BIOANTHROPOLOGY

Javier Rosique,
Department of Anthropology, University of Antioquia Medellín, Colombia

Esther Rebato,
Department of Genetics, Physical Anthropology and Animal Physiology, Faculty of Science and Technology, University of the Basque Country UPV/EHU Bilbao, Spain

Keywords: apes, biological anthropology, cladism, history of anthropology, hominins, human evolution, human niche, life cycle, paleoanthropology, physical anthropology, primates, sexual dimorphism.

Contents

Summary

This chapter aims to develop the history and concept of Bioanthropology as a science that needs the contribution of Anthropology and Biology to understand past and present of humans. Although the field has been also binomially named as Physical (Biological) Anthropology this chapter promotes the use of the term Bioanthropology as a wider interdisciplinary and pluralist field. Bioanthropology encompasses many old and new disciplines as Paleoanthropology, Primatology, Bioarcheology, Skeletal Biology, Anthropology of Human Growth and Development, Morphological Anthropology, Human Ecology, Nutritional Anthropology, Physiological Anthropology, Anthropogenetics, Molecular Anthropology, Heredity and human variation, Biodemography and Forensic Anthropology. Research in Bioanthropology covers biology of people and social behavior, and gathers and analyzes data on physiological and morphological phenotypes, health and illness, demography, DNA and genetic diversity, bone remains and environmental use. The methods of physical (natural) sciences applied to Bioanthropology have shaped the field, however there is an increased recognition that mixed methods of research, that combines qualitative (social) and quantitative (biomedical) analysis, and the methods of ethnography are also relevant to it. The essence of bioanthropological research is unique because of bio-social or bio-cultural approach of studying human variation through time and space. Environment (physical as well as sociocultural) plays an important role in determining behavioral and biological variation in human populations in past and present. Moreover, this chapter intends to show recent trends of research in human evolution, evolutionary primatology and body morphology summarizing today's significant researches in the field.

1. Introduction: Concepts, Disciplines and Trends

Anthropologists study past and present of humans by means of a four-field approach: Cultural (Social) Anthropology, Physical (Biological) Anthropology, Archaeology and Linguistics. This approach was started in the beginning of the twentieth century and was presented by Franz Boas as inherent to Anthropology (Boas, 1899). Boas played an important role in the development of academic anthropology and was a prominent force in founding the American Anthropological Association in 1902 (Spencer, 1997:189). Current scientists are enrolled in one of the four specific fields of work or intend to integrate two or more of the four perspectives in their research. The field of Physical (Biological) Anthropology has yielded to new approaches like Bioanthropology.

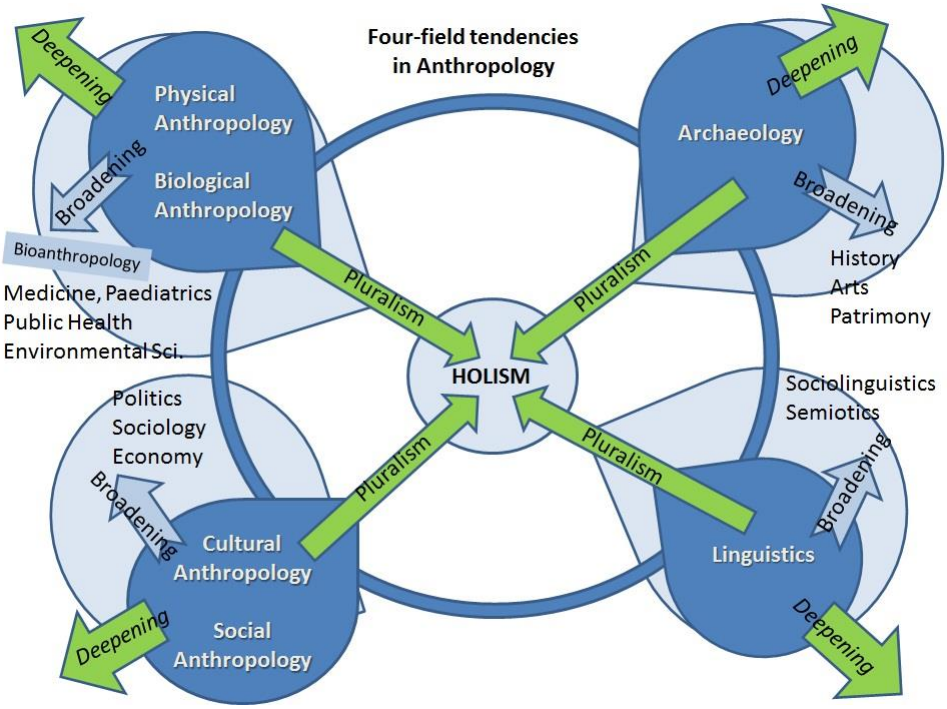

Figure 1. Forces or tendencies (arrows) experienced by the four fields in Anthropology. Pluralism is the basic force (inwards arrows) to develop interdisciplinary studies and it is based in the principle of holism. The force of specific knowledge is deepening the field (green outwards arrows). The force bringing to work in the affinity areas is knowledge broadening (blue arrows), this force is shaping a wider field: Bioanthropology.

The integration of the four fields is said to represent the principle of holism in Anthropology (Figure 1). Four-field approach in Anthropology has been submitted to different forces or tendencies since its origin: 1) pluralism is the basic force to develop interdisciplinary approach among the four fields, it is based on holism, 2) the force of specific knowledge, deepening the field (Figure 1), is and requires to develop specific methods, it is usually a stronger force than pluralism, and finally 3) an integrative and pluralistic force, knowledge broadening, brings to work in affinity areas. Bioanthropology is being shaped by knowledge widening as presented here as a wider field.

