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PLIO-PLEISTOCENE HOMINIDS: EPISTEMOLOGICAL AND TAXONOMIC PROBLEMS

Introduction

Within the historical times, which roughly corresponds with the Holocene epoch, the whole of mankind is believed to be a single species, *Homo sapiens*. But the human genealogical tree (phylogeny) is populated by a really astounding number of paleontological species and paleontological genera: *Ardipithecus ramidus, Australopithecus anamensis, Australopithecus afarensis, Australopithecus africanus, Paranthropus robustus, Paranthropus boisei, Homo habilis, Homo georgicus, Homo erectus, Homo ergaster, Homo antecessor, Homo heidelbergensis, Homo neanderthalensis, Homo sapiens.* (cf. Gyula 2002). In fact there are many more *(Sahelanthropus tchadensis, Orrorin tugenensis, Kenyanthropus platyops, Australopithecus garhi, Australopithecus aethiopicus)* but Foley (2002), quite reasonably, states that the evidence for their existence is, at present, insufficient.

The existence of these multiple forms is beyond any doubt. The doubt, however arises concerning the human or „prehuman" status of them. Were they really true specific forms, half-way between the apes and Holocene man? Is it possible that they constitute a number of different ecotypes (or paleoraces) within the same natural species of *Homo sapiens*?

The plethora of the generic and specific names within the fossil Hominidae family has no parallel in the paleotaxonomy of other primates (cf. Fleagle 1988; Young 1974). On the other hand some anthropologists argue for a radical simplification of this taxonomic oddity. Wolpoff *et al.* (1994) would drop altogether the taxon *H. erectus* and classify the fossil material as paleoraces or ecotypes of *Homo sapiens*.

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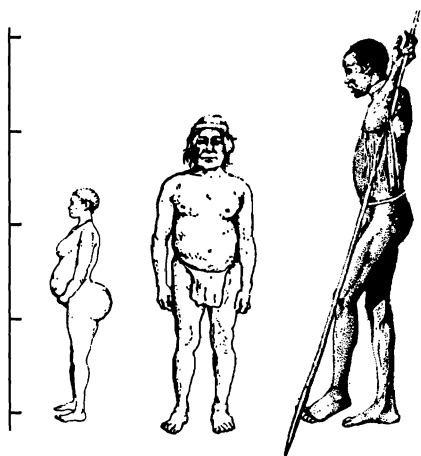
Henneberg and Thackeray (1995) go even farther and claim that from the earliest Pliocene Australopithecines on there simply existed just a single species, slowly evolving towards the present, polytypic population of man.

Fig. 1. Unity of different human populations. From left to right: a Massai, an Innuit (Eskimo), a Boshiman woman. Scale = 0.5 m (adapted from Bielicki 1976).

Is polymorphism and polydynamism a specific trait of the Holocene humanity, or does it constitute a more general phenomenon which might be looked for in the Pleistocene ancestors of our generation.

From the epistemological point of view it is important to realize how the standards of *biological* taxonomy are different from the standards of *paleoanthropological* taxonomy. In other words, what is the difference between the biological anthropology which puts all the human ecotypes and races in the same species, and the paleoanthropological taxonomy which puts a few, fragmentary fossilized remains in a separate species or even genus.

It is also crucial to realize how complex the processes of the recognition and interpretation of fossil data are. Last but not least the current paleoanthropological terminology seems to be under-developed or not consistent enough. Several misunderstandings are produced on the purely symbolic (verbal) level of discussion and argumentation. In this paper some fundamental but forgotten biological principles will be recalled or restated in order to better understand the actual meaning of man's reconstructed phylogenies.

There is no consensus on a single phylogeny of mankind (cf. Arsuaga 2000; Henneberg, Thackeray 1995; Oxnard 1984; Wood 1992; Wolpoff *et al.* 1994). Possibly the only consensus relates to the idea, that present mankind is a kind of Pliocene advanced ape-like creature – the common ancestor of the modern apes and humans. But even this idea – as we will try to show – is highly hypothetical.

From the methodological point of view it must be stressed that the empirical documentation of the discussed topics is highly selective. The actual number of possible illustrations is beyond the belief of a layman.

THE INTRASPECIFIC POLYMORPHISM AND THE INTRASPECIFIC TOTIPOTENCY
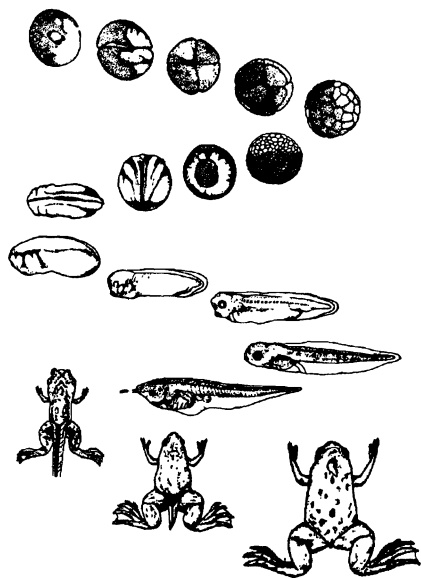
Philosophers, as a rule, concentrate upon the intellectual or „spiritual" dynamism of man. To a physical paleoanthropologist, man above all, is a concrete, biological form, it is just a species within the animal kingdom. It seems beyond any rational doubt that man is an intrinsically *composite* substance, both biological and intellectual. Both from the philosophical and paleoanthropological point of view it is important to realize how deeply man's biological dynamism influences his morphology, physiology and behavior.

Living form and species concept. The definition of biological species is an old and still unsolved problem[1]

Fig. 2. Selected stages in frog's *(Xenopus laevis)* developmental cycle (adapted from Nieuwkoop, Faber 1956).

The expression „*concrete living form*" does not imply something „frozen in time", a segment isolated from its environment, an organic structure, which we see *here and now*.

It is of crucial importance to realize that any such a specimen has no fixed mass or shape, or color, or dynamism. Every second, every billionth part of a second it changes its chemical structures, its cellular organelles and the tissues of its organs (cf. Koshland 2002; Rose, Bullock 1993/91-92). The chemical dynamism within a living body strictly follows the laws of inanimate matter, but it is considerably, selectively constrained. And this makes the most important difference between a living body and a dead corpse. Neither one reveals any chemical dynamism contrary to the laws of matter. The integrated pattern of the chemical processes is fundamental to the developmental directly observable dynamism of every living body.

This dynamism called the *developmental cycle* „marks out" the non-arbitrary boundaries of the actual and fundamental object of biologist's

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[1] In modern biology there are more than twenty species concepts – biological, morphological, ecological, genetic, phenetic, phylogenetic, etc. (cf. e.g. Hey 2001/327; Mayden 1997/381-424; Stebbins 1993/229-246).

research. The „boundaries" of a living specimen are not delineated by its anatomical structure, nor by its envelope of skin, nor by its cellular walls, but by its *developmental cycle*.

However, this does not mean that the living form is just an *individual* developmental dynamism. It is obvious that we cannot narrow down the study of the dynamics of a living form to a *single specimen*. To begin with, the fact that organisms reproduce themselves, directs our attention to the dynamics of *transmitting life* down a lineage, which means a closely linked succession of specimens. The behavior of a concrete specimen is essentially subordinated to the process of *reproduction* – the perpetuation of the life of the given living form.

Moreover, the observation of the geographically distant or ecologically distinct populations of cross-breeding and reproducing specimens directs our attention to the *variability* of the given biological form in its morphological, physiological and behavioral traits. It is obvious that this variability is closely connected with developmental dynamism – strictly speaking with the *developmental potency* of a given living form (cf. Koszteyn 2003 a, b; Lenartowicz, Koszteyn 2002; Lenartowicz, Koszteyn – in press).

Polymorphism and polydynamism. To describe a living form (no matter whether an animal, a plant or a bacterium) we have to take into account the bewildering multiplicity of appearances in which that form reveals itself to our eyes. It is not simply the particular specimens that differ one from another, structurally or dynamically. Even a single specimen, within its life cycle, can assume a radically different appearance. Let us just remind ourselves of the difference between a zygote, larval stadium, pupal stadium and the adult butterfly.

A really complete description of life processes is therefore extremely difficult and time-consuming. Until now it has never been carried out even in the case of the simplest bacterium. It would require an *in vivo* simultaneous observation of several different hierarchies of structures, and several different hierarchies of dynamisms.

The inner complexity of a particular, concrete living specimen is just the beginning of the steps leading to a full reconstruction of a concrete living form. A living form consists of many specimens and these are far from being „equal" – meaning „identical".

Two individual animals (specimens) – and to some extent plants, mushrooms, microorganisms – may be different although they belong to the same living form, i.e. the same natural species. It is because of:

    A. Different age (even among adults age alone may produce differences).
    B. Different sex (male or female) or sex combination (e.g. hermaphrodite).
    C. Different physical casts (queen, drone, worker, soldier, replete, etc.).
    D. Different phases of life cycle (egg, larva, cyst, embryo, juvenile, nymph, pupa, adult).
    E. Different body forms (polyp, medusa, medusoid, dactylozooid, gonangium).
    F. Differing positions in a colony (terminal individuals or basal ones, performing different functions, differing in structure).

G. Different seasons or in different climatic cycles (spring and summer forms, and cyclomorphosis).

H. Living in different physical habitats (arctic and temperate individuals; ecophenotypes[2]).

I. Had responded in color to differing backgrounds (color changes produced by integumentary chromatophores in response to environment).

J. Were feeding on different prey or plants[3].

K. Were living under different crowding conditions (density-dependent variation, sometimes related to availability of food[4]).

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[2] „*The nineteenth-century botanist Anton Kerner transplanted scores of plant species, such as the field violet (Viola arvensis), common groundsel (Senecio vulgaris), veronica (Veronica polita), parnassia (Parnassia palustris), campion (Lychnis viscaria), and others, from the lowland valleys of Austria to an experimental garden at 7200 feet elevation in the Tyrolean Alps. The lowland plants grown in the alpine environment produced shorter stems, smaller leaves, smaller and fewer flowers standing closer to the ground, and more brilliant coloration of both leaves and flowers than parallel lots of the same species grown in the lowlands. The plants grown in the alpine garden gave rise to seedling progeny exhibiting the same modifications as their parents as long as they were grown in the same alpine environment. But as Kerner noted: 'As soon as the seeds formed in the Alpine region were again sown in the beds of the Innsbruck or Vienna Botanic Gardens the plants raised from them immediately resumed the form and colour usual to that position. The modifications of form and colour produced by change of soil and climate are therefore not retained in the descendants. /.../ In no instance was only permanent or hereditary modification in form or colour observed'.*" (Grant 1963/129).

