A mathematical approach to recovering the original Australian Aboriginal language

Chris Illert
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Regarding thesis titled,

"A Mathematical Approach to Recovering the Original Australian Language", submitted to the University of Western Sydney for examination,

I certify that this thesis does not incorporate any material previously submitted for a degree or a diploma in any university; and that it does not contain any material previously published or written by any other person except where due reference is made in the text.

Signed

Christopher Roy Illert. 6 April 2011
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abstract

This text is submitted as a thesis by publications. It consists of four articles already published in the Journal of Applied Statistics, making up sequences of an argument, preceded by an Over-arching statement. The thesis applies mathematical concepts and reasoning to aspects of Aboriginal languages and in this way throws new light on some problems that have hitherto proved intractable for Aboriginal linguists.

Mathematical forms of analysis have not previously been much used in mainstream linguistics in general, or applied to Aboriginal languages, with the major exception of the work of George Zipf (1949), whose application of Power Laws to language phenomena has influenced researchers in many other fields while being ignored in Zipf’s own home discipline of Linguistics.

The thesis uses Power Laws allied to other mathematical ideas and operations, including Lagrange forms, van der Waals effects, Huygens principle and Snell’s law, to illuminate basic aspects of Aboriginal languages. Mathematical methods can provide new ways of treating data and drawing conclusions, and produce a revolutionary new picture of the original forms of the early language. They can be used to trace major processes of change over the 60,000 - 70,000 years currently estimated as the time Australian Aboriginal people have lived in Australia.

This thesis shows how mathematical analysis can be a powerful tool and resource for linguistics. It is able to reconstruct a proto-form of Aboriginal language from a much greater time-depth than linguists have believed is possible for any language. This takes the scientific study of language closer to the probable time when human language itself first emerged.
Thursday, twinkling, star

Wednesday, wonder, what, are you

Narawminmunburang, extremely high

Amidst

Goli, nura-bura: bura: nin

Shining, darkness

Sketch by Ainslie Roberts
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prologue

This text is submitted as a thesis by publications according to the regulations of the University of Western Sydney. Following the terms of these regulations, four published articles making up the sequences of an argument have been submitted, accompanied by an over-arching statement. In the present case this prologue plus its appendix, outlining the building blocks for the study, together form the over-arching statement. This leads to an unconventional format for the over-arching statement, in terms of the regulations. The prologue outlines the argument and rationale of the set of articles, but at 3000 words it is shorter than indicated in the regulations. However the appendix, which contains basic arguments as well as the basic set of roots, in total more than 30,000 words. Thus the ‘over-arching statement’ serves the main function of that part of the thesis, but is either much shorter or much longer, depending on how this part of the text is defined.

All four articles have been published in the Journal of Applied Statistics as a linked set. They are reproduced as published, in the thesis that follows.

There are special difficulties of formatting with this work as thesis, flowing from the software requirements for producing mathematical symbols both in the original articles and in adapted versions for the sake of the thesis. It has meant that any errors in typography, sometimes introduced during the publication process, are intractable for correction, and the accompanying text of this prologue and its appendix, which together form the over-arching statement, has been difficult to change in response to comments and criticism during the process of examination. However, I trust that readers will be able to follow the argument, even with the difficulties of format.

The thesis applies mathematical concepts and reasoning to aspects of Aboriginal languages in order to throw new light on some problems that have hitherto proved intractable for Aboriginal linguists. Mainstream linguistics, applied to Aboriginal languages and more generally, has not used mathematical forms of analysis to any great extent, even though the work of George Zipf (1949) has clearly pointed the way. Zipf’s application of Power Laws to language phenomena has been taken up and developed further by mathematicians, and applied to many other
phenomena in many other disciplines, but largely ignored in Zipf’s own home discipline of Linguistics.

This thesis will show that Power Laws can illuminate basic aspects of Aboriginal languages. This concept can be combined with or complemented by a number of other mathematical concepts. This combination of concepts can then provide new ways of treating data and drawing conclusions, to produce a revolutionary new picture of the original forms of the early language. It can trace major processes of change over the 60,000 - 70,000 years currently estimated as the time Australian Aboriginal people have lived in Australia.

methodological basis

The appendix to the prologue sets out the ground for the four specific published studies that follow, applying mathematical analyses to different aspects of the form and development of Aboriginal languages. It combines detailed, specialist descriptions and analysis of forms of Aboriginal language with the development of mathematical arguments that are also advanced. The result is a text that cannot be easily followed by the majority of its intended readers, yet this double difficulty is unavoidable, given the aim of the thesis to combine the two areas of knowledge, mathematics and Aboriginal linguistics.

To deal with this problem I will set out here in lay language the basic methodology, which is developed more fully in the prologue to the appendix. The appendix contains essential materials and premises for the work that follows, but in greater detail than general readers might wish, at the outset of their journey.

The appendix begins with the challenge that has proved a barrier for previous linguistics studies, a belief that data for Aboriginal languages in south-eastern Australia at the time of contact are so unreliable as to be unusable. Yet these languages are 200 years older than languages spoken today, many of which were subjected to a variety of influences, and these south-eastern languages were located in parts of Australia furthest from the presumed point of entry of Aboriginal people. They were less exposed to influences from visitors from the north, and hence likely to be closer to the original forms. If linguists were able to access and analyse these languages they would be a uniquely valuable corpus.
The thesis uses mathematically-based data mining methods to propose a practical solution to this problem. It shows how a simple phonological system can be recovered from this apparently fragmentary and corrupted data. This consists of 35 historic word-lists plus 9 early census-lists. This material was recorded by English speakers with no knowledge of Aboriginal languages and not even the rudiments of linguistic training. Yet this body of data, in this imperfect form, is sufficiently extensive for this purpose. Statistical analysis of this can be used to find a pathway through the different orthographies in the different sources, in order to reconstruct the likely forms of words recorded in these lists.

From this analysis it is possible to propose a basic phonological system of 18 consonants and 4 vowels to make up a basic system for many Aboriginal languages. The resulting system has a good fit with different systems proposed by leading linguists such as Dixon, Yallop and Eades. This analysis is then given a practical use, to provide an orthography to be able to normalise the many different forms of spelling that plague the early records and make this data otherwise so difficult to use.

The analysis then makes a leap, to see if it is possible to combine the repertoire of sounds with an equivalent repertoire of meanings. The basis for this exercise is the set of 6672 Aboriginal words plus 445 place names, a total of 7117 words from around 8 distinct languages from south-eastern Australia. Using this data plus power law analysis a smaller set of hypothetical roots can be proposed, which can then be reduced even further by applying the principle of octahedral symmetry.

The principle of octahedral symmetry is a powerful hypothesis about the way this set of roots is structured. It produces a manageable small number of proposed roots and defines their internal relationships, in a pattern which can be identified from this linguistic data set and analysed further. The bulk of the appendix then describes and illustrates the basic patterns of sounds and meaning that make up this set of basic roots.

Ultimately the forms elicited by these methods turn out to be the basic words from all language zones from north of Sydney, to well west of Wagga Wagga, to west of Melbourne, down south to Tasmania (which was a continuous piece of land in all but “recent” times). This preliminary finding provides strong support for the hypothesis that these roots are common and structural in historical forms of Aboriginal languages, and that the generative principles outlined are indeed active and productive.
From a linguistic point of view, these two achievements, the proposal of a single underlying phonology and the hypothesis not simply of the set of basic roots but also their underlying generative morphological principles, are so original that the thesis would not need to do more, and so controversial that more empirical work would be asked for to convince the many doubters. Some empirical data is supplied, but since this is primarily a theoretical thesis in applied mathematics, the remainder of the thesis takes this initial input and elaborates and explores some implications, using and developing a number of mathematical tools to do so.

**the argument**

The 1st Chapter (JAS 2003) begins to use these foundations to examine issues of lexigenesis, (word formation) specifically in Aboriginal languages of south-eastern Australia. From a linguistic point of view it examines the problem of how diversity and change can be acknowledged and accounted for in terms of the simple, powerful set of principles proposed.

To do so it proposes that the primary unit for analysis should be the morpheme, small elements of language, not the word or lexeme, and corresponding to this it develops morpho-statistics rather than the more common lexi-statistics. With this concept and tool it argues that the current assumption that all the languages of the Sydney basin were different languages was an artefact of this assumption. At the morphemic level, the relationships between the languages become much closer. There is far less diversity to account for in the theory than is usually supposed, and language boundaries need to be re-examined.

The existing diversity at the level of words can then be explained as the operation of two major transformational processes, condensation and permutation, acting on a repertoire of basic root-morphemes. The chapter models processes of lexical condensation leading to the development of new morphological forms, using principles from Zipf on power laws in linguistics, and also Hamming Means and recursive arithmetical additions, to reconstruct the site of deleted or condensed phonemes, and their scale and distribution. From this analysis we are able to show that roughly half of the root morphemes are hardly compressed at all, and the rest are compressed according to a Zipf power law curve.
However, the chapter then considers the cases where the data departs significantly from Zipf law predictions. It explains these as due to the role of a long tail in Zipf distributions, and to a process whereby there is a consistent collapse of lexemes (words) into morphemes, in a phase transition process analogous to the change from liquid to gas. This process is modelled according to the van der Waals effect. So the ongoing process of lexical and morphemic change is governed by the interaction of the two principles, Zipf’s and van der Waals’, in a wave-like pattern of change.

Mathematically the chapter then proposes to establish Lagrangian forms as a means to relate these two models. It generalises this Lagrangian to include a van der Waals effect as a perturbation to the Zipf distribution, as the most efficient (optimal) way for new morphemes to occur over time. It uses discrete-optimisation techniques and the new form of morpho-statistics developed in this thesis to show how roots might have developed in these languages.

The remaining three chapters use mathematical methods to examine a number of issues in Aboriginal linguistics, mainly using the principles and corpus established in the first two chapters. Chapter 2 (JAS 2004, pp. 151-155) draws on an insight of Andrew Allison to show how to fit Poisson Optimisation on data from two data sets; Eades “Dhurga” (1976) and Mathews “Thurrawal” (1903) (actually ngunuwayal from Lake George). Andrew Allison suggested the relevance of Poisson Optimization for the problem, and carried out the relevant calculations of these two data sets. However, the article itself was conceived and written entirely by myself as first author.

But herein lies a problem. The article was based upon the untested ideas of Eades having studied “Dhurga” (1976) and of Mathews having studied “Thurrawal” (1903). What if one of them were mistaken? This is why chapter 3 studies language regionally, discovering that Mathews’ “Thurrawal” (1903) is actually the neighbouring dialect “Ngunawal” from around Lake George. The distance separating the languages is small but the consequences are enormous, and backed up by a “southern Ngarigu” wordlist by Hercus (1969) and a “Ngunawal” wordlist by Mathews (1904).

From this analysis it is possible to detect major changes in the long history of the sounds of Aboriginal language. One is an increase in the number of consonants, which provides alternative evidence to confirm
the view of Australian linguists like Dixon. The other is to detect a major shift in the Zipf distribution of first consonants. This is so marked that it can be shown to correspond to the ‘mortality law’ to predict individual and species death by Gompertz. The chapter also uses this analysis to contribute to a debate amongst linguists, as to whether Aboriginal languages were always ergative, without clearly marked accusative forms. The chapter uses phonological inferences to argue for an early accusative form.

The final two chapters, 3 and 4 (JAS 2005 and JAS 2006) are a pair, which use mathematical analysis to address two related linguistic problems. One is the issue of linguistic zones and boundaries. The other is the issue of the origin of these boundaries and what they can tell us about the deep past of Aboriginal languages and history.

Chapter 3 uses the analysis and extends it to all six language groups. It proposes a basic typology of languages Type A and Type B, rigorously defined in terms of different solutions of a quadratic equation arising from Snell’s law, using a series of ‘linguistic signatures’. From this we can see how the waves of language interacted with each other over a deep period of time (about 60,000 years). This is a knowable dynamic process, of Gillieron wave propagation, acting through some well known physical rules such as Huygens’ principle and Snell’s law.

The 4th Chapter (JAS 2006) continues to apply Snell’s law to deduce the likely minimal sound systems of Aboriginal languages, before the last Ice Age and after it. Following the work of some Australian Aboriginal linguists (e.g. O’Grady and Fitzgerald) it also uses phonological evidence to reconstruct deictic systems so ancient that they may indeed derive from very early Aboriginal language before the last Ice Age. It establishes the various levels of language and the proposed source that it came from off to the north-west. Again these boundaries are used as evidence from which to reconstruct likely events over deep times, of about 60,000 years. To try out all our mathematics Mary Everitt (pages 234 and 241) and William Dawes (pages 234, 246-7 and 250) are given brief translations, and retroflexives arising in Victoria are discussed (pages 253-254).

These forms of analysis, and the interpretations and conclusions they give rise to, offer hope of re-opening some important questions about the origins of Aboriginal languages that are currently regarded as closed by linguists because they have not seen how they could be studied given the available data. Mathematical analysis as exemplified by this thesis is
presented as a powerful new tool and resource to linguistics. Although the data comes from Aboriginal languages, the methods can be applied to all languages. As argued in the thesis, the proto-form of Aboriginal language reconstructed here comes from a much greater time-depth than any other language family as reconstructed by contemporary linguistics. This would take the language closer to the probable time frame for the origins of human language itself. This gives an even greater significance to the outcomes of this study.

limitations and ways ahead

This is a pioneering work which operates on a grand scale, bringing together two areas of thought that are not usually combined. Inevitably some tasks are less well done than others for the moment. Here it is appropriate to indicate areas where I am aware of further work that is needed, or where further theory and analysis may be applied to come up with different conclusions. That situation is always the case with scientific research.

It would have been desirable to test and validate some of the mathematical techniques on artificially constructed datasets, in order to develop the principles more generally. In the same vein, it would have been more convincing if I had applied the techniques to other languages, in order to verify independently that they function usefully in other complex, real-life data sets. However, there is a limit to what one individual can do, to both build in independent data collection and also model development. I leave these two tasks to those who follow me.

Australian linguists will undoubtedly also wish that I had done more extensive empirical work on current and past languages. In my own work I draw on a number of these linguists, and I have found that some are better and more reliable than others. Even though I have argued that poor data can be mined to produce valid conclusions, I would be the first to say that good data is better than bad. In a fair distribution of labour I leave it to professional linguists to provide it.

I recognise that some of my use of data can appear circular, because I use mathematical tools to produce data, which I then use as evidence for the concepts that produced that data. While it is true that my data is not therefore ‘pure’, this is also the case with data from mature sciences, whose data is always found and shaped extensively by the dominant concepts in a field, yet is accepted within the given field. That is because
the data, even if it is carefully selected and processed, still speaks for itself and is able to refute specific hypotheses.

Given that my work crosses two basic paradigms, mathematics and linguistics, it is necessary for me to declare my position on the differences between the epistemological and ontological world views of the two. Do I assume that the mathematics I apply to language phenomena works because these phenomena are basically the same? That Snell’s law, for instance, can be applied to linguistic developments because there are fundamental affinities between language and optics?

I see this as a fair question, which could lead to further empirical work which could itself then provoke further illuminating questions. However, as a mathematician I would also insist on the right and duty of mathematicians to do the mathematics well, and not determine beforehand how or why it fits the whole of reality. Isaac Newton is a model for this as for much else. He provided the mathematics of the solar system without being able to say what gravity was or how it and other forces could work. That mathematics has been refined, but it still holds, in the sphere of its operation, and beyond it. But is that mathematics or the version of the world it projects beyond improvement? This is not the case even for Newton, and in my case far less so.
Appendix on

proto-Australian
Aboriginal woman and children, with Aunte tending the fire, on the beginnings of a Great Walk.
picture by the engraver W. Hatherell, 1888
Appendix

"The language of the blacks was not made for white man's tongue and that is why it sounds like blasphemy to hear him try to pronounce an Aboriginal word. Similarly black man's words should never have been put on paper for there is nothing in our alphabet as we understand its sounds which would make the written word any nearer the original than a feeble parody ... a haunting echoing softness might give way to an unbelievable drama and there were dread words which made your spine creep with horror even though you didn't know their meaning ...".

Bernard O'Reilly (1949), "Green Mountains & Cullenbenbone"

orthographic & phonotactic basis for south-east-Australian lexicography

In the late 19th and early 20th centuries, when traditional Aboriginal languages were dying and falling into disuse throughout south eastern Australia, the journals of the Royal Societies from various Australian States and England published hundreds of ethnological and linguistic contributions including scores of "word-lists" collected mainly by gentlemen amateurs, with no special linguistic training, who experienced difficulty with the vowels and various novel sounds of Australian languages, frequently failing to even hear or record word-initial consonants, and employing all the worst orthographic traditions of English spelling -- including poor phoneme/grapheme correspondences and "orthographic-fossil" symbols and clusters of symbols that are silent and/or inappropriate -- with the result that Aboriginal words were rarely ever spelled in the old written records anything like how they were spoken.

Some were better than others but by modern standards they were collectively an orthographic hash employing word-initial vowels, distinguishing between c and k, p and b, proposing fricatives and a letter s, even digraphs such as qu, ch, sh, ck, th, oo, ee, oe, all of which are ridiculous. Consider, for example, thirty different spellings of the same Aboriginal name by a range of historic literary sources as in TABLE 1.1. And, whilst scores of "wordlists" full of such ambiguous spellings were collected on the outskirts of main cities, important linguistic regions elsewhere were often overlooked. This problem is addressed in Chapter 3 by filling geographical gaps with data of equivalent quality from early census forms ("Aboriginal Blanket Registers") on the assumption that phonotactic frequencies should be much the same in names (on census-lists) and words (on word-lists).

page 1
Appendix

TABLE 1.1: thirty different historic spellings of the same Aboriginal name compiled by K.V. Smith, 1992, pages 168-9.

<table>
<thead>
<tr>
<th>“bangare”</th>
<th>Robert Brown, 1802</th>
</tr>
</thead>
<tbody>
<tr>
<td>“bangaree”</td>
<td>Lieut. James Grant, 1801</td>
</tr>
<tr>
<td>“bong-ree”</td>
<td>David Collins, 1798</td>
</tr>
<tr>
<td>“bongaree”</td>
<td>Matthew Flinders, 1802/3</td>
</tr>
<tr>
<td>“bongarree”</td>
<td>Phillip P. King, 1827</td>
</tr>
<tr>
<td>“bongarri”</td>
<td>Rene P. Lesson, 1838</td>
</tr>
<tr>
<td>“bongarie”</td>
<td>Robert Brown, 1802</td>
</tr>
<tr>
<td>“bongarry”</td>
<td>Charles Rodius, 1844</td>
</tr>
<tr>
<td>“bongaru”</td>
<td>Philip G. King, 1804</td>
</tr>
<tr>
<td>“bonjaree”</td>
<td>Robert Campbell, 1838</td>
</tr>
<tr>
<td>“bonjary”</td>
<td>Dr. John Harris, 1801</td>
</tr>
<tr>
<td>“boongaree”</td>
<td>P.P. King, 1817</td>
</tr>
<tr>
<td>“boongarry”</td>
<td>J.D. d’Urville, 1834</td>
</tr>
<tr>
<td>“boongari”</td>
<td>J.D. d’Urville, 1830</td>
</tr>
<tr>
<td>“boongarie”</td>
<td>P.P. King, 1819</td>
</tr>
<tr>
<td>“boongary”</td>
<td>J.D. d’Urville, 1834</td>
</tr>
<tr>
<td>“boongree”</td>
<td>David Collins, 1799</td>
</tr>
<tr>
<td>“boungaree”</td>
<td>Lieut C. Menzies, 1804</td>
</tr>
<tr>
<td>“boungari”</td>
<td>J.D. d’Urville, 1830</td>
</tr>
<tr>
<td>“boungarie”</td>
<td>Samuel Smith, 1802</td>
</tr>
<tr>
<td>“bungaree”</td>
<td>J. D. d’Urville, 1834</td>
</tr>
<tr>
<td>“bungari”</td>
<td>J.D. d’Urville, 1830</td>
</tr>
<tr>
<td>“bungarie”</td>
<td>Rev. J. McGarvie, 1829</td>
</tr>
<tr>
<td>“bungarree”</td>
<td>The Australian, 1828</td>
</tr>
<tr>
<td>“bungarrie”</td>
<td>Alexander Berry, 1838</td>
</tr>
<tr>
<td>“bungary”</td>
<td>Col. W. Patterson, 1801</td>
</tr>
<tr>
<td>“bungarree”</td>
<td>Lachlan Macquarie, 1815</td>
</tr>
<tr>
<td>“bungarrie”</td>
<td>Alexander Berry, 1838</td>
</tr>
<tr>
<td>“bungarree”</td>
<td>Dr. Joseph Arnold, 1815</td>
</tr>
<tr>
<td>“bungarri”</td>
<td>J.D. d’Urville, 1830</td>
</tr>
<tr>
<td>“bungarree”</td>
<td>Capt. J. Wallis, 1821</td>
</tr>
</tbody>
</table>

The resulting statistical analysis of 35 historic wordlists collectively containing 6672 Aboriginal words, and 9 early census lists collectively containing 445 traditional names, identifies eight distinct language regions extending throughout south-eastern Australia - in excellent agreement with traditional tribal boundaries, to the extent that they are known. Such analysis is made possible by the economy and efficiency of the following assumed orthography [Eades, 1976; Yaltop, 1982; Dixon, 1980; Austin, 1997], comprising 18 letters denoting 4 “vowels” and 14 “consonants”, which eliminates the sorts of ambiguities displayed in TABLE 1.1 whilst also simplifying and standardising the spellings of words recorded in decrepit old literary and archival sources.

\[
\begin{align*}
\text{a, b, d, d, g, i, l, m, n, n, n, n, r, u, w, y, u} \\
\ldots \text{where } \textit{U} = \textit{aya} \text{ or perhaps aia}
\end{align*}
\]

This orthography recognises four “vowels” a, i, u and U though the latter, actually a cluster, is not strictly a vowel but it behaves like one and will henceforth be referred to as “the long-vowel”. The n sounds
Appendix

<table>
<thead>
<tr>
<th>$e_1$</th>
<th>$e_2$</th>
<th>$e_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiradjuri</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gundungura</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Tharumba</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Wolgalu</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Garigu</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Kurmai</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Birdhawal</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

TRANSECTION THROUGH THE AUSTRALIAN ALPS

like *ng* in the word “singing”, the *n* sounds like *ny*, the *d* sounds like *dj*, whilst *d* is a stoppy sound intermediate between *d* and *t* sometimes written by other authors as *dh*, which is tolerable, though the digraph *th* must be strictly avoided because English speakers start hissing *θ*, like snakes, when they see it - which is inappropriate for present purposes.

Symbols in this proposed orthography, other than the “long-vowel”, constitute a standard usage of the International Phonetic Alphabet (IPA) - bearing in mind that, with only four contrasting “vowels” (as compared to twenty in English), each was able to attain a much wider range of phonetic realisation in traditional Aboriginal language. Thus we need no symbol specifically denoting the English *oo* vowel sound (as in the word “foot”) which, along with other cherished English vowel sounds, are all adequately described in our orthography by the single symbol *u*, leaving us free (for reasons of typographical utility) to commandeer the redundant keyboard character *U* for portmanteau use as above, to describe a vowel cluster about which Watkin Tench (1789) commented:
Appendix

"Some of their simple sounds, were difficult of pronunciation to mouths purely English: diphthongs often occur: one of the most common is that of æ, or perhaps, ai, pronounced not unlike those letters in the French verb hair, to hate".

The existence of this proposed "long vowel", in fundamental words with varying numbers of letters, is best illustrated by such examples as

\[
\text{gun} \quad \rightarrow \\
\begin{align*}
\text{"gayan" ("big")} & \quad \text{"koiyun" ("many")} \\
\text{D.K. Eades, 1976, dhurga} & \quad \text{Rev. L.E. Threlkeld, 1834, awabakal} \\
\text{"gaian" ("large")} & \quad \text{"kīan" ("centipede")} \\
\text{R.H. Mathews, 1903,} & \quad \text{Rev. W. Ridley, 1875, kamilaroi} \\
\text{"thurrawal" = ngunawal} & \quad \text{"giyan" ("centipede")} \\
\text{"kaiun" or "kaiyung" ("large")} & \quad \text{S. McNicol & D. Hosking, 1994,} \\
\text{L. Malone, 1875, wodi wodi} & \quad \text{wiradjuri} \\
\text{"kian" ("big, large")} & \quad \text{"kaian" ("old")} \\
\text{I. Nathan, 1849, wodi wodi} & \quad \text{J. Rowley, 1875, wodi wodi}
\end{align*}
\]

and

\[
\text{myra} \quad \rightarrow \\
\begin{align*}
\text{"meheearuu" ("large")} & \quad \text{"muřry"} \\
\text{"meheearong" ("full moon")} & \quad \text{("large, an augmentative in general")} \\
\text{J. Dawson, 1881,} & \quad \text{W. Dawes, 1790, eora} \\
\text{kuurn kopan noot} & \quad \text{J. Larmer, 1853, dhurga} \\
\text{"maiaura" ("emu")} & \quad \text{"marī" or "murri" ("large")} \\
\text{R.H. Mathews, 1902,} & \quad \text{J. Rowley, 1875 & 1878, wodi wodi} \\
\text{gippsland kurnai} & \quad \text{"muree" ("great, large, long, extended")} \\
\text{"murra" ("very")} & \quad \text{D. Paine, 1794, eora} \\
\text{Rev. W. Ridley, 1875, kamilaroi} & \quad \text{"more" ("comparative of much"), english} \\
& \quad \text{"mara" ("great river or sea"), latin}
\end{align*}
\]
Appendix

and

\[
\text{wurula} \rightarrow \text{three, several, lots of}
\]

\[
\begin{array}{ll}
\text{"werulla" (plural)} & \text{"wuraial" or "woorayl"} \\
\text{A. Mackenzie, 1872} & \text{("lyrebird" = [tail–feathers] plural)} \\
\text{"thurrawal" = wodi wodi} & \text{R.H. Mathews, 1902, gippsland kurnai} \\
\text{"wöwulli" ("three")} & \text{"waran" ("three")} \\
\text{L. Malone, 1875, wodi wodi} & \text{Rev. L.E. Threlkeld, 1834, awabakal}
\end{array}
\]

From the Wodi Wodi examples of \text{gun}, the "long vowel"

\[
\mathcal{U} \equiv \begin{cases} 
\text{"aia", J. Rowley 1875} \\
\text{"aiu" or "aiyu", L. Malone 1875} \\
\text{"ia", I. Nathan 1849}
\end{cases}
\]

can be deduced on the balance of probabilities as follows:

1) Rowley and Malone agree upon \text{ai...}, contradicting Nathan
2) Rowley and Nathan agree upon \text{...ia}, contradicting Malone

therefore \( \mathcal{U} = \text{aia} \) is demonstrated in the Wodi Wodi language zone. Additionally Dhurga \text{aya} and "Thurrawal" \text{aia} corroborate this finding, whilst the uncorroborated offerings of Threlkeld, Ridley, McNicol & Hosking (respectively \text{oiyu, ia, iya}) are all believable mishearings of \text{aia}. Also Dawson's \text{eheaa} within \text{mura} is convincing.

In larger words such as \text{mura} and \text{wurula} individual phonemes tend to be less clearly recorded due to the jumble of sounds. Nevertheless, from these three simple examples, it appears that at least some fundamental south-east-Australian words have the phonotactic structure CVCVCV... (\text{consonant-vowel-consonant-vowel-consonant-vowel...}) and, whilst they mostly seem to comprise four or less letters, Chapter 1 argues that we must nevertheless assume the existence of at least some six-letter ancestral words (such as \text{wurula}) in order to account for the large Zipf Mean which is empirically observed in historic Aboriginal word/name lists compiled in recent centuries.

Other phonotactic combinations may also seem possible. For example, English has sequences ranging from \text{CV ("see")} and \text{CVC ("hat")} to consonant clusters such as \text{CCVC ("stop")} and even \text{CCCCVCCCC}
Appendix

(“strengths”). However the alternation of consonants and vowels is so fundamental that some world languages are phonotactically self-rectifying, automatically inserting vowels to break-up consonant clusters: eg the English word illustration in Japanese becomes “irasutoreshon”, whilst best or vest both become “besuto”.

Additionally it is a statistical universal regardless of language, speaker or subject matter, that “just over 60% of everything we say will be made of consonants, and just over 40% of vowels. About a third of all the syllables we use in everyday speech will have the structure of CVC as in ‘cat’ ... [and] the 50 most commonly used words in language will make up about 45% of everything we write” [Crystal, 1997, page 86].

It is known that “typically, every word in an Australian language must involve at least two syllables. It must begin with a single consonant and can end in a consonant or a vowel ... there is just one vowel in each syllable ... [and] between each pair of vowels there must be either one or two consonants” [Dixon, 1980, pages 127 & 159]. Accordingly the phonotactic structure of words in Australian languages is taken to be CV(C)CV(C) where parentheses, (...), include optional elements. With many languages conforming exactly to this norm, and others diverging only in minor ways, our earlier-discussed CVCVCV structure is one of the simplest possible cases.

Most consonant clusters are probably not fundamental - being formed mostly through agglutination and fusion of more fundamental words or elements. For example it is argued, in Chapter 5, that the retroflexives *rn, rd, rl*, respectively arose from simple vowel-loss as follows: *ron* → *ŋ*, *rod* → *ɖ*, *rol* → *ɭ*. Also we will later see that (in addition to the velar nasal *ŋ*) SE-Australian languages had an *nːɡ* sound (as in the English word *finger*) typically arising from condensation of the repeat-word *gunːɡ(un)*. Dixon [1980, page 158] also suggests a double rhotic *rr*, and a double lateral *ll*. But, just as “the articulation of the occurrence of a vowel in a particular word is often affected by the phonetic value of consonants flanking it” [Dixon, 1980, pages 129-130], so too can different sounds arise from consonants such as *r* or *l* being flanked by long or short vowels: for example *mura* sounds quite different to *mara*, and *gula* sounds quite different to *gala*. So this study, in line with others [Eades, 1976, page 35], finds the minimal system of one lateral and one rhotic sufficient. Thus many of Dixon’s “optional” consonant clusters are probably artefacts, arising from agglutination and fusion, best ignored in our search for ancestral roots.

However even our minimal orthography, and the proposed phonotactic structure of fundamental words, is still insufficient to eliminate all

page 6
ambiguities. We also need an internally consistent system of formal logic, based upon some set of fundamental ("root") words, with which to found the study of morphology. Probably any such successful system of formal logic would correspond in some degree to actual ancestral language initially captured in idioms and, through subsequent agglutination and fusion, preserved within modern words - as below:

<table>
<thead>
<tr>
<th>ILLERT</th>
<th>TROY (1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>based on the internally</td>
<td>wrong vowels and</td>
</tr>
<tr>
<td>consistent system of formal</td>
<td>unnecessary consonants,</td>
</tr>
<tr>
<td>logic to be outlined herein</td>
<td>based on arbitrary opinion</td>
</tr>
<tr>
<td>bulu-(i)</td>
<td>balu-wi</td>
</tr>
<tr>
<td>(bu(lo)i)</td>
<td>bu-yi</td>
</tr>
<tr>
<td>(g(ura)-wu(ru)i)</td>
<td>ga-wi</td>
</tr>
</tbody>
</table>

**TABLE 1.2**: contrast between reconstructions

Thus morphology offers a systematic way of thinking about philology, based upon agglutination and fusion of ancestral ("root") words. Indeed, without some set of fundamental roots (the linguistic equivalent of the periodic table of atoms) there can be no convincing reconstructions of syntax (the linguistic equivalent of chemical reactions). Linguists such as Eades (1976), Osmond (1989), Troy (1993), Besoldt (2004) and Steele (2006), attempting syntactic reconstructions of extinct SE-Australian languages with little understanding of morphology, found they had no systematic way of determining where lexical items ended and syntax began. In linguistics as well as chemistry, without atoms all is phlogiston and aether.

In the following ancient roots are proposed based solely upon Australian lexical data, but no apology is offered for also occasionally including suggestive Indo-European words. Such philological speculation is part of the historical tradition in this field, with important early contributions having been made by G.F. Angas (1847), J.F. Mann (1840's), S. Bennett (1867) and J. Fraser (1892). And if the proposed proto-Australian roots are anything like 75,000 years old, dating halfway back to the origin of modern human speech, worldwide vocabulary must to some extent be derived from them. Indeed, any general absence of "candidate" Indo-European cognates might constitute a counter argument that our proposed roots either might not be proto-Australian or, at least, are nothing like 75,000 years old. Thus it would be negligent not to at least speculate about possible cognates from different continents when dealing with words likely to have originated at these time depths.
Appendix

"... it is not at all clear that there is such a thing as a universal stock of basic vocabulary..."