The force of pluralism in Anthropology brings us to the necessity of developing methods of integration of different types of data (i.e., the qualitative discourses and meanings of Social Anthropology and the quantitative data of Biological Anthropology). However, the degree of representation of the holism in research depends on the possibility of integrating those different types of data. Nowadays it is an attractive task for teams working together —that is of course huge. The integration comes to produce a synthesis and a picture of people lives and society. The studies of the past (Prehistoric Archaeology) can be more comprehensive when we arrive to reconstruct not only material culture and demography but also traditions, beliefs and behavior, health and causes of death of the past communities. Some researchers attracted to this kind of synthesis as Kirch (2000) included material from all four subfields in their analysis of the Pacific Island region in the past, before European contact. The Polynesian past can be better assumed not only from archaeological data on ceramics but also from data on the analysis of linguistic and physical groupings from human biological evidence as well as recent ethnographic data on canoe voyaging. However, the specialization of the fields of Anthropology makes it difficult to practice holism even for archaeologists (Chattopadhyaya, 2007). Some researchers recognized the possibilities of Anthropology to develop integrated (cross-discipline) research in many issues. Borofsky (2002) showed that there is almost no holism in the great bulk of researches done in Anthropology in the past 100 years, however he classified bioanthropological articles among the most holistic articles, because they were often written integrating fields and with a collaborative construction seeking a synthesis of knowledge. Biological anthropologists appear to be at the forefront of the trend of the holism in walking through a more integrated Anthropology as Calcagno (2003) argues.

What is Bioanthropology? While socio-cultural anthropologists analyze social patterns and cultural practices, with a special interest in how people live in particular places and how they organize, govern, and create meanings and symbolism, biological anthropologists seek to understand human biological origins, evolution and diversity. To understand these processes, they study the fossil records (Paleoanthropology) and prehistoric people (Bioarchaeology), other primates (Primatology), and the biology (e.g., health, cognition, hormones, growth and development, and ecology) including the genetics of living populations. They want to know more on how humans adapt to diverse environments, how biological and cultural processes work together to shape growth, development and behavior, and what causes disease and death in human populations.

1.1. Old and Modern Terms

Biological Anthropology is also termed Physical Anthropology in some Universities; the name depends on University tradition. In Europe, the more classical terminology ‘Physical Anthropology’ is more popular, while in America it is ‘Biological Anthropology’. However there is not a semantic difference and in professional associations as American Anthropological Association (AAA), American Association of Physical Anthropology, (APA), and also European Anthropological Association (EAA) there is the trend to call it with a binomial name Physical (Biological) Anthropology. Many physical (natural) sciences founded in the eighteenth and nineteenth centuries today tend to dissolve their frontiers of research and can now think

of problems to be closer to other fields which were previously more distant. The ambition for defining disciplines is an old trend in Anthropology, but nowadays the need in Physical (Biological) Anthropology is to gather trends in a multidisciplinary area from a pluralist point of view to integrate social and physical research to the physical/biological traditions of Anthropology.

Physical Anthropology is the classical term of this field of knowledge. Its viewpoint was centered at the beginning only in physical (body) variations and skeletal anatomy; it has paid attention well ahead to develop also theories for explaining the underlying causes of human variation. Later names of the field as Biological Anthropology and Bioanthropology, were used only after the Word War II to highlight the shifting paradigm in the pre-war science, i.e., the study of humans grounded in the evolutionary theory, genetics and ecology of human populations. Therefore, the term Biological Anthropology was very successful, because it recognized a renaissance of Physical Anthropology within the biological sciences. However several trends in the meaning of the different terms there exist. When talking with forensic practitioners Physical Anthropology is referred to the tool that permits them to study human bones and skeletons to do applied inferences. Leaving apart this particular meaning currently the field considers human variation in all body tissues, DNA and physiology, moreover it takes into account also culture as an outcome of the biological capacities and as an environment for humans producing their adaptation to environmental challenges. Now for most scientists Biological Anthropology and Physical Anthropology denote interchangeable terms (Jurmain et al., 2010) because their modern contents, and are used as synonyms of the same scientific discipline.

It is desirable that the term Bioanthropology could be used for a wider interdisciplinary area: Bioanthropological Sciences, to gather the different traditions in Anthropology—the classical disciplines and also the cross-disciplines (derived from the expansion of the principle of holism) and future perspectives coming from the social methods of research applied to bioanthropological problems. Bioanthropology is not a new field; it is a grade in the multidisciplinary level. Modern science should start to spare a term as Bioanthropology to design the area for the biocultural integration. The use of Bioanthropology is recent, in fact the editor of the *American Anthropologist* did not permit Earl W. Count the use of the term by the 1960's in the current open meaning that is growing in modern anthropology because, neologisms were not allowed in Count's paper (Comas et al., 1971). Regarding methods, Bioanthropology is a science of synthesis and can use comparative methods among disciplines.

1.2. History and Development of Bioanthropology

The scientific term comes from classic Greek (*bios* = life, *anthropos* = man/human, *logos* = science or discourse). It means the science of human as a living being. Although Aristotle influenced the way of thinking on humans at the top of the *Scala Nature* (the hierarchy or living beings), he used the term "*anthropologos*" literally as the discourse of man. Moreover, it is recognized that he drew attention to the fact that human beings were alone in the animal world (Spencer, 1997:107) and unique in many biological characteristics, i.e., in their ability in upright position and bipedal locomotion. For us, as well as for the classic Greeks, it is difficult to be the researcher and the object of

research at the same time, because we have not enough distance to understand human beings, so forth Anthropology had to manage subjectivity since its early beginning.

