Hypothesis Article

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Population genetic relationships between Mediterranean populations determined by HLA allele distribution and a historic perspective

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HLA; Mediterranean; sub-Saharan; Greeks; Macedonians; Turks; Kurds; Armenians; Fulani; Aryans

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Abstract: HLA genes allele distribution has been studied in Mediterranean and sub-Saharan populations. Their relatedness has been tested by genetic distances, neighbour-joining dendrograms and correspondence analyses. The population genetic relationships have been compared with the history of the classical populations living in the area. A revision of the historic postulates would have to be undertaken, particularly in the cases when genetics and history are overtly discordant. HLA genomics shows that: 1) Greeks share an important part of their genetic pool with sub-Saharan Africans (Ethiopians and west Africans) also supported by Chr 7 Markers. The gene flow from Black Africa to Greece may have occurred in Pharaonic times or when Saharan people emigrated after the present hyperarid conditions were established (5000 years B.C.). 2) Turks (Anatolians) do not significantly differ from other Mediterraneans, indicating that while the Asians Turks carried out an invasion with cultural significance (language), it is not genetically detectable. 3) Kurds and Armenians are genetically very close to Turks and other Middle East populations. 4) There is no HLA genetic trace of the so called Aryan invasion, which has only been defined on doubtful linguistic bases. 5) Iberians, including Basques, are related to north-African Berbers. 6) Present-day Algerian and Moroccan urban and country people show an indistinguishable Berber HLA profile.

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Definition and genetic markers

DNA sequencing and polymorphism have widely been used to study ethnic groups in order to outline population history and to detect their possible migrations and interactions with neighbours over time. Since history is a largely subjective area in terms of our present knowledge, highly polymorphic DNA variants are often able (although not always) to define populations or ethnic groups and thus allow inferences about their historical-prehistorical interactions: this subject I call historic genomics. The existence or absence of gene flow among neighbouring ethnic groups may be

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assessed with the study of HLA frequencies and the corresponding genetic distances (1, 2). Also, *epidemiologic genomics* goes together with historic genomics. It studies the origin and distribution of genes (or alleles) that provokes disease throughout world populations and the causes of their maintenance over time.

The HLA system has proved to be useful to define ethnic groups, even when its polymorphism was still low (3). Nowadays the number of alleles has increased by using indirect or direct DNA typing techniques (4–6). Most HLA-analysed populations show relatedness or unrelatedness according to geography. This is a sign that we are dealing with a good genetic marker. When historical "characteristics" are present, HLA is able to detect them: for example, the A29-B44 haplotype is frequent in northern Spaniards (including Basques), Irish, southern British and western French (7). Thus, this marker relates all these groups and their history (or prehistory) must have common genetic grounds.

Other molecular markers, like mtDNA and Y Chr are widely used for this type of research. They are also subject to selection since they are linked to diseases (OMIN: On line Mendelian Inheritance in Man: http//:www3.ncbi.nlm.nih.gov/omin), as are a number of HLA alleles. Microsatellites are more risky to use since their location in the genome is not always known, and their biological significance is sometimes doubtful (some of them are located in introns); in addition, their Mendelian inheritance does not always occur and they are often unable to define populations, probably because of their low degree of polymorphism (8–10).

Therefore, HLA genes constitute one of the best tools to study relatedness between populations. The groups studied for the present work are detailed in Fig. 1. The aim in the present study is to condense and graphically explain our long-lasting work on HLA in Mediterranean populations. Also, a more detailed hypotheses about the historical and genetic relatedness among these populations is addressed. More technical HLA calculations, results and discussion can be found in the respective papers (11–21).

Analyses and statistics

Our 20-year experience (11) on statistical analysis of HLA data has led us to the conclusion that the following analyses are the most useful and straightforward in order to obtain conclusions about populations genetics: DA genetic distances matrix was established as the most objective distance for the polymorphic HLA system (1), together with the neighbor-joining dendrogram which does not assume lack of bottlenecks on populations or a linear evolution of the polymorphism (1). The direct search for quasi-specific HLA alleles and haplotypes is also very informative. This point was overlooked in the case of the Greeks in the last International Histocompatibility Workshop: "Genetic diversity of HLA, functional and medical implications" (2). We find that sub-Saharan groups share quasi-specific DRB1 alleles (DRB1*0305, *0307, *0411, *0413, *0416, *0417, *0420, *1112, *1120, *1304, *1310) with Greeks. This relatedness probably implies that gene flow from Africa to the Aegean sea during prehistoric times (20). Correspondence analyses have also been introduced lately in our papers (16) because this analysis is complementary to genetic distances and dendrograms. It is used for displaying a global view of the relationships among populations according to HLA (or other) allele frequencies. This methodology is based on the allelic frequency variance among populations (similar to the principal component methodology) and on the graphical display of a statistical projection of the differences.

The computer software used was DISPAN, which contains the programs GNKDST and TREEVIEW (22, 23, http://www.bio.psu.edu/People/Faculty/Nei/Lab/Programs.html), Arlequin v. 1.1 software (kindly provided by L. Excoffier and M. Slatkin) (24, http://anthropologie.unige.ch), and the ViSta v. 5.02 program (25, http://forrest.psych.unc.edu).

These relatively simple combined analyses give a general overview of the population relatedness according to HLA gene variability.

Basques, Iberians and Berbers

HLA and other markers (12, 26) show that Basques are genetically close to their neighbours. Basques are probably a relatively old genetic isolate that has undergone little admixture with invaders (17). They show high frequency of a common European haplotype, A1-B8-DR3, the common western European haplotype, A29-B44-DR7 (probably representing the very old western European haplotype which correlates with high Rh-negative phenotype frequencies), and A30-B18-DR3, a haplotype proposed to be of paleo-North African origin. This haplotype analysis together with the neighbour-joining and the correspondence analyses show that Basques are close to western Mediterraneans (Fig. 3). Basque language belongs to the well-defined Usko-Mediterranean group, which is also included in the Dene-Caucasian group (27–33). Together with Berber, Burusho and some northern and southern Caucasian languages, the Basque language forms part of the living languages in this group. The dead languages are shown in the Fig. 2 footnote.