Collin Yallop (1982), page 33

occurrence of consonants in fundamental four-letter south-east-Australian words

Assuming the previously-given set of fourteen "consonants" and four "vowels", let us consider all four-letter words commencing with consonants and constructed from alternating consonants and vowels: ie words of the form CVCV. Such words can be represented by a four-vector

\[ W = (W_1 = \text{consonant}, \ W_2 = \text{vowel}, \ W_3 = \text{consonant}, \ W_4 = \text{vowel}) \, , \]

the total number of "possible" words being

\[ 14 \times 4 \times 14 \times 4 = 3136 . \]

However, if we make the simplifying assumption that only \( l \) and \( r \) can appear in the \( W_3 \) position but never word-initially, the number of "possible" words reduces by an order of magnitude to

\[ 12 \times 4 \times 2 \times 4 = 384 . \]

If we further assume that proto-Australian had a simpler sound-system, with two less consonants [Dixon, 1980, pages 158 & 174-178], the total number of "possible" ancestral root-words of this form is

\[ 10 \times 4 \times 2 \times 4 = 320 . \]

But not all of the 10 possible consonants can occur word-initially with equal frequency \( N = 32 \) because, in real-world lexicons, word-initial consonants are constrained by an Entropy-maximising "power-law" that can be approximated by a Zipf curve \( 32/(h+1) \), for integers \( h \in [0, \ H-1] \), where \( H \) is the total number of consonants capable of appearing word-initially. Thus, whilst there may naively seem to be 320 "possible" ancestral root-words of the form CVCV, in reality only those occurring underneath this curve are permitted by the physical principle of Entropy-maximisation which is discussed more fully in Chapter 2.
Appendix

Relative frequencies of respective word-initial consonants, arranged in decreasing order, must follow an Entropy maximising "power law".

![Graph showing relative frequencies of word-initial consonants]

\[ N_h = \frac{32}{h+1} \quad \text{... for } h \in [0, H-1] \]

where \( H = 10 \) for proto-Australian

The area under this "power law" approximates the maximum number of ancestral four-letter words, of the prescribed form, actually permitted by Entropy

\[ \int_{0}^{9} \frac{32}{h+1} \, dh = 32 \times ln(10) \approx 73 \]

however even this is probably an overestimate, as a Zipf curve only approximates the decreasing exponential required by rigorous theory (see Chapter 2), so 60 fundamental words may be closer to reality.

Although this "power law" dictates the frequency spectrum of word-initial consonants, it does not tell which consonants occur word-initially with which frequencies \( N_h \). This can be roughly estimated by empirical word counting from actual word-lists and, by choosing language zones with differing values of \( H \), extrapolating back to proto-Australian language for which we assume a simpler consonant inventory with something like \( H = 10 \). And we mainly need to do this for word-initial peripheral consonants because words made from them constitute approximately 60% of any lexicon - a significant sample which can be expected to be more representative than any remaining words based on rarer or less certain word-initial consonants (see data-tables on pages 204 - 213).
Appendix

<table>
<thead>
<tr>
<th>source</th>
<th>frequency (%)</th>
<th>frequency (%)</th>
<th>frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>word-initial-(l)</td>
<td>word-initial-(r)</td>
<td>word-initial-(n)</td>
</tr>
<tr>
<td>Sydney “eora” W. Dawes, 1790</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Illawarra “Wodi Wodi” Lizzy Malone, 1875</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jervis Bay “D’hurga” D.K. Eades, 1976</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Twofold Bay census 1839 “blanket register”</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gippsland “Kurnai” L. Hercus, 1969</td>
<td>4.3</td>
<td>2.6</td>
<td>0</td>
</tr>
<tr>
<td>Port Dalrymple, Tasmania J.P. Gaimard, 1826</td>
<td>11.8</td>
<td>6.5</td>
<td>0</td>
</tr>
<tr>
<td>Research Bay, Tasmania J.J.H. de Billardiere, 1793</td>
<td>12.5</td>
<td>11.1</td>
<td>0</td>
</tr>
</tbody>
</table>

| TABLE 1.3: Relative occurrence of some rare word-initial consonants in historic SE-Australian wordlists, showing increasing usage toward the south. Calculated from data tables on pages 204-213. |

In her “Dhurga” lexicon, much of which was late-collected at Jervis Bay, Diana K. Eades (1976) found no instances of word-initial-\(l\) or word-initial-\(r\). However the French Astrolabe expedition, at Jervis Bay in 1826, recorded the nouns “\(leroko\)” (“\(huitre\) = oyster), “\(loungan\)” (“\(langrayen (oiseau)\)”), and “\(lerinn\)” (“\(oeil\) = eyes”), thereby establishing a likely northern limit for word-initial-\(l\). This suggests an important linguistic boundary between “northern” coastal languages (such as “Eora” from Sydney, also “Wodi Wodi” from Illawarra) and “southern” languages (such as “D’hurga” along the NSW south coast, “Kurnai” from Gippsland in Victoria, also “Tasmanian”).

Another difference seems to involve the important nasal \(n\) which, due to its rarity, has zero frequency in all sources in the above table. However one convincing example of word-initial-\(\text{n}\) occurs in R.H. Mathews’ (1901) “Thurrawal” which documents \(\text{nora}\) (“\(yonder\)”) as “\(nharra\)” in language from the Canberra region. There also seems to have been an expression \(\text{nora:wa(ra):n}\) documented by the surveyor R.L. Campbell (1862) as “\(yarra:wa\)” (“the name of the Kangaloon forests”), and also by W. Dawes (1790) as “\(njarra:wa:n\)” (“a great distance off”). Conversely \(\text{warra:nora}\) survives today as the place name “\(woro:nora\)”. All these examples of the nasal \(n\) come from “northern” coastal language, whilst there is little evidence for it in the “south”.

page 10
Appendix

Chapter 2 shows how to precisely determine values of $H$ by using entropy maximising "power laws" that best fit historic wordlists from different language zones. But for present purposes, assuming that "northern" language such as Wodi Wodi employed $n$ word-initially but not $l$ or $r$, whilst "southern" languages such as D'hurga and Kurnai had both $l$ and $r$ word-initially but not $n$, we can estimate that $H = 12$ for Wodi Wodi and $H = 13$ for D'hurga. Hence the following extrapolation:

<table>
<thead>
<tr>
<th>word-initial consonant</th>
<th>frequency (%)</th>
<th>linearly extrapolated frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D.K. Eades, 1976</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D'hurga ($H = 13$)</td>
<td></td>
</tr>
<tr>
<td>$m$</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>$n$</td>
<td>4.4</td>
<td>17.6</td>
</tr>
<tr>
<td>$g$</td>
<td>26.5</td>
<td>14.2</td>
</tr>
<tr>
<td>$b$</td>
<td>19.3</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td>L. Malone, 1875</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wodi Wodi ($H = 12$)</td>
<td></td>
</tr>
<tr>
<td>$m$</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>$n$</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>$g$</td>
<td>22.4</td>
<td></td>
</tr>
<tr>
<td>$b$</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>protoAustralian ($H = 10$)</td>
<td></td>
</tr>
<tr>
<td>$m$</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>$n$</td>
<td>17.6</td>
<td></td>
</tr>
<tr>
<td>$g$</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>$b$</td>
<td>9.4</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 1.4:** Calculated from the data tables on pages 209 and 212.

And, taking our earlier estimate of something like 60 "possible" ancestral four-letter words permitted by entropy, we might expect to find lurking in historic Aboriginal word-lists approximately

$$60 \times \frac{20}{100} \approx 12 \text{ commencing with } m$$

$$60 \times \frac{17.6}{100} \approx 11 \text{ commencing with } n$$

$$60 \times \frac{14.2}{100} \approx 9 \text{ commencing with } g$$

$$60 \times \frac{9.4}{100} \approx 6 \text{ commencing with } b$$

Thus before studying historic Aboriginal word-lists on a larger scale we can already anticipate $12 + 11 + 9 + 6 = 38$ "likely" ancestral roots, each with the consonants $l$ or $r$ in the $w^3$ position and peripheral consonants in the $w^1$ position, approximately as above. This is more than half of the 60 "possible" roots of the prescribed form permitted by entropy.
Appendix

"Organization need not be ascribed totally to ... operators, inductors, evocators and regulators. Space ... contains its own constraints ... [that] dictate the organization of all the elements that can take possession of it ... the possible configurations are strictly limited ... The nature of space itself is such as to preclude so much, and permit so little, that there can only ever be a handful of answers to a multitude of questions."

P.S. Stevens (1974)

octahedral symmetry and the occurrence of "vowels" in fundamental four-letter words

Most Aboriginal languages throughout Australia have just three basic vowels, "a system that we tentatively assign to protoAustralian - although there is an area in the central north where five-vowel systems predominate" [Dixon, 1980, page 178]. Additionally about half of all Australian languages distinguish between long and short vowels and, from "comparison of cognates in widely dispersed languages ... there are sufficient cognates for us to be quite certain that protoAustralian had a contrast between long and short vowels in initial syllables" [Dixon, 1980, pages 131 & 212].

In saying this, previous researchers were mainly considering sounds that can be represented by a simple doubling of basic vowels indicating extra length - ii, aa, uu. The present text proposes a novel cluster aia which may possibly have been the ancestral basis for most, if not all, of the valid long vowels observed in modern languages - with the contractions a(ia), a(i) and (a)ia being phonetically distorted in various ways. Existence of this proposed ancestral long-vowel cluster is certainly a simplifying assumption with which to proceed. It may just be a device useful for generating a representative sample of fundamental ancestral words (some subset of the protoAustralian lexicon) or, alternatively, it may actually be true. Whatever the case, the Principle of Parsimony (also known as Ockham’s Razor) mandates that "the simplest explanation that fits all of the facts is probably true". Thus we need to consider the spectrum of lexical possibilities of the form CVCV, following from the minimal set of three short vowels and one proposed long vowel, before deciding whether to even think about options of greater complexity.

For specified consonants in the \( W_1 \) and \( W_3 \) positions in ancestral four-letter words, the set of all possibilities resulting from, say, the vowel \( u \) in the \( W_2 \) position can be generated from Pythagorean multiplication of monosyllables \( (1 * 4 = 4) \) whose different vowel combinations within resulting disyllabic words can be represented as a tetrahedral array.
Appendix

Example 1

*bur* is the basis for four "possible" words that can be displayed tetrahedrally -

Example 2

*mul* is the basis for four "possible" words that can be displayed tetrahedrally -

\[
W_2 = u \\
W_4 = \text{any of four possible vowels} \quad \text{complete set of four possible disyllabic words}
\]
Appendix

\[ W_2 = \text{any of four possible vowels} \quad (4) \]

\[ W_4 = \text{any of four possible vowels} \quad (4) \]

two-tiered tetrahedron
(internally containing an octahedron)
representing sixteen possible words

(16)
More generally, for specified consonants in the $W_1$ and $W_3$ positions in four-letter words of the prescribed form, the full set of vowel combinations can be generated by Pythagorean multiplication of monosyllables ($4 \times 4 = 16$) and represented as a two-tiered tetrahedron (see LEFT) containing two conjugate octahedral arrays that can be separated ($16 = 10 + 6$) and studied individually (see BELOW). Displaying all possible four-letter words in this geometrical fashion enables the entire space of lexical possibilities to be visualised and systematically studied. For example if, as suggested herein, the vowel $i$ had generally been reserved as a present-tense marker for verbs, then it would have been confusing and therefore inappropriate for it to have commonly occurred in adjectival roots and lexical items based on them. Hence we would not be surprised to find the entire top-tier of this two-tiered tetrahedron underutilized by fundamental words from actual historic wordlists. Conversely we could argue that such an underutilized slab of the total possible lexical space would, in itself, constitute evidence that the vowel $i$ served some other function in historic language.
Appendix

Consider a matrix $A$, capable of interchanging vowels in roots of the prescribed form, as follows

$$A \mathbf{w} \equiv \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \end{pmatrix} \rightarrow \begin{pmatrix} w_1 \\ w_4 \\ w_3 \\ w_2 \end{pmatrix}.$$

Its characteristic polynomial is given by the determinant

$$\| \lambda I - A \| = \begin{vmatrix} \lambda - 1 & 0 & 0 & 0 \\ 0 & \lambda & 0 & -1 \\ 0 & 0 & \lambda - 1 & 0 \\ 0 & -1 & 0 & \lambda \end{vmatrix} = (\lambda - 1)^2 (\lambda^2 - 1) = 0$$

implying a characteristic matrix equation of the form

$$(A - I)^2 (A^2 - I) \mathbf{w} = \mathbf{0}$$

which completely summarises the symmetries of this lexical space.

To understand the meaning of these component factors consider roots containing identical vowels ($W_2 = W_4$), existing at the extreme vertices of the two-tiered tetrahedron, for which we have the Tetrahedral Invariance

$$A \mathbf{w} = \mathbf{w} \quad \ldots \text{for } w_2 = w_4$$

which is a mathematical way of saying that hypothetical roots such as $mulu$, $mulu$, $mala$, $muru$, $nuru$, $nara$, $nulu$, $dulu$, $buru$, $bara$, $wuru$, $wara$, $nuru$, $nara$, etc, are all unaltered by vowel inter-changement.
Appendix

In contrast roots containing different vowels \( (W_2 \neq W_4) \), occurring at the octahedral vertices, are changed by the matrix operation

\[
A \, \hat{w} = \hat{w}^* \quad \text{... for } W_2 \neq W_4
\]
effectively “jumping” from one octahedral array to the other. For such roots, in these octahedral arrays, a second application of the matrix \( A \) is needed to restore their original form

\[
A \, \hat{w}^* = A^2 \, \hat{w} = \hat{w} \quad \text{... for } W_2 \neq W_4 .
\]

This last equation, which describes roots jumping from one octahedron to the other then back, characterises what will hereafter be called Octahedral Symmetry.

Thus the characteristic matrix equation is simply a product of terms, respectively representing Tetrahedral Invariance and Octahedral Symmetry, following from the very nature of the proposed “di-syllabic” four “vowel” lexical space in which nothing else is possible.

Octahedral Symmetry has clearly been a defining phonotactic property of lexical space since protoAustralian times but could it also have linguistic significance - specifically could there exist pairs of adjectival roots of the prescribed form, \( \mathcal{W} \) and \( \mathcal{W}^* \) (counterparts in opposing octahedral arrays), that are semantically linked? If so they would also probably be of protoAustralian origin, hence widespread throughout known Aboriginal languages, for the simple reason that lexical space would have started filling long ago, during protoAustralian times, leaving little room for an entire deep structure such as Octahedral Symmetry to “independently arise” in language much later, as an afterthought, and to spread widely across language boundaries in recent times. Homology (having the same origin in protoAustralian) would be far more likely than homoplasy (coincidentally having the same form), given that an entire deep symmetry is involved. Thus, if “universal” conjugate roots exist, they are likely to have protoAustralian origins.

The best place to initially seek surviving protoAustralian roots would be amongst the most unchanged ancient oral traditions on the Australian continent - arguably in SE-Australia where for tens of millennia Aboriginal people were geographically isolated and separated from human populations with different origins and certainly weren’t trading with Asian or Pacific neighbours. In contrast, languages in Australia’s
### TABLE 1.5: eight proposed conjugate adjectival pairs of the prescribed form, collectively suggesting that Octahedral Symmetry may also have linguistic significance, compiled mainly from First Contact sources in the Sydney-Illawarra region of SE-Australia. The UU/UU combination is most common and convincing, followed by ūa/áu. In some of these proposed words undetermined vowels are indicated by *.

<table>
<thead>
<tr>
<th>gūru</th>
<th>&quot;gūrroo&quot;, (&quot;thin&quot;)</th>
<th>T. Watling 1790, Eora</th>
</tr>
</thead>
<tbody>
<tr>
<td>=slim, concave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gūra</td>
<td>&quot;kurra&quot;, (&quot;ear&quot;)</td>
<td>J. Rowley 1875, Cowpastures</td>
</tr>
<tr>
<td>=into, toward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gūra</td>
<td>&quot;kūrū&quot;, (&quot;throat&quot;)</td>
<td>L. Malone 1875, Wodi Wodi</td>
</tr>
<tr>
<td>gāru</td>
<td>&quot;gāree&quot;, (&quot;to cough&quot;)</td>
<td>W. Dawes 1790, Eora</td>
</tr>
<tr>
<td>=out of, from</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gūl*</td>
<td>&quot;kullēr&quot;, (&quot;good&quot;)</td>
<td>J. Malone 1875, Tharawal</td>
</tr>
<tr>
<td>=shiny, vital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gūl*</td>
<td>&quot;galla(n)&quot;, (&quot;the sun&quot;)</td>
<td>Sir J. Banks 1770, Eora</td>
</tr>
<tr>
<td>g*lo</td>
<td>&quot;callooa&quot;, (&quot;to climb&quot;)</td>
<td>Capt. J. Hunter 1793, Eora</td>
</tr>
<tr>
<td>=dull, lethargic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>burū</td>
<td>&quot;barru&quot;, (&quot;tired&quot;)</td>
<td>R.H. Mathews 1903, Ngunnawal</td>
</tr>
<tr>
<td>=tired, quiet, slow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>burū</td>
<td>&quot;burrai&quot;, (&quot;quick&quot;)</td>
<td>R.H. Mathews 1904, Wiradjuri</td>
</tr>
<tr>
<td>=vigorous, noisy, quick</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bora</td>
<td>&quot;paira&quot;</td>
<td>F. McCaffrey 1920's, Wodi Wodi</td>
</tr>
<tr>
<td>=between</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bora</td>
<td>&quot;bourra&quot;</td>
<td>D. Collins 1798, Eora</td>
</tr>
<tr>
<td>=eitherside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mul(u)</td>
<td>&quot;maiāl&quot;, (&quot;stranger&quot;)</td>
<td>J. Rowley 1875, Cowpastures</td>
</tr>
<tr>
<td>=unfamiliar, strange, unexpected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mulu</td>
<td>&quot;mulla&quot;, (&quot;husband&quot;)</td>
<td>W. Dawes 1790, Eora</td>
</tr>
<tr>
<td>=familiar, usual, expected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mu(j*)</td>
<td>&quot;mai&quot;, (&quot;eye&quot;)</td>
<td>J. Rowley 1875, Cowpastures</td>
</tr>
<tr>
<td>=visible, accessible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mu(j*)</td>
<td>&quot;mia&quot;, (&quot;the eye&quot;)</td>
<td>D. Paine 1794, Eora</td>
</tr>
<tr>
<td>=invisible, obstructed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mulu</td>
<td>&quot;mileēa&quot;, (&quot;stop&quot;)</td>
<td>W. Dawes 1790, Eora</td>
</tr>
<tr>
<td>m*lo</td>
<td>&quot;mili&quot;, (&quot;eyes when shut&quot;)</td>
<td>R.H. Mathews 1903, Darkinyung</td>
</tr>
<tr>
<td>=insoluble, obstructed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wiri</td>
<td>&quot;wārī&quot;</td>
<td>(good as in &quot;to find&quot;)</td>
</tr>
<tr>
<td>=correct, proper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wiru</td>
<td>&quot;wirra&quot;, (&quot;bad&quot;)</td>
<td>J. Malone 1875, Turuwal</td>
</tr>
<tr>
<td>=wrong, improper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wiru</td>
<td>&quot;weirāh&quot;, (&quot;bad&quot;)</td>
<td>L. Nathan 1849, Wodi Wodi</td>
</tr>
</tbody>
</table>
Appendix

<table>
<thead>
<tr>
<th>ur</th>
<th>... as in</th>
<th>ru</th>
<th>... as in</th>
<th>ul</th>
<th>... as in</th>
<th>lu</th>
<th>... as in</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;urr&quot;</td>
<td>guru</td>
<td>&quot;rai&quot;</td>
<td>guro</td>
<td>&quot;ull&quot;</td>
<td>gol*</td>
<td>&quot;lloo&quot;</td>
<td>g*lu</td>
</tr>
<tr>
<td>&quot;urr&quot;</td>
<td>gura</td>
<td>&quot;ree&quot;</td>
<td>garo</td>
<td>&quot;all&quot;</td>
<td>gol*</td>
<td>&quot;leur&quot;</td>
<td>g*lu</td>
</tr>
<tr>
<td>&quot;ur&quot;</td>
<td>gura</td>
<td>&quot;rey&quot;</td>
<td>garo</td>
<td>&quot;aial&quot;</td>
<td>molu</td>
<td>&quot;lla&quot;</td>
<td>mulu</td>
</tr>
<tr>
<td>&quot;arr&quot;</td>
<td>buru</td>
<td>&quot;rai&quot;</td>
<td>buru</td>
<td>&quot;leea&quot;</td>
<td>m*lu</td>
<td>&quot;leea&quot;</td>
<td>m*lu</td>
</tr>
<tr>
<td>&quot;air&quot;</td>
<td>bura</td>
<td>&quot;rah&quot;</td>
<td>baro</td>
<td>&quot;li&quot;</td>
<td>m*lu</td>
<td>&quot;ar&quot;</td>
<td>wuri</td>
</tr>
<tr>
<td>&quot;ourr&quot;</td>
<td>bura</td>
<td>&quot;ra&quot;</td>
<td>baro</td>
<td>&quot;wuri&quot;</td>
<td>&quot;ra&quot;</td>
<td>&quot;ra&quot;</td>
<td>wiru</td>
</tr>
<tr>
<td>&quot;ar&quot;</td>
<td>wuri</td>
<td>&quot;rra&quot;</td>
<td>wiru</td>
<td>&quot;rah&quot;</td>
<td>wiro</td>
<td>&quot;rah&quot;</td>
<td>wiro</td>
</tr>
</tbody>
</table>

**TABLE 1.6:** in keeping with the Principle of Parsimony we view double rhotics and double laterals, accompanied by bizarre Roman vowel and semivowel combinations, as orthographic gibber best replaced by the indicated combinations of symbols from our efficient minimal Aboriginal orthography which specifically excludes o, oo, e, ee, h and maybe also y. This makes all the more sense as the words in **TABLE 1.5** are mostly from the Sydney-Ilwawarra region where, arguably, there would have existed a single basic sound system - not several.

Far-north and north-western regions contain recognisable SE-Asian influences and, having evolved rapidly in recent times, are less likely to resemble original ancestral language brought to Australia 75,000 or so years ago, across the SE-Asian landbridge and oceans, ultimately from Eurasia. To the extent that SE-Australia was most remote and isolated, it might be expected to have retained the most ancient linguistic features such as the proposed conjugacy of meaning associated with Octahedral Symmetry. Thus it would be best to initially find some evidence for proto-Australian conjugacy here, as in **TABLE 1.5**, before expanding the study area across different language zones throughout a much larger region of the continent.

Although SE-Australian language was the first-extinguished it was also the first-recorded, hence the most “authentic”, with written accounts dating back to the 1770’s and 1790’s. In philology, as with any branch of taxonomy, the oldest original primary sources (not the latest compilations) must be given the greatest weight and priority. And, although we can grumble about the quality of these earliest of all written sources, language from the Sydney-Ilwawarra region is by far the most extensively documented, by multiple sources, precisely because this was where First Contact occurred. Such an abundance of lexical material from a single region readily enables us to identify likely candidate pairs of conjugate words as in **TABLE 1.5** but it also results in the multiple contradictory historic spellings in **TABLE 1.6**, that are more a consequence of diversity of source material than genuine phonotactic information, in a language zone that can reasonably be expected to have had a single basic sound system.
Europeans since First Contact, unable (judging by TABLE 1.6) to consistently and efficiently represent the Aboriginal “long-vowel” sound in combination with either a rhotic or a lateral, appear to have completely missed the Octahedral Symmetry represented by the conjugate adjectival pairs suggested in TABLE 1.5. But there may also be something else happening as well. We note that whilst the words in the left column of TABLE 1.5 (with a “long-vowel” in the first “syllable”) may be relatively uncontroversial, those in the right column (with a “long-vowel” in the second “syllable”) may be far less expected. Dixon [1980, pages 131-2] wrote

"About half the languages of the Australian continent have a distinction between long and short vowels ... there are almost always restrictions on long vowels - they may not occur in successive syllables, or only one long vowel may be permitted per word. In many languages long vowels occur only in the initial syllable of a word ... Comparison of cognates in widely dispersed languages indicates that protoAustralian did have long vowels in the initial syllable of a word; there is no evidence ... at other positions”,

and again [Dixon 1980, page 212]

"... there are sufficient cognates for us to be quite certain that protoAustralian had a contrast between long and short vowels in initial syllables; but there is no evidence that it showed long vowels in latter syllables of a word”.

Whilst the proposed minimal orthographic representations \( ur \) and \( ul \) are convincing in TABLE 1.6 we need at least a partial explanation as to why previous researchers have so long been “blind” to the existence of long vowels in second and subsequent syllables. From the data in TABLE 1.6 we see that the representation \( lu \) is also convincing but, notwithstanding Octahedral Symmetry, word-final \( ru \) seems to actually have been abbreviated down to either \( rai(a) \) or \( ray(a) \) in traditional spoken language. To further study this proposed tendency we can refer back to TABLE 1.1 which supplies thirty different historic spellings of a single Aboriginal name, probably \( bongaro \), with no less than ten different spellings of word-final \( ru \)

\[
...ru \rightarrow ...rai(a) \rightarrow \begin{pmatrix}
"re" & "ri" \\
"ree" & "rri" \\
"rree" & "rie" \\
"ry" & "rrie" \\
"rry" & "ru"
\end{pmatrix}
\]
Appendix

Logically, at most, only one of these historic spellings might be true. But, given their mutually contradictory natures, all are likely to be wrong - making our proposed contraction the simplest and best representation of word-final *ru*. In making this judgement we note the existence of exactly the same sort of orthographic gibber in historic "word-lists" regardless of whether we are dealing with spellings of the different words in TABLE 1.6, or of the same word as in TABLE 1.1.

This apparent contraction of word-final *ru* in spoken language in no way undermines or contradicts the Octahedral Symmetry suggested by word-pairs in TABLE 1.5 but it does, perhaps, explain why Dixon and others have long been unable to recognise word-final occurrences of the "long vowel" in fundamental if not universal multi-syllable words - hence why they entirely missed the underlying Octahedral Symmetry in the lexicon. It may also happen that the "long-vowel" interacted phonetically with other vowels and certain consonants, in actual spoken language, resulting in similar contraction of the *ui* sound within expressions such as the verb given in TABLE 1.2,

\[bulu{-}i \rightarrow bulai(a){-}i \rightarrow "boolaay{-}ee"\ ,

and the *uj* sound as in the TABLE 1.1 name *bougaru*,

\[...uj... \rightarrow ...ai(a){-}j... \rightarrow "...aay{-}(oo)ng..."\ ,

and also in the important negation *nuj*. When one actually tries to say these combinations, it becomes clear enough why contraction occurs and there is a predictability to it. Also it was suggested earlier that such contractions of the proposed ancestral "long-vowel", may be the basis for other long-vowels and even retroflexives in recent Australian languages.

Whatever the case there is no need to apologise for logical simplifications, such as Octahedral Symmetry based upon a minimal orthography, made in accordance with the Principle of Parsimony. Nor do we need to slavishly "prove" simplifying models or assumptions, as simplicity and efficiency are real-world universals and there is nothing gained by starting with assumptions of undue complexity. Rather the burden of proof lies more squarely upon those advocating additional layers of complexity, on top of simple models and assumptions that generally seem to account for all of the known facts. If we were to take seriously double rhotics, double laterals, bizarre vowel combinations, and multiple phonologies in a single region, then all those layers of complexity would require far more justification and proof than our simple finding that the lexicon is governed by Octahedral Symmetry with the proviso that word-final *ru*, and sometimes also *uj* within words in conjunction with other vowels and certain consonants, was probably modified in spoken traditional language.

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Appendix

"The scholar is a quarryman, not a builder, and all that is required of him is that he should quarry cleanly. He is the poet’s insurance against factual error”

Robert Graves (1963)

"... I would say that the real scientist, if not the scholar in general, is no quarryman, but is precisely and exactly a builder - a builder of facts and observations into conceptual schemes and intellectual models that attempt to represent the realities ... Who would deny that a role by far the greater is played by the original thinker and critic who discerns the broader outlines of the plan, who synthesises from existing knowledge through detection of the false and illumination of the true relationships of things a theory, a conceptual model, or a hypothesis capable of test? The creativity of scientific writing lies precisely here ... to be no mere quarryman but in some measure a creator of truth and understanding”.

Bentley Glass (1964)

data mining - analysis or synthesis?

In the study of poorly understood extinct languages we hear researchers complain of lexicons “down to the last 300 words and 18 verbs” [Nugent 1981] and languages elsewhere “that have disappeared without a trace” [Crowley 1997, pages 289-291]. But, clearly, these researchers lacked more than the desired vocabularies. They also lacked an adequate understanding of morphology - of how actually “known” lexical items were constructed from more basic elements and, also, how to expand vocabulary by creating valid “entirely new” words as needed. For too long Australianists have viewed lexical items from extinct languages as irreplaceable structureless empirical facts, mere objects to be shuffled about within sentences in accordance with syntactic rules, items capable of actually being “lost”.

Significant effort also needs to be invested in studying the structure and composition of lexical items themselves. A start has been made with respect to orthography and phonotactics but, in order to study lexical items properly, we need to have some ideas about how to actually make them from more fundamental components. And we also need to be able to more accurately determine their true meanings which are usually just as poorly documented in historical sources as the lexical items themselves. Furthermore, literary and archival sources are grossly incomplete and quite unlikely to contain “free-form” examples of every adjectival root as clearly documented as those cited in TABLE 1.5. Some may only have been recorded within larger, more complicated, phrases or expressions. To recognise and study them, in such environments, will therefore require useful hypotheses and models of the the structure of lexical items including compound adjectives, verbs and nouns, also numerals and arithmetical expressions.
### Appendix

#### TABLE 1.7: examples of repeated (superlatively inflected) adjectives, including some that suggest conjugacy of superlative meanings.

<table>
<thead>
<tr>
<th>Adjective Pair</th>
<th>Superlative Meaning</th>
<th>Origin</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>gar(u) - gar(u)</td>
<td>SLIMY-EST</td>
<td>C. Richards 1902, Wiradjuri</td>
<td>“slime left behind in the trail of slugs and worms”</td>
</tr>
<tr>
<td>nulu - nulu</td>
<td>WRINKLY-EST</td>
<td>D. Collins 1798, Eora</td>
<td>“mushroom”</td>
</tr>
<tr>
<td>buru - buru</td>
<td>SLOW-EST</td>
<td>McNicol &amp; Hosking 1994, Wiradjuri</td>
<td>“laZY”</td>
</tr>
<tr>
<td>guru - guru</td>
<td>THIN-EST</td>
<td>R.H. Mathews: 1901, 1903</td>
<td>“light, not heavy”</td>
</tr>
<tr>
<td>guru - guru</td>
<td>FAT-EST</td>
<td>Mickey Munima 1863, Wadi Wadi</td>
<td>“whale”</td>
</tr>
</tbody>
</table>

Starting with the simplest case it is proposed that adjectival repetition denotes superlative inflection, in which event the examples in TABLE 1.7 suggest conjugacy of meaning extending also to superlative adjectives. In studying such examples it is important to appreciate that nouns are inappropriate as ascribed meanings for adjectival expressions. Instead we need to seek qualities of the respectively cited nouns: eg the “trail of slugs and worms” may be the SLIMY-EST substance, a “mushroom” may have the WRINKLY-EST gills, a “gun” may be the FAST-EST thing, and a “whale” may be the FAT-EST of creatures. Also, if buru-buru does have the superlative meanings FAST-EST or NOISY-EST, then conjugacy would have buru-buru meaning SLOW-EST, TIRED-EST, LAZY-EST or QUIET-EST, consistent with the imprecise historic ascriptions “lazy” and “bye and bye”. Likewise, if guru-guru has the
superlative meaning FAT-EST, then conjugacy would have guru-guru meaning THIN-EST, consistent with the imprecise historical ascriptions “lean” and “light, not heavy”.

To further expedite matters it is helpful at this stage to ignore all of the arbitrary verb tense-markers and baroque pronoun-systems proposed by R.H. Mathews, in his numerous century old publications, that seem to have been taken far too seriously by generations of subsequent researchers [Eades 1976, pages 54-55; Troy 1993; etc]. Instead, later in this Appendix, a back-to-basics analysis of primary “raw lexical data” from numerous historic literary and archival sources (including R.H. Mathews’ own writings) will provide scores of examples, from across all SE-Australian language zones, clearly demonstrating universal usage of the vowel i as a present-tense marker on verbs. Likewise overwhelming evidence will also be presented in support of the inanimate and animate noun-markers proposed in TABLE 1.8.