The roots of Western Science in anthropological knowledge come from ancient Greeks that develop evolutionary concepts on the origin of animals (Thales of Miletus, Heraclitus), and the tradition of Sciences as Cosmology, Geography, Mathematics (Pythagoras) and Medicine (Galenus). By the first century B.C. Greco-Roman culture accumulated observations on human diversity as a result of exploration across Egypt until the lands of *Aethiopians* the ancient term for dark-skinned people (*Aethiopian* means person with a burnt face) residing in those regions where the sun was thought to be closer to the Earth. Describing human diversity and giving a meaning to it was a different thing. In the past, Western cultures (ancient Greece and Rome) were led to the opinion that they were privileged beings living in an apparently privileged civilization (not like their slaves), considering the others less advantaged and less developed human groups. This kind of thinking (ethnocentrism) shared by most Western societies until the days of environmental destruction and resource depredation that characterized our times, led to the rise of racist thoughts and practices which steered to the exclusion of other people (racism) along history. Only recently, anthropological studies have been aware about their need to disassociate from the ethnocentrism.

In 1501 the word Anthropology arose for the first time with a biological meaning in the book *"Anthropologium de hominis dignitate"* by the German author Magnus Hundt who devoted attention to describe human body with illustrations of anatomical features. The history of scientific thoughts on evolution did not start until the nineteenth century, and some centuries before science was dominated by Creationism. In the seventeenth century, by 1658, James Ussher Archbishop of Armagh in Ireland established the date of the creation the 23th October of 4004 BC (Rebato et al., 2005: 20).

In the eighteenth century, Swedish Carl Linnaeus laid the foundations for the modern assignment of scientific names to animals and plants (binomial nomenclature) and gave to our human species a successful name *Homo sapiens*. He gave also taxonomic names to the varieties of man (races or subspecies). Other less discussed scientific names, as *Homo perniciosus*, proposed by other scientists were abandoned in the history of science. Perhaps, this is because we are prone to showing ourselves in a hopeful way and perhaps proud to think of ourselves as the smartest beings. Linnaeus included man in the order of Primates in 1758. Georges Louis Leclerc, Comte de Buffon, contemporary of Linnaeus proposed a gradual evolution of geological structures without admitting Catastrophism as a valid theory and made observations on biogeography suggesting that the worldwide spread of species started from a center of origin for animals and plants and asserted that climate change may have facilitated the spread of species and changes from a limited set of animals. He believed also in Monogenism (a unique origin for all human races) and admitted a gradual change in species (Rebato et al., 2005:20) and in this sense he was a precursor of Transformism (the theory of the origin and modification of species from other preceding living beings) influencing many readers as Lamarck and Darwin. In the fourth edition of Darwin's book "*On the Origin of Species*" Buffon was mentioned as an impelling scholar who did not enter into the causes or means of the transformation of species.

The eighteenth century gathered new information on voyages of exploration and discovery, encouraging the spirit of natural classification of species and peoples. Johann Friedrich Blumenbach steered his studies of Anthropology to the physical (natural) study of man, and used the comparative anatomy of human skulls as a method to show that all varieties of man belonged to the same species. He realized that Linnaeus named *Homo troglodytes* to a specimen of orangutan, it was neither a man nor a chimpanzee, and proposed that this name could not be used. Blumenbach distinguished better than Linnaeus the greater apes: chimpanzee, gorilla and orangutan from the specimens and information available in Europe in the eighteenth century. He also proposed a theory on the origin of races, establishing a fifth race (Malayan) to add to the four described by Linnaeus (Mongolian, Caucasian, American and African). He believed that races were created as a single creation and so forth the extant races had arisen as a consequence of the degeneration (Spencer, 1977: 184) of a primordial type (*varietas primigenia*). The Caucasian type was believed to be the closest to the first creation and the other types were diverged from it by degeneration.

However it is believed that Anthropology as a Science did not emerge until the nineteenth century, when Paul Broca founded the first chair of Anthropology in Paris and directed the field to depict a natural history of genus *Homo*. He is often viewed as the founder of modern anthropology and gave it a great development together with some students as Topinard and Manouvrier (Rebato et al., 2005: 25). Paul Broca was known by his enduring evaluations of Cromagnon skeletons (Spencer, 1997: 221) and argued against those who explained that the ancient Europeans were brachycephalic (short skulls) and proved the existence of dolichocephaly (long skulls) in the Quaternary Period. Moreover Paul Broca developed new instruments to measure bones and skulls and made important contributions to neurobiology by the localization of the speech function in the brain.

The French naturalist Jean Baptiste Pierre Antoine de Monet, Chevalier de la Marck (known simply as Lamarck) suggested that modified biological traits during the life of organisms can be transmitted to the offspring (Lamarckian inheritance). In his *Philosophie Zoologiche,* published in 1809, and in the last chapter described man as a result of natural transformations of preceding beings and stated that there is a tendency of organisms during life history to be more complex by a force that tends to make order. Lamarck constructed one of the first theoretical frameworks of organic evolution, and showed that the changes in organs were the consequences of the adaptation to the environment.

Charles Robert Darwin had been interested in the origin of man although he left this topic out of the "On the Origin of Species" published in 1859. However, in 1871 his book "The Descent of Man and Selection in Relation to Sex" was a serious attempt to explain human origins in evolutionary terms. He relied on Thomas Huxley for the evidence that the human species was related to apes and he believed that Africa, not Asia as Huxley thought, was the cradle of humankind. Moreover he realized that the key breakthrough separating apes and humans was the latter adopted bipedalism rather than only in the increase of brain (Spencer, 1997:317). The great contribution of Darwin was to make scientists aware of the significance of natural selection in understanding biological variation among living organisms. However, Alfred Russell Wallace is

known for his article "*On the tendency of varieties to depart indefinitely from the original type*" written in 1858, as an independent advocate of a theory of evolution due to natural selection that impelled Darwin to finish and publish earlier than expected his book "*On the Origin of Species*". Moreover Wallace is known as a defender of the work of Darwin (Slotten, 2004) and in 1889 wrote "*Darwinism: An Exposition of the Theory of Natural Selection, with some of its Applications*".