[3] „*The geometrid moth Nemoria arizonaria (Grote) occurs in Arizona, New Mexico, Texas, and northern Mexico. /.../ Although the spring and summer broods of caterpillars look the same at hatching, they develop differently. Caterpillars of the spring brood feed on oak catkins (staminate flowers) and develop into remarkable mimics of the catkins: the integument is a rich yellow color, and densely rugose in texture with many papillae; large dorsolateral processes project from the sides of the thoracic and abdominal segments; two rows of reddish-brown, stamen-like dots occur along the dorsal midline. These morphological characteristics render the catkin morphs virtually indistinguishable from the oak catkins. Caterpillars from the summer brood hatch long after the catkins have fallen from the oak trees, and they develop instead into mimics of first year oak twigs: the integument is greenish-grey and less rugose than the catkin morph; the dorsolateral processes are not as pronounced as in the catkin morphs. The two morphs also differ in the allometry of head and jaw morphology, and in their hiding behavior. The catkin morphs have small jaws suitable for cutting the soft pollen grains from the catkins. The twig morphs have relatively large mouthparts and head capsules to accommodate the massive jaw musculature needed to eat the leathery oak leaves. The two morphs also actively seek out the substrates on which they are well hidden. The catkin morphs remain still when placed on catkins, but move onto catkins if they are placed on leaves or twigs. Conversely, the twig morphs remain still when placed on twigs, but move from catkins and leaves*" (Greene 1989/643-646). Crow (1964/616) mentions the seasonal exchange of dentition in the Island ponies. In summer the ponies graze on pastures while in winter they feed on fish.

[4] E.g. positive and negative trends in Pygmees (cf. Tobias 1962, 1972, 1985). Quite similar modifications, related to the density of population are observed in insects (cf. Krebs 1997/55).

L. Differ in karyotype principally (diploidy and haploidy, homozygosity and hetero-
    zygosity with dominance)[5].
M. They come from different extremes of continuous character expression (so called
    clines). E. g. The density of melanophores increases in the cutaneous tisssues of
    the low latitude populations of man. The amount of haemoglobin in blood
    gradually increases in high altitude populations.
N. They come from differing sectors of a discontinuous character expression[6] (cf.
    Blackwelder, 1967/105-120).

As we can see, polymorphism is not an insignificant, subsidiary pheno-
menon, but rather quite typical, almost universal rule of the *intraspecific
plasticity*[7]. Even clones, quite unexpectedly, reveal an amount of polymor-
phism (see e.g. Cohen 2002; Ezzell 2003; Shin *et.al.* 2002).

It is difficult to find a truly monomorphic species within the multitude
of existing biological forms. Therefore the temporary, momentary shape and
physiology of a specimen does not and cannot reveal the true, develop-
mental capacity or the full hereditary potential of a given living form.

Phenotypic plasticity and the norm of reaction. Observations and
experiments have shown that the anatomy and physiology of specimens of
a given living form can change in an obvious correlation with some changes
in environment (cf. for instance Arnqvist, Johansson 1998; Bell, Sultan
1999; Bruni *et al.* 1999; Ghadouani, Pinel-Alloul 2002; Kühn 1971/384-394;
Lurling 1999; Noach *et al.* 1996; Pettersson 1999; Simek *et al.* 1997;
Tollrian 1993; Winn 1999; Zhang, Malmqvist 1997). Sometimes such trans-
formations of structure and dynamism can happen within a single life

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[5] In Israel lives a rodent – *Spalax ehrenbergii.* Hybrids of its varieties have 24, or 52,
or 54 or 60 chromosomes (cf. Kunicki – Goldfinger 1993/208).

[6] E.g. „*each human subspecies* (or race – JK) *has its own clinal system, some being the
exact opposites of others. /.../ Mongoloids achieve cold tolerance by an increase in basal
metabolism, while Australian aborigines and nomadic Lapps achieve it by a heat transfer
in the extremities between outgoing arterial blood and incoming venous blood. Europeans,
in general, derive insulation from subcutaneous fat, and they may be the fattest major
group of people in the world. Subcutaneous fat gives Negroes, who are as corpulent as
Europeans much less protection against the cold*" (Coon 1966/521).

[7] „*Most organisms occur in two or more distinct forms. Developmental polymorphism
or polyphenism occur when phenotypic variation is produced by differences in environ-
mental conditons rather than by differences in genetic constitution. /.../ Examples are some
color forms of caterpillars, pupae, and butterflies, winged and nonwinged morphs of water
striders and planthoppers, sexual and asexual forms of aphids, and cast systems among
social hymenopterans*" (Greene 1989/643).

„*As pointed out by several authors, the presence of alternative morphs is a very common
feature in the animal kingdom, involving differences between larval and adult stages;
normal and neotenic morphs; polymorphism of Batesian mimics among insects; trophic
polymorphism in protozoans and rotifers; polymorphism linked to dispersion phenomena
among insects; seasonal polymorphism in insects and crustaceans, etc.*" (Bavestrello *et al.*
2001). See also Mayr 1974/167-176, 178-183.

cycle[8], and sometimes they take place gradually within a number of generations[9]. In both cases the „appearance" or „disappearance" of a given trait or a set of traits occurs in a predictable, regular and reversible way. This phenomenon is named *adaptive phenotypic plasticity*. The range and the limits of this variability constitute the *ontogenetic reaction norm* of a particular living form[10] (cf. for instance Arnqvist, Johansson 1998/1847;

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[8] A special case of plasticity is represented by heterophylly, the ability of semi-aquatic plants to produce different types of leaves. Submerged leaves are thin and lack both a cuticle and stomata, whereas aerial leaves are thicker, cutinized and bear stomata. Heterophylly is quite often mediated by similar environmental cues across diverse taxa: ferns – e.g. *Marsilea*, monocots – e.g. *Potamogeton* and dicots – e.g. *Hippuris, Ranunculus, Sagittaria* (cf. Minorsky 2003; Podbielkowski, Tomaszewicz 1996/181-184; Schlichting, Pigliucci 1998/36; Szmalhauzen 1975/383-385; Wells, Pigliucci 2000).

[9] Recently Losos, Warheit and Schoener (1997) described the remarkable results of 10-14-year experiments with *Anolis* lizards experimentally introduced onto 14 very small Bahamian islands. All came from a nearby source population on the small island of Staniel Cay, Exumas, Bahamas. After 10-14 years, the island populations have differentiated, particularly in relative hindlimb length, to become closer to the 'optimal' phenotype to be expected given the shorter and thiner vegetation on their new homes. Moreover, the degree of reduction in relative hindlimb length across the 14 experimental islands parallels the extent to which the local vegetation departs from that in their common source population on Staniel Cay (Losos *et al*. 1997; see also Case 1997; Harvey, Partridge 1998). This parallel, relatively very fast and biologically effective modification of morphology indicates an inner, immanent cause for it rather, than the mutational and „selective" mechanisms postulated by the Darwinian concepts.

Cody and Overton (1996) reported the rapid loss of dispersal ability in wind-dispersed weedy plants in the daisy family (Asteraceae) on small islands off British Columbia. On newly colonized islands, they witnessed an evolutionary enlargement in the embryonic portion of the seeds and a reduction in the size of the parachute-like pappus that keeps the seeds aloft. These changes are adaptive because they reduce dispersal, which on such tiny islands often results in seeds being lost in the ocean (Cody, Overton 1996; see also Case 1997). Again the intraspecific, immanent, adaptive potential seems to be a much more reasonable explanation of the fact than the commonly invoked haphazard Darwinian processes.

[10] The concept of the „reaction norm" was introduced by Woltereck in 1909. It is not related directly to a particular, actual phenotypic manifestation but to the genetic endowment of a given living form. *„Reaction Norm – the range of phenotypic reactions of a particular idiotype (the sum total of all genetic information contained in the chromosomal and extrachromosomal hereditary determinants) or of a particular genotype (the sum total ot the genetic information located in the chromosomes), as manifested by the variety of phenotypes which the specific idio– or genotype is able to produce in response to environmental influences"* (after Rieger *et al*. 1968/372) The same definition can be found in recent biological texts: *„The complete set of phenotypes that a particular genotype could produce under all possible environmental conditions is called its norm of reaction. The change in the phenotype of a particular genotype in response to the environmental conditions is termed phenotypic plasticity"* (quoted after Schlichting, Pigliucci 1998/51).

The roots of the rich adaptive plasticity are looked for in the presumably stable „genotype agency". Many people still believe that the relatively stable agency is identical with the

Petersson 1999/25; Pigliucci 1996/168).

> *„Plastic responses are occasionally spectacular, sometimes producing individuals so distinct that they are classified as separate species (or even genera). Rollo and Shibata (1991) reported responses of this type in a species of terrestrial slug. Trainor (1995) described seasonal and environmentally derived variation in species of the green alga Scenedesmus. Typically a four-cell colony (coenobium), they also occur as unicellular form, and there is also substantial variation in cell shape and size, and in the presence and length and number of spines. Some of these forms have in the past been described as various species and placed in at least two other genera of unicellular algae (Trainor, 1996).*
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> *Plastic responses to the environment have four attributes: amount, pattern (Bradshaw, 1965; Schlichting and Levin, 1984) rapidity (Kuiper and Kuiper, 1988), and reversibility (Slobodkin, 1968; Piersma and Lindstrom, 1997)."* (Schlichting, Pigliucci 1998/52-53).

Developmental potency and totipotency. Different appearances of a given living form (a natural species) reveal nevertheless, in special circumstances, an amazing uniformity of their developmental potency. In many cases it was conclusively shown that no matter which appearance is examined – the developmental potency is the same. It was also shown that, down to a certain level of structural disintegration, this developmental potency remains intact. In biological literature this fact is usually referred to as *totipotency* [11]. That means, that in a small, deeply mutilated portion of the once living form (it may by just a single cell) the full capacity to regeneration of the lost parts is still present and active.