For present purposes it is sufficient to explain that if fundamental adjectival roots existed, as proposed in TABLE 1.5, then they did so
TABLE 1.9: examples of the kind of conjugacy of meaning that could reasonably be expected to flow from adjectival-pairs to corresponding verb-pairs or to corresponding noun-pairs based upon them. Evidence supporting these and other such conjugate-verbs and conjugate-nouns follows later in this Appendix.

within the context of language and their respective meanings can reasonably be expected to have carried through to simple verbs and to simple nouns made from them - as in TABLES 1.8 and 1.9. Furthermore any conjugacy of meaning could also reasonably be expected to have carried through from adjectival-pairs, to corresponding verb-pairs and to corresponding noun-pairs, as suggested in TABLE 1.9. Thus the existence and true meaning of any proposed adjectival root needs to be ascertained within a broader context that also includes relevant verbs and nouns for which semantic conjugacy, if true, is a powerful tool with which to clarify and more precisely determine the meanings of poorly documented lexical items and their constituent components.
Appendix

We might also expect any proposed adjectival roots to have commonly been used as descriptors, in association with noun-stems whose dual and plural cases could respectively be represented either by repetition or else with the ancient quinary system of numerals (based upon the recursive arithmetic) discussed in Chapter 1:

\[
\begin{align*}
miru &= 0 \\
dula &= 1 \\
bulala &= 2 \\
wurola &= 3 \\
nurola &= 4 \\
murola &= 5
\end{align*}
\]

For example singular nouns were sometimes represented by the numeral \textit{dula}, in conjunction with either an animate or inanimate noun-marker, as in the standard \textit{animate singular} (masculine?)

\[
\begin{array}{c}
dula: \eta \\
\begin{cases}
\text{original-A} \\
\text{original-B} \\
\text{southern-B}
\end{cases}
\end{array}
\]

\begin{align*}
\text{"dulla":} & \quad (\text{"he"}) \\
\text{Lizzy Malone 1875, Wodi Wodi.} \\
\text{"dullai":} & \quad (\text{"Aboriginal man"}) \\
\text{J. Rowley 1875, Cowpastures.} \\
\text{"dhulli":} & \quad (\text{"man"}) \\
\text{R. H. Mathews 1901, Dhurruk (original-A)}
\end{align*}

... to which adjectival descriptors could be attached (singular noun-stems being assumed unless otherwise stated) as in

\[
\begin{array}{c}
gura & \quad \eta: (dula) \\
\begin{cases}
\text{original-B}
\end{cases}
\end{array}
\]

\begin{align*}
\text{"gur̂o:ng":} & \quad (\text{"child"}) \\
\text{J. Rowley 1875, Cowpastures}
\end{align*}

and

\[
\begin{array}{c}
pura & \quad \eta: (dula) \\
\begin{cases}
\text{original-B}
\end{cases}
\end{array}
\]

\begin{align*}
\text{"yuru:η":} & \quad (\text{"young man"}) \\
\text{L. Malone 1875, Wodi Wodi}
\end{align*}
Appendix

and

\[
\begin{align*}
\text{mulu} & \quad \eta: (dula) \\
\text{visual creature} & \quad \text{ORIGINAL–B}
\end{align*}
\]

(animate [implied singular] noun)

"maliyaː nː", 
("wedge tailed eagle")
Rev. J. Gunther 1892, Wiradjuri

and

\[
\begin{align*}
\text{mulu} & \quad \eta: du (la) \\
\text{related, familiar person} & \quad \text{ORIGINAL–B}
\end{align*}
\]

SOUTHERN–B

TURUWAL

(animate singular noun)

"mʊlːːda", ("old woman")
J. Malone 1875, Botany Bay.
(TURUWAL)

"mʊlːːː", ("a man or husband")
W. Dawes 1790, Eora
(coastal ORIGINAL–B)

... likewise also with the standard inanimate singular

\[
\begin{align*}
garu & \quad n: (dola) \\
\text{from thing} & \quad \text{SOUTHERN–B}
\end{align*}
\]

"kuuruː mː", ("teat")
J. Dawson 1881, Chaap Whurung

= SOURCE

(inanimate [implied singular] noun)

and

\[
\begin{align*}
guru & \quad n: (dola) \\
\text{cyclic thing} & \quad \text{SOUTHERN–B}
\end{align*}
\]

ORIGINAL–A

"narruː nː", ("moon")
Pettit & Dawson 1850’s, Kurnai

"nurraː nː", ("daylight")
Rev. W. Ridley 1875, Kamilaroi

and

\[
\begin{align*}
\text{bur(a)} & \quad n: du (la) \\
\text{between [legs] thing} & \quad \text{HUYGENS–CIRCLE}
\end{align*}
\]

(animate singular noun)

"burː nː da", ("penis")
R. H. Mathews 1903,
"Thurrawal" = Ngunnawal

...
and

\[
\begin{array}{c}
\text{muru} - n:dula \\
\text{small} \quad \text{thing} \\
(\text{inanimate singular noun})
\end{array}
\]

\[
\begin{array}{c}
\text{SOUTHERN-B} \\
\text{ORIGINAL-B}
\end{array}
\]

Over a vast region of Australia dual-nouns were sometimes constructed using repetition of the singular noun, including usually single adjectives, as follows

\[
\begin{array}{c}
\text{mal(a)} - d\text{u}(\text{la}:n) - d\text{u}(\text{la}:n) \\
\text{bulgy} \quad \text{pair of things} \\
(\text{adjective}) \quad (\text{dual noun} - \text{stem})
\end{array}
\]

\[
= \text{CHEEKS (dual noun)}
\]

\[
\begin{array}{c}
\text{ADELAIDE} \\
\text{Teichelmann & Schurmann 1840, Kuarna}
\end{array}
\]

and

\[
\begin{array}{c}
\text{mu}l\text{u} - d\text{u}(\text{la}:n) - d(\text{ula}:n) \\
\text{visual} \quad \text{pair of things} \\
(\text{adjective}) \quad (\text{dual noun} - \text{stem})
\end{array}
\]

\[
= \text{EYES (dual noun)}
\]

\[
\begin{array}{c}
\text{HUYGENS CIRCLE} \\
\text{Dr. J. Lhotski 1835, Ngarigu}
\end{array}
\]
and

\[ \text{dul}_{(la: n)} - \text{dul}_{(la: n)} - \text{gula} - \text{m(ura)} \]

\[ \text{pair of things} \quad \text{greatly radiant} = " \text{pretty}" \]

\[ \text{stem} \quad \text{adjective} \]

\[ = \text{PAIR OF LYREBIRD TAIL - FEATHERS (dual noun)} \]

\[ \text{"di::ddy::coolu::m"} \]

\[ \text{name of historic farmstead} \quad \text{on LYREBIRD Creek NSW} \]

\[ = \text{PAIR OF PADDLES (dual inanimate noun)} \]

\[ \text{"dy}:n::dhu::k::", ("canoe paddle[s]") \]

\[ \text{R. H. Mathews 1902} \quad \text{Gippsland Kurnai} \]

... or, using the numeral bulala, in concise expressions such as the standard animate dual

\[ \eta: bula(la) \]

\[ \text{creature - s (two)} \quad \text{original - B} \]

\[ \text{(animate dual noun)} \quad \text{original - A} \]

\[ = \text{PAIR OF } \text{" } \eta:ála", ("us two") \]

\[ = \text{PAIR OF } \text{" } \eta:álu", ("we two only") \]

\[ \text{William Dawes 1790, Eora} \quad \text{(coastal original - B)} \]

\[ = \text{PAIR OF } \text{" } \eta:á'lâ", ("each other") \]

\[ \text{M. M. Everitt 1900, Gundungara} \quad \text{(original - A)} \]
Appendix

or

\[
\text{bul(ala) : } \eta \quad \frac{\text{creature - } s \text{ (two)}}{\text{(animate dual noun)}} \quad \text{ORIGINAL-A}
\]

"eel: oong", ("we two")
M.M. Everitt 1900, Gundungara

hence the standard inanimate dual

\[
\text{gura} \rightarrow \text{n : bul(ala)} \quad \frac{\text{into}}{\text{thing - } s \text{ (two)}} \quad \text{SOUTHERN-B}
\]

"jerra : n : gill", ("trousers")
N.D. Pettitt & J. Dawson 1850's
Kurnai

and

\[
\text{m(ulu) : i} \rightarrow \text{(n : bulala)} \quad \frac{\text{seeing}}{\text{thing - } s \text{ (two)}} \quad \text{ORIGINAL-B}
\]

"m : i : lla", ("the eyes")
J. Oxley 1818, Wiradjuri

and

\[
\text{(bulala} \rightarrow \text{ (ba)ru} \rightarrow \text{n}} \quad \frac{\text{pair of things}}{\text{(inanimate dual)}} \quad \text{TURUWAL}
\]

"le : ri : n", ("eyes")
J.P. Gaimard 1826
Jervis Bay

Over the same vast region tripple nouns were made simply from repetition of singular nouns and their two adjectives

\[
\text{} \rightarrow \text{ gula : } \eta \quad \frac{\text{harmful - creature}}{\text{harmful - creature}} \quad \text{HUYGENS CIRCLE}
\]

"gula : ng : gula : ng"
("large locust[s]")
R.H. Mathews 1903
"Thurrawal" = Nguraway

and

\[
\text{} \rightarrow \text{ dulu : } \eta \quad \frac{\text{shabby - creature}}{\text{shabby - creature}} \quad \text{ORIGINAL-B}
\]

"dula : ng : dula : ng"
("exhausted, sinking,
ready to stumble"
Rev. J. Gunther 1892,
Wiradjeri

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Appendix

and

\[
\begin{align*}
\text{mula:} \eta (\eta) & \to \text{mula:} \eta \quad \text{ORIGINAL-B} \\
\text{blob} & \to \text{blob} \\
\text{= [constellation of] STARS} \\
\text{(animate plural)}
\end{align*}
\]

"mulla :: mullu: ng", ("Pleiades")
Lizzy Malone 1875, Wodi Wodi.

"molo:: molo: ng", ("Pleiades")
D. Collins 1798, Eora

likewise

\[
\begin{align*}
guru: n & \to guru: n \to g(guru: n) \\
\text{arc} & \to \text{arc} \to \text{arc} \\
\text{arcs (plural inanimate)} & \to \text{RAINBOW}
\end{align*}
\]

"gura : n: gura : n: g : "
R.H. Mathews 1908, Ngarigu

... alternately

\[
\begin{align*}
\eta: wurula & \to \text{ORIGINAL-A} \\
\text{= creatures, people} \\
\text{(plural animate)} & \to \text{TURUWAL} \\
\text{ORIGINAL-B}
\end{align*}
\]

"gn: iour",
("ascidie" = a colony of ascidians)
J.P. Gaimard, 1826, jervis bay
(TURUWAL)

"n: barr",
("flock or crowd")
M.M. Everitt, 1900, gundungara
(ORIGINAL - A)

"\eta: yeellu",
("we three only")
W. Dawes, 1790.

".eeroa",
("Aboriginal people")
D. Southwell, 1788.

".eorah",
("people")
(coastal ORIGINAL - B)

in the standard concise expression

\[
\begin{align*}
\etaara & \to \text{wuru(la: n)} \quad \text{ORIGINAL-B} \\
\text{coiled} & \to \text{things} \\
\text{coils, whorls (plural inanimate)} & \to \text{[snail] SHELL}
\end{align*}
\]

"nurrē : wry : ", ("shell")
I. Nathan 1849, Wodi Wodi

This selection of plurals, all of the form adjective times noun-cluster(s), should confirm that there are probably only 38 possibilities. In fact the last two-score or so clusters is exactly what we expect. There is no evidence for diminishing vowels or exotic consonants.
Appendix

"So then always that knowledge is worthiest... which considereth the simple forms or differences of things, which are few in number, and the degrees and coordinations whereof make all this variety."

Francis Bacon

The First Fleet officer William Dawes observed that "murry" was used as an augmentative in general - thereby denoting both size and degree. Consider the example involving small thing (= bush, baby, finger etc)

\[
muru - n:\text{dula} \quad \begin{array}{c}
\text{small} \\
= \text{thing}
\end{array}
\]

\[
\text{ORIGINAL-B} \\
\text{SOUTHERN-B}
\]

"ma : n : da", ("bush")

"poroi : tcholl", ("bush")
J. Dawson 1881, chaap whurrung.
(SOUTHERN - B)

"μωρό :: ", ("baby"), greek

"murray : tooloo"
D. Collins 1798, eora.

"marry : diolo"
Capt. J. Hunter 1795, eora.
("five" = finger - sized)
(coastal ORIGINAL - B)

"mi : tti", ("little"), awabakal
Rev. L.E. Threlkeld 1834

or

\[
dol(a : n) - muru \quad \begin{array}{c}
\text{ORIGINAL-B}
\end{array}
\]

"tu : mūře ", ("short")
W. Dawes 1790, eora.

"too : muroo ", ("short")
D. Collins 1798, eora.
(coastal ORIGINAL - B)

"tah : moor ", ("bronzewing pigeon")

"thal : more ", ("shallow")

"thirl : mere ", ("a lake in Manchester" ??)
A.E. Martin 1943.

"\Theta \alpha :: \mu [\nu \xi j] ", ("bush"), greek
"\chi \alpha :: \mu \delta \{\kappa \lambda \alpha \delta o\} ", ("bush"), greek

hence a definite Yes

\[
\eta \nu \eta \\
= \text{YES}
\]

page 32
is the basis for slightly-Yes

\[
\text{murū} - \etaun \quad \rightarrow \\
\text{slightly \ YES} \quad \Rightarrow \text{MAYBE/PERHAPS}
\]

\[
\text{"murroo : ng" , ("good")} \\
J. Larmer 1853, awabakal.
\]

\[
\text{"more : mme" , ("yes")} \\
D. Collins 1798, eora.
\]

\[
\text{"marroo : k" , ("good")} \\
J. Rogers 1899, eora.
\]

\[
\text{M.M. Everitt 1900, gundugara.} \\
\text{"murra : ga" , ("maybe")} \\
R.H. Mathews 1901, dharig.
\]

\[
\text{"moo : goon" , ("maybe/perhaps")} \\
M.M. Everitt 1900, gundugara. \\
\text{"murū : bah" , ("bad")} \\
R.H. Mathews 1908, \\
\text{"dharig" = wolgulu} \\
\text{(HUYGENS-CIRCLE)}
\]

or

\[
\text{\etaun - murū \quad \rightarrow} \\
\Rightarrow \text{MAYBE/PERHAPS}
\]

\[
\text{"nga : murra" .} \\
R.H. Mathews 1901.
\]

\[
\text{"thurrrawal" = ngunawal} \\
\text{(HUYGENS CIRCLE)}
\]

\[
\text{"ngja : m" , ("bush")} \\
W. Bothong 1902, dhurga \\
\text{(SOUTHERN-B)}
\]

\[
\text{"gi : m" , ("might")} \\
Evelyn ("Granny") Ferguson 1964, \\
\text{Bunjalu}
\]

\[
\text{"noon : moo" , ("maybe")} \\
\text{ancient egyptian}
\]
A multiply recorded word-phrase is given above and expanded below. R.H. Mathews [1904, cited by Besold (2004) page 53] states that the imperative is marked with a final i inflected to the verb stem. This is wrong, as it is clearly indicative mood.

\[
\begin{align*}
\text{bul(lu)} & \rightarrow \eta u(ru) \rightarrow i \\
\text{downward} & \quad \text{failing} & \quad \text{past} \\
= \text{HIT, STRIKE} & \quad \text{present} \\
\text{bu(lu)} & \rightarrow \eta u(ru) \rightarrow i \\
\text{I:bu(lu)} & \rightarrow \eta u(ru) \rightarrow i \\
\text{future} & \quad \text{future} \\
\end{align*}
\]

"bu: ny: i: l'la", ("struck")
W.J. Enright 1900, port stephens

"bu: n'y: i: ", ("strike")
W.J. Enright 1900, port stephens

"ba : nga : baou", ("will paddle")
W. Dawes 1790, eora

R.H. Mathews 1901, "thurrawal" = ngunawal

and

\[
\begin{align*}
\text{bul(lu)} : m(ora) & \rightarrow i \\
\text{am / are} & \quad \text{maybe} \\
\text{(IMPERATIVE MOOD)} & \quad \text{may} \\
\text{am striking} & \quad \text{may be am striking} \\
\text{(present tense INDICATIVE MOOD)} & \quad \text{(present tense CONDITIONAL MOOD)} \\
\text{bul(lu)} : m(ora) & \rightarrow i \\
\text{did (past)} & \quad \text{may be did / shall strike} \\
\text{(IMPERATIVE MOOD)} & \quad \text{(past / future tense INDICATIVE MOOD)} \\
\text{bul(lu)} : m(ora) & \rightarrow i \\
\text{shall (future)} & \quad \text{(past / future tense CONDITIONAL MOOD)} \\
\end{align*}
\]

"bul: m: i:: ", ("strike")
R.H. Mathews 1901, "thurrawal" = ngunawal

"bul: m: i: a : nga: murra", ("may have struck")
R.H. Mathews 1901, "thurrawal" = ngunawal

"bul: m: i:: ", ("shall strike")
R.H. Mathews 1901, "thurrawal" = ngunawal

"bul: m:: a:: ", ("might strike")
R.H. Mathews 1901, "thurrawal" = ngunawal
whilst, conversely, the expression for definite No

\[
\begin{array}{ccc}
\text{nuy & NO} & \rightarrow \text{UNIVERSAL} \\
\end{array}
\]

\[
\begin{array}{ccc}
\text{"naiyun", "no"} & \rightarrow \text{"ning", "no"} \\
L. Malone 1875, wodi wodi. & M.M. Everitt 1900, gundungara \\
\text{"nang", "no"} & \text{(ORIGINAL - A)} \\
D. Collins 1798, eora & \text{"aiann", "no"} \\
\text{(coastal ORIGINAL - B)} & \text{J. P. Gaimard 1826, jervis bay} \\
\end{array}
\]

forms the basis for slightly-No

\[
\begin{array}{ccc}
\text{munu:nun} & \rightarrow \text{NO} & \rightarrow \text{MAYBE} \\
\end{array}
\]

\[
\begin{array}{ccc}
\text{"maraa:gin:nee", "bad"} & \rightarrow \text{"mo:gun:ning", "maybe not"} \\
\text{"muria:gin:nea", "hoax, lie"} & \text{M.M. Everitt 1900, gundungara} \\
\text{N.P. Pettit & W. Dawson 1850, kurnai} & \text{(ORIGINAL - A)} \\
\text{(SOUTHERN - B)} & \end{array}
\]

There is also a verb for shining

\[
\begin{array}{ccc}
\text{gula:i} & \rightarrow \text{ORIGINAL-A} & \rightarrow \text{ORIGINAL-B} \\
= \text{shining, radiating} & \end{array}
\]

\[
\begin{array}{ccc}
\text{"kill:i", "shine, spark"} & \rightarrow \text{"kal:i", "water"} \\
R.H. Mathews 1901, dharruk. & \text{"kil:"", "urine"} \\
\text{"gill:e", "moon"} & \text{McNicol & Hosking 1994, ngiyampaa.} \\
\text{Rev. W. Ridley 1875, kamilaroi} & \text{"kil:"", "urine"} \\
\text{(ORIGINAL - A)} & \text{R.H. Mathews 1904, wiradjuri} \\
\text{(ORIGINAL - B)} & \end{array}
\]

which is combined in one’s largest (middle) finger

\[
\begin{array}{ccc}
\text{gula:(i) & mur(a-n)} & \rightarrow \text{ORIGINAL-B} \\
= \text{shining} & \text{largest - one} \\
\end{array}
\]

\[
\begin{array}{ccc}
\text{"kullar::heaar:"} & \rightarrow \text{"second finger"} \\
\text{J. Dawson 1881, peak whurrong} & \text{(ORIGINAL - B)} \\
\end{array}
\]
Appendix

or

\[ \frac{\text{mura} \ - \ n \ - \ gul(a):i}{\text{largest} \ - \ one} = \text{shining} \]

\[ \text{ORIGINAL-A} \]

\[ \text{ORIGINAL-B} \]

"mu:n:: ya", ("finger")
J. Dawson 1881, chaap whurrong
(ORIGINAL - B)

"mee:n:: hi",
("
"one of the sisters at katoomba"")
P. Stone, SMH 1931,
C.M. Ward, 1949,
S. Gurr & G. Harrowsmith, 1949
(ORIGINAL - A)

"mora : n : gull : y",
"murri : n : gull : y",
("Chief of the Nattai Tribe, 1800 – 1858") .
"moye : n : gull : y",
("portrait by Major Mitchell") .
"mya : n : garl : ie",
W. Russell 1914, "last chief" of gundungara.
"murr : n : gurr : y",
W.A. Cuneo 1893, gundungara
(ORIGINAL – A)

There is also an expression large orbiting thing (see pages 77 & 78)

\[ \frac{\text{mura} \ - \ win \ - \ du(la:n)}{\text{large orbiting- thing} = \text{MOON}} \]

\[ \text{ORIGINAL- B} \]

"murray : yanna : dah:"
("full-month")
P.G. King 1793, eora

"mehearo : ng:::
("full-month")
J. Dawson 1881
kuurn kopan noot.

These examples of *muro* and *mura* give plausible meanings, but they do not possess the Octahedral Symmetry. We will return to this later.

turtle
picture by Ainsley Roberts, 1962

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Appendix

**mulu / mulu**

There is an adjective

\[
\text{mulu} \quad \text{unfamiliar} \quad \text{ORIGINAL - B}
\]

hence the verb

\[
\text{mu}(u):i \quad \text{startling} \quad \text{ORIGINAL - B}
\]

and the objects of such influence

\[
\text{mulu}:b(ulu) - \text{mulu}:b(ulu) \quad \text{un expected - above} - \text{un expected - above}
\]

= lightnings

HUYGENS CIRCLE

\[
\text{mullu:p::}, \text{("lightning")}
\]

\[
\text{meu:p:meu:p}, \text{("lightnings")}
\]

At the other extreme we have

\[
\text{mulu} \quad \text{familiar, expected} \quad \text{ORIGINAL - B}
\]

SOUTHERN - B

\[
\text{moolo}, \text{("hence, thus")}
\]

Rev. J. Bulmer 1876, kurnai
(SOUTHERN - B)

\[
\text{moolo}, \text{("shaddow")}
\]

D. Bunce 1859

\[
\text{maula}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{miyal}, \text{("a stranger")}
\]

D. Collins 1798, eora.

\[
\text{maial}, \text{("stranger")}
\]

J. Rowley 1875, cowpastures

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{miyal"}, \text{("a stranger")}
\]

D. Collins 1798, eora.

\[
\text{maial"}, \text{("stranger")}
\]

J. Rowley 1875, cowpastures

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maail"}, \text{("stranger")}
\]

J. Rowley 1875, cowpastures

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.

\[
\text{maula"}, \text{("man")}
\]

D. Paine 1798, eora.
Appendix

and its augmented form

\[
\begin{align*}
\text{mora} - \text{mulo} & \quad \text{ORIGIN} - \text{B} \\
\text{greatly-familiar} & = \text{"married or related"}
\end{align*}
\]

as in spouse

\[
\begin{align*}
\text{dula} : \eta & - \text{mulu} : \text{mura} \\
\text{person} & = \text{married} \\
& \quad \text{(adjective)}
\end{align*}
\]

\[
\left\{
\begin{align*}
\text{"da:: molai": } & \,, \text{ ("name - sake") } \\
\text{J. Rowley 1875, cowpastures} & \quad \text{(coastal ORIGIN \text{-} B)} \\
\text{":: mali: ma": } & \,, \text{ ("wild woman") } \\
\text{D.K. Eades 19769, dhurga} & \quad \text{(SOUTHERN \text{-} B)}
\end{align*}
\right.
\]

or

\[
\begin{align*}
\text{mulu} : \text{mura} & - \text{du(la)} : \eta \\
= \text{married} & \quad \text{(adjective)}
\end{align*}
\]

\[
\left\{
\begin{align*}
\text{"mulla:: ma:: ng": } & \,, \text{ ("husband") } \\
\text{D. Southwell 1788, cora.} & \quad \text{(SOUTHERN \text{-} B)} \\
\text{"molli:: mi:: ng": } & \,, \text{ ("husband") } \\
\text{J. Rowley 1875, cowpastures.} & \quad \text{(SOUTHERN \text{-} B)} \\
\text{"mull:: ara": } & \,, \text{ ("married") } \\
\text{D. Collins 1798, cora.} & \quad \text{(coastal ORIGIN \text{-} B)} \\
\text{"mali:: n": } & \,, \text{ ("husband") } \\
\text{D. Collins 1798, cora.} & \quad \text{(SOUTHERN \text{-} B)}
\end{align*}
\right.
\]

\[
\left\{
\begin{align*}
\text{"mulla:: ng": } & \,, \text{ ("wife, general term") } \\
\text{J. Dawson 1881, peek whuurong} & \quad \text{(SOUTHERN \text{-} B)} \\
\text{"milla:: ng": } & \,, \text{ ("wife") } \\
\text{"mul:: dha": } & \,, \text{ ("old woman") } \\
\text{R.H. Mathews 1903,} & \quad \text{(HUYGENS CIRCLE)} \quad \text{"thurawal" = ngunawal}
\end{align*}
\right.
\]

... where we start to expand the words used on page 27.
There was agreement

\[
gu(n : gun) - \text{mul}(u)
\]

extremely-familiar

= "intimate"

\[\text{ORIGINAL-B} \rightarrow \text{"go: mul"}, \text{("friendship")}
\]

D. Collins 1798, eora
(coastal ORIGINAL-B)

or

\[
\text{mul}(u) - g\text{un} : g\text{(un)}
\]

extremely-familiar

= "intimate"

\[\text{ORIGINAL-B} \rightarrow \text{"ma: kun: g"},
\]

("lover or sweetheart")
W. Dawes 1790, eora.
"mau: gohn: ",
("lover or sweetheart")
D. Collins 1798, eora.
(coastal ORIGINAL-B)

and various methods

\[
\text{mul}(u) - bora - n:(dula)
\]

familiar - between

= OFTEN (sex)
(adjective)

\[\text{event} \rightarrow \text{"mail: bra: n: ", ("often")}
\]

Rev.J. Bulmer 1876, kurnai
SOUTHERN-B

or

\[
\text{bur}(u) - i : \text{mulu} - \eta: (dula)
\]

quietly - persuaded

= UNFAITHFUL
(adjective)

\[\text{ORIGINAL-B} \rightarrow \text{"pir : milla : ng : "},
\]

"marriage by stealing a
woman and compulsion"
J. Dawson 1881, chaap whoorung

or

\[
\eta\text{ur}(u) : i : d(ara) - \text{mulu} - \eta: \text{bula(la)}
\]

running - relationship

= ELOPING
(adjective)

\[\text{ORIGINAL-B} \rightarrow \text{"yuur : t : mela : ng : bula"},
\]

("marriage by elopement")
J. Dawson 1881, chaap whoorung
Appendix

and possibly

\[
\text{mu(}lu\text{)} : i \rightarrow \text{do(}la \text{)} : n \\
= \text{anticipating thing}
\]

"mo: i: dia: ", ("give it to me")
J.F. Mann 1840's, kuringai
(coastal ORIGINAL - B)

Aboriginal woman hunting "sugar-gliders" = \text{bu::} \eta: \text{wu:} = \text{wuro::} \eta: \text{b:i}

= \text{wu::} \text{b:i} \eta . Do you notice that the spelling is all the same?

picture by engraver W. Hatherell, 1888
Appendix

**mulu / malu**

There is an animate noun

\[ mlu \rightarrow \eta \rightarrow \text{visual creature} \rightarrow \text{UNIVERSAL} \]

= [sharp] eyed

"maliya : n", ("wedge-tailed eagle")
Rev. J. Gunther 1892, wiradjuri.
"malya : n", ("eagle hawk")
Mc. Nicol & Hosking 1993, Wiradjuri
(inland ORIGINAL – B).

and the inanimate counterpart

\[ m(lu) \rightarrow n \rightarrow \text{thing} \rightarrow \text{UNIVERSAL} \]

= eye

"me : ", ("eyes")
J. Malone 1875, botany bay
(TURUWAL)

"mai : ", ("eye")
J. Rowley 1875, cowpasture.
"mia : ", ("the eye")
D. Paine 1794, eora.
"meagh : ", ("eyes")
I. Nathan 1849, wodi wodi.
(coastal ORIGINAL – B).

"mi : ng", ("eye")
N.D. Pettit & W. Dawson 1875, kurnai.
"mooeh : ", ("eye")
Rev. F.A. Hagenauer 1876, kurnai
(SOUTHERN – B)

"meh : ", ("eye")
R.H. Mathews 1903,
"Thurrawal" = ngunawal
(HUYGENS CIRCLE)

R.H. Matthews 1903, dharkinyung
(ORIGINAL – A)
Appendix

hence

\[ \mu(lu : n) - \text{buru} \rightarrow \text{lazy} \]

also the verb

\[ \mu(lu) : n - \text{dor(a) : i} \rightarrow \text{throughing} \]

= seeing, looking

and its augmented form

\[ \text{mura} \rightarrow \mu(lu : n : dora : i) \rightarrow \text{looking} \]

also exotic expressions such us

\[ g(\text{un}) : wu(\text{ru}la - i : \eta \text{ara}) \rightarrow \text{mol(\text{u} : n)} \]

= gently [curving]

= conspicuous [thing]

(noun stem)

\[ "g: wo :: meil:" \]

"feather"

Capt. J. Hunter 1793, eora
(coastal ORIGINAL – B)

At the other extreme we have

\[ \text{malo} \rightarrow \text{UNIVERSAL} \]

\[ "\text{mili}" \]

"eyes when shut"

R. H. Mathews 1903, dharginyang
(inland ORIGINAL – A).

"Thurrawal" = ngunawal
(HUYGENS CIRCLE).

"malu", ("tired, lazy")
Rev. J. Gunther 1892, wiradjuri
(inland ORIGINAL – B).

"mileea", ("stop")
W. Dawes 1790, eora
(coastal ORIGINAL – B).
and an augmented form

\[
\begin{align*}
\text{malu} : (i) & \quad \text{mura} \\
& \quad \text{= obstructive} \\
\text{= greatly} \\
\text{obstructive shielding}
\end{align*}
\]

\[\text{"mullar :: aura"}, \ (\text{"blind"})\]

R.H. Mathews 1903, "thurrawal" = ngunawal

(HUYGENS CIRCLE)

or

\[\begin{align*}
\text{mu}(:r) & \quad \text{ma}(:lu) \\
& \quad \text{= greatly} \\
& \quad \text{obstructive shielding} \\
\text{= very}
\end{align*}\]

\[\text{"meea : ma :"}, \ (\text{"not understand"})\]

W. Dawes 1790, eora

(coastal ORIGINAL – B)

and

\[\begin{align*}
\text{malu} : (i) & \quad \text{gun} \\
& \quad \text{= blind,} \\
& \quad \text{obstructive shielding} \\
& \quad \text{= very}
\end{align*}\]

\[\text{"mullo :: ko", \ ("delay, defer")}\]

D. Bunce 1859.

\[\text{"mal :: kar", \ ("shield for warding off blows")}\]

J. Dawson 1881, kuurn kopan noot, peek whurung

(coastal ORIGINAL – B) (SOUTHERN – B)

hence the repeat-word (with repetition) emphasising degree

\[\begin{align*}
\text{gun} : i & \quad \text{m(alu)} \\
& \quad \text{= BLIND-EST (superlative adjective)} \\
\text{gun} : i & \quad \text{m(alu)}
\end{align*}\]

\[\text{"kn:: ee : m – kn:: ee : m", \ ("blind")}\]

W. Dawes 1790, eora

(coastal ORIGINAL – B)

also

\[\begin{align*}
\text{malu} & \quad \text{d}u(:l) : n \\
& \quad \text{= obstructive shielding} \\
& \quad \text{thing}
\end{align*}\]

\[\text{"mela : tho : n", \ ("shield")}\]

L. Atkinson 1853, midthung

(HUYGENS CIRCLE)
or

\[
\begin{align*}
\underline{\text{dula}} & \quad \underline{\text{ma(lo)}} & \quad \underline{n} \\
\text{thing}
\end{align*}
\]

\( \Rightarrow \)

\( \text{obstructive, blockage} \)

\( \begin{align*}
" \text{hila : ma : n"}, \ ("\text{shield}\) \\
J. Rowley 1875, cowpastures.
\end{align*} \)

\( " \text{ilee : mo : n"}, \ ("\text{shield}\) \\
W. Tench 1788, eora. \\
(\text{coastal ORIGINAL} - B) \)

also

\[
\begin{align*}
\underline{\text{mal(u)}} & \quad \underline{\text{wuru(la : n)}}
\end{align*}
\]

" obstruction - s" = [river] cateract - s

" \text{mul : warrie : "}, \ ("\text{long water}\) \\
C. MacAlister 1907, midthung \\
(HUYGENS CIRCLE) \)

Looking at these examples, of unobstructed \textit{mulu} and obstacles \textit{malu}, does give a clear picture - but not in accordance with Octahedral Symmetry. We will return to this later.

