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REVISITING THE REVISITED: COULD WE SURVIVE WITHOUT THE GREAT VOWEL SHIFT?

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ABSTRACT

This is a revised and extended version of a paper read at the 12th International Conference on English Historical Linguistics held at Glasgow University, Scotland in August, 2002.¹ In it I reconsider positions supporting its existence and inner coherence, including my own dating from ten years ago, after a cumulative series of facts were examined – some of them have long been invoked as counterarguments while others stem from recent theoretical frameworks. First, since the classical model (as schematised by Jespersen 1909-1949, I: § 8.1., for example) has frequently been used to illustrate the concept of "chain shifts" ("one change within a given phonological system gives rise to other, related changes" Hock 1986 [1998]: 156), I have examined textual evidence from the London variety in the period concerned (as that presented in Lass 1999) which casts serious doubts on the inner consistency of the combined push/drag chains invoked to explain the mechanisms of operation of the shift. Second, although a two-phase GVS is widely accepted (one, raising of /e: o:/ and diphthongization of /i: u:/ completed by the early 16th century and two, raising of /e: o: a:/ to various positions), the unfolding of those two phases in the subsequent centuries is too divergent and plausibly suggest an alternative hypothesis.

In fact, I claim that no chain, whether push or drag, connecting Phase I and Phase II of the GVS is sustainable at all – at least for the development of the standard variety. My discussion is framed by the new scenario provided by theoretical views like that of languages as populations of variants moving towards attractors (Lass 1997) and speakers making loaded choices among those variants (cf. Smith 1996: 91-105).

Besides, in a general context of vowel shifts of various sizes and types characteristic of Germanic languages (cf. Stockwell and Minkova 1988, among others), Phase I is proposed as the only one having happened in most dialects from Late Middle English – and the best candidate if we

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still want some kind of unitary change with a sonorous name, provided the adjective "Great" is substituted by "Pan-dialectal" (see, in this same line Lass 1999: 56-186) and shorten the time span for its operation by at least a century.

1. Introduction

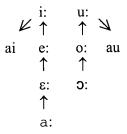
The title of this paper accounts for two things. One, that it is my second contribution to the platitude that more literature has been written on the Great Vowel Shift than on any other issue concerning English phonological evolution. Two, that in it I reconsider positions supporting its existence and inner coherence, including my own, presented at the 7th International Conference on English Historical Linguistics held in 1992 in Valencia and subsequently published in the 1994 proceedings (Guzmán 1994: 81-90).

The long controversy on the Great Vowel Shift has proved itself most fruitful, among other things, "for the amount of interesting scholarship and research produced" (Lass 1997: 40) which has raised (and allowed us to learn so much about) a number of crucial issues ranging from source evaluation to theory shapes. So abundant is it, indeed, that I felt that a change of my former opinion was almost unavoidable, once cumulative evidence over the years was examined. Such is the fate of good practice in research, though, as Ritt (2001: 23) quite sensibly writes: "we ought to admit the possibility that our investigations might cause us to revise our understanding of the concepts or even to give them up altogether". Part of this evidence has long been invoked as counterargument against the Great Vowel Shift,² while others stem from recent theoretical frameworks. The following section explores the first ones.

2. One shift, many shifts?

The classical model, especially the extremely well-known representation in terms of vowel space devised by Luick (1964) (see Fig. 1) and subsequently called the *Great Vowel Shift* by Jespersen (1909-1949, 1: §8.1.) has been employed by many linguists to illustrate their concept of *chain shifts* where "one change within a given phonological system gives rise to other, related changes" (Hock 1986 [1998]: 156).

Figure 1.



Generally accepted contemporaneous evidence (as that in Dobson 1968 [1985]) seems to show quite forcibly that both diphthongisation of Middle English /i: u:/ and raising of /e: o:/ had started as early as the 15th century, and possibly before that. Thus, Kökeritz (1978: 9-10) has argued that the "late 14th century undoubtedly used very close variants to /e:/ and /o:/ verging on [i:] and [u:] ... and they must already have been diphthongising /i:/ in *like* and /u:/ in *house* to a certain extent (at least as we do /i:/ and /u:/ today in *see* and *do*"); Lass (1999: 79-83) offers even earlier examples:

Innovating spellings begin sporadically in the East Midlands in the early fourteenth century; the first vowel involved is apparently /o:/. So Robert of Brunne's (Lincolnshire 1303) has ye touyer 'the other', doun 'to do' and a few more. William of Shoreham (Kent, 1320) has roude 'rood', bloude 'blood', touke 'took' (all Middle English /o:/ < Old English /o:/). Such spellings also occur in the Northwest Midlands at the same time (e.g., goud in the Gawain manuscript).