The link between Darwin's ideas and his exploration voyage into South America during five years, by the HMS Beagle was palpable and he remained very impressed by the observations on coral reefs, volcanic islands, endemic birds and reptiles of the Galapagos in the Pacific Ocean and the recovery of some fossil specimens of giant mammals (as *Megatherium*) and armadillo (*Glyptodont*) from Argentina. It is recognized that Darwin had a naturalist education and knew the works of Linnaeus to incorporate the scale of living beings to the gradualism from Buffon and Lyell, in geology, and the struggle for existence from Thomas Malthus (Rebato et al., 2005: 24). Darwin noted the process of natural changes in the biological characteristics of offspring and proposed natural selection from three principles (Lewontin, 1970): 1) potential reproduction depends on the size of population however in wild species more offspring are produced than can survive, 2) biological traits vary among adults leading to differential survival and reproduction, because some biological traits help to find food and others could help to find reproductive partners 3) trait differences are inheritable.

However, the evidence of human evolution was already weak because of the scarcity of fossils. Thomas Huxley, born in England in the book "*Evidence as to Man's Place in Nature*" in 1863 described two crania, one found in Belgium in 1830 and the other recovered in the Neander Valley in Germany. He recognized the robustness of the remainders but considered that they do not deserve a separate taxonomy from humans. Only in the last quarter of the twentieth century these crania were recognized as a belonging to an extinct human ancestor which now is known as Neanderthal.

The work of Ernst Haeckel in 1866 "*Generelle Morphologie der Organismen*" contained some phylogenetic trees where he reconstructed the course of evolution from the invertebrates through mammals to humans and proposed the term *Pithecanthropus* as the name of the hypothetic ape-man, not discovered in his time, that filled the gap between anthropoid apes and humans. In Haeckel's views, *Pithecanthropus* was the descent of early modern humans and gave them the name of *Homo primigenius*. He continued with the previous works of Huxley on comparative anatomy of the skull of orangutan and humans and proposed that the closest ape was orangutan, and moreover as Huxley, he proposed Asia as the cradle of mankind. While the Science of Haeckel now seems to be speculative he had many followers as the Dutch Eugene Dubois, who went in search of Haeckel's missing link and recovered from a river terrace in central Java the remains (two femur and fragments of the skull) of an early human ancestor, which he named *Pithecanthropus erectus*, and much later was recognized as *Homo erectus* from Java. Nineteenth century did not have a clear thought on the process of transmission of biological inheritance from parents to offspring. There were theories on the preformation of a small man (homunculus) inside the spermatozoids and heredity came from the father, being the biological role of the mother like a receptacle for

development. Gregor Mendel published his work on the inheritance of biological traits in 1865 and although it is known that Darwin had a copy of it, he did not pay attention to Mendel's discovery. Darwin as many of other scientists thought that biological heredity was by the admixture of the parental traits (like a mixture of colors). The laws of inheritance were not recognized until 1900 by Hugo de Vries in the Netherlands, Karl Correns in Germany and Eric Tshermack in Austria. These scientists rediscovered independently the laws of Mendel, sixteen years after his death (Rebato et al., 2005: 30).

Another author who influenced the Anthropology of the nineteenth century was the British Francis Galton. He did comparative studies of body growth in rural and urban populations. He standardized scales for determining iris color and skin pigmentation and improved some measuring instruments used in anthropometry. He paid attention to the study of longevity, sex ratio, demography and dermatoglyphics.

In the twentieth century Rudolf Martin made an influential contribution to the field, showing time and space as the most important variables in Physical Anthropology, and focusing its study in the hominid fossil remains (the extinct descent members of our linage) and humans (the only extant species). After the World War II, racial studies took a lesser importance and scientists paid attention to the insights that defined the modern Anthropology and their scopes centered in studying processes rather than only a descriptive biology.

The modern synthesis was a unifying theory in Biology developed between 1936 and 1947 and it had a great impact in Physical Anthropology. The term was diffused by Julian Huxley in his book "Evolution: The Modern Synthesis", published in 1942. The modern synthesis started when Fisher proved that quantitative biological traits and continuous variation of phenotypes could be explained by the Mendelian inheritance of discrete traits and therefore, Darwinism based in evolution by continuous variation of traits (gradual evolution) and Mendelian genetics of the inheritance of discontinuous traits were not discordant. In fact, genetics and molecular biology confirmed the principles of evolution as described by Darwin. Other problems to solve were how broad-scale changes in time (macroevolution) could be explained by changes in a narrow generational scale (microevolution). The contributions of Theodosius Dobzhansky, John B.S. Haldane, Sewall Wright, George Simpson and Ernst Mayr were decisive to those questions and shaped the modern synthesis, also known as Neo-Darwinism. Dobzhansky described in 1937 the synthetic theory of evolution in his book "*Genetics and the Origin of Species*". Explanation on the observations on extinction and the rise of new forms in the fossil record was proposed by the extrapolation from microevolution to macroevolution, a way of conciliating Darwinism and Paleontology. The rate of gradual changes was not assumed to be uniform through geologic time, but Simpson supported the basic compatibility between gradual changes and the emergence of new species across the fossil record. In the modern synthesis natural selection is by far the main mechanism of changes of the species in the wild. However the geographical isolation from other populations or the migration of part of the species to new environments, are frequent processes leading to speciation as Mayr argued. Although it is not the only way of speciation it derives in reproductive isolation. Sewall Wright paid attention to genetic drift studying the effects of inbreeding in small isolated populations in which after some generations of inbreeding they were out of adaptations

and developed maladaptive traits.