\( \text{Aboriginal men hunting "kangaroo"" = gun:guru:(n) or buru:n}. \)

picture by engraver W. Hatherell, 1888

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Appendix

**mula / malu**

There is a word

\[
\text{mula} \equiv \text{droplety, blobby, dusty (adjective)}
\]

("moola", ("sick or to vomit")

D. Collins 1798, eora.

"müla", ("blood")

J. Rowley 1875, cowpastures
(coastal ORIGINAL - B).

"muula", ("ulcer, sore, boil")

McNicol & Hosking 1993, wiradjuri
(inland ORIGINAL - B).

and the repeat-noun

\[
\text{mula : (n)} - \text{mula : n} \equiv \text{blob}
\]

= [constellation of ] STARS (multitudinous plural)

("moolo : molo : ng", ("Pleiades")

D. Collins 1798, eora.

"mulla :: mullu : ng", ("Pleiades")

Lizzy Malone 1875, wodi wodi.

"mullo : mullu : ng", ("Pleiades")

A. Mackenzie 1873.

"mulli : mülä : " ("the Pleiades")

I. Nathan 1848, wodi wodi
(coastal ORIGINAL - B).

"muula :: muula : ng", ("to be very sick")

McNicol & Hosking 1993, wiradjiri
(inland ORIGINAL - B).
Appendix

and

\[ \begin{align*}
\frac{mula}{\text{creature}} - \frac{\mu(\text{ra})}{\text{(adjective)}} & \rightarrow "\text{mula : ma"}, ("\text{vomit}") \\
& \text{R.H. Matthews 1904, wiradjuri} \\
& \text{inland ORIGINAL - B}
\end{align*} \]

also

\[ \begin{align*}
\frac{mula}{\text{droplety}} - \frac{\eta}{\text{extremely}} - \frac{\text{gun : g(\text{on})}}{\text{MENSTRUAL}} & \rightarrow "\text{mulla : n : gan : g"}, ("\text{girl}") \\
& \text{S. Mowle 1838, ngunawal} \\
& \text{St. "wife, general term"}
\end{align*} \]

\[ \begin{align*}
\text{J. Dawson 1881, peak whurrurg} \\
\text{(SOUTHERN - B)}
\end{align*} \]

\[ \begin{align*}
& "\text{milla : ng :: "}, ("\text{vulva}"), \text{ngarigu} \\
& \text{R.H. Mathews 1908, 1903} \\
& \text{(HYUGENS CIRCLE)}
\end{align*} \]

At the opposite extreme we need to imagine that solid bubbles \textit{mula} are fundamentally different to air \textit{malu}. Thus we have creatures

\[ \begin{align*}
\frac{\text{malu}}{\text{creature}} - \frac{\eta}{\text{extremely}} - \frac{\text{gun : g(\text{on})}}{\text{BUBBLEIFEROUS}} & \rightarrow "\text{malu : n : gan : g"}, ("\text{platypus}") \\
& \text{R.H. Mathews 1902, kurnai} \\
& \text{St. "platypus"}
\end{align*} \]

\[ \begin{align*}
\text{R. H. Mathews 1904, ngunawal} \\
\text{(HYUGENS CIRCLE)}
\end{align*} \]

\[ \begin{align*}
& "\text{mallu : n : gan : g"}, ("\text{platypus}") \\
& \text{M.A. Fitzgerald 1891, eora} \\
& \text{(coastal ORIGINAL - B)}
\end{align*} \]
and the juveniles

\[
dj - \text{malu} - \eta \rightarrow \text{tiny bubbles creature (noun-stem)}
\]

\[
\{ "\text{dy} : \text{malu} : \text{ng} \text{"} , \text{"platypus"} \}
\text{R. H. Mathews 1908,}
\text{"ngarrigu"} = \text{wo lg alu}
\text{(HUYGENS CIRCLE)}.
\]

\[
\{ "\text{ji} : \text{mmialo} : \text{ng} \text{"} , \text{"platypus"} \}
\text{N.D. Pettit \& W. Dawson 1850's, kurnai}
\text{(SOUTHERN - B)}.
\]

The name of the dumbbell shaped ceremonial ground, at the Great 1888 Shoalhaven Bunan, was recorded by \text{R.H. Mathews} as "wurra:wurru:tha:ng" = wuru:wuru:ga(ro)-\eta(ura).

\[\text{a goanna running amidst flanking spears}
\text{picture by Ainslie Roberts}\]
Appendix

**mala / mulu**

There is a word

\[
\text{mala} \rightarrow \begin{cases} 
"malyo", ("a swelling in general") \\
"malyo (nendi)", ("to swell, be pregnant") \\
"malyo (partanna)", ("full of joke, funny") \\
\text{Teichelmann & Schurmann 1840, kaurna (ADELAIDE – region)} \\
"\mu\alpha\lambda\alpha", \text{ greek}
\end{cases}
\]

as in

\[
\text{mal}(a) - \text{du}(\text{la: } n) - \text{du}(\text{la: } n) \\
\text{bulgy (adjective)} - \text{pair of things (dual noun – stem)}
\]

= CHEEKS (dual noun)

\[
\text{Teichelmann & Schurmann 1840, Kuarna (ADELAIDE → "mal:ta:t:y:", ("cheeks")}
\]

and also perhaps an augmented form

\[
\text{mala} - \text{gu}(n) \rightarrow \text{GREEK} \rightarrow "\mu\alpha\lambda\alpha : \kappa\imath\alpha"
\]

as it appears in

\[
\text{gun: mala} - \text{d(ula: } n) - i:(\eta ara) \\
\text{very inflated thing = stroking}
\]

= PENIS / CLITORIS / NIPPLE

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"gan : millu : tth :: i : ", ("masterbation")
R.H. Mathews 1903, dh arg inyung
(ORIGINAL – A)

or
\[
\eta(a) : i - \text{g\text{un}} : \text{ma(la)} - \text{d(ula : n)}
\]
= stroking

\[
\text{erect} \quad \text{thing}
\]
= PENIS / CLITORIS / NIPPLE

"da :: mu : t : ", ("masterbation")
R.H. Mathews 1902, kurnai
(SOUTHERN – B)

or
\[
\eta(a) - \text{d(ula : n} - \text{g\text{un}} : \text{ma(a)} - \text{i - ri}
\]
= stroking

\[
\text{thing} \quad \text{erect}
\]
= PENIS / CLITORIS / NIPPLE

"na : ty :: mil : i : ri", ("masterbation")
R.H. Mathews 1904, ngunawal
(HUYGENS CIRCLE)

and also
\[
g\text{ura} - \text{mala} - \text{bu(lu) : dar : i}
\]
= ABSORB (verb)

"carre : mille : ba : da :: ", ("to soak or wash in water")
Capt.J. Hunter 1793, eora
(coastal ORIGINAL – B)
Appendix

At the opposite extreme there is an augmented form meaning "to compactify or skrink"

\[ \text{mulu} - \text{mu(ra)} \rightarrow \text{"mulu : ma"}, \ ("shut a clasp knife") \]
\[\text{shrivelled} \quad \text{greatly} \]

W. Dawes 1793, eora
(coastal ORIGINAL – B)

Thus we anticipated approximately 12 words of the form \( m^{***} \), and immediately have 10, though \( muro/mora \) and \( mulu/malu \) do not follow Octahedral Symmetry. We will return to this later.

Aboriginal woman with pretty headware
from photograph by J.W. Lindt, 1888

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Appendix

The next candidate is

\[ \text{guru} \rightarrow \text{UNIVERSAL} \]

= fat, convex, more

"guurray", ("fat, possibly kidney fat")

"garra", ("testicles")

McNicol & Hosking 1994, wiradjuri

(inland ORIGINAL - B).

"gorai", ("fat")

J. Rowley 1875, wadi wadi.

"caura", ("whale")

D. Paine 1794, eora.

"curra", ("more")

D. Southwell 1788, eora.

"gori", ("fat")

W. Dawes 1790, eora
(ORIGINAL - B).

"gurra", ("testicles, scroum")

ngunawal 1904, ngarigu 1908.

"gurea(n)", ("fat")

thurrawal = ngunawal, 1903

R.H. Mathews

(HUYGENS - CIRCLE).

"garuy", ("the emu - apple, Owenta acidula")

"ghori", ("fat")

"guru", ("round")

"kurai" or "kurai", ("lobster")

"gurra", ("spider")

Re v. W. Ridley 1875, kumilaroi.

"karau", ("testicle")

"kurai", ("fat")

R.H. Mathews 1901, dhurug.

"curro", ("testicles")

Major Mitchell, gundungara.

(ORIGINAL - A).

"kuri", ("circle, compass")

Teichelmann & Schurmann 1840

kaurna, (ADELAIDE).

"kherooy", ("testicles"), ancient egyptian

"gamma", ("round"), greek

"giro", ("circle"), italian

hence to degrees of fatness ranging from "possum"

\[ \text{gun} - \text{guru} \rightarrow \text{gun: gara}
\]

= very = fat

D.K. Eades 1976, dhurga

(SOUTHERN - B)
and

\[
guru \quad - \quad (mu)ra
\]
\[
= \text{fat} \quad = \text{greatly}
\]

SOUTHERN – B
TURUWAL

\[
(guru : ra " \quad \text{(" possum")})
\]
D.K. Eades 1976, dhurga
(SOUTHERN – B).

\[
(gu : mara ", \quad (" possum")
\]
J. Malone 1875, botany bay
(TURUWAL).

\[
(kurua : ra", \quad (" opossum")
\]
L. Malone 1875, wodi wodi
(ORIGINAL – B).

\[
(kurra : ra", \quad (" possum")
\]
M. Munima 1863, wodi wodi
(coastal ORIGINAL – B).

or

\[
mura \quad - \quad (gu)ruru
\]
\[
= \text{greatly} \quad = \text{fat}
\]

SOUTHERN – B

\[
(murre : ra ", \quad (" whale")
\]
J. Larmer 1853, dhurga
(SOUTHERN – B).

\[
(purri : burri ", \quad (" whale")
\]
Mickey Munima 1863, wodi wodi

\[
(burri : burri ", \quad (" whale")
\]
R.H. Mathews 1903,
"thurruwal" = ngunawal

and the repeat-noun

\[
guru : n \quad - \quad guru : n \quad - \quad guru : n \quad - \quad g(uru : n)
\]
\[
= \text{arc} \quad = \text{arc} \quad = \text{arc} \quad = \text{arc}
\]

arcs (plural inanimate)

\[
= \text{RAINBOW}
\]

ORIGINAL – B
SOUTHERN – B
TURUWAL

ORIGINAL – B
SOUTHERN – B

\[\text{HUYGENS CIRCLE}\]
Appendix

"gura : n : gura : n :: g ...",
("rainbow")
R.H. Mathews 1908,
"ngarrigu" = wo lg alu
(HUYGENS CIRCLE).

At the opposite extreme of meaning we have

"gurroo(ee) ", ("thin man's name")
T. Watling 1790, eora.
"jerri", ("thin")
J.F. Mann 1840's, eora
(coastal ORIGINAL-B).

hence the adjective (with repetition implying degree)

"jarra : jarra", ("lean")
dharug, (ORIGINAL-A).
"birra : birra", ("light, not heavy")
"thurrawal", (HUYGENS CIRCLE).
R.H. Mathews: 1901, 1903

The gregarious soldier crab *mictyris longicarpus*
well known for forming large armies of perhaps
1000 on sandy tidal flats during low tide. It
buries itself and emerges by eruptions of
tumbled sand ready to feed.
Appendix

**garu / gura**

The most common root is

\[
\text{garu} = \text{FROM, out-of, sound} \quad \text{(adjective)}
\]

\[
\text{ORIGINAL} \rightarrow \text{HUYGENS CIRCLE}
\]

"gara", ("tell")
R.H. Mathews 1903,
"thurrawal" = ngunawal.
"kuru", ("wind")
Dr. J. Lhotski 1834, ngarigu.
(HUYGENS CIRCLE).

"curry", ("wind")
J.F. Mann 1840's, eara.
"gora", ("wind")
J. Rowley 1875, cowpastures.
(coastal ORIGINAL – B)

"kheroo", ("the voice"), ancient egyptian
"garrulus", ("chattering, babbling"), latin
"kara", ("from"), japanese

hence the augmented form

\[
\text{garu} \rightarrow \text{gun} \quad \text{ORIGINAL} \rightarrow \text{HUYGENS CIRCLE}
\]

"karu: gan(g)", ("common magpie")
"kurru: gaiә", ("shout")
R.H. Mathews 1903,
"thurrawal" = ngunawal.
(HUYGENS CIRCLE).

"karrai: gn", ("shout")
W. Dawes 1790, eora.
(coastal ORIGINAL – B)

and the repeat-word

\[
\text{gar(u)} \rightarrow \text{garu} \quad \text{ORIGINAL} \rightarrow \text{B}
\]

"garr: garr",
" γαρ : γαρ", ("s lime left behind in the trail of slugs and worms")
("g arg le"), greek
C. Richards 1902, wiradjuri.
(ORIGINAL – B).

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Appendix

as well as

\[
\text{gar}(u) - i = \begin{cases} \text{(OUT) GOING,} \\ \text{emanating} \end{cases} \quad \text{ORIGINAL - B}
\]

"gor: ey", ("juice" = squirt)
Capt. J. Hunter 1793, eora.
"garr: ee ", ("to cough")
W. Dawes 1790, eora.
(coastal ORIGINAL-B)

and

\[
\text{garu} - n = \begin{cases} \text{source, teat,} \\ \text{spring} \end{cases} \quad \text{SOUTHERN - B}
\]

"kuuruu: m", ("teat")
J. Dawson 1881, chaap whurrung
(SOUTHERN-B)

which is the basis for

\[
\text{some-thing going-away} = \text{GIVING / OFFERING}
\]

as in

\[
\text{\begin{cases} \text{nun} - (d'ula : n) - \text{ga}(ru) : wur(u) : i \\ \text{some-thing} \quad \text{going-away} \end{cases} = \text{GIVING / OFFERING}}
\]

\[
\text{\begin{cases} \text{ORIGINAL - A} \\ \text{ORIGINAL - B} \\ \text{TURUWAL} \end{cases}}
\]

"yoon'::: go : war' r : ee"
"yoon'::: g : eer : ee"
("a giver, to give")
M.M. Everitt 1900, gundungara
(ORIGINAL - A).

"\eta ::: \text{w} : \text{i} ", ("give")
W. Dawes 1790, eora
(coastal ORIGINAL - B).

"\eta ::: \text{a} : \text{i} ", ("give")
J. Malone 1875, botany bay
(TURUWAL)
Appendix

\[
\begin{align*}
\text{some} & \quad \text{thing} \\
\text{nun} & \quad \text{wu(ru)} & \quad \text{dula} : n & \quad \text{ga(ru} : i) \\
\text{away} & \quad \text{going} & \quad \text{= GIVING / OFFERING}
\end{align*}
\]

\[
\begin{align*}
\text{or} & \quad \text{thing} \\
\text{nun} & \quad \text{wu(ru)} & \quad \text{dula} : n & \quad \text{ga(ru} : i) \\
\text{away} & \quad \text{going} & \quad \text{= GIVING / OFFERING}
\end{align*}
\]

\[
\begin{align*}
\text{":: jillia : n : ga ::", ("towards"??)} & \quad \text{J. Rowley 1875, cowpastures} \\
\text{Re v.J. Bulmer 1876, kurnai} & \quad \text{(coastal ORIGINAL – B)} \\
\text{"yug : wa :: n ::", ("give")} & \quad \text{R.H. Mathews 1903, kurnai} \\
\text{R.H. Mathews 1902, kurnai} & \quad \text{(SOUTHERN – B)} \\
\text{":: du :: ga ::", ("give")} & \quad \text{R.H. Mathews 1903,} \\
\text{"thurrawal" = ngunawal} & \quad \text{(HUYGENS CIRCLE)} \\
\end{align*}
\]

\[
\begin{align*}
\text{or} & \quad \text{thing} \\
\text{wu(ru) : ga(ru) } & \quad \text{n : du(la) } & \quad \text{i } & \quad \text{n(un)} \\
\text{= GIVING / OFFERING}
\end{align*}
\]

\[
\begin{align*}
\text{":: ga : n : d : i : n ", ("from")} & \quad \text{kurrn kopan noot} \\
\text{R.H. Mathews 1901,} & \quad \text{(HUYGENS CIRCLE)} \\
\text{"thurrawal" = ngunawal} & \quad \text{J. Dawson 1881} \\
\text{(HUYGENS CIRCLE)} & \quad \text{"wo : ka :: k : i : n ", ("give"),} \\
\text{D. Paine 1794, eora} & \quad \text{kurrn kopan noot} \\
\text{(coastal ORIGINAL – B)} & \quad \text{"wo : ka :: g : ee ::", ("give"),} \\
\text{Re v.J. Bulmer 1876, kurnai} & \quad \text{chaap wuwrong} \\
\text{(SOUTHERN – B)} & \quad \text{J. Dawson 1881} \\
\text{"u : ca :: tho ::", ("gave I")} & \quad \text{"u : ca :: n : a ::", ("I give")} \\
\text{"u : ca :: n : a ::", ("I give")} & \quad \text{Re v.J. Bulmer 1876, kurnai} \\
\text{(SOUTHERN – B)} & \quad \text{(SOUTHERN – B)}
\end{align*}
\]
Aboriginal man sharing culture with the kids
picture by Ainsley Roberts

or

\[ \text{wu}(ru) : \text{ga}(ru : i) - \text{nun} - \text{du}(la : n) \]

= GIVING / OFFERING

"yo : ka :: nan : ga : ", ("give")

R.H. Mathews 1907, birdhawal
(coastal ORIGINAL - B)

and also (see page 63)

\[ \text{wir}(u) - \text{wu}(ru) : \text{ga}(ru : i) : \text{nun} : \text{du}(la : n) \]

improprietous, unfortunate

GIVING / OFFERING

= LOSE - ING

"parr : bu : g :: y : ", ("I have lost it")

W. Dawes 1790, eora
(coastal ORIGINAL - B)
Appendix

At the opposite extreme we have

\[
gūra \quad \text{ORIGINAL} - B
\]

= TOWARD, in-to, cavious (adjective)

\[
\begin{align*}
\text{kurui} &= \text{gara} = \text{kara}, \quad \text{(molluscan shell)}; \\
\text{koro} &\quad \text{(inner); japanese.} \\
\sigma\alpha\lambda\gamma\kappa\rho\iota &\quad \text{"snail" = tubular shell}; \\
\chi\varepsilon\iota\rho\omicron\upsilon &\quad \text{"surgeon"; greek.} \\
gur\omega &\quad \text{"mouth"; rumanian.}
\end{align*}
\]

"kurū", ("throat")
L. Malone 1875, wodi wadi.

"kurra", ("ear")
J. Rowley 1875, cowpastures.

"goora", ("drown")
P.G. King 1793, eora.

"goorā", ("sunk")
D. Collins 1798, eora
(coastal ORIGINAL - B).

also

\[
gūra - i \quad \text{UNIVERSAL}
\]

= (IN)COMING, receiving, "hearing" (verb)

\[
\begin{align*}
\text{"gur : i", ("ear")} &\quad \text{P.G. King 1793 .} \\
\text{R.H. Mathews 1903,} &\quad \text{"gor : ee", D. Southwell 1788 .} \\
\text{"thurrawai" = ngunnawal .} &\quad \text{"goor : ee", W. Tench 1788 .} \\
\text{(HUYGENS CIRCLE)} &\quad \text{"gor : ey", D. Paine 1794.} \\
\text{"gr : i",} &\quad \text{("the ear" = the receptacle for sound), eora} \\
\text{("canoe" = receptacle for people)} &\quad \text{(coastal ORIGINAL - B).} \\
\text{R.H. Mathews 1902, kurnai} &\quad \text{"kur : i", ("the ear")} \\
\text{(SOUTHERN - B).} &\quad \text{R.H. Mathews 1901, dharruk} \\
\text{("ORIGINAL - A") .} &\quad \text{"ORIGINAL - A") .}
\end{align*}
\]

and

\[
gūra - mura \quad \text{ORIGINAL} - B
\]

large-cavity = mouth, hole

"gerrō : māh", ("devil")
I. Nathan 1849, wodi wodi.

"go : mira", ("a hole")
Capt. J. Hunter 1793, eora.
(coastal ORIGINAL - B)
also the repeat noun

\[
gura : n \rightarrow \text{beak—pair}
\]

or more concisely

\[
gura : n \rightarrow \text{tube—s}
\]

also brain (= [thing] between [the] ears)

\[
gora : n \rightarrow \text{between}
\]

"ko:b:bera:", ("head")
R.H. Mathews 1901, dharruk.

"ca::bera:", ("head")
P.G. King 1798, eora.

"::brai:n", english

"ka::besa:", spanish

"k::OL:pi:o:zi", greek

or

\[
bura : n \rightarrow \text{brain}
\]

"bu::k::kurae", ("between")
kuurn kopan noot, peek whurrung.

"bu::k::karyu", ("between")
chaap wurrong.

J.F. Mann 1840's, kuringai
(coastal ORIGINAL—B)

Pettit & Dawson 1850's, kurnai
(SOUTHERN—B)

J. Rowley 1875, cowpastures
(coastal ORIGINAL—B)

J. Malone 1875, botany bay
(TURUWAL)

W. Dawes 1790 eora.

P.G. King 1790, eora.

D. Collins 1798, eora.

J. Rowley 1875, cowpastures.
(coastal ORIGINAL—B)

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hence to think / remember

\[ \text{wín} - \text{gora: bulala: (bora: n)} \]

\[ \text{= wring} \]

\[ \text{= brain} \]

\[ \text{= tube} \]

\[ \text{= greatly} \]

\[ \text{= coiling} \]

\[ \text{original - A} \]

\[ \text{original - B} \]

\[ \text{":: bulala :: ", (" forget" ??)} \]

\[ \text{R.H. Mathews 1901, dharruk.} \]

\[ \text{(original - A)} \]

\[ \text{"wínn: gārah :: ", (" to think" )} \]

\[ \text{W. Dawes 1790 eora .} \]

\[ \text{(coastal original - B)} \]

also gastropod/snail shell (= greatly coiling tube)
"ma: kour:: i: ngre", ("murex tuberculex, pl. 36")
"me: koura :: ra", ("actine" = bubble shell, Bulla quoyii)
"mara :::: ", ("nerite noire, pl. 65" = black periwinkle)
J.P. Gaimard 1826, jervis bay

or

$\text{gun} : g(\text{un}) \quad \text{=} \quad \text{tube}$

$\text{gura} : n \quad \text{=} \quad \text{coiling}$

J.P. Caimard 1826, jervis bay (TURUWAL)

"koun :: kourou :: ng", ("pls. 52 – 53", cone shell Conus sanguinol).
"koun :: gourou :: ", (" pl. 43", casque frangé shell Cassis fimbriata).
":: koro :: ng", (" peign, pl. 36", spiky cone murex)
J.P. Gaimard 1826, jervis bay (TURUWAL)

also the important form

**some-thing coming-near = RECEIVING / REQUESTING**

as in

\[
\frac{\text{some}}{\text{jun}} - \left( \frac{\text{gur(a)} : i}{i : \text{gur(a)}} \right) - \frac{\text{thing / item}}{\text{d\(\text{u}(\text{la} : n)\)}} - \frac{\text{jin}}{\text{near}} \quad \text{comin g}
\]

= RECEIVING / REQUESTING / NEEDING

UNIVERSAL

"kit : pur :: ta :: g' nin", PW
"keut : kar :: ta :: wan", KKN
J. Dawson 1881, (" ask") .
"ngun : da :: dha :: ", kurnai
R.H. Mathews 1904, (" beg") .
"ngan : oo : k :: ", wallithica
D. Matthews 1874, (" to want") .
(SOUTHERN - B)

"yoon : g' : ce :: ", (" give")
M.M. Everitt 1900, gundungara
(ORIGINAL - A) .
R.H. Mathews 1904, ngunawal
(HUYGENS CIRCLE) .

"; gar : i :: n", (" to obtain")
" : g : i :: ", (" please (pray)" )
W. Dawes 1790, eora
(coastal ORIGINAL - B)
Appendix

\[
\text{pun} - \text{nin} : \text{gur}(a) - \text{du}(la : n) - i \quad \Rightarrow \quad \text{receive} / \text{request} / \text{need}
\]

\[
\text{O} = \text{RECEIVING} / \text{REQUESTING} / \text{NEEDING}
\]

\[
\text{HUYGENS CIRCLE}
\]

\[
\text{dyung} :: \text{ga} : \text{dy}a :: i", \quad \text{"request"}
\]

\[
\text{R.H. Mathews 1904, ngunawal}.
\]

\[
\text{HUYGENS CIRCLE}
\]

also the more severe notion of "enhanced recievement" as in

\[
\text{mu}(\text{ra} - \text{gura}) :: i - \text{du}(la) : n \quad \Rightarrow \quad \text{TAKING} / \text{STEALING} / \text{DEMANDING}
\]

\[
\text{greatly incoming} \quad \text{thing}
\]

\[
\text{O} = \text{TAKING} / \text{STEALING} / \text{DEMANDING}
\]

\[
\text{D. Collins 1798, eora}.
\]

\[
\text{D. Southwell 1788, eora}.
\]

\[
\text{coastal ORIGINAL - B}
\]

or

\[
\text{gura} - \text{d(ula} : n - i) - \text{mu(ra)} \quad \Rightarrow \quad \text{TAKING} / \text{STEALING} / \text{DEMANDING}
\]

\[
\text{UNIVERSAL}
\]

\[
\text{carra} :: \text{ma", \quad \text{"stealing"}
\]

\[
\text{D. Collins 1798, eora}.
\]

\[
\text{P.G. King 1793, eora}.
\]

\[
\text{ORIGINAL - A}
\]

\[
\text{kar} :: \text{ma", \quad \text{"steal"
\]

\[
\text{J. Rowley 1875, eora}.
\]

\[
\text{coastal ORIGINAL - B}
\]

\[
\text{kur} :: \text{ba", \quad \text{"take"
\]

\[
\text{R.H. Mathews 1902, kurnai}
\]

\[
\text{SOUTHERN - B}
\]

\[
\text{R.H. Mathews 1901, dharruk}
\]

\[
\text{P.G. King 1793, eora}.
\]

\[
\text{ORIGINAL - A}
\]

\[
\text{kar} :: \text{ma", \quad \text{"steal"
\]

\[
\text{J. Rowley 1875, cowpastures}
\]

\[
\text{coastal ORIGINAL - B}
\]

\[
\text{garra :: \quad \text{catch, stop, hold or take"
\]

\[
\text{C. Richards 1902, wiradjuri}
\]

\[
\text{inland ORIGINAL - B}
\]
Appendix

or

\[ mu(ra) - d(ula) : n - \left( i : gur(a) \right) \]
\[ gur(a) : i \]

\[ \text{= TAKING / STEALING / DEMANDING} \]

\[ "\text{"ma :: n : i : au"}, \ "\text{take"} \]
R.H. Mathews 1904, dharruk
(ORIGINAL – A)

\[ "\text{"ma :: n : i : ng"}, \ "\text{take"} \]
W.J. Enright 1900, pt. stephans
(coastal ORIGINAL – B)

and also (see page 57)

\[ mu(ra : dula) : n : (gura) \]
\[ \text{wuri} \]

\[ \text{= COLLECT} \]

\[ \text{proprietously} \]

\[ \text{fortuitously} \]

\[ \text{= FIND - ING} \]

\[ "\text{"ma :: n :: wa're"}, \ "\text{to find"} \]
W. Dawes 1790, corah
(coastal ORIGINAL – B)
Appendix

**garu / gura**

A simple example is

\[
\text{garu} \quad = \quad \text{squishy, fluffy}
\]

as opposed to

\[
\text{gura} \quad = \quad \text{firm, hard}
\]
The common root is

\[
gula \quad \text{gula} \quad \text{ORIGINAL - B} \quad \text{ORIGINAL - A} \quad \text{TURUWAL}
\]

= shiny, vital
radiant
(adjective)

\[
"kuller", \quad \text{"good"}
J. Malone 1875, botany bay
(TURUWAL).
\]

\[
κάλο, \ Καλάλο \text{ (female beauty)};
καλα (well, alright, properly);
γαλα (blue sky); greek.
gulio, latin.
G.F. Angus 1847
\]

and the repeat word

\[
gol(a) - gol(a) \quad \text{ORIGINAL - B} \quad \text{SOUTHERN - B}
\]

= RADIATING - EST,
EMANATING - EST
(superlative adjective)

\[
"gall : gall", \quad \text{"noisy, as in Cicada"}
J. Dawson 1881, chaap whurrong
(SOUTHERN - B)
\]

\[
"gul : gul", \quad \text{"smallpox"}
J. Rowley 1875, cowpastures.
(coastal ORIGINAL - B)
\]

\[
"galah", \quad \text{(the cockatoo, Eolophus roseicapillus)}
yuwaalaray, northern NSW.
"killu", \quad \text{"clear, shining"}
Re v.W. Ridley 1875, kamilaroi.
(ORIGINAL - A)
\]

\[
"gila", \quad \text{"bore, place name meaning 'flowing away'"}
A.E. Martin 1943
\]
Appendix

hence the words

\[ \text{gol(a)}: i \]

= shining, radiating,
[light, vitality, sound]
(verb)

\[ \text{kal} : i, \ ("\text{water}\") \]
\[ \text{kiil} : \, \ ("\text{urine}\") \]
\[ \text{kill} : i, \ ("\text{shine, spark}\") \]
R.H. Mathews 1901, dharruk .

\[ \text{gill} : i, \ ("\text{moon}\") \]
Re v.W. Ridley 1875, kamilaroi .

(ORIGINAL – A)

\[ \text{McNicol} \ & \text{Hosking} \ 1994, \ \text{ngiyampaa} . \]
\[ \text{"kil" : }, \ ("\text{urine}\") \]
R.H. Mathews 1904, wiradjuri
(inland ORIGINAL – B)

and

\[ \text{gul(a)} : i – \etauru \]

= twinkling, sparkling
(verb)

\[ \text{"kul::nuura", \ ("moon") } \]
J. Malone 1875, botany bay .

(TURUWAL)

\[ \text{Re v.J. Gunther 1840’s, wiradjuri} \]
(inland ORIGINAL – B)

\[ \text{"gull:e:n", \ ("a swamp")} \]
C. Macalister 1907, midthung
(HUYGENS CIRCLE)

Note: A.W. Reed [1969, pages 6 – 8] complained
of the 22 different ways that wiradjuri sources alone
used to spell water: it is not science he claimed.

and also the nouns

\[ \text{gola:i (i)} \]

= radiating
(noun – stem)

\[ \text{"galla::n", \ ("the sun")} \]
Sir Joseph Banks 1770, eorah
(coastal ORIGINAL – B)

and

\[ \etauru \]

= throbbing
(noun–stem)

\[ \text{baro::n: gl: e", \ ("vein")} \]
D. Collins 1798, eorah
(coastal ORIGINAL – B)
Appendix

Also the augmented adjectival form

\[
gula: (i) \rightarrow gun
\]

very shining = NICE

as in

\[
gun : gula : i \rightarrow n
\]

very shining = NICE

place/thing

HUYGENS CIRCLE

\["gun: gahl: i: n", \ "goon: garl: i: ne",
\]
historic homestead built and named by the sportsman william davis jr in 1860's
"the Queanbeyan Age", 30th Jan 1873.

"kan: galoo:: n"
myrtle, a hardwood used for weapons,
Sir W. Macarthur 1861, midthung

and the form (see pages 85 and 95)

\[
(gun : go)la : i \rightarrow n \rightarrow min
\]

= NICE place

the

SOUTHERN – B

\["la : i : n : man", \ "good"
\]
Pettit & Dawson 1850’s, kurnai.

\["la :: n : e", \ "good"
\]
Re v.J. Bulmer 1876, kurnai

providing the logical basis for GOOD / CORRECT as in

\[
\etaun \rightarrow gun : gula : (i)
\]

YES NICELY

= GOOD / CORRECT

\["na : gun : g: ", \ "good"
\]
D.K. Eades 1976, dhurga

(SOUTHERN – B)

\["man : dhan : g: ", \ "right"
\]
R.H. Mathews 1908, ngarigu.

\["ban : gala: ", \ "excellent"
\]
W. Govett 1828 – 32, ngunawal.