(Lass 1999: 79-83)

Some of these early spellings could be alternatively interpreted as evidence for medieval short vowels (cf. Johnston 1992: 208) but, in any case, both diphthongisation and /e: o:/-raising seem to have reached completion at the beginning of the 16th century. If the Great Vowel Shift is to be accepted as a unitary change, these innovations should have provoked adjustments in the vowels below. Nevertheless, a closer examination of sources does not provide conclusive evidence for other raisings, at least in a general manner, until a century afterwards. This is certainly the case for Middle English /ɛ: o:/ where sources do not point clearly to their raising to /e: o:/ until the mid-17th century (e.g., Wallis 1653) – though the closer vowels had presumably been, common in speech for at least half a century. As far as Middle English /a:/ goes, there seem to have existed two different evolutions in two diastratic varieties which finally merged into /ɛ:/ at the end of the 17th century. The first one (corresponding to an ad-

² Cf. Schendl – Ritt (2002: 413): "Thus, if one thinks of the Great Vowel Shift as an account of something that "really happened to" long vowels in Early Modern England, one will inevitably realise that it is neither the only account that can be given, nor necessarily the truest one. In fact, the more one thinks about it, the more aspects one will find to be highly questionable".

vanced variety of the London standard) would have involved /a:/ > /æ:/ and has been claimed to be attested by the statements of Bellot (1580) and other contemporary French sources (cf. Lass 1999: 84). The second one would have kept the conservative pronunciation /a:/ (as described for example in Hart 1589; cf. also Lass 1999: 83-84) until the end of this same century, when we find descriptions pointing at a general pronunciation $/\epsilon:/$ (e.g., Lass 1999: 84).

It is true that what I have described so far is the London variety, and vowel shifts are found in other English dialects as well. They obviously need not comply with exactly the same kind of constraints and conditions, but a general overview can be illustrative. In certain Middle English northern dialects, for example, there was no diphthongisation of Middle English /u:/ as is shown by the fact that some modern Scots varieties have /hus/ instead of /haus/. Middle English /o:/ had fronted to /ø:/ well before any of the other Great Vowel Shift changes had taken place and later on, it raised to [y:]. The other vowels underwent developments similar to those described above for the London variety. As far as the East Anglian dialects are concerned, on the basis of sporadic textual evidence and subsequent historical projection, it has been claimed by some (cf. Smith 1996: 107) that they had /i: u:/ < Middle English /e: o:/ (these being the result of a merger with Middle English /ɛ: ɔ:/). They possibly had diphthongs as well but no raised /a:/.

It is generally assumed that shifts operate on one height only of the vowel scale at a time – this would account for all the failures caused by vacant slots, as in the case of Northern dialects, where /au/ < Middle English /u:/ does not exist, presumably because /o:/ was not there to initiate a push chain in the back yowels (this has often been invoked as evidence for Middle English /e: o:/ > /i: u:/ as the earliest movement in the Great Vowel Shift, cf. McMahon 1994: 19). Similarly, no drag mechanism could operate on East Anglian /a:/ since Middle East Anglian had no mid-low vowels. These shifts present diverse shapes, but it is true that similar kinds of shifts in different dialects do not need to be causally connected. Rather on the contrary, their existence is compatible with the widely acknowledged fact that "vowel shifts can be found not only in various periods and dialects, but also in other Germanic languages" (Guzmán 1994: 86). Data and argumentation in this respect have been provided from long ago by, among others, Ewen (1981), Kubozono (1982), Stockwell and Minkova (1988) and Johnston (1990). Therefore, at most, the Great Vowel Shift will be the name of just the changes undergone by long vowels in the London variety of English the variety which would eventually become the recognised standard.

