressor cell precursors have different sensitivity to different doses CY.

Our results are especially significant for the influence of low doses CY and BC on the primary humoral immune response and the reaction of contact dermatitis in hybridoma bearing mice. These doses of CY and BC possibly inhibit T-suppressor cell activity and in such a way the T-helpers are free from the comparative influence. This gives a possibility for proliferation of cytotoxic T-lymphocytes and B-cells. All this leads to an enhancement the antibody synthesis. However, the high BC and CY doses stimulate only the cell-mediated immune response, while PFC are lowered. This fad is probably due to their B-cell-cytotoxicity.

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Immune response inhibition in mice bearing sarcoma 180 Crocker, plasmocytoma Sp-2/0 Ag 14 or hybridoma

Tz. Mihova, D. Nikolova, I. Goranov*, M. Bratanov**

Department of Pathology, Medical Academy, Sofia
** Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia*

The cells of the immune system play a definite surveilance role against neoplastic diseases. There is no reason to dispute that immunological response influences the course of tumour growth and may be manipulated to benefit the host [1].

The purpose of the present study is to investigate the influence of three experimental tumours – sarcoma 180 Crocker, plasmocytoma Sp-2/0 Ag 14 and hybridoma, secreting monoclonal antibodies against the hapten dinitrophenilic group, on the immune response in mice.

Key words: immune response, sarcoma 180 Crocker (Sa 180), plasmocytoma Sp-2/0 Ag 14 (Pl), hybridoma, (H), plaque-forming cells (PFC).

Material and methods

Animals: 150 inbred, 2 to 3 months old BaLb/c mice of both sexes.
Experimental scheme: One group of mice (70) has been investigated on the 12th day and the other group of mice (70) on the 30th day after tumour-cell inoculation. Each of these groups have been subdivided into three subgroups of 20 and one of 10 mice for control. The control group has been injected with saline, while the other three groups have been inoculated subcutaneously with a suspension of 10^6 tumour cells in 0,1 ml from each one of the tumours. The vitality of tumour cells has been checked by the test of exclusion of dead cells with tripan blue. A suspension of 96% vitality of tumour cells has been applied for transplantation.

The number of antibody synthesising cells has been established by Dresser and Greaves [3].

The delayed type hypersensitivity (iduced by dinitrophenolbenzol – DNFB) has been determined by method of Cluman, modified by Bratanov et al. [2].

Results

The immune response to sheep red blood cells (SRBC) established by the quantity of PFC in the spleen shows significant variations in the three types of tumours depending on the presence of palpable tumour growth (Fig. 1). On the 12th day post tumour cells transplantation, a tumour growth is seen in some of the animals in which a significant decrease of the primary humoral immune response is established. In animals without tumour growth immune response is similar to that of the control group. There is an exception for the animals with plasmocytoma in which the immune response is almost blocked, even in the absence of a palpable

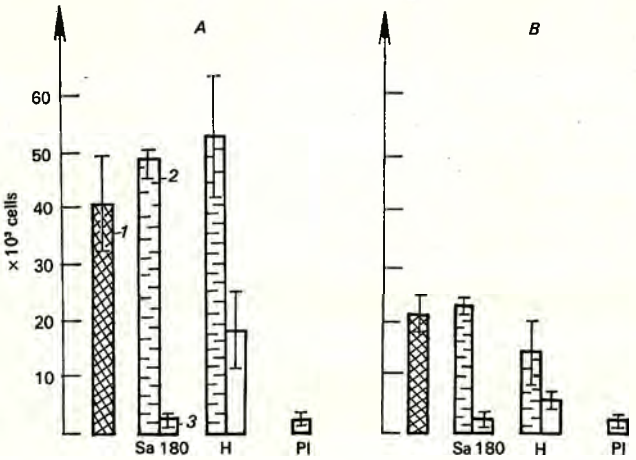


Fig. 1. PFC by sarcoma 180 Crocker, hybridoma and plasmocytoma on the 12th day from the transplantation of tumour cells
A – PFC per spleen; *B* – PFC per 10^8 spleen cells
1 – control; *2* – without tumour growth; *3* – with tumour growth

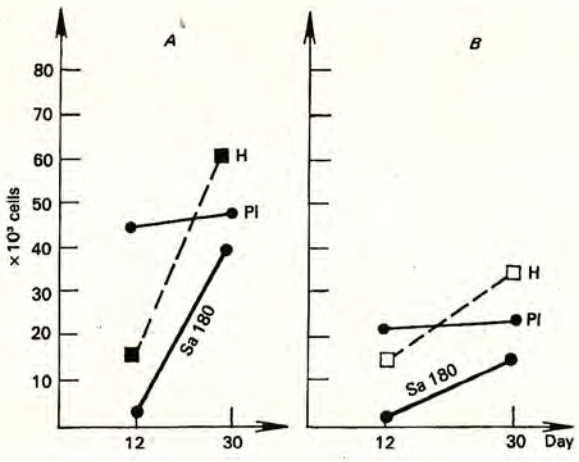
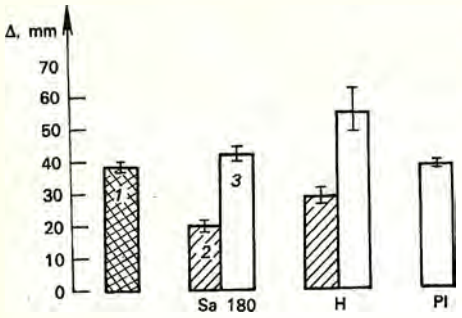


