SOUND CHANGE AND MIGRATION DISTANCE

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1. INTRODUCTION

This paper examines two variables in historical linguistics – amount of sound change and migration distance – and questions whether a significant correlation can be established between them. The original inspiration for the thesis explored here derives from the often-repeated classroom joke that the Polynesians must have 'tossed phonemes' overboard as they pressed ever eastwards, Hawaiian (with eight consonants and five vowels plus length) possessing the second smallest phoneme inventory of any known language. Although this observation is based on relative degrees of phonological merger, various observations about shift and split in other Austronesian languages can be taken impressionistically to support the same general idea, namely, that the amount of sound change in a language is positively correlated with the distance its speakers have travelled from the probable homeland of the immediate or wider genetic group to which it belongs.

In addition to these impressions of my own, two other Austronesian linguists in recent years have either implicitly or explicitly maintained that there is a general relationship between sound change and migration distance. Dahl (1976) attributed to Otto Dempwolff the view that the Austronesian homeland could not have been in the region in which the modern Oceanic languages are spoken, since the Oceanic languages exhibit far greater phonological erosion than the typical Austronesian language of island Southeast Asia.[1] Clearly implied in Dahl's interpretation of Dempwolff is a general theoretical claim that languages which are further removed from the primary centre of dispersal will be phonologically more innovative.

During a brief conversation at the Fifth International Conference on Austronesian Linguistics in Auckland, New Zealand in January 1988, Malcolm Ross and I exchanged views of a similar kind. He felt, from his intensive comparative studies of the Austronesian languages of western Melanesia, and I felt, from my knowledge of Austronesian as a whole, that a global relationship between amount of sound change and migration distance was likely. Ross has now published his own views on the matter (this volume). Ross's study is an example of what Matisoff (1990) would call a 'microcomparison': it attempts to consider in detail all of the identifiable sound changes for a small group of closely related languages with a separation time probably not much in excess of 1,500 years. He concludes that there is a clear "correlation between sedentariness and conservatism".

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[1] See Blust (1976:233) for a critique of this reading of the passage in question.

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In this paper I attempt to investigate, through macrocomparison, the same issue addressed by Ross. As will be seen, it turns out to be worthwhile to approach a similar question through both micro- and macrocomparison, as the explanatory mechanisms available for one may not always be available for the other. As a test case I examine the 'erosion sequence' **p* > *f* > *h* > zero and certain variants of this development in Austronesian languages. Proto Austronesian canonical shape was CV(C)CVC, where (C) was either the abutting consonant in a reduplicated monosyllable, or a nasal generally homorganic with a following obstruent. I have confined the present study to reflexes of initial and intervocalic **p*, since to have done otherwise would have greatly complicated the evaluation of the results.

My views on the Austronesian homeland and the major migration routes leading from island Southeast Asia into the Pacific have been stated elsewhere (Blust 1984/85). They can be summarised as follows: 1) Proto Austronesian was spoken on or near Taiwan, 2) the first migration from this centre, sometime before 4000 B.C., was southwards into the Philippines, 3) from the southern Philippines the stream of migration split, one branch (ancestral to the Western Malayo-Polynesian (WMP) languages) moving into Borneo and Sulawesi, the second branch (ancestral to the Central-Eastern Malayo-Polynesian (CEMP) languages) moving into the northern Moluccas, 4) from the northern Moluccas the stream of migration split again, one branch (ancestral to the Central Malayo-Polynesian (CMP) languages) moving south and west through the Moluccas and Lesser Sunda Islands as far as Sumbawa, the second branch (ancestral to the Eastern Malayo-Polynesian languages) moving into west New Guinea, 5) Proto Eastern Malayo-Polynesian split into Proto South Halmahera-West New Guinea and Proto Oceanic; some of the descendants of the former moved back westwards into the northern Moluccas, while the descendants of the latter continued to press south and east to the north coast of New Guinea facing the Bismarck Archipelago, 6) from the New Guinea-Bismarck Archipelago region, a rapid dispersal eastwards into the Solomon and Vanuatu chains, southern Melanesia, Micronesia and the central Pacific completed the expansion of the Eastern Malayo-Polynesian-speaking peoples, 7) from Borneo and Sulawesi the further movement of Western Malayo-Polynesian-speaking peoples was more restricted, the most spectacular exception being the settlement of Madagascar from south-east Borneo in the early centuries of the Christian era (Dahl 1951).

In discussing spatial distribution I have divided the languages into 16 major geographical groupings, displayed in Table 1. The smallest of these geographical groupings (Madagascar) contains a single language, the largest (New Guinea) contains 161. The relevance of subgrouping to the matter at hand will be discussed in subsequent sections.

Section 3 presents a summary of the data. In order to process any of the data, however, a number of methodological issues must be addressed, and this is undertaken in section 2.

2. THE QUANTIFICATION OF PHONOLOGICAL CHANGE

Before we can correlate the amount of sound change with migration distance, we must quantify sound change cross-linguistically. To attempt this for all sound changes in even a small language family would be a major undertaking; to do it for a language family such as Austronesian, with over 900 member languages, would require several volumes. Given the practical limitations of my paper I have chosen to represent sound change as a whole by a series of changes that I will call the 'voiceless bilabial erosion sequence': **p* > *f* > *h* > zero (as qualified below). The general validity of my thesis, at least as regards this particular development, has long been implicitly recognised by Austronesian linguists. So rarely is **p* altered in Philippine languages that a pioneering Philippinist devoted a paper especially to the changes **p > f* and **b > v* (Conant 1908). To anyone familiar with the historical phonology of Central Malayo-Polynesian or Eastern Malayo-Polynesian languages such an enterprise would appear strangely out of place, since *p in the languages of eastern Indonesia and Oceania is rarely retained as a stop.[2]

2.1 PARAMETER SETTING

For purposes of quantification I have set the numerical parameters of the erosion sequence **p > f > h >* zero at 0, 1, 2, 3 respectively. In other words, each language which shows no change of **p* will be assigned a numerical value of zero, each language which shows a change of **p* to [f] will be assigned a numerical value of one, and so on. Since the relative proportions are unchanged, it is irrelevant whether the parameters are set at 0, 1, 2, 3, at 1, 2, 3, 4 or at any other arbitrary range of numerical values with constant intervals.

