

Convergence in the formation of Indo-European subgroups: Phylogeny and chronology

Andrew Garrett

A note on terminology: ‘Indo-European’ (IE) here includes Anatolian; ‘Proto-IE’ (PIE) was the common ancestor of the IE languages. Many specialists think Anatolian was the first IE branch to separate (Melchert 1998; Ringe et al. 2002; Jasanoff 2003); I will call the non-Anatolian IE languages ‘Nuclear IE’ (NIE), and their common ancestor ‘Proto-NIE’ (PNIE).

1. Phylogeny: The formation of Greek

Work by Alice Kober, Michael Ventris, and John Chadwick led fifty years ago to the discovery that the Linear B writing system, used on Crete and the Greek mainland in the second millennium BCE, was a system of writing Greek. It is now well established that the dialect of the Linear B texts, Mycenaean, though documented over four centuries prior to the first significant attestation of other Greek dialects, must be treated as a Greek dialect and not as Proto-Greek or a separate IE dialect. This is because Mycenaean shares innovations with individual Greek dialects, such as the assibilation of **-ti > -si* (as in *ehensi* ‘they are’), shared with Arcado-Cyprian, East Aeolic, and Attic-Ionic (vs. West Greek *enti*). Based on shared innovation patterns, the scholarly consensus is that Mycenaean is most closely affiliated with Arcado-Cyprian (Morpurgo Davies 1992).

It is also well established that there are linguistic changes found in all first-millennium Greek dialects, including Arcado-Cyprian, that are not found in Mycenaean. Before the decipherment of Linear B such changes were assumed to be Proto-Greek, but now it is clear that they reflect areal diffusion across the Greek-speaking area. The masculine-neuter active perfect participle presents a typical case. All first-millennium dialects reflect a suffix **-wot-*, as in Homeric *arērót-* ‘fashioned’ < **arār-wot-*, but this is a Greek development; the corresponding NIE suffix was **-wos-*. Yet Mycenaean has forms like neuter plural *arārwoha* < **arār-wos-* and none with *-wot-*. An apparent Proto-Greek innovation is unreconstructible for the ancestor of all Greek dialects. How general is this pattern, and does it affect our overall view of Proto-Greek? In this context Morpurgo Davies (1988, 102n4) writes that ‘it would be a useful exercise to collect all the features which we would have attributed to Common Greek before the decipherment of Linear B.’

1.1. The evidence for Proto-Greek

This is not the place to present in detail the results of the exercise Morpurgo Davies advocates, but I can summarize its findings. I have examined features attributed to Proto-Greek by Meillet (1913), well before the decipherment of Linear B, excluding those that are not unique to Greek. It turns out that little remains of Meillet’s Proto-Greek; excluding post-Mycenaean innovations, few unique changes distinguish Greek phonologically or morphologically from NIE.¹

In inflectional morphology it is well known that the Greek verb system is quite archaic, but the first-millennium system of noun inflection has undergone significant change. Meillet (1913) stressed the loss of the spatial (ablative, instrumental, and locative) cases, which he called ‘one of

the traits that characterize Common Greek' (1975, 46); these categories survived in no Greek dialect known in 1913. While the Mycenaean case system is still controversial in part, Hajnal (1985) argues that the instrumental and locative cases both survived and that in a major inflectional class, animate athematic consonant-stem nouns, the only case-marking change from PNIE to Mycenaean was a dative-locative plural syncretism. The new ending *-si* (vs. earlier loc. pl. **-su*) shows the only clear nominal form-change that is both unique to Greek and pan-Greek, but it is a trivial adaptation based on loc. sg. *-i* and instr. pl. *-p^hi* with final *i*. The loss of the ablative had begun in IE inasmuch as its forms were parasitic on the genitive in the singular and on the dative in the plural; since the Greek genitive expresses ablative functions, the loss of the ablative can be viewed as an extension of the singular syncretism into the plural. The inflectional system of the Proto-Greek noun thus differed only marginally from that of its PNIE ancestor.

In phonology, the discussion is usefully divided into three areas: segment inventory, syllable structure, and word structure. In the area of segment inventory, the question is what the sounds of PIE were and how they have changed. Since the Greek vowel system is famously conservative, this amounts to examining the consonants and syllabic sonorants. To begin with the latter, it is well known that PIE **l̥*, **r̥*, **m̥*, and **ŋ̥* mainly did not survive in IE languages; their loss is a major cause of the collapse of the inherited morphological ablaut system. In Greek, reflexes of **l̥* and **r̥* show *a* and *o* vocalism varying across dialects; no pan-Greek development can be reconstructed. The nasals **m̥* and **ŋ̥* become *a* in first-millennium dialects but instead often show *o* in Mycenaean when preceded by labial consonants, as in **spermn̥* > *spermo* 'seed'. The IE syllabic sonorants would therefore still have been distinct phonological categories in the ancestor of Mycenaean and other Greek dialects.

Among other segment types, Mycenaean also retains the labiovelar stops *k^w*, *g^w*, *k^{wh}*, as well as *y* and *w* in most positions; indeed, the change of *y* > *h* before sonorants is recent and ongoing in Mycenaean. Associated with the general loss of *y* is palatalization of many consonant types in *Cy* clusters; the First Palatalization affecting **t^(h)y* occurred before Mycenaean, but the Second Palatalization affecting a broader range of *Cy* clusters was arguably at least still ongoing.

In segmental terms, then, any Proto-Greek ancestral to Mycenaean and the first-millennium dialects must have had the relatively archaic segment types *k^w*, *g^w*, *k^{wh}*, *y*, *w*, *l̥*, *r̥*, *m̥*, and *ŋ̥*. In fact the only IE segment types missing in Proto-Greek would have been the laryngeals **h₁*, **h₂*, and **h₃*, segments lost in all NIE languages and probably already at least partly in PNIE. On a purely segmental level, the most significant changes to have preceded Mycenaean seem to have been the First Palatalization and the conditioned change of **y* and **s* to *h*. The segmental changes that distinguish PNIE and Proto-Greek look less substantial than those differentiating English, French, or German dialects (not all of which are always mutually intelligible, of course).

Under the syllable-structure rubric can be grouped various changes simplifying original *CsC* and obstruent-sonorant clusters in first-millennium dialects. As shown by Mycenaean forms like *aiksmā* 'spear', *hehrap^hmenā* 'sewn', and *dleukos* 'sweet wine', these innovations cannot be reconstructed for Proto-Greek even where they affect all later dialects. Steriade (1993) has shown that such cluster changes reflect a basic change in syllable structure: Mycenaean retained an IE syllable structure canon allowing many more onset types than the relatively impoverished set of clusters (such as stop + liquid) of later Greek dialects.

Finally, under the word-structure rubric I consider a set of changes not often seen as related.

With characteristic insight, Meillet (1913) wrote that ‘the end of the word is distinct; without presenting any constant particularity it was felt in a precise manner’ (1975, 26). He meant by this that several Greek changes conspired to demarcate word ends: the accentual *Dreimorengesetz*, the loss of final stops, and the merger of the nasals. I would extend this approach, and suggest that it is an organizing feature of a number of Greek innovations that they serve to demarcate prosodic words both at the left and the right edge.