(HUYGENS CIRCLE)
Appendix

or

\[
\begin{align*}
(gun) : gula : i - \eta \eta & \quad \rightarrow \quad ^{\text{GOOD / CORRECT}} \\
= & \quad ^{\text{BAD / WRONG}} \\
\text{Kitty Cooper 1870's, moira} \\
(\text{SOUTHERN - B})
\end{align*}
\]

as apposed to BAD / WRONG

\[
\begin{align*}
\underbrace{gun : g(ula) : i - \eta \eta} \quad & \quad \rightarrow \quad ORIGINAl - A \\
\underbrace{= \quad \text{BAD / WRONG}} \\
\text{HYUGENS CIRCLE} \\
(\text{SOUTHERN - B})
\end{align*}
\]

\[
\begin{align*}
" \text{gun} : i : \text{ng} " , \quad (^{\text{excrement}}) \\
" \text{gur} : \text{nung} " , \quad (^{\text{bad}}) \\
R.H. Mathews 1903, \\
" \text{thurrawal} " = \text{ngunawal} \\
(\text{HYUGENS CIRCLE})
\end{align*}
\]

\[
\begin{align*}
" \text{gu} : d" : \text{ba} " , \quad (^{\text{bad}}) \\
M.M. Everitt 1900, \text{gundungara} \\
(\text{ORIGINAl - A})
\end{align*}
\]

or

\[
\begin{align*}
\eta \eta - \underbrace{\left( g(un) : gula \right)} \quad & \quad \rightarrow \quad \text{ORIGINAl - B} \\
\underbrace{= \quad \text{BAD / WRONG}} \\
\text{HYUGENS CIRCLE} \\
(\text{SOUTHERN - B})
\end{align*}
\]

\[
\begin{align*}
" \text{cù} : \text{g} : \text{gil} " , \quad (^{\text{bad, ugly}}) \\
T. Rayment 1933 . \\
" \text{wong} : \text{kal} : \text{ke} : i " , \quad (^{\text{foolishness}}) \\
" \text{wong} : \text{kal} : " , \quad (^{\text{to be a fool}}) \\
\text{Rev.L.E. Threlkeld 1834, awabakal} \\
(\text{coastal ORIGINAl - B})
\end{align*}
\]

or

\[
\begin{align*}
\eta \eta - \underbrace{\left( g(un) : gula \right)} - \underbrace{i} \quad & \quad \rightarrow \quad \text{ORIGINAl - B} \\
\underbrace{= \quad \text{BAD / WRONG}} \\
\text{HYUGENS CIRCLE} \\
(\text{SOUTHERN - B})
\end{align*}
\]

\[
\begin{align*}
" \text{nany} : \text{galon} : \text{g} " , \quad (^{\text{bad}}) , \text{queanbeyan} \\
" \text{narre} : \text{golan} : \text{g} " , \quad (^{\text{bad}}) , \text{yass} \\
" \text{tu} : \text{k} : \text{kayil} " , \quad (^{\text{no}}) \\
\text{E.M. Curr 1887, ngunawal} \\
(\text{HYUGENS CIRCLE})
\end{align*}
\]

\[
\begin{align*}
" \text{tu} : \text{g} : \text{gaelee} " , \quad (^{\text{no}}) , \text{batemans bay} \\
" \text{tu} : \text{g} : \text{g} : \text{i} " , \quad (^{\text{no}}) , \text{ylladulla} \\
\text{J. Larmer 1853, dhurga} \\
(\text{SOUTHERN - B})
\end{align*}
\]
Appendix

Stronger meaning was attained

\[
gula : i - \text{gun : g(\text{un})} = \text{extremely shining}
\]

("queah :: gan : g", gundungara
("the name of Princess Betsy")
(ORIGINAL – A).

"cull : i : a : gh", ("good")
I. Nathan 1849, wadi wadi
(coastal ORIGINAL – B)

or

\[
gu(n) : gol(a) : gu(n) : i = \text{extremely shining}
\]

as in EXCELLENT / INSPIRED / MAGNIFICENT

\[
\eta\nu(n) - g(\text{ola} : \text{i}) : \text{gun} : g(\text{un})
\]

YES extremely – shiningly

= EXCELLENT / INSPIRED / MAGNIFICENT

("nu : k :: k\text{un} : g", ("good")
R.H. Mathews 1903,
"thurrawal" = ngunawal
(HUYGENS CIRCLE)

or

\[
gula : i : gu(n) : gu(n) - \eta\nu(n)
\]

= EXCELLENT / INSPIRED / MAGNIFICENT

(":: gui : gui : gnia", ("excellent")
E. Dunlop 1840, awabakal
(coastal ORIGINAL – B)
as opposed by FOOLISH / ABSURD

\[
\begin{align*}
(gula : i) : gun : gu(n) &- nun \\
\text{extremely} & \quad \text{NOT}
\end{align*}
\]

= FOOLISH / ABSURD

\[
\text{HUYGENS CIRCLE}
\]

or

\[
\begin{align*}
nun &- (gula : i) : gun : gu(n)
\end{align*}
\]

= FOOLISH / ABSURD

\[
\text{HUYGENS CIRCLE}
\]

At the opposite extreme we have

\[
gulo
\]

= lethargic, dull, fossilized

(adjective)

\[
\begin{align*}
\text{"gooleur", \text{"koala\"}} & \quad \text{N.D. Pettit & W. Dawson 1850, kurnai} \\
\text{"kullah", \text{"koala\"}} & \quad \text{Re v.J. Bulmer 1876, kurnai} \\
\text{"gula", \text{"native bear\"}} & \quad \text{R.H. Mathews 1904, ngunawal} \\
\text{"callooa", \text{"to climb\"}} & \quad \text{Capt. J. Hunter 1793, eora} \\
\text{"kula\" or "kolle", \text{"bear\"}} & \quad \text{J. Rowley 1875, wodi wodi} \\
\text{"guulay", \text{"net bag, fishing net\"}} & \quad \text{McNicol & Hosking 1993, wiradjuri} \\
\text{"kalua", \text{"to climb\"}} & \quad \text{R.H. Mathews 1901, dharrak}
\end{align*}
\]
Appendix

as in
\[
gulu : (\eta) - \text{min} \rightarrow \\
\] = "koala" the

"kula : man", ("koala")
R.H. Mathews 1901, dharruk
(ORIGINAL - A)

"culla : wine",
Historical Records of NSW iii, p 821
(coastal ORIGINAL - B)

... the furry, nocturnal, tree-living, marsupial \textit{Phascolarctos cinereus}. It was popularly viewed as a monkey till at least 1872, a sloth till at least 1886, and a cuddly koala bear in the May Gibbs books since 1917. Vocalic metathesis has reversed the vowels.

There would also have been \textit{gulu-i} meaning "loafing" or "lazy", a verb which is conspicuous by its absence, and there are quite complicated names for Mary Everitt's red handprint caves

\[
murula : n : g(ula : i) - gulu : \eta(uru) : gun : g(\eta) \\
\] = hand (see pages 35 - 36) = marks

"murrolu : n : g : gulu : ng : :", ("red hand stencils in cave")
W. Russell 1914, gundungara
"murrolu : n : : : gun : g", ("cave with hand stencils")
Jimmy Pippen 1890, gundungara
(coastal ORIGINAL - B)

This sound again offers a plausible spectrum, but not in accordance with octahedral symmetry. We will return to this later.

picture by Ainslie Roberts, 1962
Appendix

There is a word

\[
gula
\]

- angry, harmful
- quarrelsome

(adjective)

\[
gula
\]

ORIGINAL - A

ORIGINAL - B

\[
gula
\]

- arguing, fighting
- conjuring, sulking

(verb)

- harmful - creature
- harmful - creature

= [swarm of] LUCUSTS

(animate [multitudinous] plural)

and the repeat noun

\[
gula : \eta
\]

\[
gula : \eta
\]

UNIVERSAL

thurrawal 1903 = ngunawal.

thurrawal 1904 = ngunawal. R.H. Mathews (HUYGENS CIRCLE)
also

\[
\begin{align*}
\underbrace{\text{mu(ra)}} \quad \text{gula} \quad \eta \quad \rightarrow \\
\text{greatly harmfull} \\ 
\text{creature} \\
= \text{malevolent/treacherous creature}
\end{align*}
\]

based on the adjective

\[
\underbrace{\text{gula : (mu)ra}} \quad \rightarrow \\
\text{ORIGINAL - B}
\]

with repetition expressing degree of severity

\[
\underbrace{\text{gula : m(ora)}} \quad \text{gula : m(ora)} \\
\text{malevolent} \quad \text{malevolent} \\
= \text{MURDEROUS - EST} \quad \text{(superlative adjective)}
\]

also barbed reed-spear

\[
\underbrace{\text{mu(ra)}} \quad \text{gu(la)} \quad \underbrace{\text{n(uru)}} \quad \rightarrow \\
\text{malevent} = "\text{barbed}" \\
\text{empty} \\
= "\text{reed spear}"
\]

or

\[
\underbrace{\text{nuru}} \quad \underbrace{\text{gu(la)}} \quad \text{mu(ra)} \\
\text{empty} \quad \text{malevent} = "\text{barbed}" \\
= "\text{reed spear}"
\]

\[
\begin{align*}
"\text{maia: gu: ng"}, \\
\text{"spear"} \\
\text{L. Malone 1875, wodi wodi} \\
\text{(coastal ORIGINAL - B)}
\end{align*}
\]

\[
\begin{align*}
"\text{maia: gu: ng"}, \\
\text{"spear"} \\
\text{L. Malone 1875, wodi wodi} \\
\text{(coastal ORIGINAL - B)}
\end{align*}
\]

\[
\begin{align*}
"\text{maia: gu: ng"}, \\
\text{"spear"} \\
\text{L. Malone 1875, wodi wodi} \\
\text{(coastal ORIGINAL - B)}
\end{align*}
\]

\[
\begin{align*}
"\text{maia: gu: ng"}, \\
\text{"spear"} \\
\text{L. Malone 1875, wodi wodi} \\
\text{(coastal ORIGINAL - B)}
\end{align*}
\]

\[
\begin{align*}
"\text{maia: gu: ng"}, \\
\text{"spear"} \\
\text{L. Malone 1875, wodi wodi} \\
\text{(coastal ORIGINAL - B)}
\end{align*}
\]

\[
\begin{align*}
"\text{nooro: ca: my"}, \\
\text{"[a long] spear with one barb"} \\
\text{D. Collins 1798, eorah} \\
\text{(coastal ORIGINAL - B)}
\end{align*}
\]

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Appendix

At the other extreme

\[
galu \quad \xrightarrow{SOUTHERN-B} \quad "galu" \ or \ "karlo", \quad ("white faced heron")
\]
R.H. Mathews 1902, kurnai

and mud crab (see picture on page 53)

\[
galu \quad - \quad gu(\text{ru}) \quad \rightarrow \quad "gali: ga", \ ("crab")
\]
D.K. Eades 1976, Dhurga
(SOUTHERN-B)

or

\[
guru \quad - \quad gal(\text{u}) \quad \rightarrow \quad "gari: ga", \ ("crab")
\]
D.K. Eades 1976, Dhurga
(SOUTHERN-B)

Furthermore the opposing senses are captured in

\[
gula \quad - \quad baru \quad \rightarrow \quad "gula: birra", \ ("refuse, reject")
\]
C. Richards 1902, wiradjuri
(inland ORIGINAL-B)

and

\[
galu: \text{gun} \quad - \quad baru \quad \rightarrow \quad "gala: gan: barra", \quad ("wipe the dirt off the feet")
\]
Rev.J. Gunther 1892, wiradjuri
(inland ORIGINAL-B)

and I'm sure there was a verb *galu-i* meaning "celebrating, helpful", as opposed to *gula-i* meaning "sulking". Thus we anticipated approximately 9 words of the form $g^{**}$, and immediately have 10, though the lone pair *gula/gulo* does not follow Octahedral Symmetry. We will return to this later.
Appendix

**buru / buru**

The next candidate is

\[ \text{buru} \]

\[
\begin{align*}
= & \text{slow, quiet,} \\
& \text{tired, tranquil (adjective)}
\end{align*}
\]

\[ \rightarrow \]

\[ \begin{align*}
& \text{ORIGINAL – B} \\
& \text{SOUTHERN – B} \\
& \text{HUYGENS CIRCLE}
\end{align*} \]

"burro", ("still"). kaurna
Teichelmann & Schurmann 1840
(ADALEIDE)

"birra", ("tired"). wiradjuri
McNicol & Hosking 1994
(inland ORIGINAL – B)

"barru", ("tired")
"berru(ng)", ("mist")
thurrawal = ngunawal
R.H. Mathews 1903
(HUYGENS CIRCLE)

"barray" or "burral", dhurga
(they name Shoalhaven River)
W. Bothong, cited by A. Campbell 1899
(SOUTHERN – B)

hence the superlative adjective

\[ \begin{align*}
\text{buru – buru} \\
= & \text{LAZY – EST, QUIET – EST,} \\
& \text{SLOW – EST (superlative adjective)}
\end{align*} \]

\[ \rightarrow \]

"birra : birra", ("lazy"–est)
McNicol & Hosking 1994, wiradjuri
(inland ORIGINAL – B)

"burro : burro", ("bye and bye")
Teichelmann & Schurmann 1840
(ADALEIDE)

as well as the augmented forms

\[ \begin{align*}
\text{mur(a) – buru} \\
greatly slow / quiet = " gliding" (adjective)
\end{align*} \]

\[ \rightarrow \]

"mier : barrar", ("smooth")
J. Banks 1770, eora
(coastal ORIGINAL – B)
Appendix

and

\[
gun - buru \quad \rightarrow
\]

= very slow / quiet  
(adjective)

\[
\begin{align*}
" jan : boara ", (" slow ") & \\
thurrawal & = ngunawal \\
(\text{HUYGENS CIRCLE}) & \\
M. Munima 1863, \ wadi wadi .
\end{align*}
\]

\[
\begin{align*}
" koong : burry ", (" sleep ") & \\
F. McCaffrey 1920, \ s, \ wadi wadi .
\end{align*}
\]

(also buru - i : gula : (ŋuru)  
[ lazy ] part of ] [ the daily ] shine cycle  
= NIGHT TIME

\[
\begin{align*}
" br : i : gela ", (" sleep ") & \\
J.F. Mann 1840's, \ eorah .
\end{align*}
\]

\[
\begin{align*}
" bourra :: ", (" sky ") & \\
D. Collins 1798, \ eoroh .
\end{align*}
\]

\[
\begin{align*}
" purra :: ", (" night ") & \\
J. Malone 1875, \ bo tan y bay .
\end{align*}
\]

(also coastal ORIGINAL - B)

hence the adjective

\[
\begin{align*}
buru : (gula : i : ŋuru) & \quad - \quad buru : (gula : i : ŋuru) \\
\text{black} & \quad \text{black}
\end{align*}
\]

= BLACK-EST  
(superlative adjective)

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Appendix

"boora::boora::", ("blackest")
M.M. Everitt 1900, gundungara

hence a new (= black) moon

\( \text{win}:d\text{a}(l\text{a}:n) - \text{buru}-g(\text{ula}) : i : (\text{njuru}) \)

orbitsing thing = MOON
between shine – cycles = black

" yanna : dah :: para : g : i ::",
("new moon")
P.G. King 1793, eora

as distinct from half moon

\( \eta(u:\text{uru} :i : g\text{ula} - \text{win}:d\text{ula}) : n \)

mid, half = lunar cycles

" ngirra : ng ::::: " , ("moon")
Re v.F.A. Hagenauer 1876, kurnai .
" ngerru ::::: " , ("moon")
W. T hom as 1860, kurnai .
" nerra ::::: " , ("moon")
Re v.J. Bulmer 1876, kurnai .
" narru ::::: " , ("moon")
(SOUTHERN – B)

" inarra : ng ::::: " , ("half a moon")
J. Lingard 1838, ngunawal
(HUYGENS CIRCLE)

" narra : ng ::::: " , ("anything small")
P.G. King 1793, eora.
(coastal ORIGINAL – B)

and full moon

\( \text{mura} - \eta(u:\text{uru} :i : g\text{ula} - \text{win}:d\text{ula}) : n \)

large = lunar cycles

" murray ::::: yanna : dah ::",
P.G. King 1793, ("full moon"), eora
(coastal ORIGINAL – B)

" meheer : ong ::::: ", ("full moon")
J. Dawson 1881, kuurn kopan noot
(SOUTHERN – B)

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Appendix

\[ \text{mura} - \text{du (la: n)} : \text{wijn} - g(\text{ula: i:uru)} = \text{lunar cycles} \]

"mirtae : ta : nyuu : k ::", ("full moon")

J. Dawson 1881, chaap whuuron (SOUTHERN-B)

At the opposite extreme we have

\[ \text{buru} \]

= quick, noisy, vigorous

( adjective)

"burrai", ("wallaby")
Re v.W. Ridley 1875, kamilaroi
"baro", (" quick")
R.H. Mathews 1901, dharruk.
(ORIGINAL - A)

"burra", (" quick, rock wallaby")
R.H. Mathews 1904, ngunawal.
(HUYGENS CIRCLE)

"buurray", ("fart"), wiradjuri
"burrai", (" quick"),
"burai", (" child"),
R.H. Mathews 1904, wiradjuri.
(inland ORIGINAL - B)

"barrao", (" make haste")
"beria", (" sing ")
J. Rowley 1875, cowpastures,
(coastal ORIGINAL - B)

and the adjective

\[ \text{buro} - \text{buro} \]

= FAST - EST, NOISY - EST

(superlative adjective)

"burra : burri", ("be quick")
"booroo : boorya", ("gun")
N.D. Pettit & W. Dawson 1850's, kurnai
(SOUTHERN-B)

There may even have been a verb buru-i which meant "hurrying, bustling", in opposition to the verb buru-i meaning "loafing, wasting-time, sleeping".
Appendix

**baru / bura**

Consider the word

\[
\text{baru} \quad = \quad \text{either - side, opposite (adjective)}
\]

<table>
<thead>
<tr>
<th>English</th>
<th>Original</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;birra&quot;, (&quot;cheek&quot;),</td>
<td>ORIGINAL - B</td>
</tr>
<tr>
<td>&quot;(dhaum)bara&quot;, (&quot;spread apart&quot;),</td>
<td>TURUVAL</td>
</tr>
<tr>
<td>R.H. Mathews 1903,</td>
<td>HUYGENS CIRCLE</td>
</tr>
<tr>
<td>&quot;thurrawal&quot; = ngunawal.</td>
<td></td>
</tr>
<tr>
<td>(HUYGENS CIRCLE)</td>
<td></td>
</tr>
<tr>
<td>(\mu \nu \rho (\tau \sigma), ) (&quot;arm&quot;), greek.</td>
<td></td>
</tr>
<tr>
<td>bra(cchium), (&quot;arm&quot;), latin.</td>
<td></td>
</tr>
<tr>
<td>bra(ziere), french.</td>
<td></td>
</tr>
<tr>
<td>brea(st), english.</td>
<td></td>
</tr>
<tr>
<td>&quot;peerah&quot;, (&quot;cheek&quot;),</td>
<td></td>
</tr>
<tr>
<td>M. Munima 1863, wodi wodi</td>
<td></td>
</tr>
<tr>
<td>&quot;birra&quot;, (&quot;the cheek&quot;),</td>
<td></td>
</tr>
<tr>
<td>Capt. J. Hunter 1793, eora.</td>
<td></td>
</tr>
<tr>
<td>&quot;brua&quot;, (&quot;near to&quot;),</td>
<td></td>
</tr>
<tr>
<td>W. Dawes 1790, eora.</td>
<td></td>
</tr>
<tr>
<td>(coastal ORIGINAL - B)</td>
<td></td>
</tr>
<tr>
<td>&quot;bera&quot;, (&quot;joue&quot; = cheek)</td>
<td></td>
</tr>
<tr>
<td>J.P. Gaimard 1826, jervis bay.</td>
<td></td>
</tr>
<tr>
<td>(TURUWAL)</td>
<td></td>
</tr>
</tbody>
</table>

and the word "belly-button"

\[
\text{min} \quad - \quad \text{nura} \quad = \quad \text{centre, middle}
\]

<table>
<thead>
<tr>
<th>English</th>
<th>Original</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;moo: neero&quot;, (&quot;navel&quot;)</td>
<td>ORIGINAL - A</td>
</tr>
<tr>
<td>W. Tench 1789, eora.</td>
<td></td>
</tr>
<tr>
<td>&quot;mūn: duru&quot;, (&quot;navel&quot;)</td>
<td>ORIGINAL - B</td>
</tr>
<tr>
<td>&quot;mū: nuru&quot;, (&quot;navel&quot;)</td>
<td>HUYGENS CIRCLE</td>
</tr>
<tr>
<td>W. Dawes 1790, eora.</td>
<td></td>
</tr>
<tr>
<td>&quot;moo: nōrōh&quot;, (&quot;navel&quot;)</td>
<td></td>
</tr>
<tr>
<td>D. Southwell 1788, eora.</td>
<td></td>
</tr>
<tr>
<td>&quot;moo: nurro&quot;, (&quot;navel&quot;)</td>
<td></td>
</tr>
<tr>
<td>D. Collins 1798, eora</td>
<td></td>
</tr>
<tr>
<td>(coastal ORIGINAL - B)</td>
<td></td>
</tr>
<tr>
<td>&quot;mum: birri&quot;, (&quot;navel&quot;)</td>
<td></td>
</tr>
<tr>
<td>R.H. Mathews 1901, dharruk</td>
<td></td>
</tr>
<tr>
<td>(ORIGINAL - A)</td>
<td></td>
</tr>
<tr>
<td>&quot;: nyirra&quot;, (&quot;navel&quot;)</td>
<td></td>
</tr>
<tr>
<td>R.H. Mathews 1903,</td>
<td></td>
</tr>
<tr>
<td>&quot;thurraval&quot; = ngunawal</td>
<td></td>
</tr>
<tr>
<td>(HUYGENS CIRCLE)</td>
<td></td>
</tr>
</tbody>
</table>

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Appendix

hence (points either-side of centre =) "ends"

\[ \frac{\text{nura} - \text{baru}}{\text{po int[s]}} - \frac{n: (bulala)}{\text{dual noun - stem}} \rightarrow \text{"ka : buru : n : ", ("end[s"])} \]

Rev.W. Ridley 1875, kamilaroi

(ORIGINAL--A)

and the repeat expression "cross"

\[ \frac{\text{nura} : \text{baru}}{\text{either - side of centre}} - \frac{\text{nura} : \text{baru}}{\text{either - side of centre}} \rightarrow \text{" : berai :: berai"} \]

("constellation of Orion")

"nā :: n : bir", ("cross")

Rev.W. Ridley 1875, kamilaroi

(ORIGINAL--A)

Thus we describe pairs of points, laying as dipoles, about the centre of mass \text{nura}.

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Appendix

Also we may describe a line by defining a new constant

\[ \text{min} - \text{nara} : n \]

\begin{align*}
\text{the} &= \text{edge, border,} \\ 
\text{surface} &= \text{edge, border,} \\
\text{(noun - stem)} &= \text{surface}
\end{align*}

\[ \text{ORIGINAL - A} \quad \rightarrow \quad \text{ORIGINAL - B} \]

\[ " \text{ma : nara} : n", \]

hair ornament made by sticking kangaroo teeth in hair with gum.

P.G. King 1793, eora.

\[ " \text{yin : nerri} : \text{"}, \text{("eyebrow")} \]

D. Collins 1798, eora.

\[ " \text{yiri} : n", \text{("scales of fish")} \]

R.H. Mathews 1904, wiradjuri

\[ \text{(inland ORIGINAL - B)} \]

\[ " \text{narra} : n", \text{("eyebrow")} \]

W. Dawes 1790, eora.

or a pair of parallel lines - a double edged sword

\[ \left( \text{nara} - \text{bul(ala)} \right) \]

\[ \left( \text{bu(ala)} - \text{nara(ra)} \right) \]

\[ = \text{edges} \]

\[ \text{(dual noun - stem)} \]

\[ " \text{karra : bul"} \]

"\text{bu : nya}"

"sword's edge, literally the back of the sword"

W. Dawes 1790, eora.

\[ \text{(coastal ORIGINAL-B)} \]

or the banks of a river

\[ \text{baru} - \text{nara} : \text{(bulala)} \]

\[ = \text{oppo sin g} \]

\[ = \text{edges, borders} \]

\[ \text{(implied dual noun - stem)} \]

"parro : nrah : "

"riverside bends/ flats at Bendeela in the Kangaroo Valley"

Charles Throsby, 30th March 1818

(HUYGENS CIRCLE)
Appendix

or

\[
\begin{align*}
\text{nara : (bulala)} & \quad - \quad \text{baru} \\
\quad = \text{edges, borders} & \quad = \text{opposite}\ 	ext{pines}
\end{align*}
\]

(impied dual noun - stem)

"yiri :: brai", ("edges")

Rev. W. Ridley 1875, Kamilaroi

(ORIGINAL-A)

also the repeat expression "square"

\[
\begin{align*}
\text{na(ra) : baru} & \quad - \quad \text{na(ra) : baru} \\
\quad \text{opposite edges} & \quad \text{opposite edges}
\end{align*}
\]

= "square"

" : berai :: berai"

("constellation of Orion")

Rev. W. Ridley 1875, Kamilaroi

(ORIGINAL-A)

" : barou : nga :"

("carre" = square)

J.P. Gaimard 1826, Jervois Bay

(TURUWAL)

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Appendix

We also find *baru* in the word for *eyes*

\[
\begin{align*}
\text{mol} & : i - \{ \text{b(ulo)la} \} - \text{baru} - \darrow n \rightarrow \text{UNIVERSAL} \\
& = \text{looking} \\
& = \text{eitherside (of the nose)}
\end{align*}
\]

\[
\begin{align*}
" \text{mo :: bura : }", \ (" \text{eyes}\") \\
& \text{L. Malone 1875, wadi wadi} \\
& \text{(coastal ORIGINAL - B)}
\end{align*}
\]

\[
\begin{align*}
" \text{mi :: berai : }", \ (" \text{eyes}\") \\
& \text{R.H. Mathews 1901, dharug} \\
& \text{(ORIGINAL - A)}
\end{align*}
\]

\[
\begin{align*}
" \text{le : ri : } n \", \ (" \text{eyes}\") \\
& \text{J.P. Gaimard 1826, jervis bay} \\
& \text{(TURUWAL)}
\end{align*}
\]

\[
\begin{align*}
" \text{mu :: bara : }", \ (" \text{eyes}\") \\
& \text{J. Larmer 1853, dhurga} \\
& \text{(SOUTHERN - B)}
\end{align*}
\]

and *plaits*

\[
\begin{align*}
\text{bula(la : n)} - \{ \text{m(ura)} \} - \text{ba(ro)} - i : (\text{gara}) \rightarrow \text{UNIVERSAL} \\
& = \text{pair (of things)} \\
& = \text{eitherside (of the head)}
\end{align*}
\]

\[
\begin{align*}
" \text{bala :: m: ba : i : }", \ (\text{"tresse, pour les cheveux" = plaits of hair}) \\
& \text{J.P. Gaimard 1826, jervis bay.} \\
& \text{(TURUWAL)}
\end{align*}
\]

\[
\begin{align*}
" \text{balla :: m: b : i : }", \ (\text{place name}) \\
& \text{surveyor H.F. White 1834, illawarra}
\end{align*}
\]

and in the formal description of a bivalved shell which (in contrast to the gastropod) is made from a pair of interacting shells - which need to be
considered - hence the bivalved (pelecypod) shell

\[
\begin{align*}
\text{bar(υ) - } &\quad \text{i : mu(ρ) - d(aru : n) - da(ρv) : n - nار(a)} \\
= &\quad \text{eitherside}
\end{align*}
\]

= slightly spiralling

\[
\begin{align*}
\text{bar(υ) - } &\quad \text{i : mu(ρ) - d(aru : n) - da(ρv) : n - nار(a)} \\
= &\quad \text{pair of shells}
\end{align*}
\]

(dual noun - stem)

" p : i : th : thu : n : gnar", ("oyster")
M. Munima 1863, wodi wodi.
" b : i : t : to : gni", ("oyster")
J. Rowley 1875, cowpastures.

[NOTE: Sydney Rock Oyster, Crassostrea commercialis]
(coastal ORIGINAL - B)

"bour :: da :: ", ("arche coquille")
[NOTE: Sydney Ark Shell, Anadara trapezia].
" :: ma : d :: ja :: wa ", ("telline coquille" = Tellin sp.)
J.P. Gaimard 1826, jervis bay.

(TURUWAL)

At the other extreme we have a pelican

\[
\begin{align*}
\text{bura - } &\quad \text{n : (dola)} \\
= &\quad \text{between [beaks]}
\end{align*}
\]

= creature

SOUTHERN - B

" boora : n :", ("pelican")
Pettit & Dawson 1850's, kurnai
" bura : n :", ("pelican")
R.H. Mathews 1902, kurnai

and the noun penis

\[
\begin{align*}
\text{bor(a) - } &\quad \text{n : do(λa)} \\
= &\quad \text{between [legs]}
\end{align*}
\]

= thing

HUYGENS-CIRCLE

"bur : n : da ", ("penis")
R.H. Mathews 1903,
"Thurrawal" = Ngunnawal

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Appendix

also ([thing] between labia) clitoris

\[ \text{bura} - \text{\( \gamma \)ulu} \quad \text{HUYGENS-CIRCLE} \quad \text{SOUTHERN-B} \]
\[ = \text{between} \quad \text{undulations} \quad = \text{labia} \]

("burr: nggal", ("clitoris")
R. H. Mathews 1903,
"Thurrawal" = Ngunnawal

"bra : ngolo", ("male" = X )
Re v. J. Bulmer 1876, kurnai

or (see pages 67 and 95)

\[ (\text{\( \gamma \)ulu}) - \text{bura} \quad \text{tasmanian} \quad \text{ORIGINAL-B} \]
\[ \text{undulations} \quad \text{between} \quad \text{[legs]} \]

" leu: berer ", ("woman")
" lu : bra ", ("woman")
G.A. Robinson & N.J.B. Plomley 1929 / 30

and nose

\[ \text{bura} - \text{m(olo)} : i - \text{dula : (n)} \]
\[ = \text{between} \quad \text{= eyes} \quad \text{thing} \]

(" paira : m : ce : tah ", ("smelly")
F. McCaffrey 1920's, wodi wodi
(coastal ORIGINAL - B)

": m : u : dla ":, ("nose").
Teichelmann & Schurmann 1840
ADELAIDE

and (two [things] either-side of the nose) nostrils

\[ (\text{bura}) - \text{m(olo)} : i - \text{dula} - \text{b(ulala)} - \text{ba(ru - n)} \]
\[ = \text{"nose"} \quad \text{= either-side pair [of things]} \]

": m : u : dla : p : pa ":, ("nostrils")
Teichelmann & Schurmann 1840
ADELAIDE
Appendix

**bara / buru**

In the spirit of pages 48-50 we likewise offer

<table>
<thead>
<tr>
<th>bara</th>
<th>UNIVERSAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>= amble(iferous), walk(ative) waddle(iferous) (adjective)</td>
<td></td>
</tr>
</tbody>
</table>

"baral", ("wollaby")
"booran", ("pelican")
Pettit & Dawson 1850's, kurnai.
"buran", ("pelican")
R.H. Mathews 1902, kurnai.
(SOUTHERN - B)

"burrai", ("wallaby")
Re v.W. Ridley 1875, kamlaroi.
(ORIGINAL - A)

and

<table>
<thead>
<tr>
<th>buru</th>
<th>UNIVERSAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>= bouncy, hoppy (adjective)</td>
<td></td>
</tr>
</tbody>
</table>

"buru", ("kangaroo")
"burung", ("vagina")
R.H Mathews 1903,
"thurrual" = ngunawal
(HUYGENS CIRCLE)

"burrū", ("kangaroo")
J. Malone 1875, bo tan y bay.
(TURUWAL)

"buroo", ("kangaroo")
M. Munima 1863, wodi wodi.

"burung", ("aboriginal girls name")
D.K. Eades 1976, dhurga
(SOUTHERN - B)

W. Daves 1790, eora.
(coastal ORIGINAL - B)
Appendix

**bulu / bulu**

There is a serious state

\[
\text{bulu} \quad \text{ORIGINAL—B}
\]

\text{down, flat, = "sick" (adjective)}

"bulyar" or "bulier",

("dead")

L. Malone 1875, wodi wodi.
(coastal ORIGINAL—B)

"bell"", (food descends through), english.

"billious", (feeling down), english.

"billiosis", latin.

"phala", (fruit [falls down]), sanskrit.

"pralaya", (period of rest / dissociation), sanskrit.

and its augmented form

\[
\text{bulu} - \text{gun} \quad \text{ORIGINAL—B}
\]

"sick" very

= "gravely—ill"

"billya: gooin ", ("kill")

Richard Dawsey 1887, mt. dromedary.