Unity of a natural species. Natural species, therefore, reveals a paradoxical trait. Its phenotypic manifestations are variable, changeable, while its invisible developmental potency remains the same. Two metaphors come to mind.

One is the metaphor of a novel. It may be printed in different characters, in different languages, on a different paper, with a different ink, but it remains „essentially" the same.

Second is the metaphor of a hologram. It may be cut to pieces, but the message or picture it holds remains „essentially" the same. However, the two metaphors cannot articulate the dynamic, immanently active nature of

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DNA molecule of the given living form. Yet recent laboratory data suggests that, at least in some simple bacteria, the genotype seems able to „adaptively mutate" and be responsive to environmental variability. The potential impact of mechanisms of adaptive mutation on a more complete theory of the interacting mechanisms of variation and selection are therefore profound: *„The discovery that cells use biochemical systems to change their DNA in response to physiological inputs moves mutation beyond the realm of 'blind' stochastic events /.../ we have found a genetic engineer there, and she has an impressive toolbox full of sophisticated molecular devices for reorganizing DNA molecules"* (Shapiro 1995/374)

[11] *„Totipotency. The inherent capability of a single cell to /.../ the development of an entire individual"* (Thain, Hickman 1996/619; cf. also Lenartowicz 1986/134-152 and Lenartowicz 1992/87-118).

the specific developmental potency. They may just help to direct our mind towards a more adequate concept of this agency.

The concept of „totipotency", therefore, is broader than the concept of „totipotency" used in the context of the cloning experiments. The complete developmental potency is present not only in the mutilated bodily structures, but it is also present in the particular appearances of a given living form (phenones, ecophenotypes, ecotypes, etc.). The broadly trumpeted unity of Holocene (or historical) *mankind* is to be understood in terms of the identical developmental potency of every single man. It remains to reflect on the quite widespread conviction that the prehistoric, Pleistocene ancestors of mankind had a lesser, poorer, more apish developmental potency.

THE PROBLEM OF UNITY AND DISCONTINUITY IN THE BIOLOGICAL WORLD

The predominant Darwinian way of thinking stresses the idea of a continuity all-over the biological world. This continuity can be seen in the concept of a single phylogenetic tree and in the single layer concept of heredity. An alternative view is that the processes of heredity reveal two, rather different forms of the transmission of traits, and that some unfathomable discontinuities do exist between the biological forms.

It would be vain to question the existence of a unity in the biological world. But the word „unity" in biology has several distinct meanings which have to be analyzed.

Four different meanings of the word „biological unity". Even a relatively superficial observation of living forms prompts us to distinguish four different meanings of the word *„unity"*, namely the (1) *unity of a specimen*, (2) *unity of an ecotype*, (3) *unity of a given biological form* (natural species), and (4) *unity of the whole set of biological forms* populating our planet.

Unity of a specimen. The most evident is the unity of a given, concrete specimen – be it a rabbit, a tree, a single bacterial cell. This unity refers not to a frozen photo of an animal, but to an individual „life, or developmental cycle". Considering different stages of this cycle we can detect a rather strict correlation between the embryological, developmental processes and the efficiency and economy of the adult structures and dynamisms.

Unity of an ecotype. The ecotype or the ecophenotype is to be conceived as a population of specimens which manifest an evident structural and dynamic correlation with the physico-chemical and biological factors of the environment (e. g. temperature, humidity, illumination, availability of food resources, the potential predators ... and so on). The progeny of these specimens demonstrate the same capacity to develop the above mentioned adaptive traits. On top of it we can observe that the specimens of a particular ecotype usually develop some easily detectable traits which help them to recognize and to join a sexual partner of the same developmental and adaptive tendency. Koszteyn and Lenartowicz (2001) had named them the

„traits of racial identification". The traits, together with the correlated behavioral tendencies may make the hybridization of different ecotypes more difficult, creating an „hybridization barrier".

Unity of a concrete living form. The ecotypes of a particular living form were shown to hybridize. The „hybridization barrier" is, therefore, not absolute, but only relative. Canidae, Felidae, Perissodactyla do hybridize within their families or orders (Guynup 2003; Kaleta 1998; Nusbaum-Hilarowicz 1912/231-233). This fact can be interpreted in terms of the natural unity of these kinds. All human Holocene races do also hybridize, although even here some racial, hybridization barriers are evident enough.

Unity of the animated forms. Upon a detailed analysis one can discover that all the living forms existing on Earth possess many identical, or *almost* identical structures, and reveal many identical or *almost* identical dynamisms. One can mention the identical set of the twenty basic amino acids, the identical general principles of coding, transcribing, translating the enciphered molecular DNA messages, the identical means of repairing the damaged DNA molecule ... and so on. On the negative side of it one might say that all the known living forms are dying – a phenomenon which has no sense in the mineral world.

Kinship and the hybridization barriers. Every living form manifests both an amazing number of appearances and an evident reproductive link between them. In other words the inner ties linking these disparate appearances are recognized in the direct empirical data. These ties are not the product of a logical extrapolation, the result of a purely intellectual consideration. We see these ties, we observe them – on the condition our observational space is broad enough[12]. We can directly observe a pod with numerous seeds of a pea, and we can directly observe how differently they develop in different circumstances.

Therefore we can say that in biology one has to distinguish between two different kinds of „similarity":
   – the similarity of the related forms, and
   – the similarity of the unrelated forms.
The similarity of the unrelated forms may sometimes, and quite superficially, be more evident than the similarity of the related forms. For instance a butterfly may look more evidently similar to a dragonfly than to the caterpillar stage of its parents or sisters. What decides about the recognition of the true biological link? It is an *inner developmental potential* which is evidently different in the butterflies and in the dragonflies. We

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[12] The term „observational space" refers to the temporal and spatial dimensions of our observational field. One has to be patient enough to see the evident link between a freshly laid chicken egg and the fully shaped chicken body which appears 21 days later. To observe the life of an elephant a bigger observational space is necessary than in the case of a flea.

have to admit that it takes much time and patience to observe the full developmental cycle of a butterfly, or a dragonfly. Nevertheless the evidence is direct, no less direct than during a momentary, superficial assessment of a butterfly and the dragonfly.

One has also to remember that the idea of kinship is much more comprehensive than the idea of sexual proliferation. Every living form can be a source of many related and differently shaped individuals (specimens) whether it multiplies in the sexual or vegetative mode.

Consequently it seems necessary to distinguish between
a) the reproductive isolation of the related specimens and
b) the reproductive isolation of the unrelated biological forms.

The first kind of isolation arises from a complex biological mechanism (hybridization barrier), which involves:
1) a specific set of the inner adaptive capacities, strictly correlated with the actual properties of the environment,
2) the external markings which help to recognize the right partner for reproduction,
3) the proper behavioral (instinctive) tendencies (cf. Koszteyn, Lenartowicz 2001).

A hybridization barrier protects the inner adaptive properties of a given variety, natural race, ecotype.

That barrier does not appear in the artificial „races" produced by arbitrary selective breeding. The artificial forms have to be kept isolated by men, otherwise the „purity" of the given race would be destroyed.

In wild, natural races, hybridization barriers develop whenever the integrity of a profound phenotypic and hereditary adaptation is endangered. The characteristic pattern of fur, the specific olfactory signals, the extremely complex nuptial rituals eliminate or diminish the risk of a hybridization error. The „error" consists in the conception of a hybrid embryo in which two different incompatible adaptive tendencies are mixed together. Hybridization barriers or anti-hybridization mechanisms may be therefore regarded as a *pro-adaptive mechanism*[13] This assumption may be further confirmed by some empirical observations. The sympatric forms of a given kind differ one from another much more than the allopatric forms, separated by physical, geographical barriers[14].

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[13] Experiments on marine copepods (crustaceans) show – for example – that hybrid individuals between populations some tens of kilometers apart show breakdowns in salinity tolerance, prolonged development and so on (Burton 1987, 1990). Templeton (1986) illustrates the loss of adaptation traits to local environment by the following: „*when the Tatra Mountain ibex (Capra ibex ibex) in Czechoslovakia became extinct through overhunting, ibex were successfully transplanted from nearby Austria /.../ However, some years later, bezoars (C. i. aegagrus) from Turkey and the Nubian ibex (C. i. nubuana) from Sinai were added to the Tatra herd. The resulting fertile hybrids rutted in early fall instead of the Winter (as the native ibex did), and the kids of the hybrids were born in February – the coldest month of the year. As a consequence, the entire population went extinct.*" (quoted after Kaplan, 2002/3-4).

[14] C. Vaurie (1951) studied two East Asia nuthatches – *Sitta tephronota* and *S.*

The „*reproductive barrier*" between the *unrelated* forms seems to be a quite different problem. The unrelated biological forms do not produce hybrids in wild, and man's experimental attempts also fail to produce a progeny[15]. Here, it seems, for more profound reasons have to be called upon. It is not just an adaptive potential, but the more fundamental, substantial potential of the given natural species which protects the living being against the risk of conceiving a chimera. In fact, attempts to create the interspecific chimeras have led to the annihilation of one or another specific form. Actually some of them were intraspecific manipulations, so their results do not substantiate the claim made in the reports[16].
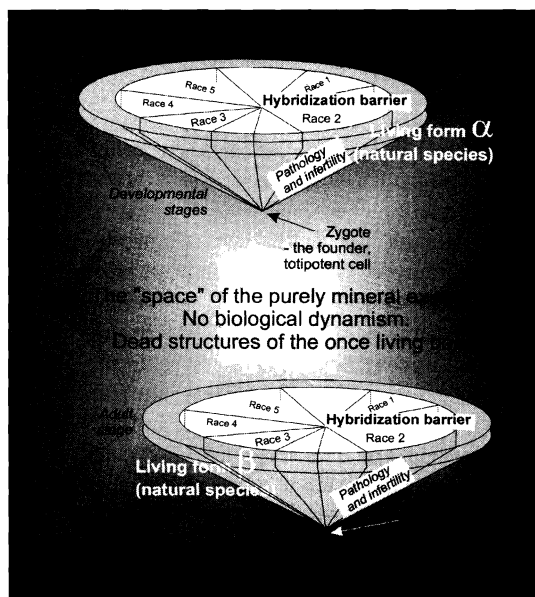

Fig. 3. The difference between hybridization barrier and pathological infertility. The „races" are identical with eco(pheno)types. The concept of the natural species refers to the full adaptive potential (norm of reaction) of a given biological form.