At the left word-edge, two Greek changes can be seen as by-products of the development of aspiration as an initial-syllable prosody. One is aspiration metathesis, by which an *h* in a second-syllable onset sometimes migrated to the beginning of the word, as in **eu^hō* > *héuō* ‘singe’ (Lejeune 1982, 95-6, 137-8). This is clearly post-Mycenaean, since ‘wheel’ is spelled <a-mo> in Linear B and must be interpreted as *arhmo*, not †*harmo*, which would be spelled <a₂-mo>; aspiration metathesis is seen in later *hárma*.

The second left-edge change is Grassmann’s Law, by which an initial aspirated stop is deaspirated when an aspirate follows in the word, as in gen. sg. **t^hrik^hos* > *trik^hós* ‘hair’. Linear B does not distinguish aspiration, but Grassmann’s Law must postdate Mycenaean because it must postdate the post-Mycenaean **p^hm* > *mm* change (compare *hehrap^hmenā* ‘sewn’ above). This in turn is shown by later forms like *tet^hramménos* ‘having been nourished’ without Grassmann’s Law, from the root **t^hrep^h-* (*trép^hō* ‘nourish’). If Grassmann’s Law preceded Mycenaean we would expect †*tetrap^hménos* > †*tetramménos*, like Homeric *epépit^hmen* ‘we had been persuaded’ from the root **p^heit^h-* (*péit^hō* ‘persuade’).

Underlying both aspiration metathesis and Grassmann’s Law is a single pattern: aspiration is a temporally extended phonetic feature stretching across the entire first syllable. A dissimilatory loss of aspiration as in Grassmann’s Law occurs when aspiration associated with the first stop is reinterpreted (due to its extended duration) as a coarticulatory effect of the second stop, while a metathesis as seen in *héuō* or *hárma* arises when the phonological source of extended-duration aspiration is phonetically obscure (Blevins & Garrett 1998; 2004).

At the right word-edge, a set of changes occurred that can be related not just phonologically as demarcative but phonetically via the inverse of initial aspiration: final laryngealization. These changes are a shift of the position of the accent, which originally could occupy any syllable of the word but in Greek is restricted to the last three syllables; the loss of all final stops; and the merger of word-final **m* and **n* as *n*. The defects of Linear B, which writes neither accent nor coda consonants, make it hard to tell whether these changes had occurred in Mycenaean. But an indirect suggestion can be made that the final nasal merger may not have taken place, since the transfer of historical *m*-stem nouns into the class of *n*-stems had not happened, as shown by the dative singular *hemei* ‘one’.² That transfer is in turn a consequence of the merger of word-final **m* and **n* as *n*. If it is plausible that the three right-edge sound changes are interrelated, it is also plausible that none had taken place in Mycenaean. Note that the tradition in Mycenaean studies is to interpret Mycenaean so as to be as similar as possible to first-millennium Greek, even where Linear B gives us no evidence. The opposite strategy may be as appropriate even if to some extent speculative.

The relationship among the three right-edge changes can be understood as follows. It is likely in Greek, as in many languages, that final stop loss had an intermediate stage with glottalized stops ([ʔp], etc.). The retention of stops before word-final *s* (as in *t^hriks* ‘hair’) supports this view,

since stops before *s* would articulatorily have a spread glottis, preventing glottalization. I suggest that the Greek accent shift regularized falling pitch at the right edge of the word; previously there was no correlation between the right word-edge and postaccentual falling pitch. This facilitated word-final stop glottalization, perhaps as a reinterpretation of the ambient laryngealization often associated with falling pitch. Merger of word-final stops as [ʔ] > ∅ and neutralization of word-final nasal place contrasts may then have been the same change: loss of distinctions cued by final VC transitions. As I have suggested, it is reasonable to speculate that these changes all occurred in the centuries after Mycenaean.

In sum, especially if we allow that at least a few post-Proto-Greek changes must already have affected Mycenaean before its attestation (it is after all a Greek dialect), detailed analysis reduces the dossier of demonstrable and uniquely Proto-Greek innovations in phonology and inflectional morphology to nearly zero. Proto-Greek retained the basic NIE noun system, verb system, segment inventory, syllable structure, and arguably phonological word structure. In all these areas of linguistic structure, Greek was not yet Greek early in the second millennium. But if so, it hardly makes sense to reconstruct Proto-Greek as such: a coherent IE dialect, spoken by some IE speech community, ancestral to all the later Greek dialects. It is just as likely that Greek was formed by the coalescence of dialects that originally formed part of a continuum with other NIE dialects, including some that went on to participate in the formation of other IE branches. With this in mind it is possible to see external links for some Greek dialect patterns. For example, the first-person plural endings *-mes* and *-men* are distributed such that *-mes* occurs in West Greek, across the Adriatic from Italic (with *s* in Latin *-mus*), while *-men* occurs elsewhere, across the Aegean from Anatolian (with *n* in Hittite *-wen*). The isogloss separating prepositional variants *protí* (as in Homer) and *potí* (West Greek) likewise corresponds to the Indo-Iranian isogloss separating Sanskrit *práti* and Avestan *paiti*.

If Proto-Greek did not exist as such and Mycenaean phonology and inflection are minimally ‘Greek’, what makes Mycenaean Greek? Chadwick, seeing the essence of the problem, has written that ‘there must have been a time when the ancestral language could not fairly be described as Greek ... [T]he best proof comes from the vocabulary, which contains numerous words which are ... specific to Greek’ (1998, 27). In short, Greek dialects in the second millennium already had a distinctive derivational, lexical, and onomastic profile. It might not overstate the case to say that Mycenaean was a late NIE dialect with Greek vocabulary; a distinctively Greek phonological and inflectional profile was largely a development of post-Mycenaean history.

1.2. Systems collapse and linguistic innovation

The finding that numerous linguistic innovations spread across the Greek dialect area in the centuries after Mycenaean makes sense both historically and sociolinguistically. Two points are key. First, archaeological evidence points to massive population shift and economic change during the Greek Dark Age c. 1200-800 BCE. Morris (2000, 195-6) writes of ‘gigantic upheavals all across the east Mediterranean around 1200’, including the destruction of the Mycenaean palaces, migration, famine, disease, ‘economic disaster’, and massive depopulation. The archaeological data, according to Dickinson (1994, 87), ‘surely reflect considerable social changes.’ The linguistic effects of these changes have been noted before; for example, during the Dark Age, nearly ‘the whole of the terminology connected with the systems of land-tenure seems to have disintegrated’ (Morpurgo

Davies 1979, 98).

Second, toward the end of the Dark Age and subsequently there is a wealth of evidence for emerging systems of interaction that linked the Greek world economically, socially, and politically. In this context Snodgrass (1980) mentions arable farming, metallurgy, colonization, pan-hellenic sanctuaries, ship-building and navigation, *polis* rivalries (in architecture, athletics, etc.), and writing and literacy.

In short, prototypical examples of two patterns are seen between the Mycenaean period and the re-emergence of Greek writing in the first millennium: a systems collapse (Tainter 1988, 10-11) and the emergence of a new system also based on peer-polity interaction (Renfrew & Cherry 1986). A salient feature of the new system is the well-known sense of Greek ethnic identity, which by defining the boundaries of a Greek dialect area must have favored the diffusion of innovations across that area and no farther.