3. One shift, two phases?

The time span for the operation of this Great Vowel Shift has generally been situated between 1400 (but see above) and 1700. Long-time spans might not per-

haps represent a theoretical problem in principle (but see Stockwell and Minkova 1988: 370), although three hundred years may be a little too long for any inner coherence to be kept ... provided there was such coherence.³ It will be recalled that no consistent evidence for Middle English / ϵ : 0:/ > / ϵ : 0:/ is found till a century and a half after the first stages of the change had been completed. Lass (1999: 92) thinks it likely that, in popular London varieties, evidence for an early raising of / ϵ :/ to / ϵ :/ and even to /i:/ can be found by 1550, that is to say, only fifty years after the completion of the high and mid-high vowel raisings.

This does not seem so long for a drag-chain shift and perhaps it could be hypothesized for the front set of vowels. But we still have the back vowel to be accounted for and here we lack conclusive evidence for /o:/ < Middle English /ɔ:/. The change does not present a reasonably finished S-curve until the mid-17th century. This poses additional questions (which to the best of my knowledge remain unsolved): firstly, we might think that early /ɔ:/ > /o:/ did take place, but that we lack contemporary evidence... but, why should that be, when attestation for the front vowels did reach us? A second possibility might well be that the drag mechanism worked at different rates for front and for back vowels. Middle English /ɔ:/ had certainly no vowel below it which could initiate a minor push mechanism – in this case we would hypothesize a mixed push/drag shift for the front vowels, that is to say, /a:/ > /ɛ:/ helping to accelerate /ɛ:/ > /e:/. But, in my opinion, the time gap is perhaps still too long for a drag chain in the case of /ɔ:/; finally, I have certain difficulties in accepting that this front/back asymmetry is not crucial for the general coherence of a *Great* shift.⁴

The alternative explanation most generally offered nowadays is that we are, in fact, facing, at least in the case of the London standard,⁵ not a unitary shift, but one composed of two different phases:

1) Raising of /e: o:/ and diphthongisation of /i: u:/, which was completed by the early 16th century. No contemporary evidence particularly favours an

³ As a matter of fact, the distance between the initial and the closing dates might be bigger: accepting that writing is basically conservative, the Uniform Probabilities Principle ("The global, (cross -linguistic) likelihood of any linguistic state of affair (structure, inventory, process, etc.) has always been roughly the same as it is now" Lass 1997:29) can be invoked and spellings such as those mentioned by Lass (1999: 79-83), however sporadic, could be considered as hints for dates earlier than the 14th century for the presence in speech of the diphthongs coming from Middle English /i: u:/ and /i: u:/ < Middle English /e: o:/.

⁴ See in this respect Lass (1999: 79): "initial front/back symmetry is not crucial for the argument".

⁵ A two-phased-Great Vowel Shift hypothesis is considered among others by Lass (1999: 80); others, like Johnston, favour a view where those two phases are distinct phenomena (though linked "at a deeper, more systemic/phonological level" cf. Johnston 1992: 220, footnote), albeit each in turn unitary, in so far as they are presented as originating in two localised areas and subsequently spreading throughout the country.

earlier date for one or the other. Most scholars, though, tend to accept now that there is some kind of connection between them and that there was a push mechanism involved.

2) Raising of /ε: 5:/ to /e: o:/ and /a:/ to /ε:/. This phase lasted longer (16th and 17th centuries) and unfolds in complex and variable ways, even in subsequent developments after the 17th century.

Differences are, in my view, such that it would be worthwhile to consider the possibility that, perhaps, (2) is not a second phase of the shift, but rather a different story.

4. One shift, but not a Great one

The closing date for the Great Vowel Shift might perhaps be looked at as too conveniently fixed just when the figure stops having a nice symmetrical design, and this would surely deserve further exploration but it falls outside this paper's scope. Rather, I would like to focus on the difficult problem of the actuation of the change. My argumentation will be based on Jeremy Smith's work (1996: 91-105) and it involves the appearance of variant phonetic realisations of the long vowels after the operation of the Open Syllable Lengthening, and the subsequent perceptually-caused adjustments of variants along social judgements and group behaviour. For the first phase of the shift, and invoking Labovian terms, this would basically mean a *change from above* linguistic awareness, combining reinforcement of group bonds, on the one hand, and innovative tendencies on the other. As Labov himself has recently stated:

Sociolinguistic variation is parasitic upon such linguistic variation. It is an opportunistic process that reinforces social distinctions by associating them with particular linguistic variants. Though in principle any social category may be associated with linguistic change in progress, it is the culturally dominant groups of society that are normally in the lead. The use of linguistic forms to increase distinctiveness of particular groups is a driving force for the acceleration of change.