In Fig. 3. the processes of embryogenesis and the adult stages of living form are represented by the shape of inverted cones. The tip of the cone (at the bottom) represents the „totipotential" cell of a given natural species („α" or „β"). Its development into adult structures depends upon the

expression of the adaptation to specific trophic niche (and avoidance of niche overlaping), whereas head pigmentation was an element of the anti-hybridization mechanism (cf. also Krebs 1997/235; Odum 1982/290-291).

[15] See for instance Williamson's experiments (1992/174-184) on *Ascidia mentula* and *Echinus esculentus*.

[16] See for instance Ge *et al.* (1997) paper entitled: *Overcoming interspecific hybridization barrier in Ornithogalum by application of NAA to the ovary*. It was not shown convincingly enough that the *Ornithogalum 'Nova'* and the *Ornitogalum dubium* really belong to the different natural species. There is a plethora of such hybridization experiments and their interpretation depends upon the right distinction between the really intraspecific and the really interspecific fertilization success. To give just one example, it is far from evident that the cucumber and the melon belong to two different natural species. So no conclusive judgement can be reached from a successful hybridization of these two plants (for bibliography see J. Staub (2003).

qualities of the actual environmental sphere. In this way the same germ cell may develop into just one out of a range of different ecotypes. The production of a proper ecotype may involve a specific rearrangement of the molecular genome (enciphered DNA messages). Consequently, the further multiplication of the ecotype may be relatively dependent upon the proper selection of the mate in the process of fertilization. The mate, preferably, should be adapted to the same environment. Within the same natural species different ecotypes (natural races) can develop some distinctive identifying structures on the surface of the adult body and several other olfactory or dynamic (wedding rituals) hints. These easily detectable hints are perfectly correlated with the fitting behavioral tendencies.

This complex set of structural and behavioral traits is somehow coupled with the more profound modification of the molecular genome and it seems appropriate to name it a „hybridization barrier". The „hybridization barrier" is a hereditary trait, although the adaptive capacities of the given ecotype are not diminished.

Essential and adaptive heredity. We have therefore to distinguish between two levels of heredity. One consists in the transfer of the full developmental potency (totipotency, or totipotentiality). This we will call the *essential hereditary potential.* Another one consists in the transfer of some particular adaptive modifications, which can appear or disappear in a changing environment. This we might call the *actual adaptive hereditary potential.*

The different segments of the cones (race 1, race 2 ... and so on) depicted in Fig. 3. represent the developmental and adult stages of different ecotypes within a single natural species. The hybridization barrier may develop between them. But the existence of the barrier does not mean that the ecotypes belong to different natural species. The nature of the „totipotency" within a given natural species remains the same in all the ecotype populations, and in all the cells of any single specimen.

The multi-adaptive cone is enclosed within the gray area of pathology. Farther away, purely mineral dynamism is observed. This means death, decay, fossilization and many other disintegrative mineral activities.

The Darwinian doctrine disregards this concept of the natural species. According to that doctrine there is just one kind of heredity and the adaptive modifications are the main source of a truly new species – different „cones" in our schematic representation (see Fig. 3). The ecotypes, according to that doctrine, are the result of mutational events together with so called „natural selection". Both operate through environmental physical influences.

Between the two natural species spreads the space of the purely mineral existence. Sometimes it is referred to as the „fertilization barrier". But it is not a „barrier" in any concrete sense of the word. No reproductive barrier can be detected or observed between whales and sharks, or between elephants and cows. It was not *constructed* by a living organism, nor was it constructed by its environment. It is not a kind of spatial distance. It is the deepest possible existential difference, namely the substantial difference.

Wasmannian concepts of „natural species" and „systematic species". The concept of „common species" („coenospecies", Turesson 1922[17]) and the „natural species" (Wasmann 1910) is related to the phenomena of polymorphism and the hybridization barrier.

Wasmann attempted to combine the Linnean concept of the immutable species (created directly by God) with the evident phenomena of the gradual evolution of species. He observed ants and came to the conclusion that even within the limits of several dozen years in some populations one can see the origin of new patterns of specific dynamism. He called this phenomenon „evolution" and considered himself as an „evolutionist", although he decisively rejected the mechanism of evolution postulated by Darwin. What made the difference between these two concepts of evolution?
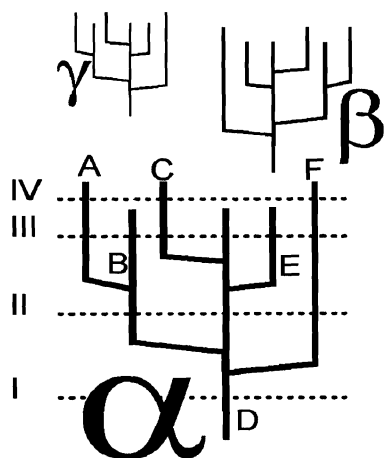
Wasmann introduced a distinction between the concept of *natural species* and *systematic species*. Any natural species, in his opinion, originated from a monomorphic form, perfectly adapted to a concrete environment. With time – and in close correlation with the changing environmental conditions – the originally almost monomorphic species manifested increasingly pronounced polymorphism. This polymorphism, observable as a range of ecotypes was, and still is the source of the taxonomic concepts of species and subspecies.

Fig. 4. Diachronic polymorphism. Schematic representation of Wasmann's concept of phylogenesis.

Wasmann believed that living forms possess an inner tendency to the optimal exploitation of their environment. This immanent tendency, in his opinion, constitutes the main mechanism of the origin of ecotypes. Cross-breeding, geographical isolation and natural selection are, in his opinion, merely secondary sources of polymorphism.

The Wasmannian concept of evolution was, therefore, rather limited. He did not practice extrapolations defying the obvious biological data. He was not convinced that a single genealogical tree, common to all living forms

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[17] Turesson G. (1922) The genotypical response of the plant species to the habitat. Hereditas, 3: 211-350 (cf. Stace 1992/29-30).

had ever existed. Instead, biologists have to investigate the numerous, separate, discontinuous phylogenetic „trees" or „bushes".

Fig. 4 represents the Wasmannian diachronic concept of phylogenesis within the limits of a given *natural species* („α", „β", „γ", ... and so on). Synchronic polymorphism refers to the multiplicity of the ecotypes within the same slice of time dimension. Diachronic polymorphism refers to the ecotypes of the same species which lived in different slices of the time dimension. Pleistocene hominids may, probably, illustrate the diachronic polymorphism within the same natural species of man.

Forms A, B, and so on, according to Wassman are just „systematic species", but they all belong to the same „natural species". The family Equidae, with all its „systematic" genera and the „systematic" species, gives another good example of a „natural" species[18].

The polymorphism of a given natural species may be evident either *in vivo*, or in the fossil remains. Fig. 4 shows four chronological strata. Only the top one (IV) is observable *in vivo*. Here the correlation between the anatomy, physiology and behavior on the one hand and the environmental parameters are evident. The three remaining strata (I, II, III) are reconstructed from the fossil material; on the condition that the material is complete enough.

On the chronological level II, the polymorphism was manifested in the *ecotypes* A, B, C. The final confirmation of such a hypothesis consists in the discovery of an evident correlation between some physiological traits and the environmental parameters. Elephants, for instance, lived in the Western Europe during the Pleistocene epoch, but only within the interglacial periods of it. In the glacial periods of the Pleistocene epoch the woolly elephants and woolly rhinoceroses were observed by the contemporary hominid population and depicted on their cave paintings. In this Wasmannian perspective the Indian elephant (*Elephas maximus*) and the African elephant (*Loxodonta africana*) together with the mammoth (*Mammuthus primigenius*), while taxonomically separate „species" and separate „genera", can in fact be treated as a single natural species with several eco(pheno)types.

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[18] „*Thus, for instance we may class as one natural species all the present varieties of horse (Equidae) and their fossil ancestors, comprising various systematic genera, although we do not yet know how far the limits of this natural species may be extended into the past of which palaeontology takes account.*" (Wasmann 1910/298-299).

THE PROBLEM OF RACES

The ambiguity of the term „race". From time immemorial some phenotypic traits have served to distinguish „races" within a given species. At present the term „race" is not used in the International Code of Botanic and Zoological Nomenclature. Nonetheless this term is commonly used in the context of the recognized taxonomic ranks.

> *„Geographical race ... a regional variant of a species, an ecotype."* (Stace 1992/257).
>
> *„Ecotype – A subgroup of a population that is locally adapted, that differs genetically and phenotypically from the main population, but is not reproductively isolated from it."* (Morales *et al.* 2002)[19].
>
> *„King and Stanfield connect 'race' to 'subspecies' – in their dictionary defined as 1. A taxonomically recognized subdivision of a species. 2. Geographically and / or ecologically defined subdivisions of a species with distinctive characteristics.' / ... / the second definition is essentially the same as the one given above by the same authors for race"* (quoted after Kaplan, Pigliucci 2002; cf. also Szymura 1999/274).
>
> *„Some authors explicitly link the 'race' concept to speciation: for example, Rehfeldt and Gallo's (2001) work on races of Douglas-fir makes the concept out to have both a ecological and cladistic component and Jiggins et al. (2001) expressly links races to the speciation process in two butterflies"* (Kaplan, Pigliucci 2002).

In the last quotation „race" is treated as a „transitory form" which becomes gradually „isolated" from the original population. The hybridization barrier, therefore, is identified with the „reproductive isolation". A Wasmannian approach forbids such an identification.

Race as an ecotype. The term „race" has such a long linguistic tradition that the elimination of this word from biological, anthropological, ethnological vocabulary seems futile and irrational. However, it should be made precise enough, to eliminate any adverse, racist connotation.

Kaplan and Pigliucci (2002) admit that within a population of specimens endowed with the same norm of reaction (i. e. the same spectrum of the developmental potency) different ecotypes may appear, although the gene flow between them seems uninterrupted. Therefore the origin of the new ecotypes needs not to be identified with the true speciation event, or with the beginning of the true speciation process.

From the biological point of view, the main human races (Caucasoid, Negroid, Mongolian and Australian; see Coon 1962/18-21) can be interpreted as ecotypes, formed in the past, when the human population was more dependent upon the biological mechanisms of adaptation, and less prepared to solve the problems of survival with the means of an advanced technology. All these racial hereditary phenomena are rooted, however, in a common, much deeper, more essential system of heredity which we might call the system of the biological specific heredity.