These historical phenomena are important sociolinguistically because they let us fit Greek into a broader picture of language change. Linguists studying social structure have found that tight social networks are 'an important mechanism of language maintenance, in that speakers are able to form a cohesive group capable of resisting pressure, linguistic and social, from outside the group ... One important corollary to the link between language maintenance and a close-knit territorially-based network structure is that linguistic change will be associated with a break-up of such a structure' (L. Milroy 1987, 182-90). By contrast, loose social networks, those with many ties outside their networks, 'are likely to be generally more susceptible to innovation' (J. Milroy 1992, 181).

Ethnographic sociolinguists mainly study local social contexts, but extrapolating to a broader scale and *longue durée* few historical settings could more aptly be called 'the break-up of a close-knit territorially-based network structure' than the Greek Dark Ages. Complex systems collapse should yield rapid linguistic change; citing the well-known case of the Algonquian languages Arapaho and Gros Ventre, Bakker (2000, 586) writes that '[i]n situations of great social upheaval and changes one can witness phonological change which takes place much faster than otherwise.' For Greek, the period between the end of Linear B documentation and the re-emergence of writing in the first millennium should have been a period of relatively rapid linguistic innovation. This change, I submit, was the formation of Greek as we know it.

1.3. *The origin of Indo-European phylogeny*

Does the model presented above apply only to Greek, or can it be generalized? In an earlier article (Garrett 1999) I suggested that Greek may be typical of IE subgroups, and that the reason we see the pattern clearly in Greek is that we have Mycenaean. For no other IE branch do we have comparable data — an Italic dialect of 1000 BCE, or an Indo-Iranian variety documented early in the second millennium. But the coherence of other IE branches can be doubted too. The problem of Italic is critically reviewed by Clackson (in this volume). Even for Indo-Iranian, not a long-standing problem like Italic, the Nuristani languages show that the RUKI sound change postdated Proto-Indo-Iranian, and the patterning of early loans into Uralic has suggested that Indo-Iranian was already dialectally differentiated c. 2000 BCE (Carpelan et al. 2001).

If the formation of Greek was a local event facilitated by local interaction patterns and ethnic identity, it is also relevant that IE branches like Indo-Iranian, Slavic, Celtic, and even the poorly

attested Venetic show evidence of a collective sense of ethnic identity. In such cases, as Nichols (1998, 240) puts it, ‘a complex native theory of ethnicity and a strong sense of ethnic identity can be reconstructed, and both the theory and the identity were based on language.’

I have argued that a Mycenaean systems collapse precipitated a period of rapid innovation in Greek dialects and the creation of a characteristic Greek phonological and morphological profile, but the collapse was no mere parochial event of the eastern Mediterranean. According to Cunliffe (1997, 41), ‘[t]he impact of the Aegean systems-collapse on the European hinterland was considerable. Existing exchange systems broke down or were transformed. Some communities, once part of European-wide networks, found themselves isolated and new configurations emerged.’ It is thus possible that the dynamics behind the emergence of Celtic, Italic, and other IE branches of Europe refract the same history as those behind the emergence of Greek. In Asia, though there can hardly be direct evidence, we may imagine similar processes at play in the formation of Indo-Iranian after the collapse of the Bactria-Margiana Archaeological Complex c. 1750 BCE (Parpola 2002, 91-2).

If this framework is appropriate for IE branches generally, we cannot regard IE ‘subgroups’ as subgroups in a classical sense. Rather, the loss or ‘pruning’ of intermediate dialects, together with convergence *in situ* among the dialects that were to become Greek, Italic, Celtic, and so on, have in tandem created the appearance of a tree with discrete branches. But the true historical filiation of the IE family is unknown, and it may be unknowable.

I conclude §1 by noting a pattern in need of an explanation. Early in the second millennium, I have suggested, IE branches such as Greek had acquired much of their lexical and derivational profile, while their grammatical apparatus continued to have its basic NIE character. Speaking in the broadest terms, early IE language spread was thus a two-phase process. In the first phase, local IE dialects acquired their specific lexical, derivational, and onomastic features; in the second phase, late in the second millennium in some cases, changes that gave dialect areas their characteristic phonology and morphology swept across those areas. What sociolinguistically plausible scenario could give rise to such effects?

2. Chronology: The dispersal of Indo-European

Phylogeny may also contribute to the debate between the two chronological frameworks posited for the initial IE dispersal. In what I will call the *first-agriculturalists* framework (Renfrew 1987), PIE was spoken around 7000 BCE and IE spread with the diffusion of agriculture from Anatolia into Europe in the seventh millennium. On this view the modern IE languages have diverged for about 9000 years. In what I will call the *secondary-products* framework, the time-depth of IE is some three millennia shallower: PIE was spoken and IE language dispersal began in the fourth millennium. This chronological framework is traditional; general presentations from this point of view include that of Mallory (1989). The name I use alludes to the *secondary products complex*. Under this rubric Sherratt (1981; 1983; 1997) has identified several emergent uses of domesticated animals — ploughing, carting, wool, and dairy — that arose in Europe in the late fourth and early third millennia; he refers to a ‘revolution’ that ‘marked the birth of the kinds of society characteristic of modern Eurasia’ (1981 [1997, 161]). New property transmission systems, land use practices, and social network patterns are said to be aspects of the transition.

2.1. Implications of convergence

Insofar as the formation of IE branches was a local process, and their characteristic innovations took place later than usually supposed, their phonological and morphological structures must have been closer in the centuries around 2000 BCE than has been thought. Table 1 shows reflexes of five PNIE numerals in three intermediate protolanguages and representative modern descendants: Greek; Spanish; and Waigali (Nuristani, Indo-Iranian [Turner 1962-6]).

PNIE	*treyes	*penk^we	*septm̥	*oktō	*h₁newn̥
Proto-Greek	*treyes	*penk^we	*heptm̥	*oktō	*ennewn̥
Modern Greek	tris	pente	efta	oxto	eñja
Proto-Indo-Iranian	*trayas	*pañča	*sapta	*ačtā	*nawa
Waigali	tre	pūč	sot	ošt	nū
Proto-Italic	*trēs	*k^wen^ke	*septm̥	*oktō	*newn̥
Spanish	tres	siñko	sjete	očo	nweve
	‘three’	‘five’	‘seven’	‘eight’	‘nine’

Table 1. Five numerals in PNIE and three NIE branches

The similarity of the intermediate protolanguages is obvious, and clearly also fewer changes occurred *en route* to each intermediate protolanguage than subsequently. Modern Greek is the most phonologically conservative language in the sample of Heggarty (2000), and even for Greek Table 1 shows only four sound changes *en route* to the intermediate protolanguage ($h_1 > e$, $k > k$, $s > h$, irregular *nn* in ‘nine’) but at least eleven historically distinct later sound changes: syllabic nasals $> a$; $k^w > t$ before e ; losses of y , w , and h ; $ee > ē$; $ē > ī$; $ea > ja$; loss of vowel length; stops $>$ fricatives before stops; and a shift from pitch to stress accent (not shown). In the other languages the later changes are plainly numerous, also including pitch-to-stress shifts, while Proto-Italic and Proto-Indo-Iranian each show only four changes.³ The Greek reconstructions follow §1.1, and it is worth adding that the Indo-Iranian and Italic forms may be too innovatory precisely because we do not have the equivalent of Mycenaean Greek proving the presence of areally diffused changes. If anything, the extent of phonological changes in the modern languages is understated.