To illustrate, imagine a hypothetical set of 30 languages with the following distributions on the **p* 'erosion sequence': **p >* [p] (one case), **p >* [f] (eight cases), **p >* [h] (eleven cases), **p >* zero (ten cases). Multiply the first case (zero) by one, the second case (1) by eight, the third case (2) by eleven and the fourth case (3) by ten, giving 60. Dividing this figure by the total number of languages for which erosion values are computed (30) gives 2.0 (corresponding to [h]) as the mean erosion value for the set of languages compared.

Since the diachronic attribute that I am attempting to measure is a phonetic characteristic, I have used phonetic values wherever they differ from phonemic values, for purposes of calculating degree of erosion. Similarly, I make the relatively non-controversial assumption that Proto Austronesian (PAN) **p* was [p].

2.2 HETEROGENEOUS REFLEXES

Many sound changes are conditioned (e.g. Tagabili, where **p > h-, -f-*), while others show unexplained splits of a proto-phoneme (e.g. Miri, where **p >* /f/ or /p/ without known conditions). In all such cases I have averaged the erosion values for the various reflexes without consideration of relative frequency. Thus, for Tagabili of the southern Philippines the erosion value is 1.5 (mid-way between [f] and [h]), while for Miri of western Borneo it is 0.5 (mid-way between [p] and [f]).

Special complications arise in the case of the Oceanic languages. In Proto Oceanic, PAN **b* and **p* merged as **p* (often reflected as a fricative) and PAN **mb* and **mp* merged as **mp* (often reflected as a bilabial stop). A certain amount of unpredictable 'cross-over' of consonant grade has long been reported for Oceanic languages (the expected reflex of POC **p* in a given morpheme actually being the reflex of **mp,* or vice versa). As shown by Ross (1988), many Oceanic languages have two reflexes of **p* that are independent of this phenomenon of oral/nasal 'grades'. He refers to these as 'fortis' and 'lenis' reflexes. Wherever the 'fortis' reflex of **p* is identical to the nasal grade reflex I treat it as an instance of the latter; where it differs from the nasal grade reflex I treat it as a case of unexplained phonemic split, and average the numerical values of the reflexes, as with the Miri case noted above.

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[2]Although this study is inherently statistical, I have made no use of statistical tests of significance, which often serve as little more than a confirmation of the obvious. As will be seen, the numerical values upon which my conclusions rest leave little doubt about the significance of the groupings obtained.

2.3 SEQUENCE EQUIVALENTS

Proto Austronesian **p* has 17 known reflexes: 1) *b,* 2) *β*, 3) *ð̆*, 4) *f,* 5) *h,* 6) *k,* 7) *p,* 8) *p̈* (apico-labial stop), 9) *pw,* 10) *ˀ*, 11) *t,* 12) *θ*, 13) *v,* 14) *v̈* (apico-labial fricative), 15) *w,* 16) *y* and 17) zero. Some of these reflexes are quite rare or are found only in highly restricted environments. For our purposes what is important is that the values [p], [f], [h] and zero form a well-established diachronic sequence involving increasing lenition (weakening of articulatory stricture).[3] Since [v] and [w] are also quite common reflexes, the question naturally arises whether either of these segments can be placed in the established erosion sequence. For purposes of the present paper I have disregarded voicing as a factor in the evaluation of degrees of lenition. As a result an equivalence is established between [f] and [v] and between [h] and [w]: parallel to the main erosion sequence sketched above, a number of Oceanic languages have participated in an equivalent sequence **p* > [f] > [v] > [w]. The numerical value for [v] as a reflex of **p* is thus set at (1), and the numerical value of [w] as a reflex of **p* is set at (2).

2.4 SECONDARY FORTITION

The adoption of an 'erosion sequence' model for the historical development of PAN **p* presupposes a unilateral direction of change. However, in a small number of cases it appears that a change **p* > [f] has reversed itself, thereby giving the prima facie impression that no change has occurred. This is seen in the Polynesian Outlier of Anuta, in which PPN **p* and **f* have merged as a voiceless bilabial stop (Feinberg 1977), and in at least two Micronesian languages, Ponapean and Mokilese, in which PMC **p* and **f* have merged as [p] (Bender, et al. 1984). For purposes of determining erosion values I have taken these reflexes at face value, although it is likely that they embody a complex history leading from stop to fricative and back to stop.

Needless to say, it is possible that some other instances of **p* > [p] are also products of secondary fortition. This is most probable in linguistic subgroups where the reflex **p* > [p] is rare.

2.5 ATOMISM

The material summarised in section 3 is taken from sources which do not pretend to describe all dialectal variations, and it is possible that some languages for which a given erosion value of **p* is reported have dialects with different erosion values. To have pursued the study to this level, however, would have greatly increased the number of reflexes that require checking, and in all probability would have affected the results very little.