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[19] The distinction between the hybridization barrier and „reproductive isolation" may be recognized in the above quotation.

Unity of the Homo sapiens population and the 1996 AAPA Statement.

Let us reflect, for a while on the 1996 Statement of the American Asso-
ciation of Physical Anthropologists. This declaration is an important
historical document. It illustrates the state of minds of probably the most
competent scientific community which analyses the phenomenon of
„humanity". For the sake of clarity the text of the Declaration was divided
into smaller parts.

a) „ / ... / *There are obvious physical differences between populations living in different
geographic areas of the world.*" (AAPA 1996/569)

Comment: The authors of the Declaration seem to have in mind the so
called „wild" or „primitive" populations of present day mankind. The
declaration does not fit to the representatives of *Homo sapiens* who, like
Martians, live in the artificial environment of modern metropolies, and
move with the aid of cars and planes.

b) „ / ... / *Some of these differences are strongly inherited and others, such as body size
and shape, are strongly influenced by nutrition, way of life, and other aspects of the
environment.*" (AAPA 1996/569)

Comment: One has to observe that the „strongly inherited differences"
(evident in different human populations) do not destroy the essential unity
of mankind. This unity is also founded upon heredity, but, obviously
essential heredity cannot be reduced to racial heredity. One has also been
aware of the fact that some of the „strongly inherited differences" are
closely related to the physical conditions of human life. This is well
documented and defended (cf. Cole 1963; Coon 1966).

In other words, man's „size and shape" depends upon the interplay of
three different levels of biological dynamism, (1) essential (substantial)
heredity, (2) racial (ecophenotypic) heredity and (3) the direct, environ-
mentally influenced „reaction" of the individual „life cycle" (of a given
human person). The above classification of man's descriptive traits is far
from being complete (Koszteyn, Lenartowicz 2001), but it still can help in
the adequate interpretation of the fossil hominids.

c) „ / ... / *the combination of these traits in an individual very commonly deviates from
the average combination in the population. This fact renders untenable the idea of discrete
races made up chiefly of typical representatives.*" (AAPA 1996/569)

Comment: The last phrase refers to the painful problem of „racism". This
problem reappears from time to time because of the economical, political or
even religious reasons. In paleoanthropology this problem re-emerged in
relation to some reconstructions of man's phylogeny (Weidenreich 1947;
Howells 1959; Coon 1962; see also Trinkaus, Shipman 1992, chapters 7
and 8).

„*Traits in an individual very commonly deviate from the average*". The
individual and racial „deviations" from the global average quantity of a trait
have no decisive value in establishing the essentially „human status" of an
individual. Even sick, underdeveloped, crippled persons are commonly
believed to be essentially human beings. From a broader chronological
perspective one should take into account the „interglacial" parameters of the

human environment in the Holocene. During glacial periods the global average of many physical traits might well be different. The technological aspect of Holocene humanity should also be taken into consideration. One may thus wonder what the value is of a given physical parameter, observed and measured on fossil hominid material (brain volume, the teeth dimensions, limb proportions).

d) „*/.../ Distinctive local populations are continually coming into and passing out of existence.*" (AAPA 1996/569)

Comment: An important distinction between „mortality", „extinction" and „disappearance" has to be introduced here.

„Mortality" affects every living being, independently of the population they belong to. In this sense the ancient Greeks, medieval population, the French revolutionists were „mortals" and are now dead.

The term „extinction" is applied to some biological forms „natural species" which are no longer observable upon our planet. In this sense the Precambrian Ediacara fauna and the 19th century zebra quagga are believed to be „extinct".

The presumed extinction may, at least in some cases, be mistaken for „disappearance". What is the difference? The ecotypes do appear and disappear, and that is what they are about. For instance, Paul Kammerer experimented with two different species of salamanders. The first, black *Salamandra atra* lives on the rather dry highland in the Alps and usually gives birth to 2 (at most 6) large, fully formed (already metamorphosed) offspring. The larval stage is absolved in the uterus. The second, spotted *Salamandra maculosa* inhabits the lowlands and gives birth to 50 small larvae which are deposited in the water. These larvae have all tadpole attributes (e.g. external gills) and gradually, after several weeks metamorphose into salamanders.

Kammerer raised black Alpine salamander in the conditions imitating the warm and moist lowland climate. They eventually gave birth to tadpoles deposited in water. With each litter it gave birth to a greater number of tadpoles. The lowland, spotted salamander was raised in the conditions imitating the cold and dry highland Alpine environment. Eventually it gave birth to fully developed salamanders (usually the fourth litter was successful) (cf. Kammerer 1907; see also Ehrlich, Petrusewicz 1958/45-46; Koestler 1975/30-31).

In the case of *Homo sapiens* „extinction" would mean a definitive extermination of all the people in the Cosmos. On the other hand the „extinction" of Ainu population does not mean the extinction of a natural species, but just the disappearance of a particular ecotype (together with its anatomical, physiological and behavioral pattern). Such disappearances are sometimes reversible, for instance the wild horse was restored as Przewalski's horse (cf. Nadachowski 2000/367-368; Rajski 1997/560-561).

e) „*/.../ There is no causal linkage between [...] physical and behavioral traits, and therefore it is not justifiable to attribute cultural characteristics to genetic inheritance.*" (AAPA 1996/570)

Comment: This fragment of the AAPA Declaration refers to: (1) the lack of an evident correlation between anatomical and behavioral traits; (2) the lack of an evident correlation between the hominid anatomical and the behavioral traits on the one hand and the cultural achievements on the other.

We have to remember that man manifests an evident and characteristic behavioral pattern, but his activity is not reducible to behavioral, psychological traits. Man is a creative being and his language, ritual, religious and other cultural dynamisms belong to his characteristic attributes in the same way as his characteristic system of locomotion. One cannot doubt that a disease or some other physical mutilation can restrict man's capacity to participate in the cultural dynamism of his species. At the same time the observation of aged or crippled individuals indicate a pronounced, although mysterious independence of intellectual and spiritual dynamism from the actual condition of man's body. The life of Hawking and John-Paul II may serve as an illustration of this point.

SYSTEMATICS AND TAXONOMY – THE BIOLOGICAL STATUS OF FOSSIL HOMINIDS

Hominids. According to a widespread convention all the bipedal Primate forms are called hominids. Consequently the „label" hominid can be applied to *Holocene man, Neandertal man, Pithecanthropus erectus, Java man, Paranthropus robustus, Paraustralopithecus aethiopicus,* the family Autralopithecinae and the like.[20]

Classification of the living forms. *„Classification is the arrangement of the individuals into groups and the groups into a system (also called classification)."* (Blackwelder 1967/3).

Between the „indivisibility" of a specimen of a given biological form and the „unity" of the „world of living things" spreads an unimaginable multiplicity of biological dynamisms. Consequently our mind tries to find a shortcut to ingest this immense baggage of data, and to discover, if possible, the inner logic of these multiple and disparate phenomena.

To the astonishment of field biologists the so-called „primitive" human populations are able to group observed living forms in a way which is quite similar to the way professional biologists do the grouping. These „primitive" people evidently have at least five different concepts of the differences concerning the nature of living things. They are able to recognize:

   a) a living being from mineral matter,
   b) a living being from a dead being,

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[20] According to Strzałko (1996/125) the Australopithecinae are among the eldest unquestionable hominids. This group is characterized by bipedal locomotion and the characteristic masticatory system.

c) plants from animals, birds from bats and butterflies, serpents from earth-worms ... and so on,

d) a close link between the different metamorphoses and different developmental stages of the same natural species – for instance larval forms and adult forms, female and male forms, the eggs and seeds of many different biological forms,

e) most of the specific forms, which are recognized by professional biologists (within the territory on which these „primitive and illiterate people" are living)[21].

So, any adult man is basically capable of creating a common sense system of biological classification, which in many aspects, does not essentially differ from the „scientific" one.

The problem of an adequate classification might be reduced to the problem of the actual traits of the body and the problem of its inner, developmental potential. The races are easily distinguishable because of their external, diagnostic traits. On the other hand the common, deep identity of the ecotypes (races) within a natural species is recognized as an identity of the developmental potency. The classification of the „higher" systematic groups has nothing to do with the inner, developmental potency. It concentrates on some selected, abstract traits such as feathers, fur, shape of the forelimbs, special structures to feed their progeny[22] ... and so on.

Taxons and ranks. Plant or animal populations sorted and grouped according to some biological criteria are called taxons (cf. Blackwelder 1967/435, 439; Stace 1992/20). In other words the whole world of living beings was divided into such taxons as, for instance: mammals, birds, echinoderms, flowering plants, grasses, salamanders and humans.

However the criteria of these divisions are far from being comparable. That lack of a common logic of divisions is illustrated in Table I.

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[21] „*For example, an international team of botanists coordinated by the New York Botanical Gardens is now surveying plants in the Brazilian state of Acre, a heavily forested region about the size of Great Britain situated at the base of the Andes in the western Amazon. So far, in over a decade of work, they have identified and collected more than 3,000 types of plants. The scientists also learned that natives and other local people had already named a majority of these plants in their own languages. This is remarkable, since their purpose has been to use the plants in customary ways and to maintain traditional cultural knowledge, not to build a comprehensive scientific database*" (Rosenberger 2003). „*/.../ in New Guinea the native Papuans recognize 137 species of birds and have a distinct name for each. Ornithologists now recognize 138 species in the same region; there are two species of small greenish bush warblers for which the Papuans had only one name*" (Grant 1963/336).

[22] Placentalia and Marsupialia provide a good illustration of this kind of classification system.