"pollyo: goh ", ("going to die")

Isaac Nathan 1849, wodi wodi.
(coastal ORIGINAL—B)

also we have the verb

\[
i : \text{bulu} \quad \text{ORIGINAL—A}
\]

falling, sinking = "stopping"

"o: belia",

(name of the Gumnut baby who sank/drowned)

May Gibbs 1921, gundungara.

(coastal ORIGINAL—A)

or

\[
\text{bulu}: i \quad \text{ORIGINAL—B}
\]

falling, sinking = "stopping"

"balu:i ", ("the watch is stopped, dead")

W. Dawes 1790, eora.

"bo: yee ", ("dead or die")

D. Paine 1798, eora.

"bo:i ", ("die")

J. Rowley 1875, cowpastures.

(coastal ORIGINAL—B)

---

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Appendix

I can not stress sufficiently that when morphology is based upon arbitrary opinion, instead of systematic formal logic, wrong consonants sneak into the orthography. For example Troy [1994, page 71] writes

\[
\begin{align*}
"bālūī" & \quad \text{W. Dawes 1790, eora.} \\
"boī" & \quad \text{J. Rowley 1875, cowpastures.}
\end{align*}
\]

\[\rightarrow\]

\[
"baluwi" \quad "buyī"
\]

... which is formally and logically wrong (refer back to TABLE 1.2).

Also there is

\[
\text{bulū : i} \quad \eta : d\upsilon(la)
\]

\[\text{ORIGINAL – A}\]

\[\text{HUYGENS CIRCLE}\]

\[
\begin{align*}
"\text{bull : i : ng : "}, \quad ("\text{die"}) \\
R.H. Mathews 1903,
\end{align*}
\]

\[
"\text{thurraval" = ngunawal} \\
(\text{HUYGENS CIRCLE})
\]

\[
\begin{align*}
"\text{bale :: tti"}, \quad ("\text{dead"}) \\
"\text{bo : i :: "}, \quad ("\text{die"}) \\
R.H. Mathews 1901, dharruk.
\end{align*}
\]

\[
"\text{ballu :: ti"}, \quad ("\text{die"}) \\
R.H. Mathews 1903, darkinyung
\]

\[\text{ORIGINAL – A}\]

and

\[
\text{bulū : i} \quad \eta : d\upsilon(la)
\]

\[\text{SOUTHERN – B}\]

\[
\begin{align*}
"\text{bullo :: n : "}, \quad ("\text{stomach"}) \\
Re v.J. Bulmer 1876, kurnia
\end{align*}
\]

\[
(\text{SOUTHERN – B})
\]

\[
\begin{align*}
"\text{pau :: n : cia"}, \quad \text{italian} \\
"\text{pau :: n : ch"}, \quad \text{spanish}
\end{align*}
\]

\[
\begin{align*}
"\text{bāu :: che"}, \quad \text{german}
\end{align*}
\]

as well as falling-down thing

\[
\begin{align*}
\text{bulū } & \quad (\text{n}) \quad \text{bul(υ) : i} \\
\text{down} & \quad \text{falling}
\end{align*}
\]

\[\text{falling down} = "\text{leaning"}
\]

\[
\begin{align*}
"\text{bulu :: bal : i"}, \quad ("\text{fall down"}) \\
R.H. Mathews 1901, dharruk
\end{align*}
\]

\[\text{ORIGINAL – A}\].

\[
"\text{bul :: b : i"}, \quad ("\text{leaning tree"}) \\
R.H. Mathews. .
\]

page 88
or

\[
\text{bu(lu)} : i \rightarrow \text{thing falling down} = \text{"waning" or "dead"}
\]

\[
\frac{\text{bu(lu)} : i}{\text{falling down}} \rightarrow \frac{n}{\text{thing down}} \rightarrow \frac{\text{bulu}}{\text{thing}}
\]

"bu :: n : bal", ("tree wood")
"boo :: n : bal", (wood)
"b :: m : bal", (wood)
":: n :: ulla", (wood)
J. Larmer 1853, dhurga.
(SOUTHERN-B)

and SUN setting (see page 99)

\[
\text{(guru)} : \text{win : dula} \rightarrow \text{bul(v) : i} \rightarrow \text{bul(v)}
\]

"SUN" falling down = "setting"

(SOUTHERN-A)

(SOUTHERN-B)

(" : wane : dilya = tull :: tull", ("sun go down")
the yelta people's "setting sun song"
Rev. J. Bulmer 1850's, kurnia
(SOUTHERN-B)

" - bu :: b",
("gunnut baby's name")
May Gibbs 1925, gundungara
(ORIGINAL - A)

and beyond-question dead

\[
\text{gun} \rightarrow \text{bul(v) : i}
\]

= very = dead

(ORIGINAL - B)

(SOUTHERN - B)

(TURUWAL)

(HUYGENS CIRCLE)

"gan : b : i", ("fire wood")
D.K. Eades 1976, dhurga
(SOUTHERN-B)

"kan : b : i", ("firewood, twigs")
R.H. Mathews 1901,
"dhurawal" = ngunawal
(HUYGENS CIRCLE)

"kan : b : y", ("fire")
I. Nathan 1849, wodi wodi.

"kun : b : ee", ("fire")
M. Munina 1863, wodi wodi.

(ORIGINAL - B)

"kam : b : i", ("feu" = fire)
J.P. Gaimard 1826, jervis bay
(TURUWAL)
Appendix

Also there is *sick*

\[
\begin{align*}
\text{mu}(\text{ru}) - \text{bul}(\text{u}) : i \quad &\text{slightly ill = "sick"} \\
\text{ORIGINAL - B} \\
\end{align*}
\]

or

\[
\begin{align*}
\text{b(ulu)} : i - \text{dj} i \quad &\text{slightly ill = "sick"} \\
\text{ORIGINAL - B} \\
\end{align*}
\]

hence

\[
\begin{align*}
\text{b(ulu)} : i - \text{dj} i - \text{η} : \text{(wur)vl(a)} \quad &\text{folk} \\
= "\text{sick}" \quad &\text{(plural noun - stem)} \\
\end{align*}
\]

in contrast to

\[
\begin{align*}
\text{bul}(\text{u} : i) - \text{mu(ra)} \quad &\text{falling, stopping = "beating"} \\
&\text{(verb)} \quad &\text{SOUTHERN - B HUYGENS CIRCLE} \\
\end{align*}
\]

or

\[
\begin{align*}
\text{mora} - \text{b(ulu)} : i \quad &\text{greatly falling, stopping = "beating"} \\
&\text{(verb)} \quad &\text{ORIGINAL - B} \\
\end{align*}
\]

Also there is a word for *clapping*

\[
\begin{align*}
\text{bul(u)} - \text{mu}(\text{ru}) : \text{gun} - i \quad &\text{very slightly = "gently"} \\
= \text{beat-} \quad &\text{OB} \\
\end{align*}
\]

Also there is *sick*

\[
\text{mu(bal: i) , ("sick")} \quad &\text{W. Davies 1790, eora} \\
&\text{(coastal ORIGINAL-B)} \\
\]

or

\[
\text{b(i : djee) } \quad &\text{" b : i : dya"} \\
&\text{First Fleeters, eora} \\
&\text{(coastal ORIGINAL-B)} \\
\]

the Castle Hill tribe who had Smallpox

Fist Fleeters, eora

\[
\text{bul :: m }", ("\text{beat, fight")} \quad &\text{D.K. Eades 1976, dhurga} \\
\]

\[
\text{bul :: ma}, ("\text{fight")} \quad &\text{R.H. Mathews 1903,} \\
&\text{"thurrawal"=ngunawal} \\
\]

\[
\text{muree : p : ie }", ("\text{beat hard")} \quad &\text{D. Paine 1794, eora} \\
\]

\[
\text{mah :: "}, ("\text{to strike"), hindostanne} \\
&\text{G.F. Angus 1874,} \\
&\text{S. Bennett 1867.} \\
\]

\[
\text{bul : m : ie }, ("\text{to clap the hands while dancing")} \quad &\text{Capt.J. Hunter 1793, eora} \\
\]

\[
\text{bul : m : gan : "}, ("\text{beat")} \quad &\text{L. Malone 1875, wadi wadi} \\
&\text{pál : mó : goh : "}, \\
&\text{("going to fight",} \\
&\text{J. Nathan 1849, wadi wadi} \\
&\text{(coastal ORIGINAL-B)} \\
&\text{παλλό:μα:ι", pulsate, greek} \\
\]
and gliding creature

\[
\begin{align*}
\text{wu}(\text{la} : \text{gon}) - \eta - \text{b(ulu)} : i \\
\text{slowly} & \quad \text{falling} \\
\text{= gliding}
\end{align*}
\]

\[\rightarrow \quad ^{\text{creature}} \quad ^{\text{"werri :: m : b : i ", ("flying fox")}}
\]

W. Russell 1914, gundungara
(ORIGINAL–A)

\[\text{wu} : \text{b : i : n ", ("flying squirrel")}
\]

R.H. Mathews 1902, kurnai
(SOUTHERN–B)

or

\[
\begin{align*}
\text{wu}(\text{ru} : \text{la} : \text{gon}) - \text{b(ulu)} : i - \eta \\
\text{= gliding}
\end{align*}
\]

\[\rightarrow \quad ^{\text{creature}} \quad ^{\text{"wo :: bb : i : n ", ("flying squirrel")}}
\]

D. Collins 1798, eora

\[\text{"wu :: b : i : n ", ("squirrel")}
\]

W. Dawes 1790, eora
(ORIGINAL–B)

or

\[
\begin{align*}
\text{bu}(\text{lo} : i) - \eta - \text{wu}(\text{la} : \text{gon}) \\
\text{= gliding}
\end{align*}
\]

\[\rightarrow \quad ^{\text{bu :: ng :: wo :: m :}, ("flying squirrel")}
\]

J. Larmer 1853, dhurga .

\[\text{"ba :: ng :: o : u ::}, ("flying squirrel")
\]

I. Nathan 1849, wodi wodi .

\[\text{"bu :: ng :: u :: }, ("flying squirrel")
\]

R.H. Mathews 1901, 1903,

\[\text{"bu :: ng :: gu ::}, ("flying squirrel")
\]

W. Dawes 1790, eora .

\[\text{"bu :: ng :: ora ::}, ("flying squirrel")
\]

(SOUTHERN – B)

\[\text{"bu :: ng :: oo ::}, ("squirrel")
\]

Rev. J. Gunther 1837, wiradjuri
(inland ORIGINAL – B) .

J. Larmer 1853, dhurga .

or

\[\text{"ba :: ng :: o : u ::}, ("flying squirrel")
\]

J. Larmer 1853, dhurga .

\[\text{"ba :: ng :: u ::}, ("flying squirrel")
\]

R.H. Mathews 1901, 1903,

\[\text{"ba :: ng :: gu ::}, ("flying squirrel")
\]

W. Dawes 1790, eora .

\[\text{"bu :: ng :: ora ::}, ("flying squirrel")
\]

(SOUTHERN – B)

... where the correct syllable is \text{wu}(\text{la}) as in McCaffrey’s word, or \text{wu}(\text{ru} : \text{la}) with a quiet \text{W} as recorded by most early lists. Billy Yerramagang (1820’s) gave the “little squirrel” as \text{pel:r:n::kan::g} or \text{cu:r:n::ke::kan} which both derive from \text{bul(o)::i::\eta::(wu} : \text{ru} : \text{la}) : \text{gon} : (\text{wu} : \text{ru} : \text{la}) : \text{gon} . The option of D.K. Eades and R.H. Mathews is simply wrong.
the sugar-glider, *Petaurus breviceps*, eating nectar from a blossom. It is a furtive nocturnal creature living in family-groups, in tree-tops, where it searches for insects and the nectar of blossoms. It has litters of two babies at a time, which live in the mother’s pouch for up to 8 weeks. They are very sociable animals, with up to 12 sharing a nest of dry leaves inside a hollow tree, cuddling together for warmth in winter.
Appendix

There is also a diectic form (pages 96-97)

\[
\begin{align*}
garo & \quad \text{from} \quad \text{past} \\
& \quad = \text{"back", behind (verb)} \\
\end{align*}
\]

\[
\begin{align*}
\text{"} g : i : li \text{" ("back")} \\
J. Rowley 1875, cowpastures .
\end{align*}
\]

\[
\begin{align*}
\text{"} kara :: bûl \text{"} \\
(\text{sword’s edge, literally the back of the sword),}
\end{align*}
\]

\[
\begin{align*}
\text{"} \ g : i : le \text{" or \ } g : i : le \text{"} \\
(\text{"that [yonder visible"]} ) .
\end{align*}
\]

\[
\begin{align*}
\text{"} ga :: li \text{" or \ } ga :: le \text{"} \\
(\text{"this [here, visible"]} ) .
\end{align*}
\]

M. Sharpe 1994, bundjalung

\[
\begin{align*}
\text{"} koro :: boul \text{", ("back")} \\
D. Paine 1794, eora .
\end{align*}
\]

(UNIVERSAL - B)

At the opposite extreme we find

\[
\begin{align*}
\text{"} bulu \text{" (adjective)} \\
\text{up, projective}
\end{align*}
\]

\[
\begin{align*}
\text{"} \text{piala} \text{", ("tell, talk")} \\
J. Rowley 1875, cowpastures .
\end{align*}
\]

\[
\begin{align*}
\text{"} pyalla \text{", ("words, testimony")} \\
M.A. Fitzgerald 1891, eora .
\end{align*}
\]

\[
\begin{align*}
\text{"} beal \text{", ("casuarina" = mangrove seedling)} \\
J. P. Gaimard 1826, jervis bay .
\end{align*}
\]

(TURUWAL)

\[
\begin{align*}
\text{"} \text{baal} \text{", ("sum tree")} \\
Kitty Cooper 1870' s, moira .
\end{align*}
\]

(SOUTHERN - B)

\[
\begin{align*}
\text{"} \text{pali} \text{", buddhist scriptures .} \\
\text{"} \text{baal} \text{", ("sun, stars, divinity")}, \text{hebrew .}
\end{align*}
\]

Capt. J. Hunter 1793, eora

(D. Southwell 1788, eora .

"byalla", ("speak")

W. Dawes 1790, eora .

"pilla", ("to laugh")

P.G. King 1793, eora

(coastal ORIGINAL - B)
and the augmented forms

<table>
<thead>
<tr>
<th>bu(lu)</th>
<th>mora</th>
</tr>
</thead>
<tbody>
<tr>
<td>up</td>
<td>greatly</td>
</tr>
<tr>
<td>= tall, high</td>
<td></td>
</tr>
</tbody>
</table>

"pu: mara"
("montagne" = mountain),
J.P. Gaimard 1826, Jervis Bay
(TURUWAL).

"baia: mi", (ancestral god of NSW)
A.W. Howitt, 1904.

"fe: mur", ("upper leg bone"), Latin.

"bau: me", ("tree"), German.

"baa: mirr", ("long tall")
McNicol & Hosking 1994, Wiradjuri
(inland ORIGINAL - B)

and

<table>
<thead>
<tr>
<th>bul</th>
<th>gun: g(um)</th>
</tr>
</thead>
<tbody>
<tr>
<td>up (above)</td>
<td>very very = &quot;extremely&quot;</td>
</tr>
</tbody>
</table>

"bulla: i", ("baby, very young"),
Re V. J. Günther 1837, Wiradjuri
(inland ORIGINAL - B)

"bulla: i", ("blossom or flower"),
Re V. J. Günther 1837, Wiradjuri
(inland ORIGINAL - B)

"n目录: track ris ing the Illawarra Escarpment"
F. McCaffrey 1920's, Wadi Wadi
(coastal ORIGINAL - B)
Appendix

and verb with noun

\[
\frac{bulu - n: du(la) - i}{\text{thing}} \rightarrow \frac{\text{ORIGINAL } - \text{ B}}{\text{SOUTHERN } - \text{ B}}.
\]

"boo: n: da : " , ("apple tree"),
W. Macarther 1861, cowpastures
(coastal ORIGINAL - B)

"baalu : n :: " ("mangrove seedling"),
J.P. Gaimard 1826, jervois bay
(TURUWAL)

"bela :: " ("casuarina" = mangrove seedling),
J.P. Gaimard 1826, jervois bay
(TURUWAL)

"μπαλο : υ :: ι" , ("baloon"), greek
"μπου : τ : ι" , ("thigh"), greek
"μπλου : ζα : " , ("blouse"), greek

and, in the far southern zone, we have

\[
\frac{(bu)lu - i}{\text{commencing, }} = \frac{\left\lbrack\begin{array}{c}
du(la : η) \\
\text{= creature}
\end{array}\right\rbrack}{\text{SOUTHERN } - \text{ B}}
- \frac{\left\lbrack\begin{array}{c}
d(ola : n) \\
\text{= thing}
\end{array}\right\rbrack}{\text{(noun - stem)}}
\]

"l : i : d : " , ("hair")
Pettit & Dawson 1850's, kurnai .
"l : i : t : " , ("hair")
Rev.F.A. Hagenauer 1876, kurnai .
"l : i : t : " , ("hair, hair of the head")
Rev.J. Bulmer 1876, kurnai ;
R.H. Mathews 1902, kurnai
(SOUTHERN - B)

... where a young woman goes from bura:ŋulu (Huygens Circle) to (ŋu)lu:bura (page 85), and a nice place is (gün:gu)la:n (page 67).
Hump-back whales *Megaptera novaeangliae*, a familiar sight in coastal waters, are migratory mammals which grow to the enormous length of 19 metres and weigh as much as 48 tonnes at maturity. The Latin name, “mega-tera” = *great-wing*, refers to their large serrated pectoral fins. These creatures spend summer in the Antarctic feeding on krill. As winter approaches they slowly migrate northward up the east-Australian coastline to give birth to calves in Queensland’s Whitsunday region. When the calves are strong enough, with a sufficiently thick layer of fat for insulation, they return southward again. During this period of increasing body mass, in deeper cooler waters, the calves sometimes experience difficulty achieving positive buoyancy. This is rather serious, for air breathing mammals that must return to the surface regularly, so the mothers sometimes swim below their calves nudging them upward. In 1817 John Rowley of Holsworthy, the son of Lieutenant Rowley, explored gunduyara territory to the southwest of Sydney along with coastal daruwul guides, in his spare time about the campfire recording Aboriginal words supposedly from the “Georges River, Cowpasture, and Appin” area. By May 1819 he and Charles Throsby had found a route from the Cowpastures (near present-day Campbelltown) to Bathurst by way of Moss Vale, Taralga and the Oberon district and, as a reward, was granted 1000 acres at Bong Bong.
It wasn't till the 1870's, by which time Rowley had retired to Scone, that his Aboriginal wordlist was finally published in Rev. W. Ridley's classic book “Kamilaroi and other Australian Languages”. A couple of these published Aboriginal words may be used to create an understandable name for the Hump-back whale

\[
\text{bul: gu-gi:lu-(n)}
\]

\[
= \text{hump} = \text{back} \quad [\text{whale}]
\]

Hill, bulga.
Back, gili.
Humpback, bulga-gili.

It was in the 1870's, by which time Rowley had retired to Scone, that his Aboriginal wordlist was finally published in Rev. W. Ridley's classic book "Kamilaroi and other Australian Languages". A couple of these published Aboriginal words may be used to create an understandable name for the Hump-back whale.

\[
\text{bul}(u:i) : \text{gu}(n:gun:n:qula) - g(aru) - i:lu \quad \rightarrow \quad "\text{bul}: \text{ga}::: " \quad ("\text{hill})
\]

\[
"::: : g : i : li : " \quad ("\text{back})
\]

\[\{J. \text{ Rowley, 1875}\} \{\text{gundanjara}\}\]

A "mountainous" back, like this, is quite different to one which is \text{nara:нулu} = "hunched or bent" with age.
Appendix

And the common

\[ \text{gun} - \frac{\text{dul(a : n)}}{\text{thing}} \rightarrow \text{UNIVERSAL} \]

\[ \text{"goon : del : ", gundungara} \]
Burrodogorung Chieftain (1802 - 1814)

(ORIGINAL - A)

\[ \text{"gun : du : ", ("tree")} \]
R.H. Mathews 1903, "dhurawal" = ngunawal
(HUYGENS CIRCLE)

\[ \text{"gheet : doo : ", ("tree")} \]
Rev. J. Gwther 1837, wiradjuri
(inland ORIGINAL - B)

\[ \text{"ghee : da : "}, ("stringy bark tree") \]

makes two adjectives and a noun give

\[ \frac{\text{b(ulu)}:i}{\text{rising}} - \frac{\text{du(la)}:n}{\text{up}} - \frac{\text{bu(lu)}}{\text{thing}} \rightarrow \text{"p : i : the : n : ba"}, \]

("new moon")
yelua peoples "moon song"

J. Bulmer 1850, kurnai
(SOUTHERN - B)

or

\[ \frac{\text{bu(lu : i)}}{\text{rising up = "upstanding"}} - \frac{\text{bu(lu)}}{\text{thing}} - \frac{\text{dul(a : n)}}{\text{thing}} \rightarrow \text{"bo :: ba : too : ",} \]

mountain in upper Kangaroo Valley

L. Atkinson, "Sydney Mail"

7th Jan 1871
(HUYGENS CIRCLE)
Appendix

and SUN rise (see page 89)

\[
\begin{align*}
\text{nu}(ru) : \text{wijn} : (dula) & \rightarrow \text{bu}(lu) : i - \text{bulu} \\
\text{"SUN"} & \rightarrow \text{rising up} \\
(\text{noun} - \text{stem}) & \rightarrow \text{ORIGINAL} - \text{A} \\
\text{MIDTHUNG} & \rightarrow \text{ORIGINAL} - \text{B}
\end{align*}
\]

Two noun-stems occur in sweat / perspiration

\[
\begin{align*}
\text{bulu} - n : \text{da}(ru) & \rightarrow \text{bulu} - n : \text{da}(ru) \\
\text{= emission-exterior/skin} & \rightarrow \text{= emission-exterior/skin} \\
\rightarrow & \text{" bla} : n : \text{da} : \text{bla} : n : \text{da", ("sweat")}
\end{align*}
\]

Rev. J. Bulmer 1850, kurnai
(SOUTHERN - B)

as opposed to possum skin rug

\[
\begin{align*}
\text{bu}(lu) : i - \text{d(aru)} & \rightarrow \text{bul(u)} : i - \text{d(aru)} \\
\text{= dead-exterior/skin} & \rightarrow \text{= dead-exterior/skin} \\
\rightarrow & \text{" p : i : t : p : i : t",} \\
\text{("possum cloak or gown")} & \rightarrow \text{"bu : d : bul : i: "}, \text{ ("opossum rug")}
\end{align*}
\]

Mickey Munima 1863, wadi - wadi
(coastal ORIGINAL - B)

J. Rowley 1875, cowpastures
(coastal ORIGINAL - B)

Thus we anticipated approximately 6 words of the form \(b\), and immediately have 8, variously twisted into form within the confines of Octahedral Symmetry. The result is most gratifying, but we shall continue on to see if the final case is similar.
wiŋ: i:.bu:ŋ:bu-miŋ-miru = the first dawn
Some words employ $\etauru = \text{periodic}$, hence the noun

$$\etauru: \text{n} \quad \overset{\text{ORIGINAL - A}}{\longrightarrow}$$

= periodic thing

(noun)

$$\etauru: \text{n} \quad \overset{\text{SOUTHERN - B}}{\longrightarrow}$$

"narru: \text{n} ", ("moon"), Pettit & Dawson 1850's
"nerra: \text{n} ", ("moon"), Rev.J. Bulmer 1876
"ngirra: ng ", ("moon"), Rev.V.F.A. Hagenaur 1876
kurnai, (SOUTHERN - B).

and the verb (with repetition implying vigour or frenzy)

$$\etauru: \text{i} - \etauru: \text{i} \quad \overset{\text{ORIGINAL - A}}{\longrightarrow}$$

= wiggling, throbbing

(verb)

$$\etauru: \text{i} - \etauru: \text{i} \quad \overset{\text{SOUTHERN - B}}{\longrightarrow}$$

"$\eta$ : $\eta$ : $\eta$ : $\eta$ : $\epsilon$", ("sew")
Rev.W. Ridley 1875, kamilaroi

"ngaier :: nger :: " , ("red")
Rev.W. Ridley 1875, kamilaroi

"ngarigu" = wolgalu,
"ngurr : i :: : ", ("shin" = wiggler)
R.H. Mathews : 1908, 1903.

(McNichol & Hosking 1994, wiradjuri)

also

$$\text{di: n} \quad \overset{\text{ORIGINAL - B}}{\longrightarrow}$$

"ji : n : man", ("wife")
J. Rowley 1875, cowpastures

"diz n tiny - thing =" clitoris"
(noun)
Appendix

hence

\[ \text{dj} : n - \eta(\text{uru}) : i \]
= tiny thing

(\textit{n}oun – \textit{stem})

\[ \Rightarrow \text{"dj} : n : \text{ng} : \text{ce"}, \ (\textit{"star"}) \]
M.M. Everitt 1900, gundungara

with repetition implying plural

\[ \text{dj} : n - \text{dj} : n - \eta(\text{uru}) : (i) - \eta(\text{uru}) : i \]
= sparkling stars

\[ \Rightarrow \text{"ji} : n : \text{ji} : n : \eta(\text{uru}) : \text{ng} : ", \]
(\textit{"sparkling stars"})
L. Malone 1875, wadi wadi

also

\[ \text{dj} : (n - \text{wuru})la - \eta(\text{uru}) : i \]
= tiny numerous [legs]

\[ \Rightarrow \text{"ji} : \text{lli} : \text{ngurr} : i " , \ (\textit{"centipede"}) \]
HUYGENS CIRCLE

"thurawal" = ngunuwal
R.H. Mathews 1903

and \( \text{gola} : \text{i-} \eta(\text{uru}) \) = \textit{"watery-pond"} (page 66), and also general cycle
\textit{"full-moon"} or even \textit{"half-moon"} (page 77) but perhaps not \textit{"new-moon"}
= \textit{black}.

At the opposite extreme we have

\[ \eta(\text{ara}) \]
= looped, spiral
(\textit{adjective})

\[ \Rightarrow \text{"gnarrâ"}, \ (\textit{"a knot or a tie"}) \]
W. Dawes 1790, D. Blackburn 1791, eora.

"gnara"," (\textit{knot or tangent in a line"})
J. Hunter 1793, eora.

page 102
and

\[ \text{gara} - \text{wurula} : (n) \quad \text{ORIGINAL - B} \quad \rightarrow \quad \text{gnar : le : } \]

also

\[ \text{bu(lu)} : \text{mura} - \quad \text{i : } \eta (\text{ara}) \quad \text{ORIGINAL - B} \quad \rightarrow \quad \text{booo : mera :: ng \text{,}} \]

"bu : mr : i : ng ",
J. Mason 1838, cowpastures.

"bu : mar : i : n ", ("boomerang")
J. Rowley 1875, cowpastures.

"bu : mmeru : ng ", ("wooden sword")
Dr. J. Oldfield 1828, eora.
(coastal ORIGINAL - B).

hence

\[ \text{daru} - \quad \text{di : (n) - wurula - } \eta (\text{ara}) \]

= exterior = tiny - numerous - spirals = fibrous strands = "stringy"

\[ \text{ORIGINAL - B} \quad \rightarrow \quad \text{dturā : du :: rala' : } \eta \text{.} \]

("the bark to make fish lines")
W. Dawes 1790, eora.

" :: wīralu :η", ("forest oak tree")
L. Malone 1875, wadi wadi.

or

\[ \text{w(ur)ola} - \quad \eta (\text{ra - } \text{di}) : n - \quad \text{da(ro)} \]

= fibrous strands = baryk

\[ \text{ORIGINAL - B} \quad \rightarrow \quad \text{wulu : } \eta \text{a :: n :: da \text{,} ("pigeonberry tree")} \]

L. Malone 1875, wadi wadi.
Appendix

NOTE: the conjugate to $\text{daru} = \text{exterior/about}$ (see pages 103, 236-7), appears to be $\text{dora} = \text{interior/through}$, as in the adjective

"$\text{dhara} : \text{marra}''$, ("draining")

"$\text{dhra}ra : \text{marra}''$, ("absorb, swallow")

C. Richards 1902, wiradjuri
(inland ORIGINAL–B).

"$\text{ti} : \text{ma}''$, ("to squeeze water from a sponge")

W. Dawes 1790, eora
(coastal ORIGINAL–B).

and the verb

\[
\begin{array}{c}
\text{i : dora} - (\text{wu})\text{rul(a)} \\
\frac{\text{through}}{\rightarrow} - \frac{\text{ing}}{\rightarrow}
\end{array}
\]

= stinging, stabbing, injecting

"$\text{trir} : \text{roul}'',$
("place named after mountain leeches")
Billy Saddler 1892, wadi wadi
(coastal ORIGINAL – B)

"$\text{dire} : \text{thura}''$, ("sting or stab")
R.H. Mathews 1903
"thuruwal" = ngunawal
(HUYGENS CIRCLE)

also nouns such as *snake*

"$\text{thuru} : \text{n}''$, Rev. J. Bulmer 1876

"$\text{tooroo} : \text{n}''$, Rev. F. A. Hagenauer 1876

"$\text{tooroo} : \text{n}'', W. Thomas 1860

"$\text{thuro} : \text{n}'$, N. D. Pettit & W. Dawson 1850
("snake"), kurnai
(SOUTHERN–B).

"$\text{thru} : \text{n}'', ("mountain leech")
Billy Saddler 1892, wadi wadi
(coastal ORIGINAL–B).
Appendix

and mosquito

\[ i : d \text{ora} - \text{d}i: \eta \]

= stinging, sucking
tiny creature

\[ " : \text{teura} : \text{die} : \text{ny} " \text{,} \text{ ("mosquito")} \]

P.G. King 1793, eora.

\[ " : \text{teura} : \text{die} : \text{ng} " \text{,} \text{ ("mosquito")} \]

W. Dawes 1790, eora (coastal ORIGINAL–B).

\[ " : \text{dir} : \text{di} : \text{k} " \text{,} \text{ ("mosquito")} \]

R.H. Mathews 1902, kurnai (SOUTHERN–B).
Finally a pair which is conjugated by different word-initial consonants -

\[ \etaulu \rightarrow \text{UNIVERSAL} \]

\( \etaulu \) = corrugated, wrinkled
folded, crushed
(adjective)

<table>
<thead>
<tr>
<th>D. Collins 1798, eora</th>
<th>Re v.W. Ridley 1875, kamilaroi</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot; gnallon&quot;, (&quot;forehead&quot; = wrinkled)</td>
<td>(ORIGINAL – A)</td>
</tr>
<tr>
<td>&quot; gnalloa&quot;, (&quot;to sit&quot; = folded legs)</td>
<td>&quot; gnullu&quot;, (&quot;forehead&quot;)</td>
</tr>
<tr>
<td>&quot; nulla&quot;, (&quot;forehead&quot;)</td>
<td>&quot; nulluc&quot;, (&quot;skin&quot;)</td>
</tr>
<tr>
<td>P.G. King 1790, eora</td>
<td>&quot; gleat&quot;, (&quot;sinews under the knee&quot;)</td>
</tr>
<tr>
<td>&quot; alloua&quot;, (&quot;to sit down&quot;)</td>
<td>Pettit &amp; Dawson 1850’s, kurnai</td>
</tr>
<tr>
<td>D. Paine 1798, eora</td>
<td>(SOUTHERN – B)</td>
</tr>
<tr>
<td>&quot; nullo&quot;, (&quot;forehead&quot;)</td>
<td>&quot; ngulu&quot;, (&quot;forehead&quot;)</td>
</tr>
<tr>
<td>W. Tench 1788, eora</td>
<td>&quot; ngulur&quot;, (&quot;sweat&quot;)</td>
</tr>
<tr>
<td>&quot; nourlew&quot;, (&quot;forehead&quot;)</td>
<td>&quot; ngullung&quot;, (&quot;sit&quot;)</td>
</tr>
<tr>
<td>M. Munima 1863, wadi wadi</td>
<td>R.H. Mathews 1903,</td>
</tr>
<tr>
<td>(coastal ORIGINAL – B)</td>
<td>&quot; thurraval&quot; = ngunawal</td>
</tr>
<tr>
<td>&quot; nguulung&quot;, (&quot;forehead&quot;)</td>
<td>(HUYGENS CIRCLE)</td>
</tr>
<tr>
<td>NcNicol &amp; Hosking 1994, wiradjuri</td>
<td></td>
</tr>
<tr>
<td>(inland ORIGINAL – B)</td>
<td></td>
</tr>
</tbody>
</table>

and

\[ \etaulu \rightarrow \text{HUYGENS CIRCLE} \rightarrow \text{ORIGINAL – B} \]

\( \etaulu – \etaulu \) = wrinkliest, folded
(superlative adjective)

<table>
<thead>
<tr>
<th>Dr. J. Lhotski, ngarigo</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot; nolo: nyula&quot;, (&quot;quarrel&quot;)</td>
<td>&quot; gnallu : ngulla&quot;, (&quot;mushroom {gills}&quot; )</td>
</tr>
<tr>
<td>(HUYGENS CIRCLE)</td>
<td>D. Collins 1798, eora</td>
</tr>
<tr>
<td></td>
<td>&quot; knulla : knulla&quot;,</td>
</tr>
<tr>
<td></td>
<td>&quot;the blacks painted a criminal white,</td>
</tr>
<tr>
<td></td>
<td>then boondied (clubbed) him to death&quot;</td>
</tr>
<tr>
<td></td>
<td>F. McCaffrey 1920’s, wadi wadi</td>
</tr>
<tr>
<td></td>
<td>(coastal ORIGINAL – B)</td>
</tr>
</tbody>
</table>
Appendix

also

\[
\etaulu - \text{gon} \quad \overset{\text{ORIGINAL - B}}{\longrightarrow} \quad " \text{gōuloū : gān"}, \ ("\text{short}\"
\]

I. Nathan 1848, wodi wodi
(coastal ORIGINAL - B).

and

\[
\etaulu(u) - \text{gon} - \text{daru} \quad \overset{\text{exterior}}{\longrightarrow} \quad " \text{chul : gun : derrā"}, \ ("\text{wave}\"
\]

J.F. Mann 1840's, eora
(coastal ORIGINAL - B).