The time-depth from the intermediate protolanguages to their modern descendants is on the order of 4000 years (Proto-Italic may be somewhat younger), and during this period significantly more phonological change has taken place than occurred *en route* from PNIE. Note too that all three intermediate protolanguages retain the basic PNIE system of nominal cases and inflection, and in the verbal system the three-way PNIE aspect contrast among present, aorist, and perfect (Meiser 2003). None of this survives in the modern languages.

The first-agriculturalists model posits a span of 3000-4000 years between PNIE and 2000 BCE. This means assuming two typologically incomparable periods, each three or four millennia long: a period marked by less phonological or inflectional change than is observed in any documented language, followed by a period when all IE languages were transformed by accumulating waves of phonological and morphological change. That is, the model requires the unscientific assumption that linguistic change in the period for which we have no direct evidence was radically different

from change we can study directly.⁴

There is nothing new in a conclusion that linguistic evidence favors the secondary-products chronology over than the first-agriculturalists chronology (Nichols 1998, 254-5), though I hope new light is shed on the question if IE subgroups are products of secondary convergence. Other types of relevant linguistic evidence include especially the evidence of linguistic palaeontology, a method with well-known pitfalls whose results in this case have been challenged; I will consider this issue in §2.2. Most importantly, as Renfrew (1987) has reminded us, it behooves a proponent of any view of IE dispersal to situate that view in a plausible model of ancient social dynamics. The central questions have always been: What caused the spread of Indo-European, and why did it spread over its broad Eurasian territory? I will sketch an approach to these questions in §2.3.

2.2. Linguistic palaeontology

In essence, the argument from linguistic palaeontology is that IE is reconstructed with words for secondary products (plough, wool, yoke) and wheeled transport (axle, nave, thill, wagon, wheel); since these technologies did not arise before 4000 BCE, the IE dispersal cannot be associated with the diffusion of agriculture several millennia earlier. In the first-agriculturalists framework, PIE and even PNIE date from before 5000 BCE, neither language could have had secondary-products or wheeled-transport terms, and the entire terminological ensemble must be a linguistic mirage if it seems reconstructible to PIE or PNIE.⁵ How then are the data explained? Even the advocates of linguistic palaeontology recognize that the method has general pitfalls, but the specific data must be scrutinized critically.⁶

One alternative account is independent formation: apparent cognates do not reflect common inheritance from a single ancestral prototype, but were separately formed in several languages. For example, perhaps the apparent PIE **h₂wrgis* ‘wheel’ (based on **h₂werg-* ‘turn around’) reflects independent formation in Hittite and Tocharian. But such an account is hardly possible for PNIE **k^wek^wlos* ‘wheel’ (in Germanic, Greek, Indo-Iranian, Tocharian, also borrowed early into Uralic and Chinese): though derived from **k^welh₁-* ‘turn’, a reduplicated *C₁e-C₁C₂-o-* noun is so unusual morphologically that parallel independent formation is excluded. Likewise, for PIE **yugom* ‘yoke’ (**yeug-* ‘harness, join, yoke’), with reflexes in Anatolian and almost all other branches, while neuter thematic nouns are common in some IE languages, they are quite rare in Anatolian and it has long been known that the category was not very productive in PIE. It is unlikely that **yugom* was independently created in Anatolian and other branches, all the more so because the form is morphologically invariant; had it been created independently we might expect other formations in some cases. Other words pose a different problem: PIE **h₂erh₃-* ‘plough’ (everywhere but Albanian and Indo-Iranian) is a root and cannot be newly formed, and PNIE **aks-* ‘axle’ (in Baltic, Celtic, Germanic, Greek, Indo-Iranian, Italic, Slavic) is not transparently based on a root and cannot be remade. In almost all cases, the forms of secondary-products and wheeled-transport terms must be reconstructed for PIE or PNIE.

For their meanings, secondary semantic shift is a possible alternative account. Thus Renfrew (2001, 46) suggests that PIE **h_{2/3}wlh₁neh₂* ‘wool’ (in Anatolian, Baltic, Celtic, Germanic, Greek, Indo-Iranian, Italic, Slavic) might originally have referred to ‘the fiber from the sheep’, perhaps used for rugs, clothing, or felt, shifting its meaning later as sheep were bred for wool. Indeed, for morphological reasons, it is clear that the word referred originally to fiber that was used in some

way: $*h_{2/3}wlh_1neh_2$ is derived via the suffix $*-neh_2$ from the root $*h_{2/3}welh_1-$ ‘to pluck or pull hair’ (Latin *vellere*). The word cannot simply have referred to hair; it must have arisen at a time when sheep had coats whose hairs were plucked. But there is no reason to believe that such a practice existed before the breeding of woolly sheep: the earliest uses of the sheep’s coat were in felting, for which there is no evidence before the third millennium, and spinning into thread for weaving, known for wool from the fourth millennium in the Near East and later in Europe.⁷ In short, *wool* makes no morphological sense on the first-agriculturalists IE chronology.

Arguments involving secondary semantic shift can be envisioned for other terms, like those for ‘nave’ and ‘thill’, which refer generally to poles in some languages; the shift to a vehicular context could be independent (Specht 1947: 100-2). But in other cases it is hard to see how secondary semantic shift can explain the data. Perhaps $*yugom$ ‘yoke’ originally referred to another joining result, but what? and why was the original meaning lost throughout IE? In the case of words for ‘wheel’, what did they originally designate if not wheels? A semantic shift from concrete ‘wheel’ to abstract ‘circle, cycle’ is plausible but the reverse shift (abstract > concrete) is unusual at best.

It remains to comment on the possibility of vocabulary diffusion or borrowing after the relevant technology arose. Borrowing ordinarily betrays itself phonologically; if ‘yoke’ had been borrowed from Indo-Iranian into other IE branches, it would have taken the form $*yugam$ after the Indo-Iranian change of *o* to *a*. One could suggest that vocabulary diffusion took place before the phonological changes of individual branches, but given the overall requirements of the first-agriculturalists chronology this would mean that IE history first had a period of several thousand years with just vocabulary change and diffusion, and that linguistic change as it occurs in clearly documented languages would only have begun with the secondary-products complex; as noted in §2.1, this idea is unrealistic. A possible alternative account invoking ‘etymological nativization’ (Hock 1991, 392-3) would founder on the divergent profiles of that process and the IE data.

It is worth adding in conclusion that linguistic reconstruction yields not just isolated words but a terminological ensemble in a coherent semantic field. The explanatory strategy forced by the first-agriculturalists framework misses the big picture by invoking an unsystematic jumble of *ad hoc* alternatives.