Under certain imaginable circumstances the inclusion of dialect material could significantly affect mean erosion value. For example Malagasy, which is normally represented by the Merina dialect, is a dialect complex with at least 18 distinguishable varieties (Vérin, Kottak and Gorlin 1969). All Malagasy dialects reflect **p* as [f], and the mean erosion value for Madagascar thus remains 1.0 whether we count only Merina, or all 18 recognised dialects. Malagasy subgroups with the languages of Borneo, and if it were included in that geographical region the mean erosion value for the languages of Borneo would differ considerably depending on whether Malagasy dialects were

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[3]Little work has yet been done on diachronic universals, but preliminary investigation of other language families suggests that this erosion sequence is universal both in the sense that it is commonly attested, and in the sense that, with rare exceptions (e.g. **f* > [p]), it always reads from left to right. This is true regardless of the source of a non-initial sequence member (e.g. Latin [f], from the merger of PIE **bh*, **dh* became written Spanish /h/, spoken Spanish zero).

counted separately or not. But since our purpose is to examine possible correlations between amount of phonological change and migration distance, it is clear that Malagasy must be treated as a geographical region separate from Borneo, regardless of its subgrouping affiliations. To my knowledge, despite the potential for such a situation to exist, no actual dialect situation would significantly affect the mean erosion value of a major geographical region if we were to adopt a more atomistic approach to the data.

2.6 GALTON'S PROBLEM

Galton's problem (named after Francis Galton, who first clearly stated it a century ago in public discussion with E.B. Tylor) formulates a basic condition on comparative research in the social sciences. If the sample units in a comparative corpus are not truly independent the results of the comparison will show sampling bias. A good example is the attempt of Lees (1953) to establish universal replacement rates of basic vocabulary through a pilot study which involved 13 languages, of which 11 are Indo-European, and six of these Romance. In general, any attempt to establish language universals inductively is subject to the same criticism.

In the present case our decision to treat each language as an independent sample unit is a fiction, but one which cannot be avoided until a complete subgrouping, down to the lowest levels of inclusion, is available for the entire Austronesian language family. To take a particularly clear example, a subgroup including all and only the Polynesian languages is universally accepted, and it is universally agreed that in its immediate ancestor PAN **p* had become **f.* To count each instance of PAN **p* > [f] in a Polynesian language as an independent example of phonological erosion is simply to multiply a single case by the number of its descendants. In the present study I have not been able to control for Galton's problem, but despite this limitation the established correlations appear to be generally valid, since many languages which have inherited one step in the erosion of **p* from a common subgroup ancestor have subsequently undergone further changes on their own.

3. DATA SUMMARY AND DISCUSSION

Data was obtained by scanning the available sources for 930 Austronesian languages, which are grouped by major geographical areas. Table 1 presents a summary of the results concerning the general lenition of **p,* without reference to specific erosion values: (1) = number of languages, (2) = percentage of Austronesian total, (3) = **p* unchanged, (4) = **p* changed, (5) = development of **p* unknown, (6) = percentage of languages with some change of **p* (rounded to nearest whole figure).

TABLE 1: A GLOBAL SUMMARY OF THE LENITION OF PAN **p* RELATED TO MAJOR GEOGRAPHICAL AREAS

No.	AREA	(1)	(2)	(3)	(4)	(5)	(6)
1.	Taiwan	22	2.4	18	2	2	10
2.	Philippines	129	13.9	69	14	46	17
3.	Borneo	96	10.3	62	2	32	3
4.	Madagascar	1	.1	0	1	0	100
5.	Mainland SEA	10	1.1	10	0	0	0
6.	Sumatra-Sumbawa	21	2.3	16	2	3	11
7.	Sulawesi	67	7.2	34	4	29	11

8.	Lesser Sundas	46	4.9	18	18	10	50
9.	Moluccas	53	5.7	2	36	15	95
10.	New Guinea	161	17.3	2	133	26	99
11.	Bismarck Archipelago	74	7.9	11	56	7	84
12.	Solomons-Santa Cruz	70	7.5	0	68	2	100
13.	Micronesia	24	2.6	0	20	4	100
14.	Vanuatu	105	11.3	0	91	14	100
15.	New Caledonia	28	3.0	0	11	17	100
16.	Rotuma, Fiji, Polynesia	23	2.5	0	22	1	100
		930	100	242	480	208	

For 208 of these languages information was insufficient to determine the reflex of initial and intervocalic *p. The remaining 722 languages are divided between two categories: (1) those in which *p > [p] is the *only* development, and (2) those in which a change of *p is *at least one* of the known developments. A brief discussion of each geographical area follows.[4]

TAIWAN

For Basai (sometimes called Ketangalan) and Ketangalan (sometimes called Luilang) the available information is insufficient to determine reflexes (Tsuchida 1982, 1985). The two Formosan languages in which **p* clearly has changed are Kulon, where **p* > [p]/[h] (Tsuchida 1985) and Favorlang, where **p* > [p]/[h]/zero (Marsh 1977). In neither case can conditions for the split be stated. The erosion values (EV) in these two cases are 1.0 and 1.66. The mean erosion value for all Formosan languages for which adequate information is available is thus (18 x 0) + (1 x 1.0) + (1 x 1.66) = 2.66/20 = .133.

PHILIPPINES

According to Conant (1908), in Ibanag and the closely related Gaddang, Yogad and Itawis of northern Luzon, **p* became [f] only before **u*. In early twentieth-century Ibanag this change had begun to generalise to other environments, although not all relevant lexical items were yet affected. In Ibaloi of north-central Luzon **p* > [f] is said to be a sporadic development. The erosion value in each of these five cases is 0.5.

Zorc (1974) has provided data on Buhid of Mindoro, in which **p* appears to have shifted unconditionally to [f]. This is the only reported example of the lenition of **p* anywhere in the central Philippines.

In Tiruray, Bilaan, Blit Manobo and Tasaday of southern Mindanao, **p* is unconditionally reflected as [f], while in Tagabili **p* is reflected as [h] word-initially and as [f] intervocalically (EV = 1.5). In Kalagan (Tagakaolo), Sarangani Manobo and Cotabato Manobo **p* is reflected as [ɸ], here treated as equivalent to [f] (EV = 1.0). The mean erosion value for all Philippine languages is thus (69 x 0) + (5 x 0.5) + (1 x 1.5) + (8 x 1.0) = 12/83 = .145.