Fig. 2. Distribution of PFC by sarcoma 180 Crocker, hybridoma and plasmocytoma on the 12th and 30th day from transplantation of tumour cells
A – PFC per spleen; *B* – PFC per 10^8 spleen cells



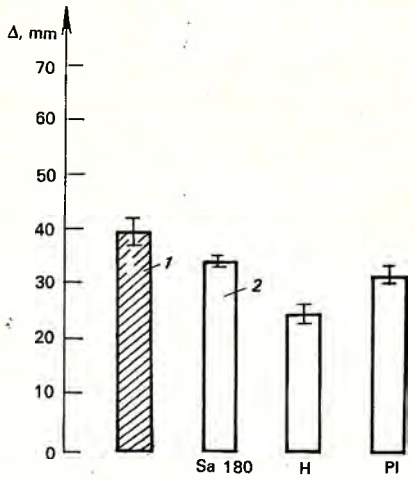


Fig. 3. Delayed type hypersensitivity by sarcoma 180 Crocker, hybridoma and plasmocytoma on the 12th day from transplantation of tumour cells
1 – control (DNFB); *2* – with tumour growth; *3* – without tumour growth

Fig. 4. Delayed type hypersensitivity by sarcoma 180 Crocker, hybridoma and plasmocytoma on the 30th day from transplantation tumour cells
1 – control (DNFB); *2* – without tumour growth

tumour growth. Immune response effect from the tumour growth is checked on the 30th day – after an immunization with SRBC on the 25th of the experiment. Results have been similar to these of the 12th day for sarcoma 180. In animals with hybridoma the number of antibody-forming cells is significantly higher than in the control group. While for those with plasmocytoma, the number of antibody-forming cells does not differ from the control group. Comparing the results of the two periods – 12th and 30th day after tumour cells inoculation we found out that the number of antibody-forming cells increases on the 30th day for the three types of tumours and especially for the hybridoma (Fig. 2).

The dependence of the immune response from tumour growth is also expressed by the reaction of delayed type hypersensitivity. This reaction on the 12th day after inoculation of tumour cells is significantly decreased in animals with well developed sarcoma 180, while in animals without a palpable tumour it does not vary from that of the control group. In all animals with plasmocytoma tumour growth is not registered on the 12th day of tumour cells inoculation, which shows a preserved cellular immune response (Figs 3 and 4).

Discussion and conclusion

There are some difficulties exist in the evaluation of the immunological adaptation to the neoplastic process. On the one hand, the immune system recognizes the tumour cells as alien, while, on the other hand, these tumour cells overcome the immune control and begin to grow progressively. In this way tumour growth suppresses the immune response [13].

In this research the inhibitory effect of sarcoma 180 on the immune response is obvious. This tumour inhibits the immune response from the beginning to the end of tumour development. Sarcoma 180 Crocker is described by Манолов [9], as a tumour that has undergone isogenic evolution and therefore represents a nonspecific tumour "stem line" applicable to different species of mice. Due to this evolution the tumour overcome the immune control of the body and gives a neoplastic growth, suppressing the immune responses.

The analysis of the results for plasmocytoma Sp-2/0 Ag 14 shows that on the 12th day the humoral immune response is significantly decreased even though there is no tumour growth. Two days after this period the first palpable tumour nodes appears. The tumour cells during this period are in a "dormant state" and the suppression of immunity is the probably sign for the beginning of the tumour growth [6].

Jorgensen, Hannestad [4] accept that the secretion of myeloma proteins in plasmocytoma TPC causes idiotype specific immune response of the T-suppressor cells which inhibits the production of antibodies. On the other hand, according to Boyd, Schrader [1] myeloma proteins can inactivate the B-cells by direct intercalation, which leads to functional inactivation of antibody-forming cells in the host and a specific immune tolerance.

In animals with hybridoma tumour on the 12th day a reduction of the number of the PFC in the spleen is observed. This shows that the allogenity of the tumour does not play a significant role. Most probably of greater importance here is the presence of components of normal singeneic cells which are tumour carriers in mice. There are sufficient data in the literature showing, that an alloantigene conjugated with autologica cells (SRBC etc.) experiences a tolerant action on the immune system [11]. In our case the tumour associated-antigens of plasmocytoma Sp-2/0 Ag 14 act as alloantigens and this explains the presence of an inhibitory effect on PFC.