2.3. The dispersal of Indo-European

Renfrew (1987) originally articulated the first-agriculturalists framework using the mechanism of demic diffusion, the slow movement of peoples over many centuries as one farmer after another moves a few miles to clear new farmland. This means of language spread is clearly documented in many cases (Bellwood & Renfrew 2002; Diamond & Bellwood 2003). For IE itself Renfrew (2000) has largely abandoned the idea, allowing in response to critics that demic diffusion was not the mechanism of IE language spread in western and northern Europe and instead invoking language shift (a term that labels a phenomenon without offering a sociolinguistic mechanism or model to explain it). For Indo-Iranian, a connection between the spread of farming and language dispersal in an area comparable in size to Europe has been abandoned altogether (Renfrew 2000, 423-4).

As recently as 2001 Renfrew has written that ‘the only process or event of sufficiently general significance for the whole of Europe to account for the Indo-Europeanisation of almost an entire continent was the coming of farming’ (Renfrew 2001, 37). Such a statement hides two misleading

assumptions. First, Sherratt and others contend that the secondary products ‘revolution’ was a watershed in European social history; the difference between a chronology based on farming and one based on secondary products is just what is at stake. Second, in this context calling Europe ‘an entire continent’ is distractingly Eurocentric. Europe is also ‘a small peninsula of the Eurasian landmass’ (Richards 2003, 142), and the IE spread is a broad Eurasian phenomenon that should be seen as such. An interpretation that sets aside half the IE area, offers an explanatory model of language spread (demic diffusion) only for part of Europe, and mainly dismisses linguistic evidence cannot be regarded as a satisfactory account of what is after all a linguistic process: the dispersal of IE languages across Europe and Asia.

I take it that PIE was spoken c. 3500 BCE, perhaps somewhat earlier, in a part of what Mallory (1989, 239) calls the ‘circum-Pontic interaction sphere’; the PIE area could not have been larger than that of ecologically comparable languages, for example the size of Spain (Anthony 1995). It is traditional to situate PIE in the Pontic-Caspian steppe, though a western Pontic PIE may suit dialect geography better (Sherratt & Sherratt 1988 propose a circum-Pontic PIE not long before 4000 BCE). It is important to bear in mind that PIE may have had linguistically related neighbors; we cannot know how the ensemble would appear in the archaeological record.

The oldest IE split, between Anatolian and NIE, may have begun as a small-scale collapse of the PIE speech community with a sociocultural reorientation of its northern and southern halves. Perhaps the southern half of the community was drawn into the interactional sphere of the late fourth-millennium Aegean, or the northern half was drawn into the Balkans. In any case, Pontic IE speakers came to be oriented towards the Balkans and the steppe, while others were oriented socioculturally towards the Aegean and Anatolia.

In the Pontic area NIE began to differentiate, with Tocharian its easternmost dialect along the Black Sea and the first known IE language to make its way to Central Asia. The second was Indo-Iranian, whose spread on the steppe and c. 2000 BCE to Bactria-Margiana is widely accepted (Mallory 1998; 2002; Parpola 1988; 1998; 2002; Renfrew 2000, 423-4). Tocharian had perhaps separated from the NIE area by c. 3000 BCE, with Indo-Iranian spreading eastward on the steppe during the third millennium.

The European expansion, even if it represents only part of IE dispersal, is a crucial problem. Renfrew (1999, 2000, 2001) suggests that NIE dialects had a long episode of mutual convergence in what he calls ‘Old Europe’, following Gimbutas (1973) — a Balkan and east-central European interactional sphere that flourished in the fifth and fourth millennia before fragmenting. In his view this period was marked by diffusion across most NIE dialects; at its end ‘the strong cultural interactions marking the “Old Europe” episode discussed by Gimbutas came to an end, and the various sub-regions tended to go their own separate ways’ (Renfrew 2001, 42).

Renfrew (1979) has strongly emphasized the consequences of systems collapse. These include linguistic diffusion as in post-Mycenaean Greek (§1.1), or linguistic replacement as discussed by Renfrew (1987, 133-7) for several state collapses. But not all complex societies subject to systems collapse are states; some are networks of the Old Europe type. In his analysis of the collapse of complex societies, including societies of several organizational types, a general pattern emphasized by Tainter (1988, 191) is that ‘[i]n each case, peoples on the periphery ... rose to prominence after the older society had collapsed.’

In the scenario I have sketched NIE dialects were spoken on the periphery of Old Europe,

and I suggest, in what I hope is not an unholy alliance of the doctrines of Gimbutas and Renfrew, that it was the *collapse* of the Old Europe interactional system that facilitated the initial spread into Europe. Like Gimbutas, I see IE dispersal as related to what Mallory (1989, 238) summarizes as mid-fourth millennium ‘cultural chaos’ and ‘something of a Balkan “dark age”.’ But I agree with Renfrew that it is not necessary or desirable to imagine invasions by warrior Indo-Europeans; systems collapse naturally led to rapid dispersal of the speech of its periphery.⁸ In a complex system IE speakers must already have interacted with more central participants in roles we cannot know (perhaps some were specialist wainwrights, weavers, or herders). The point is that an IE spread into the Balkans and east-central Europe, in the late fourth and early third millennia, would be a natural aspect of the collapse of Old Europe. As argued in §1.3, the later emergence of European IE languages that were distinctively Celtic, Italic, and so on may have followed the Aegean systems collapse of the late second millennium.

Viewing the IE dispersals broadly, it is possible to discern three major patterns. One is the steppe spread that led to the dispersal of Tocharian and Indo-Iranian. A second pattern is characteristic of the IE spread into Europe and linguistic changes that took place there: dispersal was associated with systems collapse (Old Europe, the late-second-millennium Aegean) and the social reorganizations of the secondary products complex. The Indo-Iranian spread into Iran and South Asia after the collapse of the Bactria-Margiana Archaeological Complex can also perhaps be assimilated to this pattern.

The third pattern is not widely noted but seems quite robust: a north-south spread into the interactional spheres of the urbanized zone that runs from the Aegean through Anatolia and the Near East to Bactria-Margiana. This significant Eurasian pattern has at least four instantiations:

- the initial split of PIE, insofar as it was associated with a reorientation of Proto-Anatolian towards the Aegean and Anatolia, with the subsequent eastward spread of Hittite
- the spread of Greek dialects into Greece and the Minoan sociocultural world
- the Indo-Iranian spread into the oasis citadels of Bactria-Margiana
- the spread of the Mitanni Indo-Iranian dialect into Syria

In each case the resulting sociocultural profile shows significant continuity with indigenous patterns, respectively Hattic (in the case of Hittite), Minoan, Bactria-Margiana, and Hurrian.

Mallory’s analysis of the Indo-Iranian spread may be broadly applicable here. Mallory & Mair (2000, 267) comment as follows on the interaction of Andronovo-culture steppe Indo-Iranians and the urban oasis dwellers of Bactria-Margiana c. 2000 BCE:

[T]he Andronovans would have come into contact with the oasis-dwellers, adopted items of their material culture, some of their religious beliefs and cultural practices (such as the fire cult and consumption of the hallucinogenic **sauma*), but not the language of the oasis-dwellers. Rather, the language of the steppe-dwellers would have operated as the *lingua franca* of exchange between regions, then perhaps within the settlements themselves until some variety of Indo-Iranian had become the main language of West Central Asia

Mallory (2002, 39) writes further:

Indo-Iranian tribes from the steppelands entered into the political sphere of the BMAC [Bactria-Margiana Archaeological Complex] and absorbed from it a suite of religious institutions and their names as well as the concept of a superordinate tier within their social organisation. This tier ... provided a system of coordination between the different elements both within the BMAC and the mobile units outside. It linked oasis

dwellers and steppe nomads in Central Asia and ... it could also bring together people practising different settlement and economic strategies on the northern steppe.