There is no known explanation for how the old Dene-Caucasian

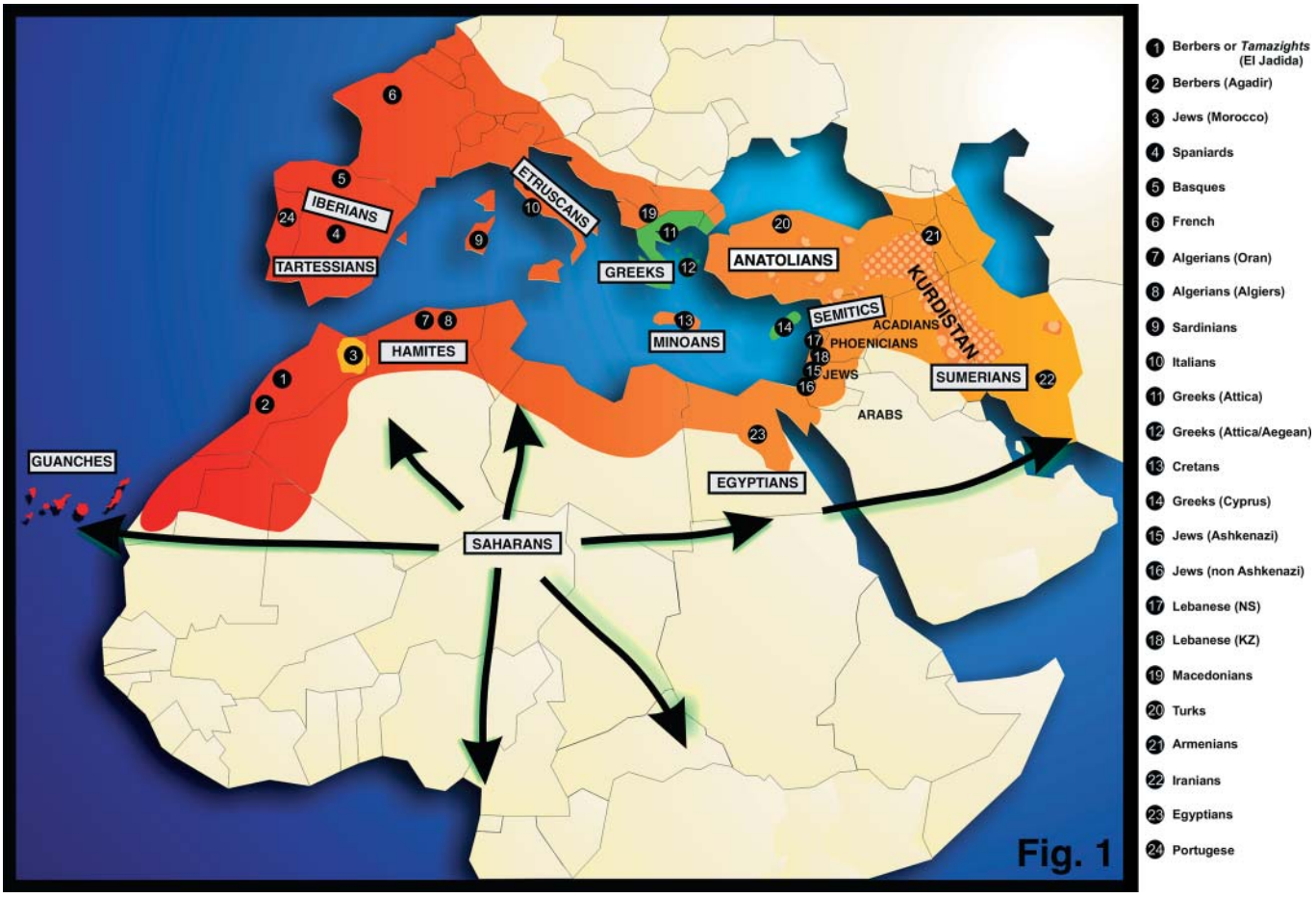

Fig. 1. **Mediterranean area showing classic populations (squares); circled numbers correspond to present-day populations for which HLA genes have been studied.** Kurds (30 million) living area is represented by pink dots. Arrows represent population movements before 3000 years B.C. (51). Etruscans had their highest development in the first millennium B.C.; however, their culture was a continuity of a more ancient "Villanovan" (Villanova, near Bologna) and pre-Villanovan cultures (2nd millennium B.C.) (62). Semitic people were nomadic people, comprising Jews, Arabs, and Phoenicians. Further details can be seen in refs. 14–16, 18, 20, 21.

group of languages was replaced by the so-called Eurasian group of languages after 2000 B.C., but many remnants of the "old" language can be observed in common and toponymic names to the present day (31, 32).

Iberians (present-day Portuguese and Spaniards) are genetically close to Basques (15) and the old Iberian language has been translated with the help of old Basque (29). The latter would be a remnant of ancient Iberian. The most frequent HLA haplotypes in present-day Iberians are the same as described for Basques (see above). It is uncertain whether Celtic people entered Iberia during the first millennium B.C. Cultural Celtic items and uses are recorded, but Celtic people may not have entered in substantial amounts (17, 18). The second historical influx of people into Iberia is recorded in the 8th century A.D. when about 30,000 Islamic North Africans invaded the Iberian Peninsula, which had about 8 million inhabitants at the time. Most invaders were recently recruited Berbers, who are also related to Spaniards. Part of the ancient Iberians probably come from Berber emigrants who were leaving the extremely arid conditions of the Sahara after 3000 B.C. They may also have populated the Canary Islands giving rise to the Guanches. These Guanches (or rather the present-day inhabitants of the Canary Islands) cluster together with Berbers using both classical and mtDNA markers (34). In addition, the Guanche language is related to ancient Libyan, Berber and Basque and thus belongs to the Usko-Mediterranean group of languages (31).