During this period, however, the delayed type hypersensitivity infiltrative reaction is well expressed. It is well known that this reaction gives a general evaluation of the immune status giving information about the level of the T cell-mediated immune response. The result observed on this case is an index of a still active cell mediated immunity.

The data for the duration of the inhibitory effect on immune response are of great interest. On the 30th day the inhibitory effect is still present for sarcoma, while for animals with hybridoma tumour there is an augmentation of the immune response to SRBC. This is difficult to explain. It resembles the immune suppression and the restoration of the immune response during pregnancy, when the semiallogeneic foetus reaches the full development of immune response [10]. For animals bearing well developed plasmocytoma the number of PFC is higher, than that on the 12th day. Терещенко, Сараева [12] explain the increase of PFC of fully developed tumours with the biological specifity of the different tumour models. In connection with antibody formation different results are announced in the literature. For example, Жеромский, Гурны [8], Балбук [7] the well developed tumours cause an inactivation of T-lymphocytes, by increasing the level of B-cells.

Of the results of the 2 examination periods systematized it will be established that the sarcoma growth render a well expressed inhibitory effect upon the both immune responses on the 30th day post transplantation, while the hybridoma and plasmocytoma affect only the cell-mediated immune response. As it is well known,

however, the cell-mediated response is with a fundamental significance in the antitumor immunity, while the humoral immunity has a contradictory character. In conclusion, the effect of tumour growth on the immune response depends of the type of the tumour and the stage of its development.

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Seasonal fluctuations of the humoral immune response in the tortoise (*Testudo graeca* Pall.)

Ch. Atanassov

Institute of Cell Biology and Morphology, Bulgarian Academy of Sciences, Sofia

The primary and the secondary immune response to a T-dependent (BSA) and a T-independent antigen (LPS) was studied on tortoises (*Testudo graeca* Pall.). Two separate experiments were conducted in summer and in winter. The titer and the class of antibodies produced was determined by ELISA. Our results show a considerable suppression in the anti-BSA and anti-LPS antibody production in winter, which is not only quantitative (titer), but also is qualitative (changes in IgM-IgG shift).

Key words: ELISA, humoral immunity, tortoise.

Introduction

A particularity of the humoral immunity in *Chelonia* is the characteristic sequence of "high molecular weight" (IgM), "low molecular weight" (LgG) and "extremely low molecular weight" (IgG lacking one or two domains of the F_c region) antibodies in the serum of repeatedly immunized *Testudo hermanni* Gmelin [1]. Other typical features are the increase in affinity of antigen-specific antibodies in *Testudo hermanni* and *Agrionemys horsefieldii* [7] and the longer intervals between the appearance of plaque-forming cells and haemolysins during the primary response of the latter species [10]. At the same time there is a lack of information dealing with the temperature and seasonal dependence on the humoral immune reactivity in a one and same Chelonian species and its response to T-independent antigens. Until now the tortoises have been immunized with various T-dependent antigens and in a restricted number of investigations hapten-carrier conjugates have been used [1, 8, 11, 12]. For this reason I decided to re-examine the possibility for seasonal fluctuations of the serum antibody production in the tortoise (*Testudo graeca* Pall.) when immunized with a T-dependent and a T-independent antigen.

Material and methods

Animals. Adult tortoises (*Testudo graeca* Pull.) of both sexes, weighting 1,0-3,0 kg, were collected in the Blagoevgrad south-west district of Bulgaria. In both seasons the animals were divided in two independent groups ("BSA" and "LPS"), 40 individuals each. The winter (December-February) and the summer (July-August) experiments were conducted on separate groups of tortoises, which were held troughout the year in a one and the same room at 15-20° C and were fed *ad libitum* with vegetables.

Antigens. The bovine serum albumin (BSA), fraction V-endotoxin free was purchased from SIGMA; the lipopolysaccharide (LPS) from *Escherichia coli*, strain 0111 : B4 : H2 – from IIPD, Sofia.

Antisera. Rabbit anti-tortoise IgM (whole molecule) and anti-tortoise LgM (whole molecule) were obtained as described previously [3, 4]. Goat anti-rabbit IgG (whole molecule), a peroxidase conjugate of IgG fraction of the antiserum was purchased from SIGMA.

Immunization schedule. The animals were immunized twice with BSA or LPS. Second injections were made at day 35 in summer and at day 50 in winter. The individual doses for BSA and LPS were 10 mg and 4 mg respectively. The antigens were administered subcutaneously on the thighs. The BSA was in an emulsion with incomplete Freund's adjuvant, the LPS – without adjuvant. Serum samples were collected three times after each injection, at various intervals as shown on the figures. The sera were prepared from blood, which was withdrawn by a cardiac puncture. The serum samples were kept frozen at – 20° C and were tested within a few days.