[4]The language list is a slightly modified version of Wurm and Hattori (1981). Where not otherwise noted major sources of data are as follows: 1) Taiwan: Ferrell (1969), Tsuchida (1971), 2) Philippines: Reid (1971), McFarland (1977), 3) Borneo: Ray (1913), Hudson (1967), Prentice (n.d.), Blust (n.d.), 4) Mainland Southeast Asia: (Lee 1966), Benedict (1984), 5) Sulawesi: Sneddon (1978), (1984), Himmelmann (1990), Mills (1975), van den Berg (1988), 6) Lesser Sundas: Fox (n.d.), 7) Moluccas: Stresemann (1927), Collins (1982), (1983), 8) New Guinea: Ross (1988), 9) Bismarck Archipelago: Ross (1988), Blust (n.d.), 10) Solomons-Santa Cruz: Tryon and Hackman (1983), 11) Micronesia: Bender et al. (1984), 12) Vanuatu: Tryon (1976), 13) New Caledonia-Loyalties: Haudricourt (1971), Haudricourt and Ozanne-Rivierre (1982), 14) Rotuma-Fiji-Polynesia: Biggs (1978).

BORNEO

Banggi, spoken on a small island off the north coast of Sabah, shows **p* > [f] (EV = 1.0), and Miri, spoken near the mouth of the Baram River in northern Sarawak, shows **p* > [p]/[f] (EV = 0.5). The mean erosion value for all languages of Borneo is thus (62 x 0) + (1 x 1.0) + (1 x 0.5) = 1.5/64 = .023.

MADAGASCAR

A single Austronesian language, Malagasy, is spoken on Madagascar. In Malagasy initial and intervocalic **p* have become [f]. The mean erosion value for Madagascar is thus 1.0

MAINLAND SOUTHEAST ASIA

The Austronesian languages of mainland Southeast Asia include Malay, Moken and the eight members of the Chamic group. No change has affected **p* in any of these languages. The mean erosion value of this geographically-defined linguistic unit is thus zero.

SUMATRA-SUMBAWA

For the geographical area including Sumatra, Java, Madura, Bali, Lombok and western Sumbawa only two languages are known to show a change of **p:* Simalur (Simeuleu), where initial **p* disappeared and intervocalic **p* became [h] (EV = 2.5), and Nias, where initial and intervocalic **p* became [f] before all vowels (EV = 1.0). The mean erosion value for this geographical region is thus (16 x 0) + (1 x 2.5) + (1 x 1.0) = 3.5/18 = .194.

SULAWESI

Several of the languages of extreme south-eastern Sulawesi show lenition of **p:* Muna and Busoa, where **p* > [f] (van den Berg 1988), Tukangbesi, where **p* is reflected as [p] or zero (EV = 1.5), and Bonerate, where **p* is reflected as [p] or [h] (EV = 1.0). The mean erosion value for the languages of Sulawesi is thus (34 x 0) + (2 x 1.0) + (1 x 1.5) + (1 x 1.0) = 4.5/38 = .118.

LESSER SUNDAS

When we reach the languages of the Lesser Sundas the mean erosion value of **p* increases dramatically. Although a number of languages, including Komodo, the languages of Sumba, the languages of Flores, Kédang and such Timorese languages as Kemak and Tukudede reflect **p* as [p], fully half of the languages for which information is to hand show some change. Reflexes and erosion values are as follows:

EV = 0.5: 1) [p]/[f] (Bimanese);

EV = 1.5: 1) [p]/zero (Savu), 2) [f]/[h] (Mambai);

EV = 2.0: 1) [f]/zero (Yamdena), 2) [h] (Galoli, Waima'a);

EV = 2.5: 1) [h]/zero (Roti, Helong, Atoni, Tetun, Idate);

EV = 3.0: (Ndao, Wetar, Kisar, Roma, Leti-Moa, Masela-South Babar, Selaru).

The mean erosion value of **p* in languages of the Lesser Sundas in thus (18 x 0) + (1 x 0.5) + (2 x 1.5) + (3 x 2.0) + (5 x 2.5) + (7 x 3.0) = 43/36 = 1.194.

MOLUCCAS

Only two Moluccan languages, Teor-Kur and Buru, are known to reflect initial and intervocalic **p* invariably as [p]. Other erosion values are as follows:

EV = 1.0: 1) [p]/[h] (Soboyo), 2) [f] (Kola, Kei-Fordata, Watubela, Geser-Goram, Masiwang, Paulohi and Ambelau of the southern and central Moluccas, Onin of the Bomberai Peninsula, and Weda, Maba and Buli of southern Halmahera), 3) [ɸ] (Ujir, Dobel, Barakai and Wokam-Tarangan of the Aru Islands);

EV = 2.0: 1) [h] (Bobot/Hatumeten, Manusela, Amahai, Wemale, Loun, Nusalaut, Saparua, Haruku, Kayeli, Giman and East Makian), 2) [ˀ] (treated as equivalent in erosion value to [h]) (Nuaulu, Kaibobo and Asilulu);

EV = 2.5: 1) [h]/zero (Kamarian), 2) [h]/[ˀ]/zero (Hitu);

EV = 3.0: (Banda, Alune, Larike-Wakasihu and Batumerah).

The mean erosion value of **p* in languages of the Moluccas is thus (2 x 0) + (16 x 1.0) + (14 x 2.0) + (2 x 2.5) + (4 x 3.0) = 61/38 = 1.605.