... and the female marker \( \text{bura}:\etaulu \) or \( \etaulu:\text{bura} \), the clitoris,
which has been discussed (see page 85).

At the opposite extreme we find the word

\[
\text{dulu} \quad \overset{\text{ORIGINAL - A}}{\longrightarrow} \quad " \text{dhulu"}, \ ("\text{straight, direct, true}\"
\]

C. Richards 1902, wiradjuri.

" dhulay", ("long, extended, straight")

R.H. Mathews 1904, wiradjuri.

" dhulu", ("straight")

thulu", ("wooden spear")

R.H. Mathews 1904, wiradjuri
(inland ORIGINAL - B)

as in

\[
\text{dulu} - \text{wara} \quad \overset{\text{far}}{\longrightarrow} \quad " \text{yula : warra"}, \ ("\text{stretch, separate}\"
\]

Rev.J. Günther 1892, wiradjuri
(inland ORIGINAL - B).

or

\[
\text{wara} - \text{dulu}(u) \quad \overset{\text{STretched}}{\longrightarrow} \quad " \text{wre : ckił"}, \ ("\text{tall}\"
\]

Rev.J. Balmer 1876, kurnai
(SOUTHERN - B).
Appendix

hence the verb

\[ dulu : i \quad \rightarrow \quad baru \]

\[ \text{sides} \quad \rightarrow \quad \text{separating} \]

= OPENING, SPLITTING (verb)

"dhala :: barra ",
"crack, burst, break, ... as when opening a pea-pod, cracking a nut, breaking a stick"
Rev. J. Günther 1892, wiradjuri (inland ORIGINAL-B).

which contrasts with

\[ mir(\nu) : i \quad \rightarrow \quad baru \]

\[ \text{vanishing} \quad \rightarrow \quad \text{sides} \]

= CLOSING, SEALING (verb)

"wIRR : i : barə ", ("shut the door")
W. Dawes 1790, eora (coastal ORIGINAL-B).

and also

\[ dulu \quad \rightarrow \quad \eta(ara) \quad \rightarrow \quad ba(\nu) \]

\[ \text{stretched, tensioned} \quad \rightarrow \quad \text{either side} \]

= knot

"thulu : m : ba ", ("knot")
Rev. J. Bulmer 1876, kurnai (SOUTHERN-B).

We see that ί*** finds it necessary to choose conjugates from different word-initial-classes. It is not that there is a lack of words, quite the opposite, it is just that mathematical-law makes it impossible to choose them for use - its the way of the Entropy Maximising Power Law.

picture by Ainsley Roberts, 1962
Appendix

"... [in] the words of the Stigmatine Fathers 'Some people see things that are and say why? We dream of things that never were and say why not?' "

P.S. Stephens (1974)

"... in 1896, I mentioned the former existence, among the Wiradhiru tribes, of a secret language [the Burbung], known only to the initiated. The Kamilaroi likewise possess a mystic tongue, called Yauan, which is inculcated at the Bora ceremonies. It is difficult to assign a reason for this language, because it is never used in the presence of women or children, but is spoken exclusively by the men when carrying out the ceremonies of initiation. It is possibly a typical remnant of the language of earlier conquering tribes in the remote past ".

R.H. Mathews (1904)

discussion

Now is an appropriate time to deal with the Octahedral Symmetry. It is a good approximation, but there are significant differences on four separate occasions: (i) muro/mora, (ii) gulo/gula, (iii) dulo/dula and (iv) mulo/malo. If these particular occasions can be justified, it would be very helpful.

The following expression (pages 62-63) illustrates a problem arising from the past-tense of verb-stems containing $g$...

\[
\begin{align*}
\text{mur}(a - dula): n - gur(a) & - \\
\text{TAKE} = \text{CATCH} / \text{GATHER} / \text{COLLECT} & \\
\frac{i: (bu)lu}{\text{did}} & \\
\frac{i}{\text{am/is/are}} & \\
\frac{i : bolu}{\text{shall/will}} & \\
\text{tense} &
\end{align*}
\]
Whilst the future-tense *mor::gur:i:bulu* and the present-tense *mo::n:g:i* pose no problems, there is a real problem with the past-tense which cannot be *mo::n:g:i:lō* because the word ... *gilō* already exists (see pages 93 and 96-97). William Dawes recorded that it was customary
"On seeing a shoal of porpoises, they sing while the fish is above the water,

no-te-le-bre la-la,
no-te-le-bre la-la...

until it goes down,

... when they sing the words
no-tee, no-tee, no-tee

until it rises again".

[D. Collins, 1798]

for $g$ to be traditionally omitted in this special case, using the special tense-marker -ma. For this to be true we also require maru, the contraction ma(ru) and conjugate of mura, to be interpreted as murō. Hence we have the breaking of the first octahedral symmetry

\[ \text{murō / mura} \]

In the second case gulō occurs instead of galō, to avoid confusion with the ablative suffix ga of ga(ru), hence we have the breaking of the second octahedral symmetry

\[ \text{gulō / gula} \]

A more subtle expression will become obvious in the third case when dulō occurs instead of galō, to avoid confusion with the contracted dietic da(ru), thereby breaking the third octahedral symmetry

\[ \text{dulō / dula} \]

The fourth case mulo occurs instead of mula, to avoid confusion with the contraction m(ur)ula = 5, hence breaking the fourth octahedral symmetry

\[ \text{mulo / malu} \]
Appendix

proto-Australian words

<table>
<thead>
<tr>
<th>bulu</th>
<th>gulu</th>
<th>malu</th>
</tr>
</thead>
<tbody>
<tr>
<td>= down, low, flat, dead, cessation</td>
<td>= dull, lethargic (as with Koala), petrified</td>
<td>= blind, obstructing, shielding, opaque, (eye) cataracts</td>
</tr>
<tr>
<td>bulu</td>
<td>gula</td>
<td>mulu</td>
</tr>
<tr>
<td>= up, high, projecting, commencement</td>
<td>= shiny, radiant, vital, nice/good, alive</td>
<td>= visible, accessible, clear, channelling</td>
</tr>
<tr>
<td>bulala=2</td>
<td>gôn = very</td>
<td>murola=5</td>
</tr>
<tr>
<td>gula</td>
<td>mulu</td>
<td></td>
</tr>
<tr>
<td>= malevolent, deadly, treacherous, angry, sorcery</td>
<td>= familiar, intimate</td>
<td></td>
</tr>
<tr>
<td>galu</td>
<td>mulu</td>
<td></td>
</tr>
<tr>
<td>= benevolent, helpful, honest, happy</td>
<td>= unfamiliar, strange, unexpected</td>
<td></td>
</tr>
<tr>
<td>buru</td>
<td>guru</td>
<td>mu</td>
</tr>
<tr>
<td>= noisy, quick, energetic, awake</td>
<td>= fat, globular, convex more</td>
<td>= [air] bubbles (as with Platypus)</td>
</tr>
<tr>
<td>buru</td>
<td>gôra</td>
<td>mula</td>
</tr>
<tr>
<td>= quiet, slow, lazy, tired, sleepy, still</td>
<td>= slim, concave, less</td>
<td>= [liquid] droplets, progeny, dust</td>
</tr>
<tr>
<td>baru</td>
<td>garu</td>
<td>mala</td>
</tr>
<tr>
<td>= either-side, opposing</td>
<td>= from, out-of, sound</td>
<td>= inflated, bulging, enhanced</td>
</tr>
<tr>
<td>bura</td>
<td>gura</td>
<td>mulu</td>
</tr>
<tr>
<td>= between, compromise</td>
<td>= toward, into, throat, orifice, cave, valley</td>
<td>= deflated, shrivelled, emaciated, diminished</td>
</tr>
<tr>
<td>buru</td>
<td>gura</td>
<td>mûra</td>
</tr>
<tr>
<td>= bouncy, hoppy (as with Kangaroo)</td>
<td>= firm (as with stones, hail or muscles)</td>
<td>= large, greatly</td>
</tr>
<tr>
<td>bara</td>
<td>garu</td>
<td>mûru</td>
</tr>
<tr>
<td>= waddling (as with Wallaby)</td>
<td>= squishy (like nasal mucous), fluffy (like clouds)</td>
<td>= small, slightly</td>
</tr>
<tr>
<td>gilu</td>
<td></td>
<td>miru = 0</td>
</tr>
<tr>
<td>= behind, rear</td>
<td></td>
<td>ahead, in front</td>
</tr>
</tbody>
</table>

TABLE 1.10: translation, phoneticisation & compilation, copyright © C. ILLERT, 2003
These four variations from octahedral symmetry are placed in our above table of words. Now we have evidence for all their existence. In Chapter 1 we study the structure of specially long words, and in Chapters 2 and 3 we test the meaning of our phonetic-alphabet to Australian languages and evolution. Chapter 4 continues looking at changes in modern languages and retroflexives.

In relation to sources of words, the most suggestive are mora (p. 4) / muru (p. 32), garu (p. 54) / gura (p. 58), dura (p. 104) / daru (pp. 103, 236-237), bulu (p. 87) / bulu (p. 93), and seperately mula (p. 45), mala (p. 48), gola (p. 65), guru (p. 51) and baru (p. 79). Whether they are ultimate universals will not be the basis for this thesis, but I know that I simply could not have done it without them.
Appendix

bibliography


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Lexigenesis in ancestral south-east Australian Aboriginal language

CHRISTOPHER R. ILLERT, School of Languages and Linguistics, University of Western Sydney, Australia

ABSTRACT The 1/x frequency distribution is known to researchers ranging from economists and biologists to electronic engineers. It is known to linguists as Zipf’s Law (Zipf, 1949) and has recently been shown not to be a consequence of the Central Limit Theorem (Troll & Graben, 1998)—leaving an ‘unsolved problem’ in information theory (Jones, 1999). This 1/x distribution, associated with scale-invariant physical systems (Machlup & Hoshiko, 1980), is a special case of the general power law $x^j$ arising from the Lagrangian $L(x, F'(x)) = \frac{1}{2}x^{j+1}F^2$ and, as $j$ need not be an integer, some related research understandably involves fractals (Allison et al., 2001). The present paper generalizes this Lagrangian to include a van der Waals effect. It is argued that ancestral Aboriginal language consisted of root-morphemes that were built up into, and often condensed within, subsequent words or lexemes. Using discrete-optimization techniques pioneered elsewhere (Illert, 1987; Reverberi, 1985), and the new morpho-statistics, this paper models lexeme-condensation in ancestral south-east Australian Aboriginal language.

1 Introduction

Mathematical modelling has been slow to penetrate linguistics. In the half century since George Kingsley Zipf published his seminal book, ‘Human Behaviour and the Principle of Least Effort’, most work on Zipf’s law has been published by researchers outside the field and scattered through journals of biology, physics and computing science.

A recent paper showing that Zipf’s law was not a consequence of the Central Limit Theorem was published in Physical Review (Troll & Graben, 1998), and a paper linking scale-invariance to 1/x ‘noise’ was delivered decades ago at a symposium of electronic engineers in Orlando, Florida (Machlup & Hoshiko, 1980).

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DOI: 10.1080/0266476022000023703
The full implications of Claude E. Shannon’s information theory have barely penetrated linguistics and even the rudimentary ‘lexico-statistical’ modelling that is practised (Crowley, 1992) was imported from the ubiquitous cladistic trees in palaeontology, taxonomy and population biology.

It is hoped that this present paper, following in the spirit of George Zipf, goes some way toward providing new and worthwhile mathematical insights of interdisciplinary significance, drawn from one frontier of modern linguistic theory.

2 The linguistic data

South-east-Australian language was amongst the most unchanged ancient oral traditions still existing on Earth when the ‘First Fleet’ arrived in Sydney Cove from England more than two centuries ago. For many tens of thousands of years, south-east Australian Aboriginal people had been geographically isolated and separate from human populations with different origins, and they certainly were not trading with south-east Asian or Pacific neighbours. This contrasts with languages about Australia’s far-north and north-western fringe that do contain recognizable south-east Asian influences and, having evolved rapidly in recent millennia, are less likely to resemble any original ancestral language brought to Australia 80 000 or so years ago, across the south-east Asian landbridge and oceans, ultimately from Eurasia. To the extent that south-east Australian language was the most remote and isolated, it might be expected to have retained the most ancient features.

Although south-east-Australian Aboriginal language was the first to be extinguished, by the ensuing European colonization and settlement, it was documented in a literary tradition spanning the centuries back to First Fleeters such as William Dawes, Watkin Tench, David Collins and John Hunter. There were also a number of important scientific expeditions to Australia, including those of Quoy & Gaimard (1826) from France and Hale (1846) from the USA, supplementing linguistic and ethnological materials gathered by early missionaries such as Gunther (1830s) in the Wellington Valley, Threlkeld (1834) north of Sydney to Newcastle, Andrew Mackenzie (1875) in the Illawarra, John Bulmer (1860s) in Gippsland, and Teichelmann and Schurmann (1840) in Adelaide. By the late 19th century, various compilations of Aboriginal words began to occur ranging from those of Curr (1886), Dawson (1881) and Ridley (1875), to that of Schmidt (1919).

Unfortunately early English observers misheard the vowels and various novel sounds, frequently failed to hear or record word-initial consonants, and employed all the worst orthographic traditions of English spelling—including poor phoneme/ grapheme correspondences and ‘orthographic-fossil’ symbols and clusters of symbols that are silent and/or inappropriate—with the result that Aboriginal words were rarely ever spelled in the old written records anything like how they were spoken. Even today words such as enough (= inuf), phlegm (= flem), light (= lait), quay (= kai), yacht (= yot) etc, illustrate spelling problems that should long-ago have motivated the English-speaking world to ‘put a broom through’ the Oxford Dictionary, making graphemes and phonemes correspond.

Whether or not contemporary Australianists realize it, the severity of this ubiquitous orthographic ‘static’ in decrepit archival source materials has been a main factor contributing toward the sense of hopelessness and defeatism in all aspects of south-east Australian linguistic salvage work. The prevailing view is extremely pessimistic, with every reason other than the obvious one being given to excuse slow progress in this field:
There has probably been so much language loss, language contact, and possibly also radical restructuring of languages brought about by interrupted transmission that proto-Australian may well prove to be unreconstructable in principle, if it ever existed ... linguists would be better off for some time yet continuing to chip away at the lower levels of reconstruction, and offering the results of their work to archaeologists for interpretation. (Crowley, 1997, p. 295)

Two centuries of failure entitle us to suspect that it is a waste of time trying to understand the various English spellings employed in old ‘word-lists’ based upon where in England the respective observers came from, whether they spoke rhotic or non-rhotic English, what their vowel systems were etc. Most were barely literate, and could not spell sensibly for that reason alone—even the educated ones spelled the same sounds differently almost every time they encountered them! This lack of consistency is typified by the writings of Thomas Mitchell, for example, who recorded the same words on different occasions as below:

<table>
<thead>
<tr>
<th>1878</th>
<th>1887</th>
</tr>
</thead>
<tbody>
<tr>
<td>foot = ‘teyrah’</td>
<td>‘gerra’</td>
</tr>
<tr>
<td>moon = ‘yonu-warra’</td>
<td>‘huerra’</td>
</tr>
<tr>
<td>head = ‘boam’</td>
<td>‘bua’</td>
</tr>
<tr>
<td>nose = ‘nar’</td>
<td>‘nga’</td>
</tr>
</tbody>
</table>

Rather than trying to understand such frustrating orthographic ‘static’ in decrepit literary/archival sources, we need instead to eradicate it using a firm knowledge of those sounds that were actually being spoken by 18th and 19th century Aboriginal people.


Unfortunately, however, no Australianists has yet had the courage to aggressively and systematically use any such tools to clean-out the ‘static’ from centuries of accrued decrepit archival materials. Sources ranging from Curr (1886) to Capell (1970) and ‘the Macquarie [Dictionary of] Aboriginal Words’ (Thieberger & McGregor, 1994) invariably revert to using the Roman alphabet and inappropriate English spellings, including digraphs and far too many vowel sounds, to represent the quite distinctive non-English sounds of south-east Australian language.

The present author suggests that ambiguity in the spelling of south-east Australian Aboriginal words may be reduced through the use of an ‘alphabet’ of 18 symbols denoting four ‘vowels’ and 14 ‘consonants’:

\[ a, b, d, d’, g, i, l, m, n, η, ñ, ñ, r, u, w, y, υ \]

where \( υ \) = aya or perhaps aia.

This orthography recognises four ‘vowels’ a, i, u and υ, although the latter, actually a cluster, is not strictly a vowel but it behaves like one and will henceforth be referred to as ‘the long-vowel’. The symbols other than this ‘long-vowel’ constitute a reasonably standard usage of the International Phonetic Alphabet.
(IPA)—bearing in mind that, with only four contrasting ‘vowels’ (as compared to 20 in English), proto-Australian can afford to allow each vowel a much wider range of phonetic realization. Thus, we need no symbol specifically denoting the English oo vowel sound (as in the word ‘foot’) which, along with other cherished English vowel sounds, are all adequately described in our orthography by the single symbol u, leaving us free (for reasons of typographical utility) to commandeer the redundant keyboard character υ for portmanteau use as above. Additionally it is well known that there is only one lateral, l, in all language throughout one third of the entire Australian continent located roughly east of the meridian through Melbourne (Dixon, 1980, map 5, p. 141). In addition, although some researchers suggest the existence of two rhotics in proto-Australian (Dixon, 1980, p. 158) there is no present need for separate symbols to denote them. Just as ‘the articulation of the occurrence of a vowel in a particular word is often affected by the phonetic value of the consonants flanking it’ (Dixon, 1980, pp. 129–130), so too might different rhotic sounds arise from r being flanked respectively by long or short vowels: for example, mora sounds quite different to mara. Thus, one lateral and one rhotic seem sufficient for our present purposes. It is uncertain whether the laminals d and n existed in proto-Australian, but they were certainly part of south-east Australian language two centuries ago (Eades, 1976) so are included in our ‘alphabet’. That this system seems to apply across numerous 18th and 19th century linguistic boundaries throughout the south-eastern quadrant of mainland Australia, a vast geographical region maybe 1000 km in diameter, suggests that it must approximate a proto-phonology. At the very least it is a plausible and useful basis from which to attempt salvage and diachronic analysis of extinct south-east Australian languages.

Even if this orthography is not completely correct it is nevertheless quite capable of significantly cleaning up decrepit literary and archival sources, eliminating impossible sounds and absurd spellings, revealing useful and important information such as the previously unknown set of conjugate-pairs of ancestral adjectival-roots, presented in Tables 1(a) and 1(b), which appear to underlie all Aboriginal vocabulary throughout south-eastern Australia, at least from Newcastle to Sydney to Canberra to Melbourne to Adelaide—yet have been entirely missed by generations of Australianists for 200 years, judging by the statement ‘...it is not at all clear that there is such a thing as a universal stock of basic vocabulary...’ (Yallop, 1982, p. 33).

Another notation in the present paper utilizes brackets and colons in an intuitive way, just as we might write the English expression ‘they’ll as they’lll using brackets to denote the missing bit and a colon to separate individual morphemes. The need for this notation is apparent, considering that English speakers tend to run ng together as in the word ‘singing’ and, although a velar nasal g does indeed exist in Aboriginal language, there is also another quite different sound denoted nːg where the g is separate like the terminal k on the English word ‘disk’. To pronounce this nːg as g is seriously wrong—but how would we know without the colon? Likewise there is an gː sound, as in the spoken English word ‘finger’, also requiring a colon as a separator.

Our precise orthography, in combination with this common-sense notation of brackets and colons, provides a scientific notation of sufficient precision to enable study of the fine-structure of condensed words, revealing what lies below the surface of decrepit 18th, 19th and 20th century ‘word-lists’. For example, the adjectival roots in Table 1 were commonly combined together in small phrases and...
Lexogenesis in ancestral south-east Australian Aboriginal language

Table 1. (a) Conjugate pairs of ancient south-east Australian adjectival roots which emerge from old word-lists when the suggested phonology is applied

<table>
<thead>
<tr>
<th>Bulu</th>
<th>Gula</th>
<th>Malu</th>
</tr>
</thead>
<tbody>
<tr>
<td>= down, low, flat, dead, cessation</td>
<td>= dull, lethargic (as with Koala), petrified</td>
<td>= blind, obstructing, shielding, opaque, (eye) cataracts</td>
</tr>
<tr>
<td>Bolu</td>
<td>Gula</td>
<td>Malu, Mal</td>
</tr>
<tr>
<td>= up, high, projecting, commencement</td>
<td>= shiny, radiant, vital, nice/good, alive</td>
<td>= visible, accessible, clear, channelling</td>
</tr>
<tr>
<td>Bulala = 2</td>
<td>Gula</td>
<td>Malu</td>
</tr>
<tr>
<td>= malevolent, deadly, treacherous, angry, sorcery</td>
<td>= familiar, intimate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gula</td>
<td>Malu</td>
</tr>
<tr>
<td>= benevolent, helpful, honest, happy</td>
<td>= unfamiliar, strange, unexpected</td>
<td></td>
</tr>
<tr>
<td>Buru</td>
<td>Guru</td>
<td>Malu</td>
</tr>
<tr>
<td>= noisy, quick, energetic, awake</td>
<td>= fat, globular, convex more</td>
<td>= [air] bubbles (as with Platypus)</td>
</tr>
<tr>
<td>Bura</td>
<td>Guru</td>
<td>Malu</td>
</tr>
<tr>
<td>= quiet, slow, lazy, tired, sleepy, still</td>
<td>= slim, concave, less</td>
<td>= [menstrual] droplets, progeny, dust</td>
</tr>
<tr>
<td>Bura</td>
<td>Guru</td>
<td>Malu</td>
</tr>
<tr>
<td>= either-side, opposing</td>
<td>= from, out-of, sound</td>
<td>= inflated, bulging, enhanced</td>
</tr>
<tr>
<td>Bura</td>
<td>Guru</td>
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<td>= between</td>
<td>= toward, into, throat, orifice, cave, valley</td>
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<tr>
<td>Bura</td>
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<td>Mura</td>
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<tr>
<td>= bouncy, hoppy (as with Kangaroo)</td>
<td>= firm (as with stones, hail or muscle)</td>
<td>= large, greatly</td>
</tr>
<tr>
<td>Bura</td>
<td>Guru</td>
<td>Mura</td>
</tr>
<tr>
<td>= waddling (as with Wallaby)</td>
<td>= squishy (as with nasal mucous)</td>
<td>= small, slightly</td>
</tr>
</tbody>
</table>

Table 1. (b) Conjugate pairs of ancient south-east Australian adjectival roots that emerge from old ‘word-lists’ when the suggested phonology is applied

<table>
<thead>
<tr>
<th>Tulu</th>
<th>Dulo</th>
<th>Wurula</th>
</tr>
</thead>
<tbody>
<tr>
<td>= sinusoidal (dunes, waves), folded (legs while sitting), corrugated or wrinkled (forehead, mushroom gills), crushed (chewed food)</td>
<td>= shabby, dirty, untidy, bent</td>
<td>= 3, plural, several, lots of</td>
</tr>
<tr>
<td>Tulu</td>
<td>Dulo</td>
<td>Wurula</td>
</tr>
<tr>
<td>= cyclical, oscillatory, twinkly, shimmer</td>
<td>= about, external, outside surface</td>
<td>= profane, improper, left, crooked</td>
</tr>
<tr>
<td>Tura</td>
<td>Dura</td>
<td>Wuri</td>
</tr>
<tr>
<td>= knotted, coiled, spiral</td>
<td>= through, internal, inside</td>
<td>= sacred, proper, right, aligned</td>
</tr>
</tbody>
</table>
ears. This is why the Sydney natives had no difficulty understanding their river cousins whose lexemes ('vocabulary'), including different names for sun and moon, seemed to European ears to be totally unrelated. Additionally, Capt. John Hunter (1793) wrote about an even more novel feature of the language, permutation of morphemes within a lexeme:

<table>
<thead>
<tr>
<th>Simple phrases (lexemes) involving condensation—with correct meanings</th>
<th>‘Words’ recorded by Dawes (1798)—with ascribed meanings</th>
<th>‘Words’ recorded by Mann (1840)—with ascribed meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>w(uru-guru):i:(bu)la-pu (ag) (= behind [distant])</td>
<td>‘wu:ce:da:pa’ ('to follow or be second')</td>
<td>‘wu:ce:ko:n’ ('behind')</td>
</tr>
<tr>
<td>puru-bu:li (a):i:vur (a):n (empty stomach = hungry)</td>
<td>‘yuru-pa:ta’ ('very hungry')</td>
<td>‘nuru::ng’ ('empty')</td>
</tr>
<tr>
<td>m(j)i:bu:li (a):i:bu (li)</td>
<td>m:all:n:aoul' ('tomorrow morning')</td>
<td></td>
</tr>
<tr>
<td>(mi)p:bu:li (a):i:bu(li)</td>
<td>‘bu:ng:eye’ ('this day now present')</td>
<td></td>
</tr>
</tbody>
</table>

‘condensed’ in different ways, as shown in Table 2, often creating several seemingly ‘different’, but actually equivalent, versions of the same lexeme—see ‘sunrise/dawn’ in Table 2 above.

First Fleeters encountered, what appeared to them to be, an astonishing lexical diversity in Aboriginal language about the Sydney region. Collins remarked that:

We often heard, that people from the northward had been met with, who could not be exactly understood by our [Sydney Aboriginal] friends; but this is not so wonderful as that people living at the distance of only fifty or sixty miles should call the sun and the moon by different names . . . In an excursion to the banks of the Hawkesbury, accompanied by two Sydney natives, we first discovered this difference; but our [Sydney Aboriginal] companions conversed with the river natives without any apparent difficulty, each understanding or comprehending the other . . . We have often remarked a sensible difference on hearing the same word sounded by two people; and, in fact, they have even been observed sometimes to differ from themselves . . . Collins (1798, vol. 1, pp. 506) Europeans never did understand that ‘the same word’ was spoken with ‘sensible difference’ on different occasions, by the same and other informants, because Aboriginal language was to a large extent operating at the level of root morphemes as in Table 1, instead of at the level of lexemes (‘words’) as in Table 2. Hence variable condensation of morphemes within a lexeme—a small matter to any native speaker—constituted a monumental difference (‘a different language’) to European ears. This is why the Sydney natives had no difficulty understanding their river cousins whose lexemes (‘vocabulary’), including different names for sun and moon, seemed to European ears to be totally unrelated. Additionally, Capt. John Hunter (1793) wrote about an even more novel feature of the language, permutation of morphemes within a lexeme:
It should be observed, that in speaking, wolle-warre frequently changes the position of his words ... so when walking one night from Prospect Hill to Rose Hill, we frequently stumbled against roots, and he exclaimed were wade, and wade were, 'bad wood', or 'bad roots'.

as in

\[ \text{wiru} \rightarrow \text{wa}(:\text{ra})::\text{d}(\text{aru}::\text{n}) - i:(\text{garu}) \rightarrow \text{"wère::wa}:d::e::\text{"} } \]

\[ = \text{bad, evil tourism-going = journeying, travelling } \]

\[ \text{wa}(\text{ra})::\text{d}(\text{aru}::\text{n}) - i:(\text{garu}) \rightarrow \text{"wa}:d::e::wère" } \]

\[ = \text{thither-going = journeying, travelling = bad, evil } \]

Further examples of exactly this kind of 'morpheme-shuffling', provided in Tables 3 and 4, leave little doubt that all of these lexemes belong to a single common

<table>
<thead>
<tr>
<th>Leximorphs arising from permutation—</th>
<th>'Words' recorded by Dawes (1790a)—with ascribed meanings</th>
<th>'Words' recorded by Mann (1840)—with ascribed meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>wjn-gu(:la:n)</td>
<td>'yana:da:: ('moon')</td>
<td></td>
</tr>
<tr>
<td>dula(:n)~wiw (:orbiting-thing)</td>
<td>'yello:wa:: ('moon')</td>
<td></td>
</tr>
<tr>
<td>wu(rula:gon)-bulu(:i- ð)</td>
<td>'wu::b::i:n ('possum')</td>
<td></td>
</tr>
<tr>
<td>bu(:li)- ð -wu(rula:gon)</td>
<td>'bu::ng::wu ('squirrel')</td>
<td></td>
</tr>
<tr>
<td>g(un):wuuru(:la)-bulu(:i- ð)</td>
<td>g:rebble: ('oppossum')</td>
<td></td>
</tr>
<tr>
<td>(slowly-falling/gliding creature = the Sugar Glider Petaurus)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g(:ra)i-ji(in:nu)i-ru(:ra):wu(:ra)</td>
<td>'gi::ni::dyu::nsi ('I have [or did] crack [the flea]')</td>
<td></td>
</tr>
<tr>
<td>wu(:ra):ndu(:ra-juin::nu)i- g(:ra)i</td>
<td>'u::n::de::k:i ('come here')</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leximorphs arising from permutation—</th>
<th>'Words' recorded by various observers—with ascribed meanings</th>
<th>'Words' recorded by various observers—with ascribed meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>dula-ma(:li)-n</td>
<td>'hila:ma:n ('shield')</td>
<td></td>
</tr>
<tr>
<td>(obstructing-thing = shield, cataract)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mala-d[i(:la)-n</td>
<td>'hile:mo:n ('shield')</td>
<td></td>
</tr>
<tr>
<td>(obstructing-thing = shield, cataract)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>puru-gu(:la)-mu(:ra)</td>
<td>'moor:ca:mo ('[a long] spear with one barb')</td>
<td></td>
</tr>
<tr>
<td>(obstructing-thing = shield, cataract)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mu(:ra):gu(:la)- pl(uru)</td>
<td>'maia:gu:u ('spear')</td>
<td></td>
</tr>
<tr>
<td>(= hollow (reed) barred [spear])</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
language based upon the universal roots given in Table 1. It becomes quite difficult
to argue that the lexemes in Tables 2, 3 and 4 differ, even at dialect level, once
one understands that what Europeans thought of as unique fixed ‘words’ were
merely lexemes with multiple equivalent cognates deriving from parent leximorphs
that vary according to the permutation and condensation of constituent
morphemes.

These leximorphs in Tables 3 and 4 are a conceptual breakthrough, for the first
time enabling Australianists actually to understand the linguistic basis underlying
Tench’s (1798) observation that:

Although our natives and the strangers conversed on a par and understood
each other perfectly, yet they spoke different dialects of the same language;
many of the most common and necessary words used in life bearing no
similitude, and others being slightly different. That these diversities arise
from want of intercourse with the people on the coast can hardly be
imagined, as the distance inland is but thirty-eight miles; and from Rose
Hill not more than twenty; where the dialect of the sea-coast is spoken.
It deserves notice that all the different terms seemed to be familiar to
both parties, though each in speaking preferred its own.

To appreciate how this revolutionizes existing Australianist scholarship we need
only consider the paper of Capell (1970) which contrasted early ‘word-lists’
(actually lexeme-lists) obtained in the vicinity of Sydney by Dawes (1790a) and
Mann (1840s). Dawes obtained his lexemes at Sydney Cove, on the southern side
of Sydney Harbour, near the present Sydney Opera House, mainly from a young
woman ‘budgurry’ (= ‘tubby’) with whom he was living. Mann obtained his words
from ‘Long Dick’, son of ‘Bungaray’ and ‘Queen Gooseberry’ of the Pittwater
Tribe, from Broken Bay on the northern side of Sydney Harbour. These two
groups traded and intermarried and would have met each day, in their canoes,
whilst fishing out on Sydney Harbour. It is simply inconceivable that they would
not have been able to understand each other.