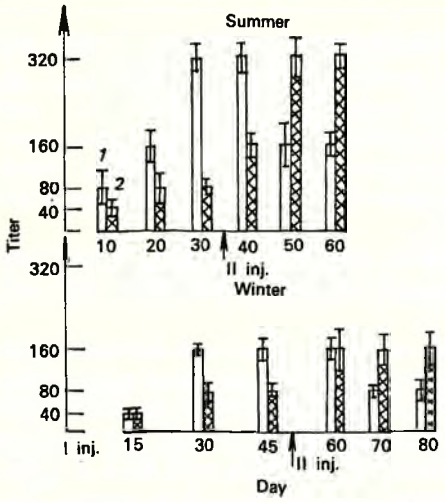
Enzyme-linked immunosorbent assay (*ELISA*). This was performed by the "amplified" method of Butler, McGivern and Swanson [6] with substantial modifications as described previously [5].

Statistics. The Student's *t*-test was used to compare the geometric means of antibody titers from every group of 40 tested sera. If $p < 0{,}05$, the difference was considered significant.

Results and discussion

In summer, the detection of anti-BSA antibodies revealed a primary response, which was predominantly of IgM class (titer 1 : 320 at day 30). The secondary response differed by a specific IgG increase (1 : 320 at days 50 and 60) and by a marked IgM decrease (until 1 : 160) for the same interval (Fig. 1). Similar to the summer one dynamics of the antibody production to BSA, but in significantly lower titers was observed in the winter experiment (Fig. 1). The development of the primary response was due mainly to IgM activity: highest titers 1 : 160 at days 30, 45 and 60. The secondary response was with "mixed" IgM-IgG production, the anti-BSA antibodies of IgG class being in higher titers at days 60, 70 and 80.

The anti-LPS antibodies in summer tortoises were mainly of IgM class and they reached the highest titer 1 : 320 at day 30 after the initial antigenic stimulation (Fig. 2). Their level was without alteration even after the second injection and it persisted until day 50. Ten days later (day 60) they were lowered to a titer 1 : 160. Along with the anti-LPS response of IgM origin, a presence of IgG antibodies was found. It was in too low titers – 1 : 40 at day 30 and 1 : 80 at days



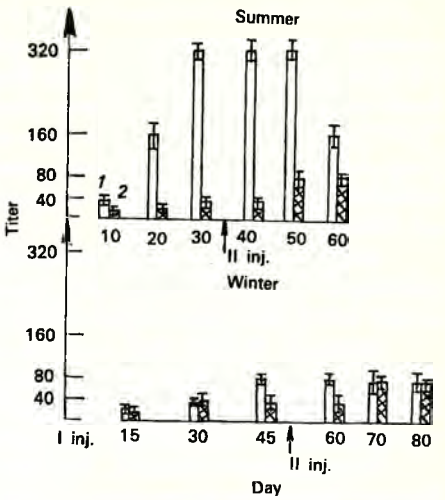


Fig. 1. ELISA for measuring antibodies to bovine serum albumin in the tortoise (*Testudo graeca* Pall.). Each column represents the geometric mean of antibody titer ± standard deviation ($n=40$)
1 – IgM; *2* – IgG

Fig. 2. ELISA for measuring antibodies to lipopolysaccharide in the tortoise (*Testudo graeca* Pall.). Each column represents the geometric mean of antibody titer ± standard deviation ($n=40$)
1 – IgM; *2* – IgG

50 and 60 (Fig. 2). The winter response of *Testudo graeca* Pall. was characterized by longer intervals for the appearance in the serum of low-titer antibodies (until 1 : 80) of both immunoglobulin classes. It is notewothy that in the secondary response the IgG titer became equal to that of the IgM.

In earlier studies on *Testudo hermanni* Gmelin [1] it has been shown that by a combination of suitable conditions (choice of antigen, adjuvant and multiple immunizations) a production of high-titer haemagglutinating antibodies could be achieved. Probably, the lower ELISA titers that were found in *Testudo graeca* Pall. could be explained by several ways: weak immunogenicity of the BSA, which was administered only twice at greater intervals between injections and in lower individual doses. A similarity was established with respect to the class of anti-BSA antibodies in *Testudo graeca* and to that of anti-pig serum protein antibodies in *Testudo hermanni* [1]. It concerns the early (at day 10) appearance of IgM antibodies, which persisted in the serum of *Testudo graeca*. A discrepancy was found in the production of IgG antibodies. While in *Testudo hermanni* the "low-molecular weight" antibodies (IgG or IgY) appear after three months (confirmed by passive haemagglutination test of fractions from gel-filtration of the immune sera), low-titer antibodies were detected in *Testudo graeca* ten days after the first injection. However, it would be inappropriate to compare directly results from ELISA and passive haemagglutination test, since they are quite different assay systems. The latter is also valid for the interpretation of our results from experiments with the T-independent antigen LPS and the data about hapten-carrier conjugates [2, 7]. The observed, in some cases, anti-dinitrophenol (or anti-trinitrophenol) haemagglutinins in *Testudo hermanni*, which were in higher titers than that of the anti-LPS antibodies in *Testudo graeca*, could be due

to a greater epitope density of the haptens on the carrier surface, stimulation of a T-helper subpopulation against the carrier, pre-existence of natural antibodies [2] and/or to a weaker immunogenicity of the lipopolysaccharide. These results rather differ from similar experimental data on mammalian species where the same antigen (LPS) has been used [9].