(Labov 2002)

Whatever had been the reasons for the speakers of the various dialects to favour already closed and glided variants of the two high sets (present in speech by the very articulatory and perceptual nature of long accented vowels) it would not be unreasonable to think that by the end of the 15th century two varieties coexisted in London, as shown in Figure 2. I will call them V1 and V2. V3 would represent the "state of affairs" c. 1600 (1650); the notation <Gi Gu> implies no compromise as to the quality of the glide in the diphthongs, in itself a highly controversial issue but not essential for my argumentation:

Figure 2.

V1	V2	c. 1600 (1650)		
i: u: Gi e: o: Gu	i: u: Gi e: o: Gu	i: u: Gi e: o: Gu		
ε: ο:	0. 0. 0. 0.	ε:		
æ: ↑				
a:	a:			

V1 is more conservative and would stem from earlier pronunciations associated with the higher classes - the arrow simply represents a certain amount of variation with increasing evidence for /æ:/ towards the end of the century. Speakers of this variety would have made a conscious choice to stick to their system of vowels and thus mark a boundary from the pronunciation of lower classes. V2 would be more advanced, and would correspond to a heterogeneous group of speakers, connected in various ways with East Anglia, among which we could perhaps count Alexander Gil's "Mopsae" (Gil 1619), and who are described by Lass as "a type of affected, over-delicate, hypercorrecting female speaker⁶ - what we would now call 'refayned'. The Mopseys affect a 'thin' pronunciation ('omnia attenuant'), rather than speaking they 'chirp' ('pippiunt')" (Lass 1999: 92). This group has been characterised by those studying the period from the perspective of the social network theory of language change as "upwardly mobile" (cf. Conde-Silvestre - Hernández-Campoy - Pérez-Salazar, forthcoming 2000, and, for details regarding social networks, James Milroy 1992, and Lesley Milroy 1987 [1992]), with weak ties to their social class or local area - that is to say, the typical innovators. They are assumed to be "prone to hypercorrect or overshoot when faced by linguistic systems perceived by them as prestigious" (Smith 1996: 93).

It will be recalled that the push chain starting in V1 by the raising of /a:/ might just account for the dates in the developments of the front series – but not very well for the raising of /ɔ:/. Smith (1996: 107) thinks that /ɛ:/ in V3 would result from the attempts of the speakers of V2 to imitate the increasingly fashionable V1 /æ:/. If he is right, and I cannot see why he should not be, then my impression is that what phase (2) of the Great Vowel Shift really consists of is the surfacing into the standard of the evolution of the mid and low vowels which

⁶ In this respect, Gordon and Heath's views (as quoted by Nichols 2003: 298) are worth noting: "Gordon and Heath (1998) find a sex-based motivation for such changes: women are likely to lead in the raising of front vowels, men in any shifts involving backing and/or lowering".

is typical of V2, inclusive maybe of what Wallis describes as /e: o:/ – and commonly assumed by the literature as raised / ϵ : o:/.

Explanations for these developments could perhaps be sought in part amidst the historical and socio-economic circumstances from the mid-17th century onwards, which placed many of those "upwardly mobile innovators" in actual "upper" positions. Their pronunciation would therefore have become less and less stigmatised as the 17th century advanced, as it is shown by rhyming in poets like Edmund Waller and John Dryden and "homophone lists" like those of Richard Hodges (cf. Smith 1996: 109; also Dobson 1968: 400). It should not be surprising, though, because these kinds of evidence generally reflect the speech of those classes which, according to Smith (1996: 108) the Civil Wars of the mid-century brought to political power and socially influential positions.