Our own and others' studies show that present North African inhabitants of small urban and village areas (in Morocco, Algiers and Egypt; 13, 18, 31, 35) are not genetically distinguishable from Berbers. These are also very close to Iberians (Fig. 3). This suggests that the 7th-8th century A.D. Arab invasion had strong cultural

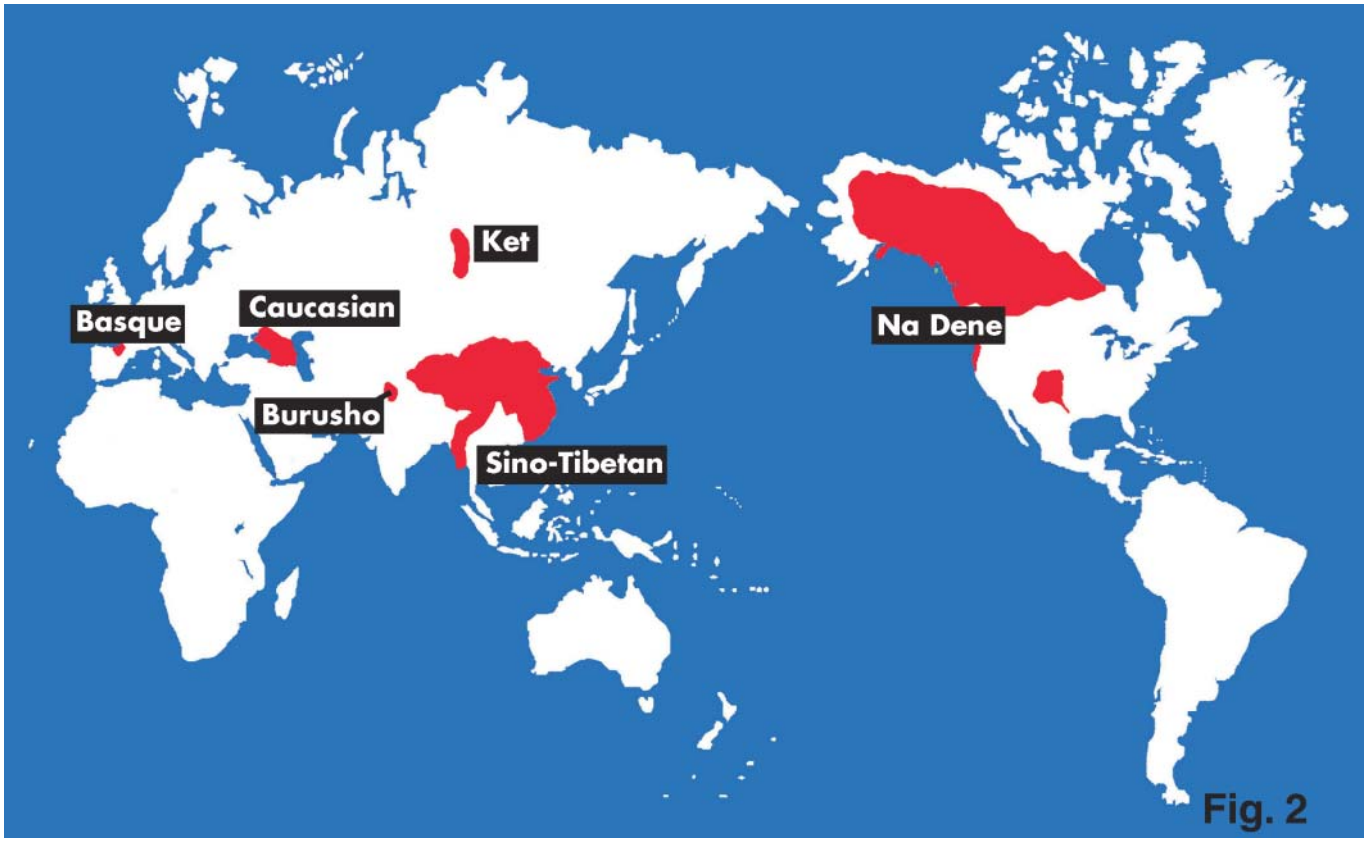

Fig. 2. **The Dene-Caucasian languages include Sino-Tibetan: (Mandarin, Cantonese, Wu, Hakka, Tibetan, Burmese, Karen, Bodo), Caucasian (Abkhaz, Kabardian, Chechen, Ingush and probably Kartvelian; 28, 33), Na-Dene (Haida, Tlingit, Koyukon, Navajo, Apache), Burushaski, Ket, and Basque. Dead languages include Iberian-Tartesian, Guanche, Etruscan, Minoan (linear A), ancient Libyan (proto-Berber), Egyptian, Hittite, Hurrian, Sumerian, Eblaic and Elamite (29–33).**

effects in both Iberia and North African countries, but made little contribution to the pre-existent genetic pool. This type of invasion is called "elite" invasion and we also find this in Anatolia (see below). Turks were also an "elite" with little genetic effect on the populations of ancient Anatolia (21).

In summary, present-day western Mediterraneans are genetically similar, either coming from Europe or Africa. Furthermore, both neighbor joining (NJ) and correspondence analyses (Figs 3 and 4) show that there is a smooth gradient of relatedness between western to eastern Mediterranean populations; on each side the groups tend to cluster together. This supports ancient circum-Mediterranean flow of genes and culture, the latter being more evident through language relatedness. Also, skeletal research from the Mesolithic/Neolithic transition in Iberia and North Africa does not support the eastern to western demic diffusion model of agriculturalists replacing hunter-gatherer populations. A circum-Mediterranean model of diffusion is supported by genetic, linguistic and paleo-skeletal data (17, 36).