The results of our winter experiment could be compared, with some limitations, with the data of similar studies on *Testudo ibera* [8] and *Testudo hermanni* [1]. The latter investigation has been performed on animals that were immunized 12 times in the course of several years. Hence, such data could be used with respect to their final conclusion only: for a delay in the antibody production of haemagglutinins to pig serum proteins [1] and of precipitins against *Brucella* antigens [8].

The most common conclusive remark, which could be made is that the immune system of the tortoise (*Testudo graeca* Pall.) shows clear seasonal quantitative and qualitative fluctuations in its function to produce serum antibodies to BSA and to LPS.

Acknowledgements

This work was supported by the Institute of Zoology, Sofia, where the experiments were conducted as a part of a postgraduate thesis.

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Cell proliferation kinetics of mouse ascites tumour AISM after treatment with chalone containing tumour extract (CCTE) in vitro

*M. Bogoeva, D. Venkova**

Institute of Zoology, Bulgarian Academy of Sciences, Sofia
** Acad. K. Bratanov Institute of Biology and Immunology of Reproduction and Development of Organisms*

It has been shown that a chalone containing tumour extract (CCTE) obtained from AISM tumour depressed the proliferative activity of the same tumour at in vitro conditions. CCTE affects both the mitotic index and labelled index by application of 250 μg/ml. The data obtained show that the decrease of proliferative activity is a result of temporary block of tumour cells in G_1 and G_2 phases of the mitosis cycle. The duration of G_1-block is about 2 hours while G_2-block continues 2-7 h.

Key words: chalone, tumour, cell culture, proliferative activity.

Attempts to purify the inhibitors of cell proliferation (chalones) date back to the late 1960s. The identification of mitosis inhibitors of granulocytes [4], epidermal epithelium [3], intestinal epitelium [7] and liver [6] gave no immediate results. Now it becomes known that the mitosis inhibitors are small peptides and they are similar in chemical structure, suggesting a larger family of regulatory peptides [5].

In a previous work [8] it has been established that the proliferative activity of mouse ascites tumour AISM changes rhythmically during twenty four hours. Later we isolated a mitosis inhibitor (chalone) from the same tumour and showed that its activity also changes during a twenty four hour span [1]. The encapsulation of the chalone into liposomes evoked a significant prolongation of inhibitory effect on the tumour cell division [2].

In the work presented here we followed up the effect of chalone containing tumour extract (CCTE) obtained from AISM tumour on the cell proliferation activity of the same during a 24-hours span at in vitro conditions.

Material and methods

The mouse ascites tumour AISM is maintained by i.p. transplantation of 10^6 tumour cells on BALB/c mice every seven days. Explanted tumour cells from seven-days-old AISM tumour were used for preparation of a suspension cell culture. The composition of culture media was: 20% bovine serum (NIEM – Sofia), 56% RPMI 1630 with Hepes (GIBCO), 24% S-MEM Eagle (GIBCO) and antibiotics (Penicilin 10000 E/ml, Streptomycin 100 μg/ml, Nistatin 20 E/ml).

The culture media was distributed in glass vials by 1,5 ml/vial. The initial concentration of tumour cells was 6.10^5/ml. The glass vials were termostated in Elpan water bath shaker setted at T 37° C, speed 120 c.p.m., amplitude 6. Four experimental and four control samples were presented for each experimental point.

Two hours after starting of culture growth 250 μg/ml CCTE was added to the experimental samples, dissolved in advance in 0,5 ml sodium saline. Saline only in the same quantity was added to the control samples. The effect of CCTE on proliferative activity of AISM was followed up after 30 minutes, 1, 2, 4, 6, 8, 10, 20, 22 and 24 hours. Thirty minutes before sampling 1 μCi*/ml Methyl-^{3}H thymidine (Chemapol, sp. ac. 925 Gbq) and 4 μg/ml Colchicin (Fluka) were added to the respective control and experimental samples. The smears were fixed with concentrated Methanol, dyed with Schiff's reagent and covered with ILFORD K2 photosensitive emulsion. The smears were analysed under microscope (oc. 12,5; ob. 100) after development. The mitotic index (MI) was defined after scoring of metaphases on 1000 tumour cells while the labelled index (LI) after scoring of labelled nuclei on 1000 tumour cells. The nuclei with more than five grains were accepted as labelled.

The chalone containing tumour extract (CCTE) was obtained from AISM tumour according method described earlier in detail [2].

All data are statistically processed by using of Student-Fisher test.