Gradualism dominated the explanations of evolution until Elredge and Gould (1972) proposed in their work "*Punctuated equilibria: an alternative to phyletic gradualism*" another possible way of modeling the rate of evolution by an alternating process to accelerate evolution (punctuation) and periods of equilibrium with almost no changes (stasis). The term punctuation departs from the graphics of the tree of evolution (phyletic tree) when a new punctuation breaks the branch of the tree (previous species), develops a new parallel branch for a new species. This contribution was known as "punctuated equilibria" or "punctuated equilibrium" and was developed in the context of the studies of the origin of new species by means of geographic barriers that can isolate part of an original population due to migration of individuals from the coast to an island or due to long distance migration with loss of contact (allopatric isolation). The isolation by geographic barriers can leave new populations, with opportunities for rapid speciation, on the two sides of the barrier, without crossbreeding and with isolation, as a consequence of this process in the fossil record no gradual inter-species breeding could have been detected and the new allopatric species could have a "gap" in the paleontological record.

Isolated small populations could be quickly divergent by random genetic drift and natural selection. Although the rate of evolution has these two possible models: gradualism and punctuated equilibrium, they are not contrasting models and are somehow compatible, because the same underlying processes of natural selection, mutation, genetic drift, migration and admixture shape the phyletic tree in different forms depending on the branches considered. Branches of the tree with intense allopatric speciation would have more punctuation (gaps in the fossil record) and branches without important migrations in the past beyond geographic barriers could exhibit more gradual inter-species characteristics.

The origin and diversity of humans continued to be the focus of the research by the middle of the twentieth century, however it incorporated paradigms as the research of the relationships between form and function in Anatomy, the relationships between phenotype and genotype, the models of environmental pressures (natural selection) on the biology of people, the genetics of migration and admixture of people and the ecology and ethology of humans. Washburn (1951) laid down a distinction between the pre-1951 and the post-1951 traditions of Physical Anthropology, meaning that it was moved from a descriptive study of biological parameters to an understanding of their causes and a modelization of biology of populations. Physical Anthropology paid attention to the frequency and distribution of physical traits as an "end" in itself but was heavily descriptive and did not pay attention to hypothesis testing, or at the structure-function relationships.

The old Physical Anthropology reduced the understanding of human variability to the study of races and after the modern synthesis, race concept lost its biological meaning. Washburn was known as a critic of the race concept in the 1960s and defended its limited use and the lack of scientific support for any claims of racial inferiority (Caspari, 2003). After the modern synthesis in biology, race was not any more an important concept because the unit of study becomes the species. Any subdivision of

species as variants or subspecies (races) was shown as a reversible process impelled by the dynamics of the populations, this is because the traits of the subdivided populations could change by new migrations and new admixture. The new trends in the field were parallel to the changes experienced in Biology after the 1960's by the impact of the modern synthesis and evolutionary research (Little and Kennedy 2010) and contributed to the success of the term Biological Anthropology. However, only after the 1970's Biological Anthropology incorporates in their models of study a third perspective beyond evolution and genetics, the ecological perspective, starting the explanatory triangle of Stein and Rowe (1974): biology (genetics), environment, culture.

-

-

-

Bibliography

References

Ahern J.C.M. (2005). Foramen magnum position variation in *Pan troglodytes*, plio-pleistocene hominids, and recent *Homo sapiens*: implications for recognizing the earliest hominids. *American Journal of Physical Anthropology*, 127, 267-276. [This article shows how to recognize the more anterior position of the foramen magnum in hominids when looking at the basicranium in comparison with *Pan*].

Bhasin V., Bhasin M.K. (2007). *Anthropology today: trends, scope and applications.* Dehli (India), Kamla-Raj Enterprises. [This part of the book is devoted to review many recent trends and new researches on anthropology to contrast and compare different fields and views].

Blakely R.L. (1982). *Biocultural adaptation in prehistoric America*. Athens, Georgia, University of Georgia Press. [This book shows how to apply biocultural models to explain prehistoric findings].

Boas F. (1899). Anthropology. *Science*, New Series, Vol. 9, 212, 93-96. [This article helps to understand the origins of the four-field approach].

Borofsky R. (2002). THE FOUR SUBFIELDS: Anthropologists as Mythmakers. *American Anthropologist*, 104 (2), 463-480. [This article is a criticism on the holism in Anthropology and argues why holistic research is scarce in Anthropology].

Boyd R., Silk J.B. (2009) *How humans evolved*. New York, Norton & Company (fifth edition). [This book is a complete text on human evolution, quite easy to understand for beginners, with parts on comparative primate behavior, intelligence and social structure of groups and it is valuable showing interesting debates on Bioanthropology].

Brunet M., Beauvilain A., Coppens Y., Heitz E., Moutaye AH., Pilbeam D. (1995). The first australopithecine 2500 kilometres west of the Rift Valley (Chad). *Nature*, 378, 273–275. [This article shows the first description of a new australopithecine far away from the usual places of discoveries in southern and eastern Africa].

Buikstra J.E., Beck L.A. (2006). *Bioarchaeology: The Contextual Analysis of Human Remains.* Academic Press/Elsevier. [This book is an insight into recent trends in Bioarchaeology].