NEW GUINEA

Most of the Austronesian languages of New Guinea are divided between the South Halmahera-West New Guinea and Oceanic subgroups, with a small number of Central Malayo-Polynesian outliers in south-west Irian (Sekar, Uruangnirin, Kaiwai). Despite this relative diversity the languages of this area almost universally show some erosion of **p*. Dusner (SHWNG) and Tarpia (Oceanic) reflect **p* as [p], but all other languages for which data are available show erosion in at least one position. The known developments are summarised in the following paragraphs:

EV = 0.5: 1) [p]/[v] (Gitua, Piu, Kapin, Mumeng, Mapos Buang, Manga Buang, Vehes, Hote, Yamap, Misim, Kaiwa, Dawawa, Igora, Nara, Molima, Bosilewa, Kurada and Muyuw), 2) [p]/[f] (Yalu, Sirak, Wampar, Sirasira, Sukurum, Silisili, Dangal, Maralango, Wagawaga and Mekeo), 3) [b]/[f] (Kuni);

EV = 0.66: 1) [p]/[v]/[ɣ] (Garuwahi);

EV = 1.0: 1) [f] (Maya, Sekar, Uruangnirin, Kaiwai, Biak, Ron, Irahutu, Sobei, Bongo and Adzera), 2) [f]/[v] (Wogeo and Fagululu), 3) [v] (Bwaidoka), 4) [p]/[h] (Musom, Mari, Wampur, Motu and Doura), 5) [p]/[w] (Malamalai, Mutu and Kehelala), 6) [p]/[b]/[h] (Doga, Mukawa, Gapapaiwa, Boianaki and Roro), 7) [p]/[v]/[h] (Bunama), 8) [p]/[b]/[w]/[h] (Bukawac);

EV = 1.25: 1) [p]/[b]/[w]/zero (Anuki), 2) [p]/[v]/[ɣ]/zero (Kukuya);

EV = 1.33: 1) [f]/[v]/[w] (Kairiru), 2) [p]/[f]/zero (Takia, Gedaged, Mindiri, Biliau, Wab and Bohutu), 3) [p]/[v]/zero (Wedau, Taupota, Bina, Magori, Yoba, Ouma, Keapara, Gabadi, Misima and Nimowa), 4) [b]/[f]/zero (Arifama-Miniafia and Ubir), 5) [b]/[v]/zero (Sud-est), 6) [p]/[w]/[h] (Duau);

EV = 1.5: 1) [p]/zero (Ali, Ulau-Suain, Lukep, Roindji, Malasanga, Sewa Bay, Barim, Guwot, Mangap-Mbula, Sio, Tami, Kela, Dobu), 2) [p]/[f]/[h]/zero (Bilbil, Matukar), 3) [f]/[v]/[ɣ]/zero (Sinagoro, Kalokalo, Yamalele), 4) [p]/[v]/[w]/zero (Kilivila, Budibud);

EV = 1.66: 1) [p]/[w]/zero (Kis, Bam, Manam, Medebur, Yabim, Numbami, Tubetube);

EV = 1.75: 1) [p]/[h]/[w]]/zero (Suau), 2) [f]/[v]/[w]/zero (Iduna, Diodio);

EV = 2.0: 1) [h] (Mor, Labu), 2) [v]/zero (Gumasi);

EV = 2.5: 1) [h]/zero (Ham, Nengaya), 2) [w]/zero (Kaiep);

EV = 3.0: (Wandamen, Waropen, Ansus, Woi, Pom, Marau, Munggui, Papuma, Busami, Serui-Laut, Ambai, Wadapi-Laut, Kurudu, Sera, Sissano, Tumleo).

The mean erosion value for reflexes of PAN **p* in the Austronesian languages of New Guinea is thus (2 x 0) + (29 x 0.5) + (1 x 0.66) + (28 x 1.0) + (2 x 1.25) + (21 x 1.33) + (20 x 1.5) + (7 x 1.66) + (3 x 1.75) + (3 x 2.0) + (3 x 2.5) + (16 x 3.0) = 182.08/135 = 1.348.

BISMARCK ARCHIPELAGO

The prima facie evidence suggests that the Austronesian languages of the Bismarck Archipelago – particularly those of New Britain – are relatively conservative in their erosion values for **p.* Eleven languages (Mengen, Mamusi, Mangseng, Kapore, Pasismanua, Lamogai, Mok-Aria, Arawe, Longa, Kilenge, Maleu) reflect **p* as [p], and a twelfth (Okro) reflects **p* as [p]/[b]. Other erosion values are:

EV = 0.5: 1) [p]/[f] (Wuvulu-Aua, Ponam, Kara, Konomala), 2) [p]/[β] (Andra-Hus), 3) [p]/[v] (Tabar, Tolai, Melamela, Nakanai, Xarus, Bola, Bulu, Bali-Vitu);

EV = 1.0: 1) [f] (Kaniet, Nalik, Tanga), 2) [p]/[h] (Bipi-Sisi, Likum, Levei-Tulu, Pelipowai, Ere-Lele-Gele-Kuruti, Leipon, Titan, Nali, Loniu, Mokerang, Pak-Tong, Lenkau, Penchal, Nauna, Patpatar), 3) [b]/[h] (Hermit, Lindrou, Sori-Harengan);

EV = 1.33: 1) [p]/[f]/zero (Siar), 2) [p]/[v]/zero (Kandas, Duke of York);

EV = 1.5: 1) [p]/zero (Baluan-Lou-Pam, Mussau-Emira, Lavongai, Tigak, Tiang, Notsi, Lavatbura-Lamusong, Madak, Barok, Kaliai-Kove, Bariai);

EV = 1.66: 1) [p]/[h]/zero (Papitalai, Lihir, Sursurunga);

EV = 2.0: 1) [h] (Seimat, Uvol), 2) [v]/[h]/zero (Tomoip);

EV = 3.0: (Tenis).

The mean erosion value for PAN **p* in languages of the Bismarck Archipelago is thus (12 x 0) + (13 x 0.5) + (21 x 1.0) + (3 x 1.33) + (11 x 1.5) + (3 x 1.66) + (3 x 2.0) + (1 x 3.0) = 62/67 = .925.