Table I. Complexity of the biological classification systems

		Lower level of classification		Higher level of classification	Purely nominal, hierarchical system of names
	Basis of classifi- cation	*Classification I* Observation of individual life cycles	*Classification II* Observation of kinship between the individual life cycles	*Classification III* Some objectively existing, but abstract biological traits	*Classification IV* Arbitrary, non- biological system of ranks (so- called taxonomic categories)
		I.	**II.**	**III.**	**IV.**
A.	**Examples.**	Lions, tigers, leo- pards, cheetahs, ocelots, horses, zebra, donkeys	Hominidae, Canidae, Felidae, Equidae.	Invertebrata, Insectivora, Car- nivora, Primates	Kingdom, type, class, order, fam- ily, genus, spe- cies, race.
B.	**Criteria.**	The same pheno- typic adaptive potential (ana- tomical, physio- logical, behavio- ral), the same ecotype markings, the same prefe- rences in the se- lection of the se- xual partners, parent-child rela- tion.	The observed parent-child relation – both in the natural and in the artifi- cial condi- tions.	More or less „universal" pre- sence of a set of traits believed to be objectively „essential" (e. g. the presence of the back-bone is more universal than the pre- sence of feathers).	A hierarchy of ranks in which a strictly deter- mined subordina- tion of members is essential. That dependence, ho- wever, is purely nominal.
C.	**The kind of the con- ceptual structure.**	Synthetic concept, a kind of a data- base containing all the available information on the object (a lion, a horse, a man).	Synthetic concept, a kind of a data-base containing all the available information on the object.	A selection of the analytical (ab- stract) concepts („arthropoda", „autotrophs", „mammalia" ... and so on).	The concept of the „II-nd inten- tion", a kind of a mental scaffold which ignores the biological charac- ter of the object.
D.	**The genesis of the con- cept.**	An observation guided by the awareness of the intrinsic logic of a given ecotype or the natural, „wild" race.	An observa- tion guided by the awa- reness of the intrinsic logic of a given natural spe- cies.	An attempt to put into a rational order several different and incompatible biological forms (man and ape for instance).	An attempt to put into a hie- rarchical order the groups deter- mined by the classification III.
E.	**The onto- logical status.**	A set of objects tied together by the ties of their individual inte- grative dynamis- ms and the ties of kinship.	A set of ob- jects tied to- gether by the essential identity of their totipo- tency.	A set of objects which manifest a mentally deter- mined set of tra- its. The likeness of some traits do not prove their ontological con- nection.	A system indica- ting the rank of a „common trait". The trait charac- terizing a king- dom is consi- dered more essential than a trait characte- rizing a class.

The cognitive and ontological differences between different taxons.
Table I helps us to realize that at least two concepts of a „taxon" must be accepted.

One concept (classification I and II – or lower level of classification) reveals the inner, full and complex dynamism of the *natural species taxon*. The „subspecies", „race" and „variety" taxons reveal simply a portion of this complex dynamism. This kind of concept is not dependent upon any „universal" abstract ideas. There is nothing universal in the transformation of the caterpillar body into a butterfly body. Yet this transformation makes us reflect upon the sources and inner laws of this transformation. In this way the advanced concept of a natural species provokes our mind to search for the deepest mechanisms of biological dynamism.

The second concept of a taxon (classification III – or the higher level of classification) is a product of mental abstraction and the abstract analysis of separate traits. The concepts of an order, a class, a type or a kingdom exemplifies this fact. The „universal" concept of a Carnivora puts together dogs, cats and bears. The „universal" concept of a Primates puts together lemurs, baboons, apes and man. The cognitive value of such concepts is rather limited from the purely biological point of view, although it has some important philosophical consequences.

The structure of the hierarchy of taxons (classification IV) is, without any doubt, artificial and related to the broad white patches of our ignorance. Why the carnivorous marsupial wolf is ranked closer to the marsupial form of a rodent rat, than to the carnivorous placental dog seems rather mysterious. Some taxons however have to be recognized not as a temporary bridge above the white patches of ignorance, but as a solid and lasting achievement of empirical observation. The observational data concerning the kinship and plasticity of adaptive ecophenotypic transformations are known from antiquity and no future discovery will put the axolotle larval form and the spotted salamander form into a separate taxonomic group. The prolonged observations of the related life cycles carried in the different environmental circumstances help to reveal the intrinsic links between the superficially (anatomically, physiologically and behaviorally) disparate ecotypic forms. On the other hand such observations help to realize the objective limits of a given natural species' developmental plasticity.

The higher levels of the taxonomical ladder are founded upon the observation and comparison of some selected, fragmentary aspects of biological structure and dynamism. Here the abstract, *analytical concepts* are of crucial importance. The ranking of these concepts is related to the idea of „universality". More „universal", i. e. the more abstract a taxonomic concept is, the higher is the rank of the taxonomic category.

Biological classification is closely related to a concept of the hierarchical order of different biological groups. This hierarchical order, because of the dominance of the Darwinian theory of the universal evolution of life is more

or less correlated with the idea of universal phylogeny (i.e. the universal kinship of living forms). Previous higher level taxons were grouped on the basis of the mainly physiological traits. The present day, predominantly phylogenetic classification favors some genetic traits, which are seldom directly related to the physiological dynamism of living forms. In this way the evidence concerning the DNA of Neanderthal man is often considered more essential than the evidence concerning his psychological and intellectual capacities.

One has therefore to remember that our mind is able to create many ad hoc mental instruments of understanding. These instruments, however, are not identical with the empirical knowledge, although they may help to „handle" this knowledge for a time

The distinction introduced between the three levels of classification and the distinction between the means of classification and the taxonomical conventions might, in our opinion, help to separate the temporary mental scaffolding from the actual empirical evidence discovered and assembled by biologists and paleoanthropologists.

Identification and classification of biological forms. Taxonomists (neontologists) deal with concrete and individual organisms. One of their main task is to classify a given specimen to a proper classification pigeon hole, namely the proper species. Should this specimen be classified together with another, previously known biological form, or be given a new pigeon hole, and a new specific name should be created? The decision is difficult. Taxonomists are aware of the broad, sometimes unexpected adaptive plasticity of biological forms. On the other hand they are compelled to obey the present day rules of modern taxonomy. Many of them would agree that all forms of zebra (together with the extinct quagga variety) may be considered a single species embracing many races (ecotypes). At the moment, however, it is impossible because of the corset of the accepted taxonomic rules.

Taxonomic vs. natural species. Taxonomic species therefore should not be mistaken for natural species. A natural species quite often is polymorphic, while the taxonomic species is rather monomorphic and it quite often refers to merely one of the ecotypes of phenons.

TAXONS AND PARATAXONS

Holotypes vs natural species. A taxonomist may discover a specimen which does not seem to fit into any of the already described and accepted pigeon holes, i.e. the taxonomic species. In such a case a new taxon is created in the mental system of biological classification. The „creation" or „distinction" is strictly determined by the rules of the International Code of Zoological Nomenclature.

Among these rules there is one, concerning the so called „holotype". The etymology of this word can produce many serious misunderstandings. „Holos" is a Greek word for „complete", „whole", „undivided". „Type" is a Greek word for something which is regular, repetitive. From the etymological point of view the term „holotype" should be applied to, at least, the whole life cycle of a given biological form, together with all its hereditary adaptive potentiality in the anatomical, physiological and behavioral sense of the word.

This almost „ideal" (etymological) concept of holotype evidently differs from the taxonomical practice and perhaps even theory. According to the above mentioned Rules „a holotype is the single specimen upon which a new nominal species-group taxon is based in the original publications" (art. 73.1.; *International Code of Zoological Nomenclature*, 1999). Such a „model specimen" consists of the dead and deeply modified anatomical structures of the adult stage kept in a museum. Of course, the taxonomist has usually observed the living forms of the species in question. He is aware of the differences between the juvenile, sexual and adaptive forms of this species. Holotype is just a form of „documentation". Moreover dead structures of different phenons are usually kept in the museum and called „paratypes". One has also to remember that the description of a new species, together with the „holotype" and the „paratypes" are just an introductory signal of the new taxonomic species. Further detailed studies are needed to produce a more complete description of a taxon which „normally consist of whole organisms in all their life stages" (art. 2.2 ICBN, Greuter *et al.* 1998/127).

The cognitive value of the paleontological taxons. The above does not refer to the paleontological taxons. Here just mineralized fragments of the dead body are available for observation and study. Usually they are limited to teeth and bones, which can mineralize and endure, in the original anatomical form, for thousands and millions years. This dead and fragmentary material cannot be compared with the observation of a living, adapting, developing form. So the identification and distinction of taxons upon fossil material creates serious difficulty and serious problem.

In 1997 a project of the International Rules for the Scientific Names of Organisms was worked out. In this project a new concept of „parataxon" was introduced:

> „For practical reasons, in some categories of organisms taxa are recognized and can be named that correspond only to parts of organisms or to definite stages of their life history. Such taxa are termed parataxa" (art. 2.2 ICBN, Greuter *et al.* 1998/127).

What are the advantages of this proposal? It underlines a decisive dissimilarity between biological and paleontological data.

We can easily observe the full range of human dynamism, we can also observe the other primate species such as the gorilla and chimpanzees. Within the last 50 years of biological and psychological research some data indicate that the difference between man and ape amounts to just 1% (calculations based on the DNA sequences) while other empirical data

indicate that the distance between ape and man is „astronomical", so that man should be placed in a separate biological kingdom (cf. Marks 1984). If such a confusion exists in the biological interpretation of living, directly observable forms no wonder that the interpretation of the paleontological dead, static, fragmentary, damaged and mineralized material leads to really strange and disparate conclusions[23].

C.S. Coon has written:

> „*Taxonomy is the art of sorting and classifying living things. It is an art, because art takes over where science leaves off, and job must be finished however much or little is known. It is appropriately based on the Greek word taxis, meaning "battle order". In combat between land troops, the most critical taxon is the sergeant; in taxonomy it is the species.*" (Coon 1966/516).

„The art of sorting and classifying living things" is certainly much easier than the art of sorting and classifying the dead fragments of once living things.

The ecological scenery. The „historical times" are roughly identical with the geological period of the Holocene, which may be regarded as an interglacial period. It started some ten thousand years (10 kyr) ago. Holocene fossil remains give us an idea of the holocene hominid, who is commonly known as *Homo sapiens*. The earlier hominid fossil remains come from the geological epoch of the Pleistocene (ca. 1800–10 kyr ago) and the late Pliocene epoch (ca. 4000–1800 kyr). During the Pleistocene several successive cold and warm periods have been detected. In Europe, from about 800 kyr on at least four serious cold periods are distinguished (Günz, Mindel, Riss and Würm). Each one lasted for more than 100 kyr, and were interrupted by relatively short periods of warming, lasting roughly some 10 kyr each. The woolly elephants and the woolly rhinoceroses which then lived in Europe provide the most obvious evidence of the climate hardship our ancestors had to confront. But apart from the cold some other ecological changes have to be mentioned.