The origin of Greeks and Macedonians

Our analyses place the Greeks as an outgroup among other Mediterraneans, including Macedonians and Cretans. Quasi-specific high-frequency DRB1 Greek alleles were sought throughout Asia and Africa in order to explain this discrepancy. Sub-Saharian / Sahel African populations share these alleles with Greeks, i.e. Mossi, Fulani, Rimaibe (from west Africa and sampled in Burkina-Fasso; 20) and Nuba (Sudan), Oromo and Ahmara (Ethiopia, east Africa; 20). Neighbour joining and correspondence analyses put Greeks together with the above mentioned sub-Saharan groups (Figs 3 and 4).[1]

The following explanations of how Negroid populations could have reached Greece (and not Crete) may be put forward:

[1] Other Negroid genes have also been found in Greeks. They are the only Causasoid population who bears cystic fibrosis mutations typical of Black Africans (Chromesome 7). See Dork, et al. In Am. J. Hum. Genet, 1998: 63: 656–682.

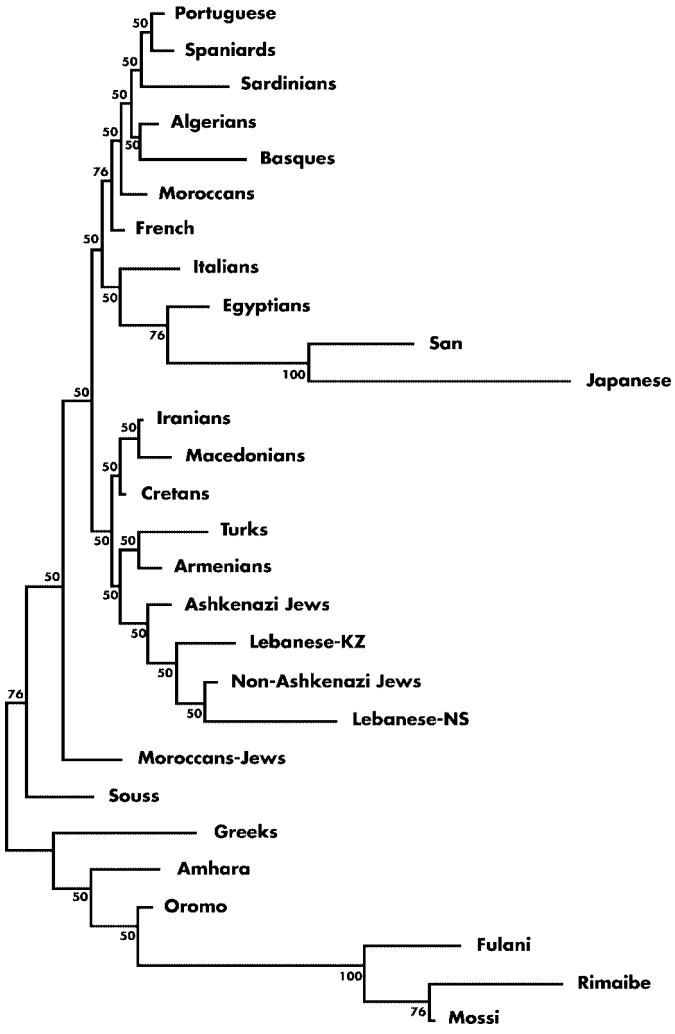

Fig. 3. **Neighbor joining dendrogram showing relatedness between Mediterranean and sub-Saharan populations.** Genetic distances between populations (DA) were calculated by using HLA-DR and -DQ (generic typing). Data from other populations were from refs. 2, 12–16, 18, 20, 21, 61.

1) It is possible that the densely populated Hamitic Sahara (before 6000 B.C.) may have contained an admixture of Negroid and Caucasoid populations and some of the Negroid populations may have migrated (16, 19, 31) towards present-day Greece. This could have occurred when arid Saharan conditions became established and large-scale migrations occurred in all directions from the desert. In this case, the more ancient Greek Pelasgian substratum would come from a Negroid stock.

2) A more likely explanation is that some time during Egyptian pharaonic times a Black dynasty with their followers were expelled and went towards Greece. Indeed, ancient Greeks believed that their religion and culture came from Egypt (37, 38). Also, Herodotus (37) states that the daughters of Danaus (who were black) came from Egypt in great numbers to establish a presence in Greece. Otherwise, the Hykso pharaohs and their people were expelled from Egypt and may have reached Greece by 1540 B.C. However, the Hyksos are believed to come from modern Israel and Syria. Other gene input from Ethiopians (meaning "Blacks" in ancient Greek) may have come from King Memmon from Ethiopia and his troops, who went to help the Greeks against Troy according to Homer's Iliad.

Having identified an African input to the ancient Greek genetic pool, it remains to determine the cultural importance of this input for constructing the classical Hellenistic culture.

The fact that Crete does not show a Black African input may be due to the fact that the Ethiopian emigration may have occurred in Minoan times, when Crete had a strong sea empire and did not allow the invaders into Crete (16).

The Black Fulanis from West Africa (also named Peul) and associated Mossi and Rimaibe are believed to have come from eastern Africa based on the present-day socio-cultural inheritance. Fulanis extend nowadays throughout most Gulf of Guinea countries and Mauritania, Mali, Burkina-Fasso and Niger (39). Our genetic studies confirm that many of these are related to the peoples from what is now Sudan/Ethiopia or otherwise they share a very ancient genetic pool since times when Sahara was heavily populated (Figs 1 and 5). Neither eastern nor western Black Sahel populations are related to South African or autochthonous Senegalese Blacks (Fig 5).

The origin of the West African Black ethnic groups (Fulani, Mossi and Rimaibe sampled in Burkina-Fasso) is probably Ethiopian (39, 40) (Fig. 5). The Fulani are semi-nomadic hunters and gatherers and one of the few people in the area to use cows' milk and its by-products to feed themselves and for trade; their facial and skin colour parameters suggest a Caucasian admixture. An extensive anthropological, cultural and linguistic study strongly supports that Fulani have many features in common with ancient Egyptians (41). The authors postulate that they came from pharaonic Egypt. However, it is possible that the shared characteristics are due to the same Saharan origin, before aridity and emigrations left it almost unpopulated (after 3000 B.C.; 42). The Rimaibe Blacks were slaves belonging to the Fulani and frequently mixed with them (39). Present-day Mossi constitute more a socio-political group with an admixture of ethnicities (including Fulani) rather than a people with a common culture and ancestry. They inhabit mainly Burkina Fasso, Gahna and Mali. The Nuba people are now widespread all over Sudan, but are descendants of the ancient Nubians that ruled Egypt between 8th–7th centuries B.C. (43) and later established their kingdom at Meroe, north of Khartoum. Two kinds of Nubians were described in ancient times: Reds and Blacks, perhaps reflecting the degree of Caucasian admixture. Both the Oromo and Amharic peoples live in the Ethiopian mountains (39) (Fig. 5). They probably

share a common genetic background with the west-African groups mentioned above. Linguistic, social, traditional and historical evidences support these relationships (see above, 39, 40).