For Greece, Palaima (1995, 127) describes ‘a process whereby the established Helladic/Aegean and Indo-European features of mainland culture were transformed and made part of the Late Helladic palatial culture through a strong, selective adaptation of diverse elements of Minoan material culture and Minoan social, political and religious ideology.’ Across Eurasia generally, I suggest, IE language spread may be interpreted partly as a result of such interactions between a northern periphery and a southern urban zone.

To speculate further, the same pattern of interaction may well lie behind the two-stage process identified in §1. The first stage of IE language spread is characterized by a distinctive lexical, derivational, and onomastic profile; this corresponds to urbanization and the use of indigenous sociocultural traditions by speakers of IE languages. In Anatolia, Greece, and Bactria-Margiana respectively, compare the ‘dominant role of Hattic elements in Old Hittite religion and cult and ideology of kingship’ (Melchert 2003, 17), including Hattic loanwords like *halmaššuit*- ‘throne’; the elite semantic profile of ‘Minoan’ loans in Greek (Renfrew 1998), including the vocabulary of kingship (Mycenaean *wanaks* > *ánaks*, perhaps *g^wasileus* > *basiléus*); and the dossier of borrowed Indo-Iranian social and religious vocabulary, including important terms like **indra-* ‘Indra’ and **dāsa-* ‘(hostile) people’ (Lubotsky 2001).⁹ In such circumstances, we expect significant lexical change as well as changes in more socioculturally embedded aspects of morphology, such as onomastics and ways of deriving occupational terms, ethnic adjectives, and the like. What is responsible for this first stage of IE dispersal is thus the sociocultural continuity we see in Anatolia, Greece, and Bactria-Margiana as IE languages arrive.

The second stage with its phonological and inflectional transformations corresponds, on this view, to the emergence of local ethnic identities and networks. In some cases this may have been a long, gradual process; in others a systems collapse may have facilitated rapid innovation, as in Greek, Indo-Iranian (if a Bactria-Margiana collapse c. 1750 BCE played a role in the emergence of distinctive Indo-Iranian phonology and morphology), and perhaps some European IE languages.

3. Conclusion

I have made two main arguments in this chapter. In §1, based on a new analysis of Mycenaean, I argued that the apparent features of Proto-Greek mainly diffused throughout Greece during and after the Mycenaean period. It follows that Proto-Greek — or if this did not exist, IE speech of c. 2000 BCE that was to become Greek — was linguistically closer to IE than has been supposed. I suggest more generally that we should contemplate models of IE phylogeny that assign a greater role in the formation of IE branches to convergence *in situ*.

In §2, I explored the chronological consequences of this view of IE phylogeny. If the linguistic changes in various IE branches took place relatively late in their histories, then it is unlikely that PIE was spoken c. 7000 BCE as in the first-agriculturalists framework. Speculatively but I hope constructively, I briefly sketched a scenario for IE dispersal that fits the linguistic facts and may perhaps answer what Renfrew rightly asks of Indo-Europeanists, that any account be situated in a plausible model of linguistic change and social dynamics.

Acknowledgements

Thanks to James Clackson, Peter Forster, and Colin Renfrew for inviting me to participate in the Cambridge symposium and to other participants and Juliette Blevins for useful discussion. For valuable comments on a written draft of this chapter, which have saved me from many errors, I am very grateful to Jay Jasanoff, Leslie Kurke, Craig Melchert, Anna Morpurgo Davies, Colin Renfrew, and Michael Weiss (few if any of whom agree with all my conclusions).

Notes

1. For information about Mycenaean Greek readers may consult the handbook of Bartoněk (2003) and the lexicon of Aura Jorro (1993), both with full references to other literature. A change in the verb system that should be noted because it is seen in Mycenaean is the development of thematic 3 sg. **-eti* > *-ei* (which, I would argue, is indirectly related to the First Palatalization mentioned below).
2. On this view <ko-to-na-no-no> (PY Ea 922) cannot be interpreted as haplography for <ko-to-na-na-no-no> with acc. sg. *ktoinān* (Morpurgo 1963 s.v.), and the epigraphically uncertain form at PY Eq 146.11 cannot be interpreted as <ī-qō-na-to-mo> with gen. pl. *hik^wk^wōn* ‘horses’ (Chadwick 1979, 25). As far as I know, unambiguous Mycenaean forms where a final nasal is written in sandhi have not yet been found.
3. The Indo-Iranian changes are laryngeal loss, palatal stop affrication, the Law of Palatals, and the merger of non-high vowels and syllabic nasals as *a*. The Italic changes are laryngeal loss, *y* loss, *ee* > *ē*, and the *p* > *k^w* change in ‘five’. For Proto-Italic I follow Meiser (2003, 30-31) except that I take *ew* > *ow* as a secondary development in light of early Latin forms like *neuna*. In any case, among the Italic changes only laryngeal loss is secure: *y* loss is precisely a change formerly reconstructed for Proto-Greek before the decipherment of Linear B, *ee* > *ē* contraction is dependent on *y* loss, and the *p* > *k^w* change is only weakly reconstructible.
4. To be sure, in a widely publicized study, Gray & Atkinson (2003) have suggested that computational phylogenetic analysis may support the first-agriculturalists chronology. But even setting aside methodological questions, and doubts about linguistic reconstruction from lexical data, the specific results of Gray & Atkinson’s research are likely to be in error as a result of a bias in the underlying data (Dyen et al. 1997). Modern IE branches show examples where, in a particular semantic slot, their known common ancestor (Latin, Sanskrit, etc.) has one word which has been replaced by a different word in all or most descendant languages. Thus Latin *ignis* ‘fire’ has been replaced by reflexes of Latin *focus* ‘hearth’ throughout Romance, and archaic Sanskrit *hanti* ‘kills’ has been replaced by reflexes of a younger Sanskrit form *mārayati* throughout Indo-Aryan. This process especially targets words of IE antiquity, which are more often irregular and therefore prone to replacement. This pattern creates the illusion of a slower rate of change in the internal histories of modern branches: it seems in retrospect (say) that Latin *focus* replaced an IE word for ‘fire’ in the prehistory of Latin and not later in Romance. Because the overall rates of change posited in Gray & Atkinson’s model are based on apparent rate of change in modern branches with known histories, the overall rates of change assumed will be too slow. Over the evolution from PIE to Proto-Italic, Proto-Indo-Iranian, etc., the time depth calculated will thus be too long. I cannot assess the precise effects of this bias, but to speculate, if 5% of the data is like *focus* a ‘true’ average lexical retention rate of 80% over 1000 years will instead look like 85%; this is equivalent to 23% retention over 9000 years, while an 80% rate is equivalent to a similar figure (26%) over 6000 years. Precisely this 3000-year difference distinguishes the first-agriculturalists and secondary-products models.
5. It is not true, as alleged by Renfrew (2000, 432-4; 2001, 45), that the morphology of such vocabulary shows that it is post-PIE, nor is this suggested by Specht (1947) or Lehmann (1993), whom he cites. Rather, the argument is that because athematic nouns are older than thematic nouns *within the prehistory of PIE*, wheeled-transport terms were relatively new *in PIE*.
6. The sensibly skeptical assessment of Clackson (2000) treats mainly the weakest evidence in the dossier, and in a crucial case he offers an inconsistent analysis, rightly noting that ‘thill’ and ‘yoke’ terms ‘do not need the reconstruction of a chariot, but could also apply to a plough’ (445), but then suggesting that ‘claims linking Indo-European to ... the “secondary products revolution” ... can also be challenged in much the same way’ (447). If the apparent secondary-products vocabulary is illusory then it should not be used to explain other vocabulary.
7. See Barber (1991, 24-5, 221) and Sherratt (1983 [1997, 203]). According to Barber (1991, 24n8), ‘the kempier type of wild sheep’ have ‘virtually unspinnable’ coats. Because wool was plucked or torn before it was shorn