During the cold periods a great amount of water was imprisoned in the huge ice caps covering a vast part of the hemispheres. The sea level decreased and a considerable part of continental African territory turned into desert land. During the warm interglacial periods the ice melted, sea level rose, rains became frequent and the same territory was gradually covered by tropical flora and populated by tropical fauna. These changes have to be kept in mind while discussing the fate of the hominids who lived during the glacial epoch.

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[23] „*If taxonomy (above species level) is ever to become more than mere stamp collecting, it must define its spheres of usefulness and examine its philosophical basis. It will be an objective science if it can reflect some part of the real world and if it can be made testable against some other standard*" (Groves 1986/187).

The technological context. The oldest evidence for the systematic production of the standard stone tools comes from the late Pliocene (some 2500 kyr ago). The oldest evidence indicating that hominids were able to control fire comes from the early Pleistocene (some 1500 kyr). The earliest hints of a building behavior (primitive shelters) are some hundred kyr older. It seems rather obvious that the more developed technology reduced the pressure of the environment on the biological resources of early man. And, vice versa, the lack of developed technology put a greater burden on the muscles, teeth and bones of primitive man. Consequently the fossil remains of the hominid body may, to a certain extent, be considered as an indicator of technological progress.

Above all it should be stressed that the ecotype had to exist and the inner capacity to biological phenotypic adaptation must have been pronounced during the severe and fluctuating period of Pleistocene.

The inner capacity to adapt (in the morphological, physiological and behavioral sense) makes up one of the most characteristic, essential and hereditary elements of a particular, specific form of life.

Whenever a modification of the locomotory or masticatory system in the hominid fossil material is recognizable the possibility of a phenotypic adaptation should be seriously taken into account. However, it is not the end of the story. Man has an inner tendency to replace purely biological protective structures and dynamisms, with technical protective structures and dynamisms. Consequently some changes in human anatomy and physiology manifest a gradual reduction of the biological system (the Pleistocene reduction of the masticatory muscular, bony and dental structures in the hominid lineage is the best example of such a change).

Human ecotype and human culture. It seems plausible that in the case of human races two different dynamisms are involved. One dynamism consists in the inner, unconscious tendency to adapt biological structures to the influences of the environment (biological hereditary adaptation). Another mechanism consists in the conscious, free, although culturally dependent preferences influencing the processes of sexual selection (cultural hereditary adaptation). This second mechanism is analogous to the processes of domestication and artificial breeding. In other words regional and cultural patterns, the accepted set of the „ideal" body shape or behavior may influence the physical traits of a given human population (cf. Pearson 2000).

In the case of the Holocene hominids it is rather difficult to disentangle the element of biological hereditary adaptation from the element of cultural hereditary adaptation. Biological hereditary adaptations are less pronounced because most human populations are already protected, by technical means, from the adverse influences of the physical environment.

In the case of the Pleistocene hominids – it seems – the identification of the element of hereditary biological adaptation should be more easy,

because the technological element was not yet developed enough. On the other hand the scarcity of the fossil material makes such an identification very difficult.

One seems evident – the locomotory and masticatory dynamism of the so-called „Australopithecus" group does not differ sufficiently from ours, to substantiate the idea that the Australopithecinae belong to one natural species and the Holocene hominids to another one.

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Jolanta KOSZTEYN

PLIO– I PLEJSTOCEŃSKIE HOMINIDY: PROBLEM EPISTEMOLOGICZNY I TAKSONOMICZNY

Streszczenie

Plioceńskie i plejstoceńskie szczątki naszych przodków bywają zaliczane do ponad dziesięciu różnych rodzajów i kilkudziesięciu różnych gatunków. Populacja człowieka holoceńskiego – mimo, że nie jest jednorodna ani pod względem kulturowym, ani morfologicznym – zaliczana jest do jednego rodzaju, z jednym gatunkiem – *Homo sapiens.* Powstaje zatem pytanie, czy taki stan rzeczy wynika z samej „natury" materiału empirycznego, czy też z odmiennych zasad klasyfikowania? Ponieważ wśród paleoantropologów spotyka się zupełnie skrajne opinie co do liczby taksonów w obrębie hominidów plio– i plejstoceńskich, należałoby przyjrzeć się dokładniej warunkom, w jakich tego rodzaju opinie są kształtowane.

Zacznijmy od tego, że złożoność natury człowieka przewyższa złożoność jakiejkolwiek formy zwierzęcej. Człowiek bowiem, w warstwie morfologicznej, fizjologicznej i behawioralnej jest prawdziwą formą biologiczną, zdecydowanie odrębną od innych takich form. Ponadto człowiek jest istotą intelektualną i wolną. Ten aspekt człowieczeństwa jest głównym przedmiotem zainteresowania nauk humanistycznych (m.in. antropologii filozoficznej). Natomiast paleoantropologowie mając do czynienia przede wszystkim ze szczątkami szkieletów, koncentrują się w pierwszym rzędzie na biologicznym aspekcie człowieczeństwa. Ślady tzw. „kultury materialnej" stanowią średnio mniej niż 10% materiału wykopaliskowego i dopiero późniejsze, lepiej zachowane oraz bardziej zaawansowane formy cywilizacji technologicznej pozwalają na pełniejsze wniknięcie w potencjał intelektualny naszych przodków.

Ponieważ ogromna większość materiału kopalnego dotyczy biologii hominidów należy podkreślić, że formy biologiczne cechuje *polimorfizm* i *polidynamizm.* Gatunki naturalne z reguły występują jako „wachlarz" różnorodnych postaci, zmieniających się nie tylko w związku z rozwojem struktur ciała osobnika, ale również w związku z wieloma czynnikami środowiskowymi, takimi jak klimat, ukształtowanie terenu, rodzaj dostępnego

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Streszczenie

Plioceńskie i plejstoceńskie szczątki naszych przodków bywają zaliczane do ponad dziesięciu różnych rodzajów i kilkudziesięciu różnych gatunków. Populacja człowieka holoceńskiego – mimo, że nie jest jednorodna ani pod względem kulturowym, ani morfologicznym – zaliczana jest do jednego rodzaju, z jednym gatunkiem – *Homo sapiens.* Powstaje zatem pytanie, czy taki stan rzeczy wynika z samej „natury" materiału empirycznego, czy też z odmiennych zasad klasyfikowania? Ponieważ wśród paleoantropologów spotyka się zupełnie skrajne opinie co do liczby taksonów w obrębie hominidów plio– i plejstoceńskich, należałoby przyjrzeć się dokładniej warunkom, w jakich tego rodzaju opinie są kształtowane.

Zacznijmy od tego, że złożoność natury człowieka przewyższa złożoność jakiejkolwiek formy zwierzęcej. Człowiek bowiem, w warstwie morfologicznej, fizjologicznej i behawioralnej jest prawdziwą formą biologiczną, zdecydowanie odrębną od innych takich form. Ponadto człowiek jest istotą intelektualną i wolną. Ten aspekt człowieczeństwa jest głównym przedmiotem zainteresowania nauk humanistycznych (m.in. antropologii filozoficznej). Natomiast paleoantropologowie mając do czynienia przede wszystkim ze szczątkami szkieletów, koncentrują się w pierwszym rzędzie na biologicznym aspekcie człowieczeństwa. Ślady tzw. „kultury materialnej" stanowią średnio mniej niż 10% materiału wykopaliskowego i dopiero późniejsze, lepiej zachowane oraz bardziej zaawansowane formy cywilizacji technologicznej pozwalają na pełniejsze wniknięcie w potencjał intelektualny naszych przodków.

Ponieważ ogromna większość materiału kopalnego dotyczy biologii hominidów należy podkreślić, że formy biologiczne cechuje *polimorfizm* i *polidynamizm.* Gatunki naturalne z reguły występują jako „wachlarz" różnorodnych postaci, zmieniających się nie tylko w związku z rozwojem struktur ciała osobnika, ale również w związku z wieloma czynnikami środowiskowymi, takimi jak klimat, ukształtowanie terenu, rodzaj dostępnego

pokarmu, charakter zagrożeń, itp. Zmiany morfologiczne, dotyczące np. skali ciała, proporcji umięśnienia, zabarwienia powłok, to tylko jeden aspekt zmienności wewnątrz-gatunkowej. Zmienność dotyczy również behawioru, „stylu życia" (co pośrednio może wpływać na anatomię ciała).

Wspomniana zmienność postaci jest wyraźnie skorelowana z warunkami otoczenia, co wyraża się optymalnym wykorzystaniem możliwości, które ono stwarza. Taka zaadaptowa-na postać nazywana jest *ekotypem*. Pojawienie się ekotypu jest wyrazem wewnętrznego, aktywnego potencjału danej formy żywej. Repertuar tych możliwości adaptacyjnych stanowi tzw. *normę reakcji*. Ukryty potencjał normy reakcji tkwi w komórce rozrodczej. Zatem komórka rozrodcza konkretnej formy żywej jest *„totipotencjalna"* w dwojakim znaczeniu. Z jednej strony zawiera aktywny potencjał budowania zintegrowanego systemu organów postaci dojrzałej. Z drugiej strony zawiera ogromny potencjał do kształtowania różnorodnych ekotypów.

Ekotypy, mimo, że należą do tego samego gatunku naturalnego są od siebie odgrodzone *mechanizmami antyhybrydyzacyjnymi* (tzw. *„barierą hybrydyzacyjną"*). Taki mechanizm składa się między innymi ze specyficznego oznakowania barwnego, zapachowego … itd., oraz z charakterystycznego zespołu zachowań instynktowych (np. tańce godowe). Dzięki temu zmniejsza się ryzyko powstawania hybryd (mieszańców), które – o czym świadczą liczne obserwacje – mają zakłóconą sprawność działania jako ekotyp. Mechanizm antyhybrydyzacyjny powstaje dzięki dynamice właściwej danemu gatunkowi naturalnemu.

Natomiast trudno mówić o jakimś „mechanizmie izolacji rozrodczej" tam, gdzie mamy do czynienia z formami żywymi o całkowicie *odmiennym* potencjale życiowym (rozwojowo-adaptacyjnym). O ile bariery hybrydyzacyjne są przekraczalne, o tyle „przepaść" pomiędzy gatunkami naturalnymi wydaje się – w świetle empirii biologicznej i paleontologicznej – nieprzekraczalna.

