Reports

Did Indo-European Languages Spread Before Farming?[1]

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The question of how the Indo-European family of languages came to occupy a broad swath of Europe and western Asia has long attracted discussion. The actual range that the Indo-European family of languages had achieved by early historical times is uncertain, but they were certainly present in central and northern Europe, southeastern Europe, Anatolia, and parts of the Near and Middle East. Celtic, Germanic, and Slavic migrations may have produced a relatively late overlay of Indo-European languages in parts of western and northern Europe, though without written records of the preexisting languages it is impossible to say what was widespread before then. Migrations and conquest may likewise have carried Sanskrit and Tocharian farther east shortly before early historical times. While acknowledging that these identifiable movements of cultures and peoples contributed to the later spread of the Indo-European languages, scholars have long discussed what events before this time might have led to the group's present distribution.

Recent discussion of the prehistoric spread of the Indo-European language group has generally concentrated on two sets of hypotheses. On one hand there is the view that migrations of warlike peoples (e.g., the Kurgan or Battle-Axe culture) (Childe 1950, Gimbutas 1980) had spread the languages through conquest of relatively passive farming populations. A more recent alternative view (Renfrew 1987, 1992) is that the main event in the spread of the western branch of these languages was the initial spread of farming out of the Near East, providing a population "wave" (due to the increased carrying capacity of the farming lifeway) that swamped the non-Indo-European languages of the hunter-gatherer groups that had previously existed in the area. This idea has received some support from genetic evidence of a southeast to northwest gradient in gene marker frequencies across Europe (Cavalli-Sforza, Menozzi, and Piazza 1994), but it has been argued that other (earlier or later) population movements could have followed the same track.

While both the battle-axe and the farming-wave hypotheses have much to recommend them, they may not be the only reasonable explanations in terms of what is known of the prehistory of Europe and western Asia against a background of environmental changes. The possibility that the initial dispersal event of the Indo-European languages involved not Neolithic farmers or Bronze Age warriors but Mesolithic hunter-gatherers has been mentioned briefly by several writers (e.g., Renfrew 1987), but no one seems to have given the idea more than a passing thought. Here we aim to discuss this idea in greater depth, examining what is known of the climatic and the archaeological record, together with general ecological principles of populations, to determine whether it stands up to more detailed analysis.

CLIMATE INSTABILITY AND LANGUAGE SPREAD

The past 100,000 years have been marked by many dramatic climate oscillations (Van Andel and Tzedakis 1996), each of which would have been capable of causing changes in human population density as the resource base shifted. Episodes of relatively low population density—for example, during intense cold and dry phases—would have been followed by rebound periods in which humans could expand in range and in numbers across the region. As well as acting as a source of genetic shifts in population composition, the "sampling error" caused by contraction of populations followed by exponential expansion out of refuge areas could have produced the spread of waves of linguistic and cultural uniformity across the region. Just such a wave of population out of the Near East may have carried Indo-European languages across much of Europe and some distance into Central Asia.

Following a climate phase marked by low human population densities across the region, any one group that acquired both the general cultural traits that caused it to spread rapidly out of a refugium and the technology to enable it to do so would have experienced rapid exponential population growth in an environment relatively free of competition from other hunter-gatherer groups. Such a group, spreading out northward and westward and possibly eastward as well, would have made a disproportionate contribution to the genetic and linguistic legacy of Europe and parts of the Near East. Other groups even a few centuries slower in expanding in size and range in response to the climate

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change would have been numerically dominated by the earlier colonists as they left their refugial homelands, given the likely exponential growth rates of these populations. Even at the relatively low densities that hunter-gatherer populations would have been capable of achieving, competition or at least interaction between groups would eventually have become more frequent, and the less numerous (non-Indo-European-speaking) groups would have been much more likely to lose their cultural and linguistic identity among a larger wave of Indo-European-speakers. This scenario may explain the existence of the Basque language group, which may have been a "potential" European dominant that narrowly failed to expand before the Indo-European-speakers became abundant in central and eastern Europe, southeastern Europe, and possibly also most other parts of Europe. The extinct Etruscan, Ligurian, and Iberian language groups may be regarded as further examples of the same. As the hypothetical Indo-European wave spread out in each direction, it can be expected to have gathered up the genetic and linguistic legacies of scattered smaller populations it encountered along its way as each of these began a slightly later spread out of southern European refugia. This process of gathering up may explain some of the current east-west and north-south genetic gradients which now exist in Europe and some of the differences between the present-day branches of the Indo-European family of languages.

It is thus possible that much of the initial (mid-Holocene) range of the Indo-European languages across central and northern Europe, the Balkans, and the Near East was achieved by the rapid spread of a sparse hunter-gatherer wave out of either southern Europe, the Levant, Anatolia, or western Asia, preceding the farming wave.