Ethiopia and the Sahel (southern Sahara) area contain ethnic groups which are an admixture of Negroids and Caucasoids (39). Pigmented skin is a common feature of all human groups though there is an exception in some Caucasoid groups from western Europe, where a mutation arose affecting the melano-stimulant hormone receptor gene (44). In general, skin is more pigmented in people living closer to the Equator and is less pigmented far from the Equator. This is due to the high intensity of Ultraviolet (UV) light at the equator which keeps the skin dark (high-affinity melano-stimulant hormone receptors) in order to protect the dermis from UV light-induced mutations. After years of residing far from Equator the skin tends to become less pigmented probably through mechanisms related to mutations in the melano-stimulant hormone receptor molecule which changes affinity for the hormone (45). Thus, those "dark-skinned" peoples who may have migrated long ago from Africa towards the Mediterranean could have deveoped higher pigmentation due to the relative lack of a strong UV light stimulus and also because of an admixture with lighter-skinned peoples. All populations have the same number of skin melanocytes and the variation in skin colour is only due to the amount and spatial distribution of melanin granules within the cell (46).

Herodotus wrote that Macedonians came from the Pindos mountains, now in Central Greece (37) and might have been displaced by Greeks. Old Macedonian language may belong to the oldest Mediterranean substratum of the Usko-Mediterranean languages (32). These belong to the Dene-Caucasian group and include living languages (Basque, Chechen, Berber) as well as dead ones (see Fig. 2 footnote). "Heaven" in old Macedonian is ATE while ATE in Basque is "After-death Door", a sacred word common to all Usko-Mediterranean language texts (32).

The fact that classical Greeks recognized Macedonians as barbarians speaking other languages and fought against them, together with the present HLA genetic results that show a distant Macedonian/Greek relatedness may help to achieve more accurate historical interpretations (20). Macedonians fought and defeated Greeks and Alexander the Great and his Macedonian and mercenary or forcedly recruited troops (including Greeks) conquered much of the known world at the time up to the Himalayas (47). This had wide political and historical implications since Alexander divided the conquered world and gave it to his generals. The generals in charge of Egypt (Ptolemy), Armenia, Iran, Iraq, Afghanistan and part of central Asia (Seleukos) and Anatolia-Middle East (Antigonos) had a strong bearing and impact of the history and culture of the conquered countries; however, not all of these countries acquired "Hellenistic" or "Macedonian" acculturation. In fact, Alexander identified himself as an Egyptian divinity (The Son of Amon; 43), since both Macedonians and Greeks believed that Egypt was the origin of culture (37, 48).

Anatolians and the Indo-Europeans

Turks

Previous studies by ourselves and others show that the Anatolian genetic substratum is a Mediterranean one with little influence by Altaic Turks (21, 49). The latter probably carried out a so-called "elite" invasion: a relatively small number of people with higher cultural and military abilities imposed a foreign culture and language (Turkish).

Anatolia (most of modern-day Turkey) contains many of the earliest signs of western civilization: Catal Huyuk, near Konya, is an urban city constructed during the Neolithic period (7000 B.C., 50). Troy is placed at the Dardanelle Strait and is famed for its war with the Greeks (1200 B.C., see Iliad by Homerus, 50). In general, Anatolian development was quite distinct from the one that occurred in Egypt and Mesopotamia. By 5400 B.C., the Hacilar culture flourished in the South-eastern Anatolian Lake District. Fortified citadels were common in central and western Anatolia and also in Mycenae by 3000 B.C.; this construction was brought to western Europe by the Crusaders many centuries later. By 2400 B.C., Anatolia had the resources and the technology to exploit bronze and was in a commanding position. It is probable that local developments (and not invasions) led to the Hittite Empire flourishing in central Anatolian part and in the Arzawa Kingdom on the Aegean coast (1400 B.C.); others put Hittite origins (as autochthonous) back to the 3rd millenium B.C. (50). Many other scholars identify Hittites with Indo-European invaders who spoke a different language (1400–1200 B.C.). The "sea people" led to the fall of both cultures by 1200 B.C. Later Neo-Hittites (in Northern Syria), Assyrians and Arameans held power through different parts of Anatolia from time to time. By 800 B.C., a new Kingdom appeared: Urartu, at the Armenian mountains. Urartu rule was destroyed by Assyrians; also, Cimmerians from southern Russia broke through the Caucasus and descended on Urartu (714 B.C.), but were held back by an Assyrian-Anatolian coalition. Medes (from Iran) and Babylonians invaded Anatolia in the 6th century B.C.; the former entered the Armenian mountains (northwards) while the latter confronted the people of central Anatolia (Lydians). Peace followed and Persians led by Cyrus defeated the Medes and overran Anatolia, bringing to an end the rule of the Neo-Hittite and other so-called pre-Indo-European speaking people (5th century B.C.) (50).

Alexander the Great expelled the Persians from Anatolia which

after his death it was inherited by his general Seleucus. Romans and to a lesser degree Muslims took over Anatolia until the Turks coming from central Asia through Iran invaded Anatolia in 1055 A.D. and finally took Istanbul in 1453 A.D.. Turks first fought against Islamic warriors but they finally adopted the religion of Islam, although they held on to their conquests and expanded throughout Europe and along the Mediterranean Coast (51). By 1800 A.D., Turks still held power in Algeria, Libya, Tunisia, Egypt, Saudi Arabia, Yemen, Palestine, Syria, Lebanon, Iraq, all Balkan countries and neighbouring southern Russia, Hungary, Anatolia and southern Caucasus (Georgia, Armenia) (51).