Results and discussion

The data concerning effect of CCTE on AISM cell proliferation are presented in Table 1. It is shown that 30 min after treatment with CCTE the MI decreases up to 49% below the control level, one hour later up to 52% and two hours after treatment up to 45% ($P < 0,05$). We observed also a complete recovery of MI to the control level at the 4th and 6th hour after treatment and a rise of the MI up to 75% over the control level 8 hours after treatment. Later it has been established a second decrease of MI up to 32% below the control level which was of short duration and took place 10 hours post treatment. During the rest investigation span no differences between the MI of the control and the experimental groups were established.

The observation of CCTE effect on the DNA-synthesis showed a decrease of the amount of DNA-synthesizing cells up to 36% ($P < 0,05$) four hours after treatment. However, two hours later the LI exceeds the control level by 40% ($P < 0,05$). During the rest investigation span no significant differences between the LI of control group and the LI of experimental group were established.

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* $1 Ci = 3,7.10^{10}$ Bq.

Table 1. Influence of chalone containing tumour extract (CCTE) obtained from mouse ascites tumour – AISM on cell proliferation of the same tumour after single application of 250 μg/ml in vitro

Time of exposition	Control group		Experimental group	
	MI, ‰	LI, ‰	MI, ‰	LI, ‰
30 min	64,7±3,2	316,7± 5,2	33,0±2,6 $P<0,001$	311,7± 4,4 $P>0,05$
1 h	57,7±2,2	313,7±12,3	26,0±1,7 $P<0,001$	330,3± 9,4 $P>0,05$
2 h	55,3±2,0	301,3± 9,7	30,3±0,9 $P<0,001$	308,3± 9,1 $P>0,05$
4 h	52,3±5,0	271,0± 6,7	55,3±2,2 $P>0,05$	172,6±11,3 $P<0,01$
6 h	39,3±1,8	254,3± 6,8	36,3±2,9 $P>0,05$	356,3±26,2 $P<0,05$
8 h	38,3±1,2	215,0± 7,6	67,0±3,0 $P<0,001$	255,3±11,3 $P>0,05$
10 h	34,3±2,7	226,7± 9,3	23,3±1,3 $P=0,05$	231,0± 9,7 $P>0,05$
20 h	43,0±1,2	143,0±11,9	42,3±2,0 $P>0,05$	122,3± 8,1 $P>0,05$
22 h	38,7±1,4	145,0± 3,6	37,7±1,5 $P>0,05$	156,3± 5,5 $P>0,05$
24 h	29,7±1,2	106,0± 7,0	29,3±2,3 $P>0,05$	108,3± 8,8 $P>0,05$

The analysis of the experimental data shows that CCTE acts almost immediately on the tumour proliferation. Most apparently it is demonstrated by the amount of devided cells. A lowering of MI by 49% below the control level is measured 30 min post treatment. The MI remains stable below the control level during the first two hours after treatment with CCTE. We asuume that the tumour cells are delayed in G_2-phase of the mitotic cycle and the minimal duration of G_2-block is two hours. Later the tumour cells gradually get free from G_2-block, enter in mitosis and as a result the MI reaches the control level at the 4th and the 6th hour after treatment. The increase of MI up to 75% over the control level observed at the 8th hour post treatment probably due to a more sinchroniously entering in mitosis of the tumour cell population that has been arrested in G_2-phase to this moment. Thus formed by CCTE the depot of G_2-arrested tumour cells has gradually empty and we supposed that the maximum duration of G_2-block is about 6-7 hours.

As it was mentioned above, a second decrease of MI up to 32% below the control level was established 10 hours post treatment. We tend to propose that it is a result of a short duration decrease of LI that takes place at the 4th hour after CCTE treatment. The LI decrease shows that a part of tumour cell population is arrested in G_1-phase of mitotic cycle due to CCTE influence. Such delay of tumour cells in G_1-phase could possibly result in: first – a decrease of cell amount entering in synthetic phase of mitotic cycle that was demonstrated by the LI decrease four hours after treatment; and second – a later influence on the MI as a consequence of the decrease cell amount passed through S-phase of the mitotic cycle. The blocking of tumour cells in G_1-phase is of short duration (about 2 hours) and complete reversibly as the LI increases up to 40% over control level two hours later.

The obtained results indicate that CCTE blocks temporary and reversibly the tumour cells in G_1- and G_2-phases of the mitotic cycle. The G_1-block has a duration about two hours while G_2-block continues from two to seven hours. The release of arrested tumour cells allows more synchronous entering in S- and M-phases of the mitotic cycle, which is manifested by the increase of LI and MI over the control level respectively.

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Book and journal reviews

Epigenetic Variants of the Human Skull by G. Hauser and G. F. de Stefano. Stuttgart, Schweizerbart, 1989. 300 p.

It is a beautiful book indeed nicely and richly illustrated, acompained by an excellent list of literature. It is a book that you will unmistakably need if you are interested to the epigenetic variants and its application.