Calcagno J.M. (2003). Keeping Biological Anthropology in Anthropology, and Anthropology in Biology. *American Anthropologist*, New Series, Special Issue, 105 (1), 6-15. [This article shows arguments on the

actual use of holism in Biological Anthropology].

Caspari R. (2003). From Types to Populations: A Century of Race, Physical Anthropology, and the American Anthropological Association. *American Anthropologist*, New Series, Special Issue, 105 (1), 65-76. [This article shows the role of Washburn and other anthropologists as critics of the race concept during the recognition of new contents and new researches in Physical Anthropology after 1960].

Chattopadhyaya I. (2007). Understanding the Present and the Past: Perspectives on Anthropology and Archaeology. In: Bashin, V. and Bhasin, M.K. (eds.) *Anthropology today: trends, scope and applications.* Dehli (India), Kamla-Raj Enterprises, pp. 19-24. [This is a chapter dealing with relationships between Anthropology and Archaeology].

Chen F.C., Li W.H. (2001). Genomic divergences between humans and other hominoids and the effective population size of the common ancestor of humans and chimpanzees. *Am J Hum Genet,* 68 (2), 444–456. [This article shows the results of sequencing 53 DNA autosomal segments of Human, Gorilla and Pan to find differences among hominoids, establish the time of the divergences and effective population size at the splitting up of the ancestral population].

Cole T. J. 1990. The LMS method for constructing normalized growth standards. *European Journal of Clinical Nutrition* 44: 45–60. [This article explains the basis for smoothing anthropometric original data to find precise centile curves and central tendency lines. LMS is a mathematical method and can be applied from free software by users in the field of public health and anthropometry developed by the author of the article].

Collard, M. 2002. Grades and transitions in human evolution. In: Crow TJ, editor. *The Speciation of Modern Homo sapiens*. Oxford: Oxford University Press, Proceedings of the British Academy 106. p 61-100. [This chapter analyzes the evolutionary models of sexual selection in males and females].

Comas J., De Castillo H., Méndez B. (1971). *Biología Humana y/o Antropología Física. Resultados de una encuesta.* México, Instituto de Investigaciones Históricas, UNAM. [This book, only partly in Spanish, shows a collaborative discussion on the results of a survey drawn for scholars from various countries on the contents of Physical Anthropology].

Curnoe D. (2010). A review of early Homo in southern Africa focusing on cranial, mandibular and dental remains, with the description of a new species (*Homo gautengensis* sp. nov.). *Homo –Journal of Comparative Human Biology,* 61, 151-177. [This article describes the reconstruction of new remainders proposed as *Homo gautengiensis*].

Datta Banik S., Bhattacharjee P., Das S., Barman R.K., Das S., Giri S.P., Jana A., Purkait P. (2009). Sexual Dimorphism in Health and Nutritional Status of Three Communities of Darjeeling District in West Bengal and Comparison with Some Other Populations of Eastern India: An Anthropometric Appraisal. *J Life Sci*, 1(1): 27-34. [This article shows inter-population data about sexual dimorphism of common nutritional indicators in endogamous tribal populations from India].

Elredge N., Gould S.J. (1972). Punctuated equilibria: an alternative to phyletic gradualism. In: Schopf T.J.M. (ed.) *Models in Paleobiology*, San Francisco, Freeman, pp. 82-115. [This is a seminal chapter showing the principles of punctuated equilibrium].

Fessler DMT, Haley KJ, Lal RD. 2005. Sexual dimorphism in foot length proportionate to stature. *Ann Hum Biol* 32 (1): 44-59. [This article is a research on size dimorphism of foot length in relation to stature].

Goodman M., Tagle D.A, Fitch D.H.A., Bailey W., Czelusniak J., Koop B.F., Benson P., Slightom J.L.(1990). Primate evolution at the DNA level and a classification of hominoids. *Journal of Molecular Evolution,* 30 (3), 260–266. [This article shows a new classification of hominoids and explains the necessity of the term hominin to replace the usual term hominid].

Jurmain R., Kilgore L., Trevathan W., Ciochon R.L. (2010). *Introduction to Physical Anthropology*. Belmont, USA, Wadsworth, Cengage Learning. [This is a complete book that covers deeply the development of evolutionary theory, living Primates, Paleoanthropology and contemporary human variation].

Kaplan H., Hill K., Lancaster J., Hurtado A.M. (2000). The evolution of Intelligence and the human life history. *Evolutionary Anthropology,* 9 (4), 156-184. [This article describes the main characteristics of the

human live history, and some evolutionary events in relation to diet and intelligence that shaped the human life cycle].

Kimura M. (1977). Preponderance of synonymous changes as evidence for the neutral mutation theory of molecular evolution. *Nature*, 267, 275-276. [This article shows how mutations can be used to study the time of split-up of lineages in evolution].

Kirch P. (2000). *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact.* Berkeley, University of California Press. [This is a book showing how Biological Anthropology and Archaeology can work together in studying past populations].

Kunimatsu Y., Sawada Y., Sakai T., Hyodo H., Itaya T., Nakaya H., Saegusa H., Mazurier A., Saneyoshi M., Tsujikawa H., Yamamoto A., Mbua E. (2007). A new Late Miocene great ape from Kenya and its implications for the origins of African great apes and humans. *Proceedings of the National Academy of Sciences*, 104 (49), 19220, 19225. [This article presents a new ape fossil discovered in Kenya to be proposed as the closest ancestor to *Homininae*. It retains a great proximity to other Miocene ape, *Ouranopithecus* from Greece].