5. Conclusion

In the light of this interpretation, therefore, no drag shift connecting Phase I and Phase II is sustainable at all for the standard. Besides, the outcomes of these supposedly two phases seem to have had rather independent stories in the following centuries. Phase I is really the only one which seems to have taken place in most dialects of English from late medieval times. Consequently, my suggestion would be that if we want some kind of unitary change with a grand name, perhaps we should consider the possibility of substituting the adjective Great for Pan-dialectal (a term that, as I discovered recently, Roger Lass also favoured once) – and shortening the time span for its operation by at least a century (although re-examination of early sources might modify dating). The validity of the chain shift analysis as affording "a unitary framework that predicts the kinds of relations we actually get between the attested nuclei" (Lass and Wright 1985: 141) and its effectiveness as metaphor (cf. Schendl and Ritt 2002: 413) are not necessarily thus challenged – but the length of the chain gets substantially reduced.

Surely, further exploration and comparison of the social and historical circumstances on the different English dialectal areas where shifts have happened would be most fruitful and illustrative. The attempts at explaining the actuation of the different shifts in terms of a combination of linguistic and extra-linguistic factors do not seem unreasonable. Basically this combination would consist of speakers making loaded choices from among a population of variants – in the case of vowel shifts, these variants would be the multiple realizations of English long stressed vowels, which as it was pointed out above, include various degrees of raisings and glidings because of their very articulatory and perceptual nature. Apart from those I have called Pan-dialectal, we should explore the possibility of various other shifts in various directions in different dialects. In any case, in my opinion the Great Vowel Shift is the label for a metaphorical repre-

sentation, most fruitful, though perhaps misguided and certainly misleading, based on the one hand, on a major feature of long accented vowels, and, on the other, upon very specific views of the processes of standardization and of language change. A metaphor so neatly and efficiently designed that generations of historical linguists have felt reluctant to abandon it. *Eppure si muove* ... and I feel that if we would still rather keep the label Great Vowel Shift, whether for practical (and/or) sentimental reasons, we should be careful not to be distracted by what Roger Lass calls "geometrical beauty or neatness" when stating the real nature of the connections among the different evolved vowels, because as Lass himself (1999: 77) writes "of course do not always correlate with truth".

REFERENCES

Aitchison, Jean

1981 Language change: Progress or decay? London: Fontana.

[1986] [Reprinted].

Alston, Robin Carfrae (ed.)

1969 English linguistics 1500-1800. Vol. 175. Menston: The Scholar Press.

Bellot, Jacques

Le maistre d'escole anglois, contenant plusieurs profitables preceptes pour les naturelz françois, et autres estrangers qui ont la langue françoise pour paruenir a la vraye pronociation de la langue angloise. London: Thomas Purfoote.

Campbell, Lyle

1998 Historical linguistics. An introduction. Edinburgh: Edinburgh University Press.

Conde-Silvestre, Juan-Camilo – Juan-Manuel Hernández-Campoy – Antonio Pérez-Salazar

in press "A sociolinguistic approach to the diffusion of Chancery written practices in late fifteenth-century private correspondence", *Neuphilologische Mitteilungen*. [Based on an unpublished paper presented at the 11th International Conference on English Historical Linguistics, Santiago de Compostela, Spain, September, 2000].

Cooper, Christopher

1687 The English teacher. London: The Author.

[1969] [Reprinted in R. C. Alston (ed.)].

Danielsson, Bror (ed.)

1955 John Hart's works on English orthography and pronunciation [1551, 1569, 1570].

Part I. Biographical and bibliographical introductions. Text and index verborum.

Stockholm: Almqvist & Wiksell.

Dobson, Eric John

1956 English pronunciation 1500-1700. Oxford: At the Clarendon Press.

[1968] [Reprinted].

Eaton, Roger - Olga Fischer - Willem Koopman - Frederike van der Leek (eds.)

1985 Papers from the 4th International Conference on English Historical Liguistics.

Amsterdam, 10-13 April 1985. Amsterdam: John Benjamin's.

Ewen, Colin

Aspects of phonological structure with particular reference to English and Dutch. [Unpublished PhD dissertation, University of Edinburgh].

Fernández, Francisco - Miguel Fuster - Juan José Calvo (eds.).

1994 Papers from the 7th International Conference on English Historical Linguistics. (Current Issues in Linguistic Theory 113). Amsterdam: Benjamins.

Gil, Alexander

1619 Logonomia Anglica. Alexander Gil's logonomia anglica. (Edited by Bror Danielsson and A. Gabrielsson). Stockholm: Almqvist & Wiksell.