In spite of all these varied invasions, the present-day Turkish HLA profile reflects an older Mediterranean substratum, not very different from Jewish (14) or Lebanese (see Figs. 3 and 4). It is unlikely that Turks (Anatolians) mixed extensively with the people ruled by them either in Europe or in the Mediterranean Basin.

Kurds

Kurds number approximately 30 million people and are distributed in Turkey (11.4 m.), Iran (6.6 m), Iraq (3.9 m), Armenia and Azerbaijan (0.9 m) (51). Their Diaspora throughout other countries accounts for another 5.5 m. They speak an Iranian language with a strong Caucasic influence (Ergative composition, toponyms) (52); there are Kurd communities in the West of southern Caucasian republics including Georgia (in its capital, Tblisi) (51).

HLA genetic distance and haplotypes observed in Kurds place them among the Middle East-Mediterranean stock (21); present-day Turkish and Kurdish people seem to originally have belonged to a similar ethnic group. The lack of any other genetic data in this group makes further studies necessary. However, they both share characteristically Mediterranean HLA haplotypes (21) and this makes any other origin for the Kurds unlikely. Kurd tribes have traditionally lived in the mountains. The Halaf culture (Tell Halaf, Southern Diyarbakir, Turkish Kurdistan) (53) (6000 B.C.) extended its decorative motifs to rugs presently made by Kurds and other peoples from the area (54, 55); the Halaf pottery distribution is coincidental with the present-day Kurdistan, except for the Mesopotamian lowlands (56). By the second millenium B.C. (53), a new people came to dominate (or be respected in) the Kurdish mountains and surrounding areas: the Hurrians, who spoke a Caucasian (non-Indo-European) language (33, 21). Larger political-military entities evolved out of the older Hurrian city-states: Urartu, Mushku, Urkish, Subara, Baini, Guti and Manna. Some authors believe that Mushku originated the definitive Hittite downfall in Anatolia: the present-day city of Mush survives in central Kurdistan (Turkey) (Fig. 5). Subaru has probably left its name to a famous Kurdish tribe "Zubari", which still inhabits the area around Arbil city (Iraq) (Fig. 5). It is thus possible that Hurrian people are one of the most ancient bases for a Kurdish identity. Many Kurdish body tattoos already appeared in Hurrian figurines. Kurdistan was regarded as a single civilization by the neighbouring peoples: Sumerians re-

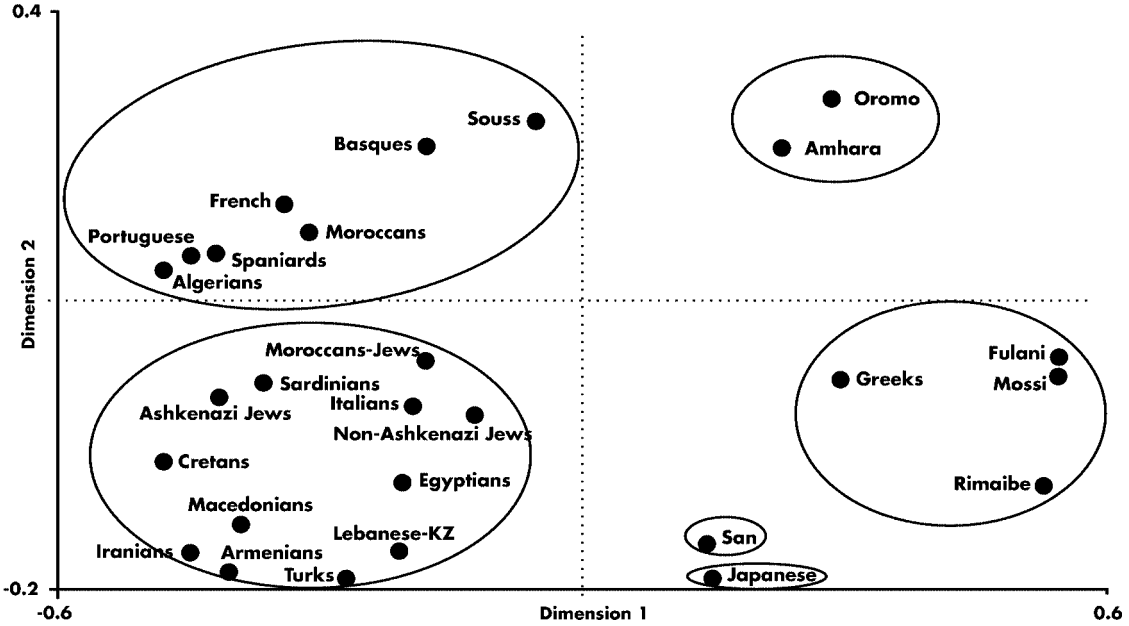

Fig. 4. **Correspondence analysis showing a global view of the relationship between Mediterraneans and sub-Saharan and populations according to HLA allele frequencies in three dimensions (bi-dimensional representation).** HLA-DR and DQ allele frequencies data.