- (Barber 1991, 21), $*h_{2/3}welh_{2-}$ gives the right sense where a verb root ‘cut’ would not.
8. For a review of archaeological data see Whittle (1996), who notes ‘extensive and profound changes throughout south-east Europe’ c. 4000-3500 BCE and suggests that IE languages ‘may have spread *after* these changes were underway, not as their primary cause’ (126-7).
 9. It is important to emphasize that Hattic linguistic influence on Hittite has been overstated in the past and that the case is stronger for Luvian linguistic influence (Melchert 2003). For Greek, Renfrew’s (1998) otherwise lucid treatment is marred by a failure to distinguish two processes of contact-induced language change, borrowing via maintenance and interference via shift (Thomason & Kaufman 1988, Thomason 2001); the two leave distinct linguistic ‘footprints’, and the Greek data show borrowing.

References

- Anthony, D., 1995. Horse, wagon, and chariot: Indo-European languages and archaeology. *Antiquity* 69, 554-65.
- Aura Jorro, F., 1993. *Diccionario micénico*, 2 vols. Madrid: Consejo Superior de Investigaciones Científicas.
- Bakker, P., 2000. Rapid language change: Creolization, intertwining, convergence, in Renfrew et al. (2000, vol. 2, 585-620).
- Barber, E. J. W., 1991. *Prehistoric textiles*. Princeton: Princeton University Press.
- Barber, E. W., 1999. *The mummies of Ürümchi*. New York: W. W. Norton.
- Bartoněk, A., 2003. *Handbuch des mykenischen Griechisch*. Heidelberg: C. Winter.
- Bellwood, P., and C. Renfrew (ed.), 2002. *Examining the farming/language dispersal hypothesis*. Cambridge: McDonald Institute for Archaeological Research.
- Blevins, J., and A. Garrett, 1998. The origins of consonant-vowel metathesis. *Language* 74, 508-56.
- Blevins, J., and A. Garrett, 2004. The evolution of metathesis, in *Phonetically based phonology*, ed. B. Hayes, R. Kirchner, and D. Steriade. Cambridge: Cambridge University Press, 117-56.
- Carpelan, C., A. Parpola, and P. Koskikallio (ed.), 2001. *Early contacts between Uralic and Indo-European: Linguistic and archaeological considerations*. (Mémoires de la Société Finno-Ougrienne, 242.) Helsinki: Suomalais-Ugrilainen Seura.
- Chadwick, J., 1979. The use of Mycenaean documents as historical evidence, in *Colloquium mycenaeanum: Actes du sixième Colloque international sur les textes mycéniens et égéens tenu à Chaumont sur Neuchâtel du 7 au 13 septembre 1975*, ed. E. Risch and H. Mühlestein. Genève: Droz, 21-32.
- Chadwick, J., 1998. The Greekness of Mycenaean. *Aevum* 72, 25-8.
- Clackson, J., 2000. Time depth in Indo-European, in Renfrew et al. (2000, vol. 2, 441-54).
- Cunliffe, B., 1997. *The ancient Celts*. Oxford: Oxford University Press.
- Darden, B., 2001. On the question of the Anatolian origin of Indo-Hittite, in Drews (2001, 184-228).
- Diamond, J., and P. Bellwood, 2003. Farmers and their languages: The first expansions. *Science* 300, 597-603.
- Dickinson, O., 1994. *The Aegean Bronze Age*. Cambridge: Cambridge University Press.
- Drews, R. (ed.), 2001. *Greater Anatolia and the Indo-Hittite language family: Papers presented at a colloquium hosted by the University of Richmond, March 18-19, 2000*. Washington: Journal of Indo-European Studies.
- Dyen, I., J. B. Kruskal, and P. Black, 1997. Comparative Indo-European database. Downloaded on 3 July 2004 from <http://www.ntu.edu.au/education/langs/ielex/IE-DATA1>.
- Garrett, A., 1999. A new model of Indo-European subgrouping and dispersal, in *Proceedings of the Twenty-Fifth Annual Meeting of the Berkeley Linguistics Society, February 12-15, 1999*, ed. S. S. Chang, L. Liaw, and J. Ruppenhofer. Berkeley: Berkeley Linguistics Society, 146-56.
- Gimbutas, M., 1973. Old Europe c. 7000-3500 BC: The earliest European civilization before the infiltration of the Indo-European peoples. *Journal of Indo-European Studies* 1, 1-21.
- Gray, R. D., and Q. D. Atkinson, 2003. Language-tree divergence times support the Anatolian theory of Indo-European origins. *Nature* 426, 435-9.
- Hajnal, I., 1995. *Studien zum mykenischen Kasussystem*. Berlin: Walter de Gruyter.
- Heggarty, P., 2000. Quantifying change over time in phonetics, in Renfrew et al. (2000, vol. 2, 531-62).
- Hock, H. H., 1991. *Principles of historical linguistics*, 2nd ed. Berlin: Mouton de Gruyter.
- Jasanoff, J. H., 2003. *Hittite and the Indo-European verb*. Oxford: Oxford University Press.
- Lehmann, W. P., 1993. *Theoretical bases of Indo-European linguistics*. London: Routledge.
- Lejeune, M., 1982. *Phonétique historique du mycénien et du grec ancien*, 2nd ed. Paris: Klincksieck.