Leakey R., Lewin R. (1993). *Origins reconsidered. In search of what make us humans.* New York, Anchor Books. [Beginning with the stunning discovery of a 1.5 million-year-old skeleton near Kenya's Lake Turkana, this book explores our fossil record and asks fundamental questions about the origins and evolution of the human species].

Lewontin R.C. (1970). The units of selection. *Annual Review of Ecology and Systematics,* 1, 1–18. [This is an article to understand Darwinian principles and basic concepts on natural selection].

Little M.A., Kennedy K.A.R. eds. (2010). *Histories of American Physical Anthropology in the twentieth century.* Plymouth, U.K., Lexington Books. [This books helps to understand the role of key professors and researchers in the changes experienced by the field during the twentieth century].

Lohman T.G., Roche A.F., Martorell R. (1988). *Anthropometric Standardization Reference Manual.* Illinois, Human Kinetics Books. [This book is a training manual to learn standard anthropometric procedures to measure with accuracy and repeatability the human body].

Marini E, Rebato E, Racugno W, Buffa R, Salces I, Borgognini Tarli SM. 2005. Dispersion Dimorphism in Human Populations. *Am J Phys Anthropol* 127: 342-350. [This article shows a reduction of dispersion dimorphism due to physical fitness in many anthropometric measures].

Marques-Bonet T., Ryder O.A., Eichler E.E. (2009). Sequencing Primate Genomes: What Have We Learned? *Annual Review of Genomics and Human Genetics,* 10, 355–86. [This article shows the goals of 12 genome projects in primates. Genome sequencing can be a great advancement in phylogeny understanding and also in many aspects of biomedical research].

Meehan J.P. (1955). Individual and racial variations in a vascular response to a cold stimulus. *Military Medicine,* 116, 330–334. [This article describes the first studies in Physiological Anthropology].

Powell M.L., Bridges P.S., Mires A.M.W. (1999). *What mean these bones? Studies in Southeastern Bioarchaeology.* Tuscaloosa, University of Alabama Press. [This book is an important contribution to the understanding of modern Bioarchaeology].

Rebato E., Susanne C., Chiarelli B. (2005). *Para Comprender la Antropología Biológica.* Navarra (Spain), Editorial Verbo Divino. [This textbook in Spanish covers extensively the main subdivisions of Biological Anthropology].

Riddoch C.J., Bo Andersen L., Wedderkopp N., Harro M., Klasson-Heggebø L., Sardinha L.B., Cooper A.R., Ekelund U. (2004). Physical activity levels and patterns of 9- and 15-yr-old European children. *Med Sci Sports Exerc* 36: 86-92. [This article shows an analysis of the tendencies found in boys and girls to practice physical activities in general populations. It is a research on behaviors and compares boys and girls behaviors].

Ritenbaugh C. (1978). Model Course VI. Nutritional Anthropology. *Medical Anthropology Newsletter*, 9 (2), 23-29. [This brief article summarizes the scopes of Nutritional Anthropology].

Ronen A. (2006). The oldest human groups in the Levant. *Comptes Rendus Palevol,* 5, 345-351. [This article describes the first human occupations in Middle East and discusses the migrations out of Africa].

Ruvolo M. (1997). Genetic diversity in hominoid primates. *Annual Review of Anthropology*, 26, 515-540. [This article shows the basis of the genetic similarity of hominoids and the great proximity between human and chimpanzee].

Sarich V.M., Wilson A.C. (1967). Immunological time scale for hominid evolution. *Science*, 158, 1200-1203. [This article shows the use of the concept of molecular clock in human evolution studies].

Simpson G.G. (1945). The principles of classification and a classification of mammals. *Bull. Am. Mus. Nat. Hist.*, 85, 1–350. [This article shows the principles of classical taxonomy based of similarities (homologies) and proposed a classification of hominoids, and served to remark the concept of hominid as beings belonging to *Hominidae* family].

Slotten R.A. (2004). *The Heretic in Darwin's Court: the Life of Alfred Russell Wallace*. New York, Columbia University Press. [This book is a biography on the life of Wallace and opens new striking insights on the impact of Darwin's ideas on this contemporary scientist].

Spencer F. (1997). *History of Physical Anthropology: an encyclopedia*. New York, Garland Publishing. [This is a useful and helpful book to consult biographies of physical anthropologists and many scientists working in related fields, and also helps to reconstruct the first steps of the history of this field in many countries].

Steegmann A.T. (2006). Physiological Anthropology: Past and Future. *Journal of Physiological Anthropology*, 25(1), 67–73. [This article clarifies the roots of Physiological Anthropology from Human Biology and describes the future direction of research].

Stein P.L., Rowe B.M. (1974). *Physical Anthropology*. London, U.K., McGraw-Hill. [This is a useful book. It is a complete and comprehensive manual of Physical Anthropology. Last edition, 2010].

Stini W.A. (1978). Malnutrition, body size and proportion. *Ecol Food Nutr* 1: 121-126. [This article considers some nutritional causes of body size variation in human populations].

Stini W.A. (1982). Sexual dimorphism and nutrient reserves. In: Hall RL, editor. *Sexual dimorphism in Homo sapiens.* New York: Praeger. pp. 391-419. [This chapter in a book about sexual dimorphism shows differences between sexes to nutritional stressors and famine].

Tarnopolsky M.A., Saris W.H.M. (2001). Evaluation of gender differences in physiology: an introduction. *Curr Opin Clin Nutr Metab Care* 4: 489-492. [This article examines differences between males and females in endurance sport completion].

Wagner G.P., Booth G., Bagheri-Chaichian H. (1997). A population genetic theory of canalization. *Evolution* 51:3 29-347. [This article explains the genetic concepts involved in the theory of canalization and ecosensibility].