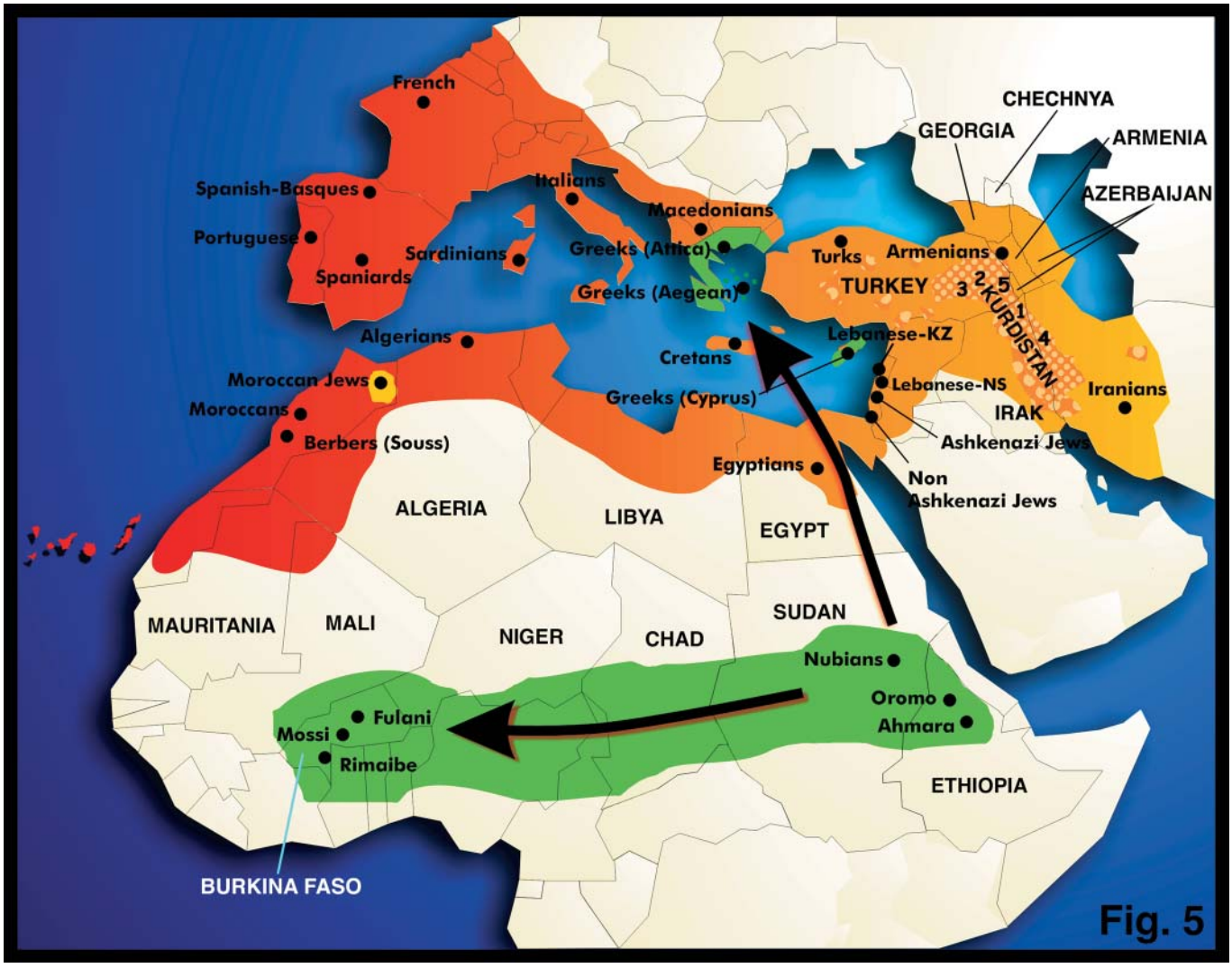

Fig. 5. **Populations map stressing the smooth transition degree of relatedness between western (red) and eastern (yellow) Mediterraneans.** African areas (green) show where populations related to Greeks live. The populations tested in the present work are depicted (see also Fig. 1) and the relationships among them are based on HLA genetic distances and the neighbor joining dendrograms of relatedness. Arrows show postulated migrations from Ethiopia to both West Africa (alternative hypothesis to the one shown in Fig. 1) and Greece, the latter probably occurring in Pharaonic times. Present day Kurdistan cities mentioned in the text are: 1.- Arbil (Iraq), 2.- Mush (Turkey), 3.-Diyarbakir (Turkey), 4.- Hamadan (Iran) and 5.- Bahçesaray (or ancient Kurti, Turkey).

ferred to them as "Subaru"; Akkadians, Assyrians and Babylonians called mountain people from the area "Guti". Mittani political power appeared by 1500 B.C. around present-day Diyarbakir (Turkish-Kurdistan) (Fig. 5) (21). The people may perhaps have come from other areas (Sindis from Iran-India); however, the name Mittani is an old Hurrian name that can still be found in extant Kurd tribes (Mattini Millani) (56). Hurrians were still one of the strongest groups in the Mittani Empire. By 1200 B.C., Medes and other political powers invaded Hurrian cities (and the entire area of the Mittani) and by 850 B.C. the old language (probably from the Dene Caucasian group) (16, 27) had changed into a so-called Indo-European one throughout the mountains, probably giving rise to the present-day Kurdish language. However, ergativity remains in present-day Kurdish language as from their old Hurrian (or similar Caucasian) language (52, 53). Ecbatana (Hamadan) was the Medes capital in 727 B.C. Modern Kurdish historians consider themselves as coming from Medes (56) and Kurds have a calendar based on the Medes destruction of the Assyrian Empire when Nineveh was occupied by Medes (612 B.C.) (21). Kurds remained as "the mountains people" through Persian, Greek and Roman Anatolian rule. By 1071, Turkish warriors imposed Islam in mostly Christian Anatolia after the battle of Manzikert. The first recorded name of Kurds (Kurti) was given by

the Assyrians around 1000 B.C. to people living in Mt. Azu or Hizan (near lake Van (in easternmost Turkey)). Kurti existed in Mt Hizan until 60 years ago (present-day Bahçesaray) (Fig. 5) (56). "Kurts" are also mentioned by early classical historians like Polybios (133 B.C.) and Strabo (48 A.D.). In the classical world, "Kurti" referred to people who lived in the mountains (Zagros, Taurus) in the first centuries B.C.