It starts with an introduction on the biology of the characters, on their genetics, on their variations and medical relevance. According procedure is followed for each character and is required for comparability. A detailed but also a more simple analysis is proposed. Each character is described through its anatomy, function, embryology and development, genetics, medical relevance, methodology, within population variation, variation among populations. Statistical data are foreseen for all characters too.
The following characters are described.

Types of characters

A. Facial cavities
B. Sutures (chape, persistence), sutural and fontanelle osicles
C. Spines, tubercles, tori
D. Notches, depressions, groovers, osseus bridges, foramina, canals
E. Miscellaneous

Guide to the use of the atlas

Indications to photographs
Indications to the methodologies
Indications to the references in the text and tables

General location of characters

Frontal View
Superior View
Occipital View
Basal View
Internal View
Mandible
Laternal View

There is only one conclusion after reading this comprehensive and authoritative work: to recommend it.

L. Tzatcheva

Bulgarian Academy of Sciences

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Assen Ivanov Hadjioloff – Biobibliography by Jores Yordanov and Zdravka Boyadjieva. S., Publishing House of the Bulgarian Academy of Sciences, 1990. 365 p.

In the presented to the Bulgarian scientific and cultural community Biobibliography of the well-known Academician Assen Ivanov Hadjioloff – a medical and biological scientist, the remarkable life and creative development of the eminent scientist and social activist of ours is displayed thoroughly. It has been really hard for the authors to encompass the almost 60-year long scientific production of an investigator such as A. I. Hadjioloff who with his pioneer studies in various fields of cell and tissue biology (cytology, histology, embryology, cytochemistry, fluorescent microscopy etc.) ranks among the first scientists of an international scope. Full survey of the numerous works of Acad. A. I. Hadjioloff on the problems of tissue and organ histology is not comparatively an easy task also because of the fact that all works are characterized with the use of a broad spectrum of modern methods – histochemical, histoenzymatical, fluorescent microscopical, historadiographical, embryological, TEM- and SEM-ultracytochemical ones having found a wide application in the developed under A. I. Hadjioloff's long-year guidance experimental laboratories, Chair of Histology and Embryology at the Medical Faculty – Sofia and Institute of Cell Biology and Morphology at the Bulgarian Academy of Sciences.

All these difficult tasks have been fulfilled brilliantly by the two authors of the Biobibliography encompassing most thoroughly the period of his life and creative achievement till 1987 – his 85th anniversary and 60 years of the publishing of the first scientific work of the great medical and biological scientist of ours. Save for a scientist-researcher A. I. Hadjioloff is known also as a researcher of history of science, organizer and popularizer of scientific knowledge, teacher, social activist, sponsor of young scientists and aspirants and creator of a scientific school and trends in the Bulgarian morphological science.

The biobibliography consists of five chapters which are preceded by the absorbing study of professor Jores Yordanov "Academician Assen Ivanov Hadjioloff – life and scientific tribute". The first chapter comprises the basic dates and events of the life and work of Acad. Hadjioloff, arranged chronologically. The second chapter represents a bibliography of his scientific works in which a total of 984 are systematized – most of them published independently or in collaboration, systematized in groups of five problems and chronologically – following the turn of their publication. The five groups of works from this second chapter include the scientific-research works – articles and monographs, textbooks in cytology, histology, embryology and hematology, articles on the problems of the history, philosophy and organization of science, reviews on books and science-popularization articles, references, biographical notes etc. In the third basic chapter of the biobibliography the editorial activity of A. I. Hadjioloff is summed up as a founder, editor-in-chief and a member of editorial staffs of many Bulgarian and foreign journals. In the fourth chapter of the book are systematized the chronologically defended under the scientific guidance of Acad. Hadjioloff lots of pH. D. and D. Sci., dissertations as well as the ones whose reviewer he has been himself. The fifth chapter embraces the literature sources dedicated to the scientific and research activity as well as to the tutorial and social activity of A. I. Hadjioloff. Except for the mentioned chapters the authors also presented three original indexes aiming at an easier orientation: 1. Subject-systematic index of the A. I. Hadjioloff's works composed according

to the various fields of science in which he has worked and published (histochemistry of the lipids, luminescence analysis of the cells and tissues, blood and nervous systems etc.); 2. Index of the proper names of A. I. Hadjioloff's coauthors – in the Cyrillic and Latin alphabet separately, with figure data concerning the sources in which the corresponding name is arranged; 3. List of the sources – also separately in Latin and the Cyrillic.

In a more detailed familiarization with the biobibliography a strong impact is produced by the large number of the used and cited bibliographic materials (journals, newspapers, monographs, reference books) as well as the succession in their arrangement in order to be presented to the reader in an easy-to-understand way which contributes a lot to the popularization of the tributes of this outstanding Bulgarian scientist not only in our country but also in a future edition abroad – before a broader circle of foreign readers. Undoubtedly, this edition is very useful for A. I. Hadjioloff's collaborators and disciples who find in it an exceptionally complete bibliographic reference to their common works including brief summaries and information about the citation of each paper in our country and abroad. For the young scientific workers the biobibliography emerges not only as a valuable example of an exceedingly profound in its essence scientific creative work but also as a bibliographic source which undisputedly will arouse new interests and future research projects.