THE POTENTIAL IMPORTANCE OF THE YOUNGER DRYAS COLD PHASE

An obvious candidate for an environmental change which could result in rapid and widespread change in languages, cultures, and genetic composition of human populations is the Younger Dryas cold event (about 10,800–10,000 ^{14}C years ago), which returned much of western Asia to cold semidesert conditions (Huntley and Birks 1983, Starkel 1991, Landmann, Reimer, and Kempe 1996, Jalut et al. 1988, Rossignol-Strick and Planchais 1992, Velichko 1993), apparently through a series of rapid stepwise cooling events (see table 1). The transition to the Holocene is marked by noticeable changes in technologies (to the Mesolithic) and in human skeletal morphology across this region, possibly suggesting an immigration event. Reviewing the evidence for hunter-gatherer carrying capacities in different environments, Steele, Adams, and Slukin (1998) suggest that temperate forest and moist steppe have a much higher overall carrying capacity than either semidesert or arctic environments.

Drawing on a variety of sources, Rossignol-Strick (1995) suggests that in many areas of Greece and across

TABLE 1
Sudden Climate Changes in Europe and the Near East during the Past 15,000 Years

Calibrated Years Ago	Climate
14,500	Warm and moist; rapid deglaciation
13,500	At least as warm and moist as today's
13,000	Cold (Older Dryas)
12,800 ± 200	Transition to cold, dry (Younger Dryas)
11,500 ± 200	Transition to warm and moist (Holocene, or isotope stage 1)
9,000	Warmer and often moister than today's
8,000	Slightly warmer and moister than today's
5,900	Cold (corresponding to "elm decline")
4,500	Becoming fairly similar to present
2,600	Relatively wet/cold in many areas

SOURCES: Adams (1998), Adams, Maslin, and Thomas (1998).

Turkey the Younger Dryas period was even more arid than the most extreme part of the last glacial, with semidesert predominant. Conditions across most of the rest of Europe are variously thought to have resembled open cold forest steppe or possibly (at some stages) semidesert (Starkel 1991). A priori, such conditions may be expected to have resulted in some change in human population densities and distribution, though it is difficult to demonstrate or disprove this idea given the limitations of the archaeological record for the Younger Dryas period. In Europe and most of the Near East the record of human occupation during the Younger Dryas is ambiguous, with the age plateau in radiocarbon ages adding to the confusion (10,000 years ago in radiocarbon terms can mean anything between 11,200 and 12,200 "real" years ago). In northern and central Europe, the record is perhaps detailed enough to suggest a complete or almost complete depopulation during the Younger Dryas. However, in the Levant conditions seem to have remained relatively moist (Rossignol-Strick 1995), with relatively strong signs of continuity in human settlement (the Natufian) (Henry 1989). Even in this area, for instance, in the Jordan Valley, aridity and a large decrease in food plants are accompanied by smaller human populations clustered around relatively moist "oases" (Wright 1993). Following the Younger Dryas, warm, moist Holocene conditions seem to have returned rapidly all across Europe and western Asia, taking only a few decades according to the latest ice-core indicators of regional climate (Taylor et al. 1997).

Given the magnitude of the change in environments across the region, the earlier climate transition (about 12,000 ^{14}C or 14,500 calibrated years ago) to the much colder, arid Younger Dryas could well have eliminated much of the previous Late Palaeolithic population of northern and central Europe or at least drastically reduced interior population densities, and (from available indications of the carrying capacity of temperate forest environments for hunter-gatherers [Steele, Adams, and

Slukin 1998]) the rapid return of warm conditions would have provided an opportunity for rapid human population expansion to fill this gap.

Renfrew (1987, 1992) has vigorously attacked the techniques of linguistic dating and has found broad support among archaeologists if not among linguists. He makes the point that linguistic dating (based on degree of similarity in vocabulary and the use of specific "technology" words to pin down the culture of the earliest Indo-Europeans) is potentially subject to great imprecision. If one takes Renfrew's view that linguistic dating of language history is unreliable, then an earlier divergence relating to hunter-gatherer recolonization after the Younger Dryas may be more plausible for a spread of Indo-European languages by this type of mechanism. An error of about a factor of two in the estimated rate of divergence taken from the earliest written records would be sufficient to push the point of common origin back several thousand years from the early-to-mid-Holocene to the earliest Holocene. Given that during this time there was dramatic cultural change to relatively sedentary Neolithic farming (with lesser changes in trade patterns and technology) all across the region, one must ask whether the linguistic chronology is accurate. One can suggest, for instance (M. Fraser, personal communication), that relatively mobile hunter-gatherer populations moving across large areas of the European continent would have retained their cultural and linguistic unity more readily than denser and more sedentary farming populations.