SOLOMON AND SANTA CRUZ ISLANDS

From the Solomon Islands eastwards the oral grade of PAN *p is never exclusively [p], although [p] may be one reflex.[5] Erosion values are as follows:

EV = 0.5: 1) [p]/[v] (Hahon, Teop, Piva, Papapana, Vaghua, Varisi, Ghanongga, Lungga, Simbo, Nduke, Roviana, Kusaghe, Hoava, Ughele, Marovo, Vangunu, Talise, Lengo, Birao, Longgu), 2) [b]/[v] (Babatana);

EV = 0.66: 1) [p]/[v]/[ɣ] (Banoni);

EV = 1.0: 1) [f] (Laghu, Kokota, Zazao, Blablanga, Gao, Lau, Langalanga, North Malaita, Kwaio, Dori'o, Tikopia), 2) [v] (Bugotu, Nggela, West Guadalcanal, Malango), 3) [f]/[v] (Kia), 4) [p]/[h] (Halia, Solos, Petats, Mono-Alu) 5) [b]/[f]/[h] (Cheke Holo) 6) [p]/[v]/[w] (Tanimbili);

EV = 1.33: 1) [p]/[v]/zero (Timputz, Ririo, Uruava);

EV = 1.5: 1) [f]/[h] (Kwara'ae, Takuu), 2) [v]/[h] (Bauro, Kahua), 3) [p]/zero (Torau);

[5]The Pol nesian Outlier language of Anuta in the Solomons chain reflects PAN **p* invariably as [p]. However, as noted in the discussion of 'secondary fortition' (section 2.4), Anuta [p] reflects Proto Polynesian **f*.

EV = 1.66: 1) [p]/[w]/zero (Nehan);

EV = 2.0: 1) [h] (Marau, 'Are'are, Sa'a-Ulawa, Oroha, Arosi, Fagani, Rennell-Bellona, Luangiua, Sikaiana, Pileni), 2) [v]/zero (Nembao, Asumboa, Vano, Buma, Tanima).

The mean erosion value for PAN **p* in languages of the Solomon and Santa Cruz Archipelagoes is thus (21 x 0.5) + (1 x 0.66) + (22 x 1.0) + (3 x 1.33) + (5 x 1.5) + (1 x 1.66) + (15 x 2.0) = 76.32/68 = 1.122.

MICRONESIA

The languages of Micronesia are genetically diverse. Most belong to the Oceanic subgroup of Austronesian, but Palauan and Chamorro are generally classified as co-ordinate branches of Western Malayo-Polynesian, and the position of Yapese remains enigmatic. Apart from Ponapean and Mokilese, which appear to show secondary fortition of Proto Micronesian **f*, all of the languages of Micronesia, both Oceanic and non-Oceanic, show some erosion of PAN **p*. Erosion values are as follows:

EV = 1.0: 1) [f] (Mortlockese, Trukese, Puluwat, Satawalese, Woleaian, Chamorro, Saipan Carolinian, Ulithian, Yapese, Sonsorolese);

EV = 1.5: 1) [p]/zero (Ponapean, Mokilese);

EV = 2.0: 1) [y] (Marshallese), 2) [h] (Nukuria, Kapingamarangi, Nukuoro), [w] (Palauan);

EV = 3.0: 1) (Nauru, Gilbertese, Kosraean);

The mean erosion value for PAN **p* in the languages of Micronesia is thus (10 x 1.0) + (2 x 1.5) + (5 x 2.0) + (3 x 3.0) = 32/20 = 1.600.

VANUATU

What appears to be the oral grade of **p* is retained as a stop in a few of the languages of Vanuatu, but only in certain positions. Erosion values are as follows:

EV = 0.5: 1) [p]/[v] (Morouas, Butmas-Tur, Akei, Fortsenal, Polonombauk, Litzlitz, Repanbitip, Malfaxal, Port Vato);

EV = 1.0: 1) [v] (Vunapu, Piamatsina, Tolomako, Malmariv, Navut, Lametin, Amblong, Wailapa, Narango, Tutuba, Malo, North-east Aoban, Central Maewo, Baetora, Vovo, Malua Bay, Mae, Larevat, Vinmavis, Lingarak, Katbol, Dixon Reef, Unua, Rerep, Letemboi, Aulua, Burmbar, Port Sandwich, Axamb, Maskelynes, Ura, Sie), 2) [f] (Mele-Fila, Futuna-Aniwa), 3) [v]/[θ] (Lorediakarkar, Shark Bay), 4) [v]/[ð] (Roria, Tambotalo), 5) [v]/[v̈] (Tangoa, Mafea, Aore, Vao), 6) [p]/[v]/[w] (Apma, Uripiv-Wala-Rano);

EV = 1.33: 1) [v]/[v̈]/[w] (Araki, Mpotovoro);

EV = 1.5: 1) [v]/[w] (Hiw, Loh, Lehali, Lehalurup, Motlav, Vatrata, Mota, Mosina, Lakona, Nume, Koro, Wetamut, Merlav, Nokuku, Wusi, Marino, Sowa, Atchin, Maragus, Labo, Namakura, Lenakel, Whitesands, South-west Tanna, Kwamera), 2) [f]/[w] (Lonwolwol, South Efate), 3) [b]/zero (Sa);

EV = 2.0: 1) [v]/[w]/zero (Valpei, Tasmate, North Tanna), 2) [v]/zero (Raga, Seke), 3) [h] (South-east Ambrym);

EV = 2.33: 1) [h]/[w]/zero (Aneityum);

EV = 2.5: 1) [y]/zero (Sakao).

The mean erosion value for PAN **p* in the languages of Vanuatu is thus (9 x 0.5) + (44 x 1.0) + (2 x 1.33) + (28 x 1.5) + (6 x 2.0) + (1 x 2.33) + (1 x 2.5) = 110/91 = 1.209.