Assoc. Prof. Dr. E. Zvetkova, pH. D.

Bulgarian Academy of Sciences

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Review of Homo (vol. 41, 1990, No 1)

Sujoldzic, A. *The analysis of population history and cultural (linguistic) microevolution of the Slavic settlements in Molise, Italy (1-15).*

This paper explores the consequences of the migration and subsequent cultural evolution of the Slavs who settled several centuries ago in the region of Molise, Italy. This investigation is based on the lexicostatistical method introduced by Swadesh and Lees, modified and detailed described by the author (1983, 87). Determination of linguistic distances between the dialect spoken in Molise and ten local dialects spoken in Yugoslavia, provides evidence of their specific place of origin. The linguistic analysis indicates that the Slavs in Molise are the highly isolated population.

Cocilovo, J. A., F. Rothhammer. *Paleopopulation biology of the southern Andes: craniofacial, chronological and geographical differentiation (16-31)*

To develop this study, mean values of nine craniometrical variables were obtained for 22 samples of chronologically distinct prehistoric populations. D^2-distances between groups are calculated and an analysis using the Wagner-tree technique are used. The study of similarities and differences estimated from the hypothesis, in conjunction with mean vectors for each pair of groups, allows for the schematic construction of biological development. The present study represents an attempt to examine craniofacial variation exhibited by skeletal samples and to relate observed differences to the action of evolutionary forces; particularly gene flow.

Turner, C. G., M. A. Markowitz. *Dental discontinuity between Late Pleistocene and recent Nubians (32-41).*

Late Pleistocene and recent Nubian skeletal samples were examined to assess Nubian population history. All observations were made following the ASU dental anthropology system which is based on standardized ranked scale plaster reference plaques for scoring intratrait variation (Turner, Scott, 1977, Turner, 1979). It is hypothesized that the late Pleistocene people were not solely ancestral to the recent Nubians, and Holocene population replacement has occurred in the Nile Valley.

Irish, J. D., C. G. Turner. *West African dental affinity of Late Pleistocene Nubians (42-53).*

This study is build on the dental discontinuity finding of Turner and Markowitz (1990) between late Pleistocene and recent Nubians. Altogether 276 individuals are examined. The authors testing their results with additional dental traits and identifying a west African population that has a strong resemblance to the late Pleistocene Nubians. It is hypothesized that the late Pleistocene Nubians and/or northwest African late Paleolithic Mechta-type peoples who are phonetically similar to them, contributed significantly to the modern west African gene pool.

Welpe I., E. Welpe. *Explanation of geometric patterns of Irish megalithic passage graves as endogenous patterns (54-71).*

The paper deals with the explanation of geometric patterns of Irish megalithic culture whose origin and meaning rested unexplained up to now. The hypothesis was put forward that the megalithic patterns of Ireland represent stroboscopicly stimulated endogenous patterns, which the authors are explained as eigenpatterns of visual cortical nerve-nets. For examination of the

hypothesis Irish megalithic patterns were compared with stroboscopic patterns.

Riedl, B. I. *Morphological and metrical characteristics of the male and female leitmotif in mate-selection and its impact on the selection of the spouse* (*72-85*).

This paper deals with the morphology of the human face and its impact on mate selection process (over the "leitmotif", the "Partnerleitbild" Knussmann, 1965). 192 individuals (=96 couples) between 20-40 years of age are investigated. Couples were asked to describe ideal faces with the help of a computer programme designed to establish phantoms of criminals. The ideal faces were compared with the real faces of the probationers. Moreover, it was tested whether the spouses resembled each other, whether the ideal faces of the same couple or the ideal face and the face of the probationer who had assembled it were alike.

N. Kondova, D. Paskova-Topalova

INSTRUCTIONS TO AUTHORS

SUBMISSION: Original papers and review articles written in English are considered and should be sent to the Editor-in-Chief.

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Institute of Cell Biology and Morphology
Acad. G. Bonchev Str., bl. 15
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CONDITIONS: In submitting a paper, the author should state in the covering letter that this article has not been published elsewhere and has not been submitted for publication elsewhere.

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ARRANGEMENT:

Title page. The first page of each paper should indicate the title, the authors' names, and the institute where the work was conducted.

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1.Tuohy, V. K., Z. Lu, R. A. Sobel,R. A. Laursen, M. B. Lees. A synthetic peptide from myelin proteolipid protein induces experimental allergic encephalomyelitis. — J. Immunol., **141**, 1988, 1126-1130.

2. Norton, W. T., W. Cammer. Isolation and characterization of myelin. — In: Myelin (Ed. P. Morell), New York, Plenum Press, 1984, 147-180.

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