We do not claim that this particular hypothesis has any more merit than either the battle-axe hypothesis or the farming-wave hypothesis, but it should be seriously considered (given the uncertainty about the early linguistic history of the region) alongside these as another possible scenario. Further light might be shed on this matter if the archaeological record of the region improved, allowing this hypothesis to be subjected to more rigorous testing. For example, good evidence of severe depopulation of most of Europe and western Asia during all or part of the Younger Dryas or the early Holocene cold phase would lend support to it, while lack of any depopulation might be seen as evidence against it.

A PLETHORA OF POPULATION WAVES IN THE LATE GLACIAL AND HOLOCENE?

The post–Younger Dryas colonization hypothesis is only one of a range of potential scenarios, suggested by the paleoenvironmental and archaeological record, leading to the spread of Indo-European languages or of higher-order language groups such as the paired Indo-European/Uralic familes or the still broader and more heterogeneous Nostratic superfamily. Another event that might have affected the spread of Indo-European by either hunter-gatherers or early farmers or both is the widespread cold, dry event at 8,200 calibrated years ago (table 1). This event seems to have been about half as severe as the Younger Dryas (Adams, Maslin, and Thomas 1998) and to have come on (and also ended) over at most a few decades, lasting in total about 200 years. Here again, a decline in human population densities across much of the region seems plausible from the extent and the suddenness of this event. Turnover in population or in cultural identity among hunter-gatherers resulting from this disruption might well have initiated or added to the spread of the Indo-European languages.

Estimates of the linguistic chronology of the Indo-European languages have been used to suggest that much of their common vocabulary has a more recent origin (about 7,000 years ago) (Swadesh 1972) than the early Holocene divergence that this sparse-hunter-gatherer-wave hypothesis (and Renfrew's farming-wave hypothesis) would seem to require (about 10,000–11,000 years ago). In this sense, the more likely candidate is the later, less severe cold event 8,200 years ago.

There is also a possibility (though it conflicts still more strongly with the linguistic dating) that the population increase causing the initial spread of the Indo-European languages occurred at the earlier warming event at the end of the Last Glacial Maximum (about 14,500 years ago), with the onset of the Younger Dryas itself, or perhaps at an even earlier event (Otte 1994). One can also envisage scenarios combining aspects of each of the three hypotheses. Quite independent of climate change, a more effective "Mesolithic" technology might have led directly to a population wave of increased carrying capacity analogous to that associated with the Neolithic transition. As pointed out above, another major cold and arid event—lasting perhaps 200 years—affected Europe and western Asia around 7,400 ^{14}C 8,200 calibrated years ago (Alley et al. 1997) (table 1). An initial early Holocene sparse-hunter-gatherer-wave spread of the Indo-European languages might have been followed by a period of relatively long-distance cultural and linguistic exchange (with possible spread of innovations in the language, continually updating aspects of the general substratum of Indo-European languages [*sensu* Sherratt 1996]) by relatively mobile hunter-gatherer groups and later farming and warrior groups.

A major refuge of population in the Europe-West Asian region during the Younger Dryas seems to have been the area of the Jordan Valley, where populations clustered in moist sites in which wild nuts and grains could be gathered. It is interesting to consider that this region, having the general characteristics of a source region for a sparse wave of hunter-gatherers, was also a key source for the farming wave. The Indo-European languages might thus have been propelled out of this source region by two successive population waves, first one of hunter-gatherers and then a slower one of farmers.

The idea that a phase of colder, drier conditions might have led to a regional decline in population density depends crucially on the cultural habits and cultural flexibility of the hunter-gatherer inhabitants of the region. One might hypothesize (as mentioned above) that an opening-up of the returning woodlands due to cold and/or aridity would have favoured hunting of large animals, making possible an increase in population density. This could merely push the dating of the necessary population wave slightly farther back in time. However, animal protein is not a principal source of food outside arctic and coastal environments, so it would be unlikely to result in anything other than a net decrease in population elsewhere as the plant food availability from wild grasses and nut-bearing trees declined with a shift towards cold steppe and semidesert conditions. The upshot of the complexity of human behaviours is that different cultural groups of humans might have responded to the same change in opposite ways, and such a pattern of simultaneous decline of one group and expansion of another might have produced a pattern of linguistic spread. In any case, overall population density seems likely to have declined during cold, arid events, and the archaeological evidence from the Near East supports this.

Thus, if climate events were rapid and intense enough to disrupt hunter-gatherer (and/or farming) populations, they may have been responsible for population or cultural replacements which helped to spread languages. Since the most intense events (the Younger Dryas and the cold event of 8,200 years ago) precede the Neolithic across most of the Europe/Near East region, hunter-gatherers may have been the vectors of the Indo-European languages.