Armenians

Armenians believe that they come from the old Urartians, who are one of the groups of Hurrian tradition with a pre-Indo-European language (see above) (57) which attained the maximum regional power by 900 B.C. This civilization had its center at Lake Van, but Assyrians first (from the West) and Scythians from southern Russia conquered Urartu by 600 B.C. Present-day Armenians have their own alphabet and speak an Indo-European language probably imposed by the Medes (whose language is completely unknown); their original language probably belonged to the Dene Caucasian group (27, 32, 33). Persian was followed by Roman rule (Alexander the Great did not invade Armenia). The Armenian people have remained Christian ever since. Armenians were attacked and deported (51) between 900 and 1400 A.D. by Byzantium, Turks, and Muslims. An Armenian kingdom was founded by displaced Armenians in the Mediterranean coast between modern Turkey and Syria. But Turks made it disappear and the Armenian people's identity returned once more to the southern Caucasus (51) at the Araxes valley. Meanwhile, the Armenian Diaspora had led many Armenians to Istanbul, Macedonia, Bulgaria, Poland, Italy and France.

The A33-B14, B35-DR11 and B49-DR11 haplotypes imply that Armenians belong to the older Mediterranean substratum. Also, its genetic distances are very close to both Turks and also to Kurds (21). HLA dendrogram (Fig. 3) and correspondence analysis (Fig. 4) show how close Armenians are genetically to Turks and also to Kurds. The Armenian Diaspora may have displaced a common Armenian haplotype A33-B14 all over the Mediterranean, including to the western most part (Iberian, Morocco and Algeria).

Iranians

It is very much debated whether or not the Iranians represent the western branch of an hypothetical Aryan invasion. Invasions by these peoples are only postulated on linguistic bases, therefore the possibility exists that this "Aryan invasion" was an "elite" invasion, where a few rulers imposed a new language. Soon after 1000 B.C. the Medes came to notice as an empire conquering the Zagros mountains and lower Mesopotamia (53, 57). Probably, the rise of these people is associated with the appearance of the Iron Age in the area. The Medes capital was Ecbatana (current-day Hamadan in Iran). The Medean Achemenidan dynasty proclaimed Zoroastrianism as the official religion, expanded westwards and its kings Ciro, Cambires and Dario took over most of Middle East, including Anatolia and Egypt. Alexander the Great from Macedonia brought it to an end in the 4th century B.C. Later, the Arabs also brought to an end the Achemenidan (Sasanian) empire by 638 A.D. The official religion of Zoroastrian was replaced by Islam but the old Persian language survived.

Our genetic data show that modern-day Iranians are close to other Middle East and Mediterranean populations (Macedonians, Cretans, Anatolians, etc.) (Figs. 3 and 4) (20). Thus, the genetic data support the hypothesis that Iranian genetic stock comes from the ancient autochthonous people and that the origin of this Indo-European (Iranian) language is uncertain. It could probably have been imposed in the Zagros Mountains and Mesopotamia (1st millenium B.C.) by immigrant warriors or it could have been an autochthonous development (58, 59).

Did the Indo European invasion exist?

Hittite and other old Anatolian languages (Armenian, Kurd) have been considered as imported Indo-Europeans, i.e. belonging to a family which includes most western European languages (Spanish, English, French, German, etc.) and Hindi and Iranian. On these linguistic bases, comparing a piece of Hittite with Hurrian language (59) and the apparent translation of Hittite texts with words similar to German language (59) by Hrozny, an Indo-European theory has been created that includes a common origin for these supposedly homogeneous peoples. Postulated places of origin for Indo-Europeans include: Northern Capsian sea region (Gimbutas), Southern Caucasus (Gamkrelidze and Ivanov), India, the area surroundings the Aral Sea, Rumania, Germany and Baltic Republics (59); Colin Renfrew also proposes that they may have expanded from central Anatolia towards East and West, but he does not discard an origin on the Eurasian steppes (59).

The Hittite language could be a Na-Dene Caucasian language related to Caucasian, Basque (27, 32) and other dead languages (like Summerian, Elamitic, Egyptian, Etruscan and Iberian). Kurds, Armenians and Iranians are considered as Indo-Europeans (on linguistic bases only) who invaded Anatolia, Iraq and Iran by 1200–1300 B.C., but according to our HLA genetic data on Iranians, Turks, Kurds and Armenians, they seem very similar to each other and also similar to other Middle East and Mediterranean people. They do not seem to come from Caspian or other Asian areas as postulated but have mostly an old autochthonous substratum. Either the

Indo-European invaders who replaced the old (Dene Caucasian) language were very similar to Mediterraneans in genetic HLA composition or this invasion is not genetically measurable. No doubt a language change started after 2000 B.C. (27, 32) and Indo-European languages started establishing but this could have been an "elite" process with undetectable genetic consequences. The HLA composition of Central Asian people is quite different and should be noted (60). Even Sanskrit speaking people from Pakistan and India (also Indo-European according to language) are quite distinct regarding their HLA characteristics (1, 61).

In summary, there are several reasons to think that there was not massive movement of the so-called Indo-Europeans (or Aryans) (see refs. 31, 32, 49, 59). 1) Belief in Aryan invasion is largely based on linguistic studies which do not fit our genetic findings. An examination of correspondence between Anatolian Hittites (Aryans "new people") and Hurrians ("old people") from around 2000 B.C. revealed Indian divinity names. Thus, Aryans "invaded" Indus civilization sites and Anatolia between 1500 and 1200 B.C. 2) Hittite has recently been proposed as a non-Indo-European language. 3) Renfrew thinks that Aryans lived in Anatolia earlier than 7000 years B.C. and a little later in Indus valley. Sanskrit would derive from Indus people coming from the West. 4) The most ancient Indo-European document is written in Sanskrit (the Rig-Veda) and no signs of invasion are visible: geography, climate, flora and fauna are those of northern India. 5) The older Dravidian-speaking people record no invasion in India. 6) Archeology in the Indus valley cities of Harappa and Mohenho-Daro does not show the presence of invaders but a continuity since 6500 B.C. There is also a continuity in archeological skeletons in the Indus valley and also in Harappa-Sanskrit writing. In summary, the reasons for language changes in the second millenium B.C. are still unknown but are not apparently associated with a genetically noticeable population immigration into Middle East and India.

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