[1972]

Gordon, Matthew - Jeffrey Heath

"Sex, sound symbolism, and sociolinguistics", *Current Anthropology* 39/4: 421-449.

Guzmán, Trinidad

1994 "The Great Vowel Shift revisited", in: Francisco Fernández – Miguel Fuster – Juan José Calvo (eds.), 81-90.

Hart, John

An orthographie, conteyning the due order and reason, howe to write or paint thimage of mannes voice, most like to the life or nature. London: [No indication of publisher].

[1955] [Reprinted in B. Danielsson (ed.), 165-228].

Hock, Hans Henrich

1986 Principles of historical linguistics. Berlin: Mouton de Gruyter.

[1998] [Reprinted].

Jespersen, Otto

1909-1949 A Modern English grammar on historical principles. Copenhagen: Munskgaard.

Johnston, Paul A.

1990 "Lass's Law and West Germanic Vowel shifts", Folia Linguistica Historica 10/2: 199-261.

"English Vowel shifting: One Great Vowel Shift or two small vowel shifts?", Diachronica 9/2: 189-226.

Joseph, Brian D. - Richard D. Janda (eds.)

2003 The handbook of historical linguistics. Oxford: Blackwell.

Kastovsky, Dieter - Gero Bauer (eds.)

1988 Luick revisited. Tübingen: Gunter Narr Verlag.

Kemp, J. Alan (ed. & trans.)

1972 John Wallis' grammar of the English language. London: Longman.

Kökeritz, Helge

1978 A guide to Chaucer's pronunciation. Toronto: University of Toronto Press.

Labov, William

1994 Principles of linguistic change, Vol. 1: Internal factors. Oxford, UK - Cambridge, USA: Blackwell.

2001 Principles of language change, Vol. II: Social factors. Oxford, UK - Malden, Mass., USA: Blackwell.

Lass, Roger

1997 Historical linguistics and language change. Cambridge: Cambridge University Press.

1999a "Phonology and morphology", in: Roger Lass (ed.), 56-186.

Lass, Roger (ed.)

1999 The Cambridge history of the English language. Vol. III: 1476-1776. Cambridge: Cambridge University Press.

Lass, Roger - S. Wright

"The South African Chain shift: Order out of Chaos?", in: Roger Eaton – Olga Fischer – Willem Koopman – Frederike van der Leek (eds.), 137-161.

Luick, Karl

1964 Historische Grammatik der englischen Sprache. Oxford: Basil Blackwell.

MacMahon, April

1994 Understanding language change. Cambridge: Cambridge University Press.

Martinet, André

1955 Economie des changements phonétiques. Berne: Francke.

Milroy, James

1987 Language and social networks. Oxford, UK - Cambridge, USA: Blackwell.

1992 Language variation and change. Oxford, UK - Cambridge, USA: Blackwell.

Nichols, Johanna

2003 "Diversity and stability in language", in: Brian D. Joseph – Richard D. Janda (eds.), 283-310.

Ritt, Nikolaus

Selfish sounds and linguistic evolution, with a chapter on the descent of [mæn].

[Habilitationschrift zur Erlangung der venia docendi für das Fach Anglistik:

Sprachwissenschaft an der Geisteswissenschaftlichen Fakultät der Universität
Wien].

Samuels, M. L. - Jeremy J. Smith (eds.)

1988 The English of Chaucer and his contemporaries. Aberdeen: Aberdeen University Press.

Schendl, Herbert - Nikolaus Ritt

2002 "Of vowel shifts great, small, long and short", Language Sciences 24: 409-421.

Smith, Jeremy J.

1996 An historical study of English. Function, form and change. London: Routledge.

Stockwell, Robert P. - Donka Minkova

1988 "The English vowel shift: Problems of coherence and explanation", in: Dieter Kastovsky – Gero Bauer (eds.), 355-394.

Wallis, John

Johannis Wallisii grammatica linguae anglicanae. (6th edition). London: William Bowyer.

ELECTRONIC SOURCES

Labov, William

"Driving forces in linguistic change". [Paper read at the 2002 International Conference on Korean Linguistics, Seoul, 2nd August. Available at http://www.ling.upenn.edu/~wlaov/Papers/DFLC.htm].