This is merely speculation, but laying out possible scenarios is important to show that the situation in the region could well have been more complex than has generally been thought. The very variable environmental record of the Late Glacial and Holocene suggests that there would have been ample opportunities for population and cultural/linguistic replacement quite unrelated to agriculture or migrations of warriors on horseback.

CONCLUSION

The paleoenvironmental record suggests various times over the past 15,000 years at which major changes in hunter-gatherer population density *could* have occurred on a regional scale as a result of environmental changes. Such population shifts would be difficult to detect in a sparse archaeological record subject to large ^{14}C anomalies, but they remain a distinct possibility given the magnitude of the climate and ecological changes recorded from across the region. While the ending of the Younger Dryas event seems particularly likely to have resulted in population waves in the approximate time range of the origin of the Indo-European languages, any one of these prehistoric changes could have initiated the spread of the Indo-European language group (and in a broader sense the linked Indo-European/Finno-Ugric group). Given the existing dating and the detailed linguistic analysis suggesting a divergence time around 7,000 calibrated years ago, a somewhat later climate change (early-to-mid-Holocene; e.g., the cold event of 8,200 or that of 5,900 calibrated years ago) would seem more consistent with observations. A change 8,200 years ago could have promoted the spread of Indo-European languages by either hunter-gatherers or farmers or both.

Alternatively, climate change may have had little or no role in the spread of the languages by farmers or post-Neolithic warriors. Different processes could coincidentally have aided the spread of the Indo-European language family at different times. It may be that an initial sparse wave of recolonizing hunter-gatherers carried this group of languages part-way into central Europe and western Asia, with later processes such as the spread of farming and migrations of warrior cultures being responsible for its further spread.

Our hypothesis that climate change promoted the spread of Indo-European languages by causing changes in the population density of hunter-gatherer groups may be difficult or impossible to test. Given the a priori case which can be made, it seems fairly plausible, although like Renfrew's farming-wave hypothesis it contradicts paleolinguistic analyses. The severity of this weakness is uncertain, however, as Renfrew (1987, 1992) has pointed out various grounds on which the paleolinguistics can be doubted.

The general hypothesis that past climate changes strongly affected linguistic patterns can also merge into more traditional explanations; sudden climate change could have been the primary cause of migrations of Indo-European-speaking Neolithic farmers or horse-riding warriors. If one accepts the paleolinguistic view that such "technology" words as "wheel" and "copper" were initially present at the point of divergence of Indo-European languages and that they applied to items such as a fully formed wheel or worked copper, then the 8,200- or 5,900-year climate event (rather than the Younger Dryas) could have been more important, respectively influencing migrations of farming groups or of horse-riding warriors. The fact that one can so readily add and interchange alternative hypotheses concerning the spread of the Indo-European languages (and other language groups, all of which have formed in the highly variable world of the Late Quaternary period) should perhaps be seen as reason for scepticism regarding any prospect of understanding the true nature of the initial spread of the Indo-European languages. Finding out what one does not know is, however, a vital part of the scientific process; it is always better to realise that there are grounds for uncertainty than to hold an unfounded belief that one knows the answer. This uncertainty is reason for open-mindedness as to the causes of the spread of Indo-European rather than any sharp division into entrenched views.

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Mezmaiskaya Cave: A Neanderthal Occupation in the Northern Caucasus[1]

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Mezmaiskaya Cave, located in the Northern Caucasus, has yielded new facts about the life and death of Neanderthals in Eastern Europe. The cave contains a stratified sequence of Middle and Upper Paleolithic levels dating to the Last Glacial. It has produced the partial skeleton of a Neanderthal infant representing an almost certain example of intentional burial. It also contains evidence of significant technological change during the Middle Paleolithic, perhaps in response to Last Glacial climatic oscillations. Exceptionally well-preserved faunal remains have provided much information on the economy. Mezmaiskaya Cave has also yielded the first dated early Upper Paleolithic assemblage in the Northern Caucasus and provides our first glimpse of the Middle-to-Upper-Paleolithic transition in this part of Europe.

The Northern Caucasus lies on the southeastern boundary of Europe and represents one of the routes by which modern humans may have entered the continent from the adjoining Near East. The region is characterized by a mild climate and a rich supply of plant and animal life. Although Paleolithic remains were initially discovered in the Northern Caucasus a century ago at the Il'skaya site (Zamyatnin 1929), a clear picture of Pleistocene settlement history was slow to emerge owing to the lack of well-stratified and dated sites (Lyubin 1977). In recent years, the discovery of deeply stratified sites at Matuzka Cave in the northwestern Caucasus and Myshtulagty lagat (Weasel Cave) in the north-central Caucasus altered this situation (Golovanova, Levkovskaya, and Baryshnikov 1990, Hidjrati et al. 1997). In addition, new excavations at two previously known sites in the northwestern Caucasus (Barakaev-

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