Można więc rozróżnić pomiędzy ewolucją w sensie *wasmannowskim* i ewolucją w sensie *darwinowskim*. W pierwszym wypadku, ewolucja polega na *pojawianiu się (ujawnianiu się) nowych ekotypów*, w miarę, jak osobniki danego gatunku naturalnego zasiedlają nowe obszary geograficzne, strefy klimatyczne, lub stykają się z jakimiś nowymi czynnikami zamieszkiwanego przez siebie środowiska. W sensie wasmannowskim, żaden ekotyp (w obrębie danego gatunku naturalnego) nie jest bardziej fundamentalny, niż jakikolwiek inny.

Zupełnie inaczej wygląda koncepcja ewolucji darwinowskiej, w której nie bierze się pod uwagę istniejącego – choć „ukrytego" – potencjału adaptacyjnego. W myśl tej koncepcji, przypadkowe mutacje produkują gamę zmienności, z której selekcja naturalna niejako „odcedza" formę zaadaptowaną. Ten mechanizm – wg darwinizmu – stoi u podstaw po-wstawania nie tylko odmian istniejących już gatunków, ale zupełnie nowych form żywych, które tak dalece różnią się od siebie pod względem anatomicznym, fizjologicznym czy behawioralnym, że zaliczane są do odrębnych rzędów, gromad, czy typów.

W koncepcji ewolucji darwinowskiej pojawia się wizja jednego drzewa genealogicznego, wspólnego dla wszystkich istniejących na Ziemi gatunków. W koncepcji ewolucji wasmannowskiej pojawiają się liczne drzewa genealogiczne, osobne dla każdego gatunku naturalnego z całą gamą jego ekofenotypów.

W koncepcji wasmannowskiej dochodzi do odróżnienia pojęcia *gatunku naturalnego* i *gatunku systematycznego*. By zrozumieć istotę tego rozróżnienia, należy przyjrzeć się metodom klasyfikacji biologicznej.

U podstaw wyodrębniania niektórych grup organizmów leżą przede wszystkim:
(1) badania nad poszczególnymi *cyklami życiowymi* (w aspekcie rozwojowym i behawioralnym) w *różnorodnych warunkach środowiskowych*, oraz
(2) badania nad *więziami pokrewieństwa* (czyli nad realizowanymi w przyrodzie lub eksperymentalnie ujawnionymi relacjami rodzic-potomek).

Tego rodzaju metoda prowadzi do syntetycznego pojęcia gatunku naturalnego w sensie wasmannowskim. Należy podkreślić, że ta metoda nie nadaje się do klasyfikowania szczątków kopalnych. Szczątek kopalny nie jest bowiem – co oczywiste – dynamiką, a jedynie „zamrożonym" w momencie śmierci fragmentem struktur anatomicznych (będących śladem dynamiki biologicznej).

Klasyfikacja form żywych, które nie są powiązane obserwowanymi więziami pokrewieństwa, powstaje w wyniku koncentracji uwagi na wybranych fragmentach, aspektach struktury lub dynamiki biologicznej. Dochodzi tutaj do utworzenia *pojęć analitycznych*, będących wyrazem naszej tendencji poznawczej do usystematyzowania zbioru różnorodnych skądinąd gatunków.

W wasmannowskim pojęciu gatunku zawierają się liczne i bardzo różnorodne ekotypy. Niektóre z nich trwają w niemal niezmienionej postaci przez wiele setek, tysięcy, czy nawet milionów lat. Stąd w biologii przyjęło się nazywać takie ekotypy gatunkami. Wasmann nazywa je *gatunkami systematycznymi*. W rzeczywistości bowiem są one tylko fragmentem dynamicznego potencjału danego gatunku naturalnego.

W analogicznym sensie, każda ludzka rasa (mongoloidzi, kaukasoidzi, australoidzi, itp.) jest tylko ograniczoną postacią dynamiki gatunku *Homo sapiens*. Powstaje zatem pytanie, czym naprawdę były liczne „gatunki" i „rodzaje" hominidów, wyróżniane przez paleoantropologów na podstawie szczątków pochodzących z ostatnich milionów lat.

Te ostatnie miliony lat obfitowały w liczne i dramatyczne zmiany klimatu, naprzemienne okresy zlodowaceń i interglacjałów, zmiany szaty roślinnej i fauny. Z punktu widzenia biologicznego takie zmiany otoczenia powinny prowokować ujawnianie się nowych ekotypów. Czy pojawienie się różnorodnych form hominidów jest wyrazem ewolucji w sensie wasmannowskim, czy ewolucji w sensie darwinowskim?

Jakie dane empiryczne mogłyby pomóc w rozstrzygnięciu tego problemu?

Praktycznie rzecz biorąc, szczątki kopalne pozwalają na wiarygodne zrekonstruowanie struktury i dynamiki dwóch układów anatomicznych: lokomocyjnego i mastykacyjnego. Te dwa układy stanowią – *de facto* – rodzaj kryterium, na podstawie którego dany okaz kopalny zaliczany jest do grupy hominidów. Jak dotąd, charakterystyczna dla człowieka lokomocja dwunożna, sięga niewątpliwie do hominidów zwanych Australopitekami.

Proporcje długości kończyn, tułowia, proporcje rozwoju mięśni i związanych z nimi struktur kostnych, wykazują znaczną zmienność nawet w populacji współczesnego człowieka. Jednak system mastykacji i lokomocji działa u wszystkich ludzi w oparciu o tę samą zasadę. Ową niezmienność zasady działania da się prześledzić aż do poziomu Australopiteków.

Tam, gdzie chodzi o genealogię człowieka, paleontologia usiłuje zrekonstruować dynamikę intelektualną, a nawet wykryć jej ewolucję z poziomu innych form naczelnych. W tej kwestii paleoantropologia koncentruje się z jednej strony na próbach rekonstrukcji układu nerwowego, a z drugiej – na interpretacji nielicznych śladów kultury materialnej.

Jeśli chodzi o układ nerwowy, to jedynymi danymi empirycznymi są zmineralizowane odlewy mózgu i pomiary pojemności mózgoczaszki. Australopiteki miały pojemność czaszki wyraźnie mniejszą niż średnia pojemność czaszek człowieka holoceńskiego. Jak ten fakt zinterpretować? Czy ma on związek z inteligencją człowieka?

Z czysto biologicznego punktu widzenia należy zauważyć, że u wielu gatunków zwierząt różnice w wielkości mózgu są ogromne, a mimo to nie widać, by prowadziło to do jakichś istotnych różnic behawioralnych.

Z punktu widzenia intelektualnego, swoistego dla *Homo sapiens*, można powiedzieć, że opisane w literaturze wypadki mikrocefalii nie zawsze są związane z upośledzeniem intelektualnym. Jeśli wziąć pod uwagę niezwykle mały wzrost np. Australopiteków, niewielka pojemność ich czaszki nie powinna dziwić, ani stanowić istotnej przesłanki w rekonstrukcjach ich inteligencji.

Pozostaje kwestia kultury materialnej. Kultura materialna nie jest czymś tak zasadniczo niezmiennym, jak np. system lokomocji, ale jest zjawiskiem, które cechuje

postęp. Człowiek jest istotą, która dokonuje *postępu technologicznego*. Zatem nie konkretny, osiągnięty poziom technologii, lecz *zdolność do osiągania* kolejnych poziomów jest tym, co świadczy o intelektualności człowieka. Jest rzeczą oczywistą, że im bardziej cofamy się wstecz, tym bardziej pierwotna będzie kultura materialna istot ludzkich. Można też dodać, że niektóre z holoceńskich plemion człowieka nie zmieniły swojej technologii od czasów *Homo erectus*.

Niewątpliwe, standaryzowane narzędzia kamienne, wykonane ze starannie wyselekcjonowanego materiału, czasami nawet transportowanego z dużej odległości, były znajdywane w kilku stanowiskach zawierających szczątki Australopiteków i datowanych na przynajmniej 2,5 miliona lat. Ten typ narzędzi był potem wykonywany nie tylko przez człowieka neandertalskiego (kilkadziesiąt tysięcy lat temu), ale również przez plemiona ludzkie epoki historycznej. Można dodać, że charakterystyczną cechą najwcześniejszych narzędzi Australopiteków są ich bardzo małe rozmiary, co wydaje się wiązać z małymi rozmiarami ich ciała.

Wczesne Australopiteki posiadały niezwykle duże zęby trzonowe i bardzo silne umięśnienie szczęk, co wskazuje na duży wysiłek niewątpliwie związany z rozdrabnianiem twardego lub łykowatego pokarmu (nasiona traw, lub surowe mięso). Od ok. 2,5 do ok. 2 mln lat temu, rozmiary ciała hominidów powiększają się i rozmiary uzębienia jeszcze wzrastają. Jednak od około 2 mln lat temu – mimo dalszego, trwającego aż do dzisiaj wzrostu rozmiarów ciała – uzębienie hominidów ulega stopniowej redukcji. Z czysto biologicznego punktu widzenia, jest to sytuacja paradoksalna. Wydaje się, że jedynym rozsądnym wyjaśnieniem tych zmian jest postęp we wstępnej obróbce pokarmu, zmniejszający wysiłek związany z mastykacją. Cecha biologiczna staje się w ten sposób wskazówką kultury materialnej.

Czy rzeczywiście hominidy były naturalnymi gatunkami lub rodzajami, czy też były one ekotypami jednego i tego samego gatunku człowieka? Materiał kopalny dotyczący hominidów pozwala na wysunięcie hipotezy, że nie były one odrębnymi gatunkami naturalnymi, a jedynie ekotypami tego samego gatunku. Czy można by je nazywać pradawnymi rasami człowieka? Wydaje się, że tak, pod warunkiem, że pojęcie rasy ludzkiej będzie odpowiednio wzbogacone. Szeroko pojęta kultura ludzka (nierozerwalnie związana z intelektualnością człowieka) ma wyraźny wpływ na kształtowanie się cech biologicznych. Postęp techniczny może wpływać na mechanizmy prowadzące do adaptacji biologicznej. Obyczaje plemienne, poglądy religijne mogą w dostrzegalny sposób wpływać również na dobór seksualny, a poprzez to na podkreślanie, lub eliminowanie pewnych cech biologicznych.