NEW CALEDONIA AND THE LOYALTY ISLANDS

In some of the languages of New Caledonia PAN **p* is retained as a stop in initial position, but never in intervocalic position. Erosion values are:

EV = 1.0: 1) [v] (Voh-Kone, Iaai), 2) [f] (Faga Uvea), 3) [p]/[v]/[w] (Kumak);

EV = 1.5: 1) [p]/zero (Caac, Jawe, Nemi, Fwâi, Pije, Xârâcùù, Xârâgùre).

The mean erosion value for PAN **p* in the languages of New Caledonia and the Loyalty Islands is thus (4 x 1.0) + (7 x 1.5) = 14.5/11 = 1.318.

ROTUMA, FIJI AND TRIANGLE POLYNESIA

Although the nasal grade of PAN **p* is commonly reflected as a stop in the languages of this geographical region, the oral grade of **p* has invariably changed.[6] Erosion values are:

EV = 1.0: 1) [v] (Western Fijian, Eastern Fijian), 2) [f] (Tongan, Niue, Samoan, Tuvaluan, Wallisian, Tahitian, South Marquesan) 3) [ɸ] (Moriori);

EV = 1.5: 1) [f]/[h] (Tuamotuan), 2) [ɸ]/[h] (Maori).

EV = 2.0: 1) [h] (Rotuman, Manihiki-Rakahanga, Tongareva, North Marquesan, Hawaiian), 2) [ʔ] (Rapa, Austral, Rarotonga, Mangarevan), 3) [w] (Pukapukan).

The mean erosion value for PAN **p* in the languages of Rotuma, Fiji and triangle Polynesia is thus (10 x 1.0) + (2 x 1.5) + (10 x 2.0) = 33/22 = 1.500.

Table 2 summarises the results obtained in this survey of the data. (1) = mean erosion value, (2) = distance from Taiwan in kilometres. Mean erosion values are given both as a numerical expression and as an approximation to a phonetic quality. Distances were calculated by approximating the mid-point of each geographical region, and measuring from this to central Taiwan. Geographical categories in Table 2 are arranged by increasing distance from the probable Austronesian homeland.

TABLE 2: SPECIFIC EROSION VALUES FOR PAN **p* IN RELATION TO DISTANCE FROM TAIWAN

No.	AREA	(1)	(2)
1.	Taiwan	.133 (p)	-
2.	Philippines	.145 (p)	1230
3.	Mainland SEA	0 (p)	1930
4.	Borneo	.023 (p)	2810
5.	Sulawesi	.118 (p)	2900
6.	Moluccas	1.605 (f/h)	3160
7.	Micronesia	1.600 (f/h)	3800
8.	Sumatra-Sumbawa	.194 (p)	3865
9.	Lesser Sundas	1.194 (f)	3865

[6]For purposes of determining erosion values I have disregarded the Eastern Polynesian 'double labial dissimilation' (as in PPN **fafine* > PEPN **wahine*). However, since [w] and [h] have the same numerical value in my inter retation of the erosion scale of **p*, this simplification of he data has no effect on the outcome of he calcula ions.

10.	New Guinea	1.348 (f)	4390
11.	Bismarck Archipelago	.925 (f)	4680
12.	Solomons-Santa Cruz	1.122 (f)	5560
13.	Vanuatu	1.209 (f)	6730
14.	New Caledonia	1.318 (f)	6900
15.	Madagascar	1.000 (f)	8243
16.	Rotuma, Fiji, Polynesia	1.500 (f/h)	10200

What, if anything, does the summary in Table 2 tell us about a possible correlation between erosion value and migration distance? The regions have been arranged by increasing distance from Taiwan, and in 10 of the 15 transitions between adjacent categories the erosion value increases. This in itself suggests a positive correlation between degree of phonological erosion and mean lineal distance from Taiwan. However, in a number of cases (Taiwan-Philippines, mainland Southeast Asia-Borneo, Borneo-Sulawesi, Solomons-Vanuatu, Vanuatu-New Caledonia and Loyalties) these increases in erosion values are statistically insignificant.

If instead we group the mean erosion values of Table 2 into larger geographical categories defined by thousand kilometre intervals we see a much more focused pattern (Table 3).

TABLE 3: EROSION VALUES OF **p* AS A FUNCTION OF DISTANCE FROM TAIWAN IN 1000KM INTERVALS

DISTANCE	MEAN EROSION VALUE
zero-1000	-
1000-2000	.073
2000-3000	.071
3000-4000	1.148
4000-5000	1.115
5000-6000	1.122
6000-7000	1.264
7000-8000	-
8000-9000	1.000
9000-10000	-
10000-11000	1.500

In Table 3 an abrupt leap in erosion value appears at about 3000km distance from Taiwan. Languages less than this distance from the probable Austronesian homeland overwhelmingly reflect PAN **p* as [p], whereas the norm for those located more than 3000km from Taiwan is [f], with a value mid-way between [f] and [h] in Polynesia. There are, however, serious difficulties with reaching straightforward conclusions from these figures.

First, lineal distance from a probable homeland and actual migration distance are not the same thing. Many of the Oceanic languages of Micronesia are no more than 3800km from Taiwan, while those of New Guinea and the Bismarck Archipelago are somewhat more distant. Yet languages such as Trukese, Ponapean or Marshallese are descended from Proto Oceanic, which probably was spoken in the New Guinea-Bismarck Archipelago region. In this case, then, greater migration distance has *decreased* lineal distance from the probable Austronesian homeland. In principle we could correct for this discrepancy between lineal distance and migration distance if we knew the migration routes which led to the settlement of each area represented in Table 2. Unfortunately, however, our knowledge of these matters is at best highly tentative and probabilistic.