- Lubotsky, A., 2001. The Indo-Iranian substratum, in Carpelan et al. (2001, 301-17).
- Mair, V. H. (ed.), 1998. *The Bronze Age and Early Iron Age peoples of eastern Central Asia*, 2 vols. (Journal of Indo-European Studies Monograph 26.) Washington: Journal of Indo-European Studies.
- Mallory, J. P., 1989. *In search of the Indo-Europeans: Language, archaeology and myth*. London: Thames & Hudson.
- Mallory, J. P., 1998. A European perspective on Indo-Europeans in Asia, in Mair (1998, vol. 1, 175-201).
- Mallory, J. P., 2002. Archaeological models and Asian Indo-Europeans, in Sims-Williams (2002, 19-42).
- Mallory, J. P., and D. Q. Adams, 1997. *Encyclopedia of Indo-European culture*. London: Fitzroy Dearborn.
- Mallory, J. P., and Victor H. Mair, 2000. *The Tarim mummies: Ancient China and the mystery of the earliest peoples from the west*. London: Thames & Hudson.
- Meiser, G., 2003. *Veni vidi vici: Die Vorgeschichte des lateinischen Perfektsystems*. München: C. H. Beck.
- Meillet, A., 1913 (8th ed. 1975). *Aperçu d'une histoire de la langue grecque*. Paris: Klincksieck.
- Melchert, H. C., 1998. The dialectal position of Anatolian within Indo-European, in *Proceedings of the Twenty-Fourth Annual Meeting of the Berkeley Linguistics Society, February 14-16, 1998: Special Session on Indo-European Subgrouping and Internal Relations*, ed. B. K. Bergen, M. C. Plauché, and A. C. Bailey. Berkeley: Berkeley Linguistics Society, 24-31.
- Melchert, H. C., 2003. Prehistory, in *The Luwians*, ed. H. C. Melchert. Leiden: Brill, 8-26.
- Milroy, J., 1992. *Linguistic variation and change: On the historical sociolinguistics of English*. Oxford: Blackwell.
- Milroy, L., 1987. *Language and social networks*, 2nd ed. Oxford: Blackwell.
- Morris, I., 2000. *Archaeology as cultural history: Words and things in Iron Age Greece*. Malden (MA): Blackwell.
- Morpurgo, A., 1963. *Mycenaeae graecitatis lexicon*. Rome: Ed. dell'Ateneo.
- Morpurgo Davies, A., 1979. Terminology of power and terminology of work in Greek and Linear B, in *Colloquium mycenaeum: Actes du sixième Colloque international sur les textes mycéniens et égéens tenu à Chaumont sur Neuchâtel du 7 au 13 septembre 1975*, ed. E. Risch and H. Mühlestein. Genève: Droz, 87-108.
- Morpurgo Davies, A., 1988. Mycenaean and Greek language, in *Linear B: A 1984 survey*, ed. by A. Morpurgo Davies and Y. Duhoux. Louvain-la-Neuve: Peeters, 75-125.
- Morpurgo Davies, A., 1992. Mycenaean, Arcadian, Cyprian and some questions of method in dialectology, in *Mykenaiika*, ed. J.-P. Olivier. (Bulletin de Correspondance Hellénique, Supplément 25.) Paris: Boccard, 415-32.
- Nichols, J., 1998. The Eurasian spread zone and the Indo-European dispersal, in *Archaeology and language II: Correlating archaeological and linguistic hypotheses*, ed. R. Blench and M. Spriggs. London: Routledge, 220-66.
- Palaima, T. G., 1995. The nature of the Mycenaean *wanax*: Non-Indo-European origins and priestly functions, in *The role of the ruler in the prehistorical Aegean*, ed. P. Rehak. (Aegaeum, 11.) Liège: Université de Liège, 119-39.
- Parpola, A., 1988. The coming of the Aryans to India and the cultural and ethnic identity of the Dāsas. *Studia Orientalia* 64, 195-302.
- Parpola, A., 1998. Aryan languages, archaeological cultures, and Sinkiang: Where did Proto-Iranian come into being, and how did it spread?, in Mair (1998, vol. 1, 114-47).
- Parpola, A., 2002. From the dialects of Old Indo-Aryan to Proto-Indo-Aryan and Proto-Iranian, in Sims-Williams (2002, 43-102).
- Renfrew, C., 1979. Systems collapse as social transformation, in *Transformations, mathematical approaches to culture change*, ed. C. Renfrew and K. L. Cooke. New York: Academic Press, 275-94.
- Renfrew, C., 1987. *Archaeology and language: The puzzle of Indo-European origins*. London: Cape.
- Renfrew, C., 1998. Word of Minos: The Minoan contribution to Mycenaean Greek and the linguistic geography of the Bronze Age Aegean. *Cambridge Archaeological Journal* 8, 239-64.
- Renfrew, C., 1999. Time depth, convergence theory and innovation in Proto-Indo-European: 'Old Europe' as a PIE linguistic area. *Journal of Indo-European Studies* 27, 257-93.
- Renfrew, C., 2000. 10,000 or 5000 years ago? — Questions of time depth, in Renfrew et al. (2000, 413-39).
- Renfrew, C., 2001. The Anatolian origins of Proto-Indo-European and the autochthony of the Hittites, in Drews (2001, 36-63).
- Renfrew, C., and J. F. Cherry (ed.), 1986. *Peer polity interaction and socio-political change*. Cambridge: Cambridge University Press.
- Renfrew, C., A. McMahon, and L. Trask (ed.), 2000. *Time depth in historical linguistics*, 2 vols. Cambridge: McDonald Institute for Archaeological Research.
- Richards, M., 2003. The Neolithic invasion of Europe. *Annual Review of Anthropology* 32, 135-62.
- Ringe, D., T. Warnow, and A. Taylor, 2002. Indo-European and computational cladistics. *Transactions of the Philol-*

- ogical Society* 100, 59-129.
- Sherratt, A., 1981. Plough and pastoralism: Aspects of the secondary products revolution, in *Patterns of the past: Studies in honour of David Clarke*, ed. I. Hodder, G. Isaac, and N. Hammond. Cambridge: Cambridge University Press, 261-305 (reprinted in Sherratt 1997, 158-98).
- Sherratt, A., 1983. The secondary exploitation of animals in the Old World. *World Archaeology* 15, 90-104 (revised in Sherratt 1997, 199-228).
- Sherratt, A., 1997. *Economy and society in prehistoric Europe: Changing perspectives*. Princeton: Princeton University Press.
- Sherratt, A., and E. S. Sherratt, 1988. The archaeology of Indo-European: An alternative view. *Antiquity* 62, 584-95 (reprinted in Sherratt 1997, 471-85).
- Sims-Williams, N. (ed.), 2002. *Indo-Iranian languages and peoples*. (Proceedings of the British Academy, 116.) Oxford: Oxford University Press.
- Snodgrass, A., 1980. *Archaic Greece: The age of experiment*. London: J. M. Dent and Sons.
- Specht, F., 1947. *Der Ursprung der indogermanischen Deklination*. Göttingen: Vandenhoeck & Ruprecht.
- Steriade, D., 1993. *Greek prosodies and the nature of syllabification processes*. New York: Garland.
- Tainter, J. A., 1988. *The collapse of complex societies*. Cambridge: Cambridge University Press.
- Thomason, S. G., 2001. *Language contact*. Washington: Georgetown University Press.
- Thomason, S. G., and T. Kaufman, 1988. *Language contact, creolization, and genetic linguistics*. Berkeley: University of California Press.
- Turner, R. L., 1962-6. *A comparative dictionary of the Indo-Aryan languages*. London: Oxford University Press.
- Whittle, A., 1996. *Europe in the Neolithic: The creation of new worlds*. Cambridge: Cambridge University Press.
- Zimmer, S., 2002. The problem of Indo-European glottogenesis. *General Linguistics* 39, 25-55.
- Zvelebil, M., 1995. Indo-European origins and the agricultural transition in Europe. *Journal of European Archaeology* 3, 33-70.