Washburn S.L. (1951). The New Physical Anthropology. *Transactions of the New York Academy of Sciences Series-II* 13: 298-304. [This historical article shows the trends in Physical Anthropology in the early 1950's as a result of the development of modern Biology].

Wells J.C.K. (2007). Sexual dimorphism of body composition. *Best Pract Res Clin Endocrinol Metab* 21 (3): 415-430. [This article analyzes body composition differences between males and females and the health outcomes and health risks due to sex differences in body composition].

Wood B., Richmond B.G. (2000). Human evolution: taxonomy and paleobiology. *J. Anat*., 196, 19-60. [This article shows the new classification of hominoids and is a review on the anatomical characteristics of the hominins].

Wu Rukang (1990). Paleoanthropology and Neoanthropology. In: Guldin G.E. (ed.). *Anthropology in China: defining the discipline*. pp 111-113. New York: M.E. Sharpe. [This chapter helps to define Neoanthropology as a distinct subdiscipline of Paleoanthropology in Chinese Anthropological School].

Zollikofer C.P.E., Ponce de Leon M.S., Lieberman D.E., Guy F., Pilbeam D., Likius A., Mackaye H.T., Vignaud P., Brunet M. (2005). Virtual cranial reconstruction of *Sahelanthropus tchadensis. Nature*, 434, 755-759. [This article shows the digital reconstruction of *Sahelanthropus* cranium and discusses the proximity of this species to humans].

Zuckerkandl E. (1963). Perspectives in molecular anthropology. In: Washburn S.L: (ed.), *Classification and Human Evolution*. Chicago, Aldine, pp. 243-272. [This chapter shows the use of molecular

similarities of protein sequences as homologies to construct phylogenies in human evolution].

Links

h t t p : / / humanorigins . si . edu / resources / intro – human - evolution [This web "What does it mean be human?" available by the Smithsonian National Museum of Natural History is a good introduction to human evolution with many resources and video-presentations. It affords clear answers to simple and complex evolutionary questions].

h t t p : / / w w w . bbc . co . u k / sn / p rehistoric _ life / human / human_ e volution / [By way of the BBC, the web "Science and Nature: Prehistoric Life" is committed to the evolution of man, it has many links with brief news and serious information].

h t t p : / / w w w . becominghuman . org / [It is available by The Institute of Human Origins at Arizona State University, it shows assays on the evolutionary meaning of a huge array of hominin species and fossil recoveries, moreover it has many news, graphics and video-presentations with recent explanations on paleoanthropology].

Biographical Sketches

Javier Rosique received in 1992 his Ph.D. from Basque Country University, Bilbao, Spain, and his doctoral dissertation was on the field of Auxology of Basque population. He developed courses of Anthropology as assistant in Basque Country University and Deusto University in Bilbao. In 2000 he moved to University of Antioquia (Medellín, Colombia) to work in the Department of Anthropology, were at present he is Professor of Biological Anthropology. In 2010 accredited his skills in anthropometry by the ISAK (International Society for the Advancement of Anthropometry) receiving level 2. His main research interests are focused on the fields of Didactics of Anthropology, Human Growth and Development and Nutritional Anthropology. His teaching duties include Paleoanthropology, Human Ecology as well as Nutritional Anthropology. Recent publications: 1) Rosique J., Aréchiga J. (2010). "Human growth of children from popular neighborhoods of Mexico City" In: S. Datta Banik (ed.). *Research in Physical Anthropology: Essays in Honor of Professor L.S. Penrose*. Mérida (México), Unasletras Industria editorial, ISBN: 978-6079054-01-4. Chapter 13, pp 261-284. 2) Rosique J., Gálvez A., Restrepo M.T., Manjarrés L.M., Valencia E. (2012). "Food and nutrition in Embera indigenous people" In: Naidoo L. (ed.) *Ethnography*. Croatia, InTech Open Access Publisher. ISBN: 979-953-307-426-8.

Esther Rebato received in 1985 her Ph.D. in Biology from the University of the Basque Country (UPV/EHU), Bilbao (Spain). Her doctoral dissertation was focus on the Bioanthropology of the Basque population. From 1985 to 1989 she worked as assistant professor (1985/86), associated professor (1986/89), and titular professor of Physical Anthropology in the Department of Genetics, Physical Anthropology and Animal Physiology (Faculty of Science and Technology, UPV/EHU), and in 2011 she was habilitate as full Professor for the National Agency for Quality Assessment and Accreditation of Spain. Her main research interests are focused on the fields of Nutritional Anthropology, Human Growth and Development, Quantitative genetics of the human complex traits, and Genetics and Environmental determinants of obesity (with special attention to Gypsy Spanish population). Her teaching duties include Paleoanthropology, Anthropogenetics, Primatology, Human Ecology, Human Biology, Forensic Anthropology and Anthropology of Food. At present she is the President of the Physical Anthropology Spanish Society (SEAF) and Board member of the European Anthropological Association (EAA). Recent publications: 1) Jelenkovic, A., Poveda, A., Rebato, E. (2010): A statistical investigation into the sharing of common genetic factors between blood pressure and obesity phenotypes in nuclear families from the Greater Bilbao (Spain). *Journal of Hypertension*, 28: 723-731; 2) Jelenkovic, A., Ortega-Alonso, A., Rose, R.J., Kaprio, J., Rebato, E., Silventoinen K. (2011): Genetic and environmental influences on growth from late childhood to adulthood: A longitudinal study of two Finnish twin cohorts. *American Journal of Human Biology*, 23:764-73. In 2009 she received the Commemorative medal of Dr. Ales Hrdlicka in the City of Humpolec (Czech Republic).