A second difficulty with accepting the correlation of mean erosion value and lineal distance in Table 3 is that there is essentially no gradient within either of the sharply distinguished geographical regions. In other words, there is no evidence that erosion value increases with lineal distance for the languages of Taiwan, the Philippines and western Indonesia. Similarly, apart from Polynesia, there is little evidence that erosion values increase with increasing distance from the Moluccas to New Caledonia and the Loyalties. What can hardly be overlooked in this pattern, however, is the abrupt increase of erosion values when we pass from languages of the Western Malayo-Polynesian group to languages of the Central-Eastern Malayo-Polynesian group. Apart from Madagascar, which must be discarded as statistically unusable on grounds of sample size, no WMP-speaking area has an erosion value for **p* that even remotely approaches 1.0, whereas erosion values above 1.0 are the norm throughout the 580-language CEMP-speaking area of eastern Indonesia and the Pacific. This apparent correlation of erosion value with major subgroup boundary as opposed to lineal distance is starkly evident in comparing geographical regions 8 (WMP-speaking) and 9 (CEMP-speaking), which are about equally distant from Taiwan.

Why does the erosion value of **p* appear to correlate with major subgroup boundaries? The facile answer to this question would be that **p* had already begun to lenite in Proto Central-Eastern Malayo-Polynesian. Yet many CEMP languages retain PAN **p* as a voiceless bilabial stop. Are all of these stop reflexes instances of secondary fortition? Or have there been factors other than migration distance which have contributed to the higher erosion values of **p* in CEMP-speaking areas? And if so, what might these be?

In his contribution to this volume Ross has found a positive correlation between what he calls 'sedentariness' and 'conservatism'. He has discovered this correlation from a compilation of *all* sound changes in all members of a small group of closely related languages. Although the correlation he discusses appears to be well-founded, Ross is well aware that there is no obvious reason why it should exist. In an effort to explain it he proposes a probabilistic scenario of how language communities might hive off to form new linguistic colonies. According to Ross, emigrants from an established language community are likely to consist predominantly of members of the younger generation together with their near relatives (young married couples and their children), while those left behind would be mostly elderly:

> If Oceanic settlement occurred through small groups who left their home villages on the periphery of the region in which Oceanic was spoken and moved to a place beyond that periphery, then it is probable that the settlers were usually led not by the gerontocrats of the village, but by the middle generation of men with young families. The new settlement would then have a different generational and authority structure from the old. As a result the speech patterns of the younger generation, which tend in most cultures to be innovative, would form a larger proportion of daily discourse than before, and, in the absence of the former elders, would go unchecked. Change resulting from this situation would accord with the probably innovative values of the new migrants, and, as the new community developed its own sense of identity, more novel forms of speech would become emblematic of communal identity and thereby entrenched. Since in many cases the new community would have maintained contact with the old, members of the old community would be aware of this linguistic innovation, and would emphasise the conservative features of their own speech as emblems of *their* identity.

What is noteworthy about the macrocomparison conducted here is that it agrees with Ross in revealing a general correlation between amount of sound change and lineal distance from the probable homeland, but the explanation for this correlation cannot be the one which Ross proposes. PAN **p* must have remained a voiceless bilabial stop for many generations after the break-up of Proto Central-Eastern Malayo-Polynesian, yet CEMP languages exhibit far higher erosion values of **p* than do Formosan or WMP languages. Given this observation a correlation of sound change with migration distance can be maintained only by arguing that every CMP language arrived in eastern Indonesia and that every OC language arrived in the Pacific as a result of separate migrations – one per attested language. If we reject this scenario (which clearly we must) it follows that the far higher erosion values of **p* in CEMP languages are the result of changes which in some cases must have taken place *many generations after* the major moves which brought the languages to or near their historic locations. If indeed there is a causal relationship between migration and amount of innovation we would expect change in a language to follow immediately upon the physical relocation of its speakers. On the level of microcomparison explored by Ross in his paper this appears to be the case; on the level of macrocomparison explored in this paper it does not.

4. CONCLUSION

In conclusion, mapping of the erosion sequence **p* > [f] > [h] > zero in Austronesian languages as a whole reveals a general correlation between erosion value and lineal distance from the probable Austronesian homeland. However, this correlation appears to be largely a by-product of factors other than distance as such. Ross's proposal that younger and linguistically more innovative speakers would tend to venture to new homelands, leaving the older and linguistically more conservative generation behind, is difficult to apply to broad patterns of phonological erosion, since many generations must have separated speakers of Proto Malayo-Polynesian (in which PAN **p* was reflected as **p*) and Proto Oceanic (in which PAN **p* was also reflected as **p*). Unless PAN **p* had already begun to lenite in PCEMP, and underwent secondary fortition far more often than is generally assumed, we are confronted with a correlation that has no ready explanation: **p* exhibits a drift-like tendency to erode at a far more rapid rate in CEMP languages than in WMP languages.

Before concluding we might note impressionistically that several other erosion sequences in Austronesian languages appear to follow a mapping pattern very similar to that of **p*. Among these are: 1) **S* > [s] > [h] > zero (sibilant reflexes only in Taiwan, [h] fairly common in the Philippines and less so in western Indonesia, with non-zero reflexes *(h-)* in a single CEMP language; cf. Blust 1981), 2) **k* > [h], [ɣ], [ʔ] > zero (eroded reflexes virtually absent in Taiwan, rare in the Philippines and western Indonesia, but relatively common in eastern Indonesia and the Pacific), 3) **t* > [s], especially before **i* (absent in Taiwan, rare in the Philippines and western Indonesia, common in the Pacific), and 4) loss of final consonants (absent in Taiwan, rare in western Indonesia, not uncommon in eastern Indonesia, extremely widespread in the Pacific).

The geographical distribution of these innovations still must be carefully documented. However, once the documentation is available it appears likely that the question we have been forced to ask in relation to **p* will return even more insistently to demand an answer: is the tendency to increased phonological change in the Austronesian languages of eastern Indonesia and the Pacific as compared with those of Taiwan, the Philippines and western Indonesia purely a function of increased migration distance, or is the correlation of this spatial dimension with the WMP:CEMP language boundary indicative of some other causal factor or factors that continue to elude us?

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