Yet, based upon a cursory comparison of their different ‘words’ (actually
lexemes), Capell (1970) concluded:

. . . the Sydney language did not cross Port Jackson . . . [it] was limited to
the peninsula on which Sydney now stands . . . [this is] evidence not
simply of a new alignment of tribal boundaries about Sydney, but of a
language new to the Australian inventory. The fact that the Sydney
language—whatever it should be called—did not cross Sydney Harbour
. . . has some historical importance . . . the difference between the two is
at language level, not dialect level; it would be necessary for natives of
each area to learn each other’s language, as apparently they did, or the
existence of two languages would have been noticed at the first.

In fact, a morpheme-level comparison between the Dawes and Mann ‘word-
lists’, as in Tables 2 and 3, reveals that natives on both sides of Sydney Harbour
were speaking exactly the same language. One would be scratching to even argue
in support of a difference at dialect level. Capell (1970) got this wrong and is by
no means alone amongst Australianists. Just about all determinations of linguistic
boundaries throughout south-eastern Australia, made in recent decades based
upon ‘lexico-statistical’ analyses (Crowley, 1992, pp. 168–190), are likewise wrong
for the same reason—they unjustifiably assume that language functioned at the
level of lexemes (‘words’) rather than at the level of morphemes. The very name ‘lexico-statistics’ tells why this methodology, still in universal use amongst Australianists, is fundamentally flawed. The only meaningful basis for comparison of lexemes from old ‘word’-lists would be ‘morpho-statistics’.

Dixon, who also claims little difficulty drawing firm language and dialect boundaries throughout south-eastern Australia, admits that ‘the methods of lexicostatistics are not fully applicable to the Australian situation’ but asserts that the trick is to ‘place equal reliance on grammar . . . any tentative conclusions from short vocabulary comparisons need to be verified by comparing the full grammatical systems . . .’ though even this has limits because ‘. . . languages change at such a rate that, after more than about three or four thousand years of separation, genetic links are no longer recognisable’ (Dixon, 1980, pp. 37, 229, 237). Thus, Australianists, who generally agree that all language from the southern portion of the Australian continent ‘is related’, have made ‘no attempt . . . to PROVE a genetic connection, by explicit reconstruction . . .’ (Dixon, 1980, p. 222).

So, whilst Australianists cringe at the problem of extracting ‘information from noise’, researchers in other fields such as Stanley et al. (1999) are busy . . . adapting to DNA the Zipf approach to analysing linguistic texts, and the Shannon approach to quantifying the ‘redundancy’ of a linguistic text in terms of a measurable entropy function . . .’.

The present paper supplies a ‘workable’ proto-phonology and a list of ancient south-east Australian adjectival-roots in Tables 1(a) and (b) which, alone, are more than has been accomplished to date by any previous researcher. Additionally, the discovery of leximorphs (as in Tables 3 and 4) enables multiple independent confirmations (‘sightings’) of ancient adjectival-roots, within the different syntactic-environments of cognate-lexemes from scores of genetically related ‘modern’ south-east Australian languages, in a fashion never previously possible. This enables a mathematical description of ‘optimal’ lexeme condensation which, in turn, provides a reliable new basis for diachronic studies spanning previously unimaginable times (tens of thousands of years instead of mere thousands)—so much so that we may even have identified the first ‘lexical echoes’ from another continent in such ancient yet recognisable words as: *ŋuːkbul* = nipple, *baraːd* = breast, *guːgʊral* = cockle, *gːwʊrd* = quail or squirrel, *dolːn* = zahlen or tally, *miruːdːmiːdʊ* = arithmetic. But, even should these particular examples prove coincidental, it is certain that no links *ever will* be found if Australianists continue to accept the defeatist premise that all evidence is lost, making it pointless for scholars even to discuss ‘. . . genetic connection between Australian languages and anything outside the continent . . .’ (Dixon, 1980, p. 238).

3 Morpho-statistics

Root-morphemes, perhaps from an isolating proto-language, were originally up to four phonemes long, as in Tables 1(a) and 1(b). The passage of time produced stable lexemes (the linguistic equivalent of ‘molecules’) through agglutination and morphological fusion of these root-morphemes within ‘common phrases’ (called leximorphs), which varied in complexity up to full transitive sentences formed from the intersplicing of a noun-phrase (containing an *n* or *g* marker) and a verb phrase (containing an *i* marker). Examples have already been given of root-morphemes variously condensed (as in Table 2) and permuted (as in Tables 3 and 4). To describe
more accurately this process of agglutination and morphological-fusion we define the Hamming Value, \( H \), as the number of phonemes missing from any given morpheme. We then take any lexeme and plot a graph/histogram of \( f \), the frequency distribution of its variously condensed root-morphemes, versus their respective Hamming values over the interval \( H \in [0, 4] \).

The downward sweep of this frequency distribution reflects a belief that severe condensations, especially the omission of entire root-morphemes, should occur less often. In this model, the total number of (variously condensed) root-morphemes in a lexeme is

\[
T = \sum_{H=0}^{4} f_H
\]

and their mean-condensation is

\[
\bar{c} = \frac{\sum_{H=0}^{4} H \times f_H}{\sum_{H=0}^{4} f_H} = \frac{1}{T} \times \sum_{H=0}^{4} H \times f_H
\]

The simplest model of lexeme composition assumes that half the root-morphemes (note: a better approximation is \( f_0 = 0.45T \)) are not condensed at all, with the remainder being variously condensed according to the Zipf distribution

\[
f_H \approx \frac{\frac{1}{2} T}{H + 1} \quad \text{for } H \in [0, 4]
\]

where
Lexigenesis in ancestral south-east Australian Aboriginal language

\[ T_{zipf} = \sum_{H=0}^{4} \frac{1}{2} \frac{T}{H+1} = \left( \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} \right) \times \frac{1}{2} T \approx T \]

and

\[ e_{zipf} = \sum_{H=0}^{4} \frac{T}{H+1} = \left( 0 + \frac{1}{2} + \frac{2}{3} + \frac{3}{4} + \frac{4}{5} \right) \approx 1.2 \]

which is an average condensation of slightly more than one phoneme per root-morpheme.

Example 1

sun-rise/dawn (= birth/commencement [of the] day)

A comprehensive survey of relevant south-east Australian literary and archival sources reveals that the lexeme for 'sunrise/dawn', appearing in Table 2, is just a fragment from a set of (at least four) equivalent leximorphs which are as follows:

\[ = \text{[the] solar day which [is]} \]

\[ \text{wi} \text{n}: \text{(dola:n)} - \text{i: } \text{ba(} \text{lu}) - \text{g} \text{u}: \text{ra} - \text{bo} \text{l(} \text{u}) - \text{m} \text{i} \text{n} \rightarrow \text{sun rise cycle} \]

\[ \text{win':yoo::a:boo:ng::bâ:mîn} \text{ "::bu:ng::eye:::*(this day now present*"
\[ (=\text{litt, sunrise}) \]
\[ "::bu:n::yell:*" (*sun"
\[ (Everitt, 1900) \text{[gundüngara]} (Mann, 1840) \text{[coera]}
\[ = \text{being born, commencing} \]

and

\[ = \text{[the] solar} \]

\[ \text{wi} \text{n}: \text{(dola:n)} - \text{b(} \text{ola}: \text{i} - \text{m} \text{i} \text{n} - \text{bo} \text{l(} \text{u}) - \text{gal(} \text{a}: \text{gur} \rightarrow \text{sun day} \]

\[ = \text{being born, commencing} \]

\[ "::b:i:m:bul::ong*" (= "Tuesday* ???)
\[ "::mun::gaal::oon*" (= "Sunday* ???)
\[ (Throsby, 1821) \text{[dariwjl]} (Bunce, 1853) \text{[darling downs]}
\[ "::mun::garra*" (*sun"
\[ (J. Rowley, 1875) \text{[gundüngara]}
\[ "::mun::garra*" (*sun"
\[ (Bunce, 1853) \text{[darling downs]}

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Lexemes from this set of lexicmorphs have mean-condensation rates, $\bar{c}$, ranging typically from about 1.8 up to 2.4. Smaller values indicate the relative independence of morphemes, and looseness of clustering, within their respective lexeme. Greater condensation rates imply the emergence of a lexeme as a 'word' in its own right, with the individual meanings of constituent morphemes becoming less important over vast time-periods. By comparing Hamming distributions of lexemes in varying states of condensation, we can guess the relative-age and also identify those individual morphemes considered most deletable by native speakers.
Lexigenesis in ancestral south-east Australian Aboriginal language

Example 2

*sun-set/dusk* (=*sun going-down* [distant])

Conversely, we have a set of leximorphs for *sun/moon-set*

\[ \text{bu\text{-}lu} \rightarrow \text{d(ola\text{-}n)} - \text{gar\text{-}i\text{-}n(u\text{-}nora)} - \text{wi\text{-}n} \rightarrow \text{going there} \ (\text{distant}) \]

- "pu:::ker:i:ng:::" ("sun")
  (Mackenzie, 1874) (durga)
- "bu:::gur:i:n:::" ("sun")
  (Hale, 1839) (durga)
- "boo:::goo::ya:::" ("summer")
  (Russell, 1814) (dunga)
- "bu:::g:gr:e:n:::" ("sun")
  (Larmer, 1853) (durga)

and

\[ \text{gar(i\text{-}n)} - \text{bu(lu)} - \text{nu\text{-}ru\text{-}n} - \text{wi\text{-}n(dola\text{-}n)} \rightarrow \text{sun\text{-}moon} \]

- ":::winu:::" ("hot")
  (Russell, 1914) (gundungara)
- "kaa::pa\text{-}(g)nuu\text{-}nang:::" [Peek Whurrong]
  (Dawson, 1881) ("go down sun")

and

\[ \text{wi\text{-}n(dola\text{-}n)} - \text{gar(i\text{-}n)} - \text{bu\text{-}lu} - \text{i\text{-}(u\text{-}nora)} - \text{gul(a)} \rightarrow \text{going down there} \ (\text{distant}) \]

- ":::yarra::bu::nye:::" ("go away")
  (Larmer, 1853) (durga, Braidwood)
- "woi::d::g:i::tt::gull:::" ("Wednesday" ?)
  (Throsby, 1821) (dariwul)
Again it is instructive to plot Hamming distributions for lexemes in varying states of condensation:

\[
\begin{array}{c|cccc}
\text{bu:ga:wi} \eta & \eta(u \eta) & \text{ga}(r \eta) & \text{bu}(l \theta) & d(\delta \alpha) \\
\text{(Everitt et al., 1900)} & (n) & (n) & (n) & (n) \\
0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

\[T = 8, \quad \bar{C} = 15/8 = 1.875\]

\[
\begin{array}{c|cccc}
\text{bu:gar:i:p} \eta & \eta(u \eta) & \text{gar}(r \eta) & \text{bu}(l \theta) & d(\delta \alpha) \\
\text{(Hale, 1846)} & (n) & (n) & (n) & (n) \\
0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

\[T = 8, \quad \bar{C} = 17/8 = 2.125\]

\[
\begin{array}{c|cccc}
\text{ga:bu:n:nu} \eta & \eta(u \eta) & \text{ga}(r \eta) & \text{bu}(l \theta) & d(\delta \alpha) \\
\text{(Dawson, 1881)} & (n) & (n) & (n) & (n) \\
0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

\[T = 8, \quad \bar{C} = 15/8 = 1.875\]

\[
\begin{array}{c|cccc}
\text{bu:gar:v:p} \eta & \eta(u \eta) & \text{gar}(r \eta) & \text{bu}(l \theta) & d(\delta \alpha) \\
\text{(Mowle, 1838)} & (n) & (n) & (n) & (n) \\
0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

\[T = 8, \quad \bar{C} = 16/8 = 2\]

\[
\begin{array}{c|cccc}
\text{gar:r:bu:n} \eta & \eta(u \eta) & \text{gar}(r \eta) & \text{bu}(l \theta) & d(\delta \alpha) \\
\text{(Larmer, 1898b)} & (n) & (n) & (n) & (n) \\
0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

\[T = 8, \quad \bar{C} = 17/8 = 2.125\]

\[
\begin{array}{c|cccc}
\text{bul:a:gar:v:p} \eta & \eta(u \eta) & \text{bul}(r \eta) & \text{gar}(l \theta) & d(\delta \alpha) \\
\text{(Mathews, 1903)} & (n) & (n) & (n) & (n) \\
0 & 1 & 2 & 3 & 4 \\
\end{array}
\]

\[T = 8, \quad \bar{C} = 15/8 = 1.875\]

All these words contain some version of the morphemes \textit{gar} = i = \textit{going} and \textit{bul} = \textit{down} hence ‘setting’. The most deletable morphemes seem to be \textit{nu}ra = \textit{yonder/there} [distant] and \textit{dola:n} = \textit{thing} [singular] = ‘sun’.

These examples demonstrate that our estimate of 1.2 is too small for the Zipf mean-condensation. The smallest values attained in actual lexemes were \(\bar{c} = 16/9 = 1.7777\) (‘sunrise’) and \(\bar{c} = 15/8 = 1.875\) (‘sunset’). For simplicity our initial estimate assumed \(H \in [0,4]\) ... the Hamming spectrum of \textit{root}-morphemes.
But there are also morphemes which, although not fundamental roots, nevertheless commonly occur in lexemes. Some of these morphemes contain up to six phonemes; examples being the numerals \textit{bulala} = 2, \textit{wurula} = 3, \textit{nurula} = 4 and \textit{murula} = 5. This means that our earlier estimate neglected the asymptotic tail of the Zipf distribution, beyond $H = 4$, and that a better estimate for the Zipf distribution is as follows:

$$f_H = \frac{f_0}{H+1} \quad \text{for } H \in [0, 6]$$

hence

$$\varepsilon_{\text{zipf}} = \sum_{H=0}^{6} H \times \frac{f_0}{H+1} = \left( \frac{0 + \frac{1}{2} + \frac{2}{3} + \frac{3}{4} + \frac{4}{5} + \frac{5}{6} + \frac{6}{7} } {1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} } \right) \approx 4.40714 \approx 1.7$$

which is very realistic! Thus, even though lexemes such as ‘sunrise’ and ‘sunset’ may not themselves contain any of these larger (six phoneme) morphemes, the morphemes that they do contain are nevertheless condensed according to a law that takes into account the existence of larger morphemes. Clearly the asymptotic tail of the Zipf distribution cannot be ignored. A useful formula for calculation purposes is:

$$\varepsilon_{\text{zipf}}(m) = \frac{\gamma + m - 1 - \ln(m+1)}{\gamma + \ln(m+1)} \quad \text{for } H \in [0, m]$$

where the Euler constant $\gamma = 0.577215664901532860606512$.

\textbf{Example 3}

\textit{female-breasts/nipples (\textit{= pair of lactators})}

A set of leximorphs, containing six-phoneme morphemes and demonstrating the full $H \in [0, 6]$ tail of the Zipf distribution, underlies lexemes for women’s breasts (\textit{= large [things]}) or nipples (\textit{= small [things]}):

$$\begin{align*}
ba(\text{ra}) &= \text{either-side} = \text{large/small} \\
muru &= \text{large/smaller} \\
mara &= \text{lactating} \\
garu(\text{i:}:\text{g}(\text{uru}):\text{w}(\text{ur}):\text{il}(\text{a})) &= \text{pair of [things]} \\
\text{ba}(\text{la}:\text{n}) &= \text{ba}(\text{la}:\text{n}) \\
\end{align*}$$

\begin{align*}
\text{“pa::::::pilla:” ("nipple[s")} & \quad \text{“p::e:n:g:al::” ("poitrine = chest, bosom")} \\
\text{(Pliny the Elder) \{latin\} \{durga\}} & \quad \text{(McCaffrey, 1920s) \{dariw\\}} \\
\text{“bera:::::::” ("cheek[s")} & \quad \text{pa::::::yil:::” ("the breasts")} \\
\text{(Hale, 1846) \{durga\} \{awabakal\}} & \quad \text{(Threlkeld, 1834) \{awabakal\}} \\
\end{align*}
and

\[ \text{\texttt{\textbackslash{u}n\textbackslash{u}}} \text{(Threlkeld, 1834)} \{\text{awabakal}\} \{\text{Collins, 1798}\} \{\text{eora}\} \]

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\[ \text{Chapter 1, JAS 2003} \]
Lexogenesis in ancestral south-east Australian Aboriginal language

### Chapter 1, JAS 2003

#### 1. Lexogenesis in ancestral south-east Australian Aboriginal language

<table>
<thead>
<tr>
<th></th>
<th>b(art)</th>
<th>ℓ(uru)</th>
<th>(m<em>r</em>)</th>
<th>(garθ)</th>
<th>(bulala)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

\[ T = 8, \bar{C} = 24/8 = 3 \]

#### 2. ηu:b:bu:u:n:g

<table>
<thead>
<tr>
<th>n</th>
<th>(i)</th>
<th>ηu(uru)</th>
<th>g(art)</th>
<th>(m<em>r</em>)</th>
<th>bu(lala)</th>
<th>(wurθla)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

\[ T = 8, \bar{C} = 23/8 = 2.875 \]

#### 3. ηu:m:i: pu η

<table>
<thead>
<tr>
<th>i</th>
<th>fuy</th>
<th>(n)</th>
<th>ηu(uru)</th>
<th>m*(r*)</th>
<th>(garθ)</th>
<th>(bulala)</th>
<th>(wurθla)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ T = 9, \bar{C} = 26/9 = 2.8888 \]

#### 4. ga:m:barθ

<table>
<thead>
<tr>
<th>barθ</th>
<th>(i)</th>
<th>ga(art)</th>
<th>(m<em>r</em>)</th>
<th>(uru)</th>
<th>(bulala)</th>
<th>(wurθla)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

\[ T = 8, \bar{C} = 23/8 = 2.875 \]
Example 4

*bivalved-shell* ( = pair of opposing spiral[thing]s)

Another set of leximorphs containing six-phoneme morphemes, and demonstrating the full \( H \in [0, 6] \) tail of the Zipf distribution, is as follows:

\[
\begin{align*}
\text{bulala}: (n) &= \left( g\text{un}:w\text{ural} (a) : g\text{u} (n : i) \right) \\
&= \text{pair of [things]}
\end{align*}
\]

\[
\begin{align*}
i : m (u r u) \\
&= \text{slightly/gently spiralling}
\end{align*}
\]

\[
\begin{align*}
b a (r o) &\longrightarrow \eta (a r a) \\
&= \text{either-side [opposing]}
\end{align*}
\]

\[
\begin{align*}
\text{ba} (r o) &= \left( g\text{un}:g\text{on}: w (u r) (a) : i \right) \\
&= \text{slightly/gently spiralling}
\end{align*}
\]

\[
\begin{align*}
i : m (u r u) \\
&= \text{pair of [things]}
\end{align*}
\]

\[
\begin{align*}
b a (l a : n) &\longrightarrow \eta (a r a) \\
&= \text{either-side [opposing]}
\end{align*}
\]

| "le:::ro::ko:::" ("huitre" = oyster) | "tallo:::p:::" (Peek Whurong) |
| ":::kan:el:::" ("moule coquille" = mussel) [pl. 78] | "chaluu:::p:::" (Chaap Whurong) |
| ":::woour:ra:::" ("venus" = cockle) [pl. 84] | (Dawson, 1881) ("shell of mussel") |
| (Quoy & Gaimard, 1826) (djuerga, Jervis Bay) | |

and

| "bi:i:m:ba:::" ("cochle, mussel, mud-clam") | "tii:m:bo::nn" ("shell of a mussel") |
| (Eades, 1976) (djuerga: Jervis Bay) | (Dawson, 1881) |

| "pee:::w:ee:::" ("shells") | ":::co:q:uill:ee:::" (French) |
| (Munima, 1863) (dariwul: Illawarra) | |

| ":::co:ck:l:e:::" (English) | ":::ka:k::i:::" (Japanese) |

---

\[
\begin{array}{|c|c|c|c|c|c|}
\hline
\text{ba:wi} & \text{(Munima, 1863)} \\
\hline
\text{Munima, 1863) (dariwul: Illawarra)} & \text{ba:wi} \\
\hline
\text{0} & \text{1} & \text{2} & \text{3} & \text{4} & \text{5} & \text{6} \\
\hline
\end{array}
\]

\[
T = 8, \quad \bar{C} = 24/8 = 3
\]
Example 5

**gliding-possum** (= **slowly-falling** [gliding] **creature**)

The gliding possums *Petaurus*, including the ‘sugar glider’ and its cousin the ‘squirrel (g:wurul?) glider’, have the name *diving/gliding creature*. The relevant lexemes, appearing in Table 3, are fragments from the following set of leximorphs:

\[
g(\text{on}) : wu(\text{rul}) \rightarrow g(\text{on}) - \eta \rightarrow \text{bula}: i \rightarrow \text{creature}
\]

\[
\text{slowly} \downarrow \quad \text{falling} \downarrow \quad \text{gliding}
\]
and

\[
\begin{array}{c}
\text{wu}(\text{rola}:\text{gun}) - b(\text{ula}) : i - \eta \\
= \text{gliding} \\
\rightarrow
\end{array}
\begin{array}{c}
\text{wu}(\text{bb}:i:n) \\
(\text{Collins, 1798}) \\
(\text{cora})
\end{array}
\]

and

\[
\begin{array}{c}
\text{bu}(\text{lu}) : i - \eta - \text{wuru}(\text{la}:\text{gun}) \\
= \text{gliding creature}
\rightarrow
\end{array}
\begin{array}{c}
\text{wu}(\text{bb}:i:n) \\
(\text{Dawes, 1790}) \\
(\text{cora})
\end{array}
\]
Lexogenesis in ancestral south-east Australian Aboriginal language

Statistical quantities such as $\bar{c}$ are most meaningful for lexemes with many morphemes, say $T \geq 6$, indeed the more the better. These lexemes for ‘gliding-squirrel’, made from only five morphemes, can experience significant variations in $\bar{c}$ (from 1.6 to 2 in the above histograms), scattered either side of $\bar{c}_{\text{Zipf}} = 1.7$, depending merely upon the condensation of a single morpheme (in this case wurala). Exactly the same thing happens for bu:ji:wuro (McCaffrey, 1920) ($\bar{c} = 1.6$) and bu:ji:wi (Dawes, 1790a) ($\bar{c} = 2$). Additionally g:wuro:bulo (Mann, 1840s) has a value $\bar{c} = 1.2$, which is significantly less than the Zipf mean.

To avoid such erratic behaviours of lexemes made from small numbers of morphemes, we can average all the $\bar{c}$ values within a parent leximorph or, indeed, over the entire set of leximorphs. Between the extreme values 1.6 and 2, in the above histograms, lies a statistically more meaningful mean $\bar{c}_{\text{Zipf}} = 1.8$. An instructive example like this, involving only five morphemes, raises awareness of the errors likely to arise in this kind of analysis and how to minimize their impact.

4 Lexeme → word, ‘a phase transition’

Critical re-examination of previously given histograms for various lexemes, each with its own respective mean-condensation $\bar{c} > \bar{c}_{\text{Zipf}} = 1.7$, reveals that almost none are well described by the Zipf distribution alone. They generally seem to drop to a minimum in the vicinity of $H = 1$ or 2, thereafter rising to a crest at $H = 2$ or 3 or 4, eventually falling away toward zero as $H \to 6$. These distinctive undulations, which also occur in non-linguistic contexts (Jones, 1999), are particularly pronounced in lexemes possessing large values of $\bar{c}$ such as

- la:ro:gu (= oyster) (Quoy & Gaimard, 1826)
- b:i:ji:tool (= female breasts)

but are also apparent for smaller values of $\bar{c}$ as in the examples

- du:bu:wi:pbo:i:g (= sun-rise) (Pettit & Dawson, 1850s)
- wu:ki:ji (= gliding-possum) (Dawes, 1790a)

Generally the Zipf distribution with mean-condensation $\bar{c}_{\text{Zipf}} = 1.7$ describes individual relatively independent morphemes, some slightly condensed, coexisting (up to a dozen at a time) in syntactic environments (called leximorphs) which must originally have been ancient sentences or phrases. The observed values of $\bar{c}$ amongst subsequent genetically-related lexical progeny quantify the extent to which constituent morphemes have become progressively and collectively condensed, through time, into increasingly bound clusters (called lexemes) which can eventually emerge as independent ‘words’ in their own right. In this way new morphemes can be created to cluster with previously existing morphemes, within new hybrid lexemes, all the while constrained by a universal Zipfian law that perpetually transcends syntactic scales and grammatical regimes across countless millennia.

The above-mentioned undulation in Hamming frequency histograms, belonging to real-world lexemes, arises because increasing condensation is achieved through
less-frequently condensing morphemes slightly (creating a trough at about $H = 1$ or 2), and more frequently condensing morphemes severely (creating a crest at about $H = 2$ or 3 or 4). With increasing condensation, the collapse of a lexeme into a word in its own right (with constituent morphemes irrevocably bound together and no longer functioning individually) is in every sense a phase-transition analogous to the physical condensation of gas to liquid or liquid to solid. It may be carrying the analogy too far, thinking of morphemes as ‘elementary particles’ whose phonemes that are lost through condensation equate to ‘lost mass’ manifesting itself as binding-energy that holds the lexeme together, but some physical analogy is needed.

The celebrated Kinetic Theory of Ideal Gasses models phase transitions using two terms: one due to Robert Boyle (1627–1691), which has volume varying inversely with pressure (analogous to the Zipf law in linguistics), and another term due to Johannes van der Waals (1837–1923) which describes the deviation from ideal behaviour during phase change (Starling & Woodall, 1950). In a similar spirit we now model condensation of real world lexemes as follows:

$$F(H) = \kappa + \frac{A}{H + \alpha} + \frac{B}{(H + \beta)^2 + \sigma}$$

George Kingsley Zipf  Johannes van der Waals
(1902–1950)  (1837–1923)

for $H \in [0, 6]$ and $\varepsilon \geq \varepsilon_{\text{Zipf}} = 1.7$

Where $A > 0$ and, in order for $F$ to collapse to the Zipf limiting case, we typically have $\kappa = -T(\varepsilon - \varepsilon_{\text{Zipf}})/6\alpha$, $\alpha = (T\varepsilon - A)/(T\varepsilon_{\text{Zipf}} - A)$, $\beta = -3.5\varepsilon_{\text{Zipf}}/(6 - \ln(7))$ and $\sigma = A\varepsilon_{\text{Zipf}}/6$. To determine the main constants, $A$ and $B$, we return to the definition of the Hamming mean:

$$T \times \varepsilon = \sum_{H=0}^{6} H \times F(H)$$

$$= \sum_{H=0}^{6} \int_{x=H+1}^{x} \left( \kappa(x - 1) + \frac{A(x - 1)}{x - 1 + \alpha} + \frac{B(x - 1)}{(x - 1 + \beta)^2 + \sigma} \right) dx$$

$$= 18\kappa + A \left[ 6 - \alpha \ln \left( \frac{6 + \alpha}{\alpha} \right) \right]$$

$$+ B \left[ \frac{1}{2} \ln \left( \frac{(6 + \beta)^2 + \sigma}{\beta^2 + \sigma} \right) - \frac{\beta}{\sqrt{\sigma}} \left( \text{atan} \left( \frac{6 + \beta}{\sqrt{\sigma}} \right) - \text{atan} \left( \frac{\beta}{\sqrt{\sigma}} \right) \right) \right]$$

Rearranging for $B$ in terms of $A$ gives

$$B = \frac{1}{2} \ln \left( \frac{(6 + \beta)^2 + \sigma}{\beta^2 + \sigma} \right) - \frac{\beta}{\sqrt{\sigma}} \left( \text{atan} \left( \frac{6 + \beta}{\sqrt{\sigma}} \right) - \text{atan} \left( \frac{\beta}{\sqrt{\sigma}} \right) \right)$$
In the Zipf limit the two sides of this equation simplify as follows:

$$\lim_{c \to \text{Zipf}} \left[ B \right] = 0$$

$$\Rightarrow \lim_{c \to \text{Zipf}} \left[ A \right] = \lim_{c \to \text{Zipf}} \left[ \frac{T\bar{c} - 18\kappa}{6 - \bar{c} \ln \left( \frac{6 + \bar{c}}{\bar{c}} \right)} \right]$$

$$= \frac{T\bar{c}_{\text{Zipf}}}{6 - \ln (7)} = \frac{1.7}{4.05409} \approx T \approx \frac{1}{2}$$

which is consistent with our earlier definition of the Zipf curve.

At the other extreme, as $H \in [0, 6]$, we might imagine $\bar{c}$ attaining a maximum value of 6 (if all morphemes were six phonemes long and all were totally condensed). In such a case $\bar{c} - \bar{c}_{\text{Zipf}} = 6 - 1.7 = 4.3$, hence the first-order approximation

$$A \approx \frac{T\bar{c}_{\text{Zipf}}}{6 - \ln (7)} \left[ 1 - \frac{1}{4.3} (\bar{c} - \bar{c}_{\text{Zipf}}) \right]$$

for $\bar{c} \in [\bar{c}_{\text{Zipf}}, 6]$ can be used to numerically calculate $\alpha, \kappa, \sigma$ and $B$, from previously given equations, in terms of the known quantities $T$, $\bar{c}$ and $\bar{c}_{\text{Zipf}}$. Thus, by varying $\bar{c}$ we are able to plot progressive stages of lexeme-condensation (Fig. 2) following the genesis of words through time.

![Figure 2](image.png)

**Fig. 2.** As $\bar{c}$ increases, from the Zipf value 1.7, the above numerically-generated family of optimal frequency-distributions describe diachronic-condensation of eight typical morphemes ($T = 8$) within an increasingly-bound lexeme. This model applies for $\bar{c}$ values up to about 3.4, beyond which the (dashed) curves drop below the $H$-axis implying unphysical negative frequencies. This is discussed further in Example 6.
This numerical model predicts an upper limit to ‘allowable’ values of $c$ in real-world lexemes, approximately when $c = 2\zeta_{\text{Zipf}}$, beyond which the trough of the frequency distribution drops below the $H$-axis, implying unphysical negative frequencies. Unfortunately, due to extinction of Aboriginal language throughout south-eastern Australia, it is no longer possible to check this prediction through diachronic studies involving living language but, as arithmetical lexemes may (in principle) be indefinitely enlarged (Mathew, 1899), we do have another avenue for studying real-world lexemes condensing toward this predicted limit.

Example 6
Numerals

\[ 0 = \text{mirō} \]
\[ 1 = (\ldots) - \text{mi}(\text{ra}) - \text{do}(\text{la}) - n \rightarrow \]
\[ + \quad \text{zero} \quad \text{unity} \]
\[ \text{zero + unity} = 1 \]

- "me:ta:nn" ("one, today")
  (Quoy & Gaimard, 1826) {dorga}
- "mi:to:ng"
  (Bennett, 1832) {tjunuwul}
- "me:du:ng"
  (Everitt, 1900) {gondo\nara}
- "mi:da:ng"
  (Eades, 1976) {dorga}
- "mi:tu:n"
  (Mackenzie, 1872) {dorga}
- "mi:tu:ng"
  (Mackenzie, 1874) {dorga}
- "mi:tu:ng"
  (Lhotski, 1834) {tjunuwul}
- "mi:tu:n: dthāli"
  (Mackenzie, 1874) {dorga}
- "mira:n: yalla"
  (Lhotski, 1834) {tjunuwul}
- "mira:n: yalla"
  (Lhotski, 1834) {tjunuwul}

and

\[ \text{mirō} - n - \text{dola} \rightarrow \]

\[ \text{bu} \quad (n) \quad \text{(dō)la} \quad \text{(mi)ra} \quad \text{(dō)la} \quad \text{(mirō)} \]
\[ \begin{array}{cccc}
0 & 1 & 2 & 3 & 4 \\
1 & 1 & 1 & 1 & 1 \\
\end{array} \]

\[ \begin{array}{c}
buck:ar\theta = 2 \\
\text{(Munima, 1863)} \end{array} \]

\[ T = 6, \]
\[ \zeta = 13/6 = 2.1666 \]
Lexigenesis in ancestral south-east Australian Aboriginal language

\[ 2 = + [1, 1] = \underbrace{bu - (miro:do)la - (mi)ra:(do)la - n}_{1} + 1 = 2 \]

\[ 3 = + [2, 1] = wu - \underbrace{(bu:miro:dola:miro:dola - mi)ra:(do)la - n}_{2} + 1 = 3 \]

(Bennett, 1832) [jano:vu] (Larmer, 1853) [danga]

“nu:.....:ro:”
(Oldfield, 1828) [cora]

5 = + [4, 1] = nu = (nu:wu:bu:miro:dula...miro:dola − mi)ro:dola − n

4 + 1 = 5

“ma:.....::ry:diolo:” (“five”)
(Hunter, 1795) [cora]

“ma:.....::ro:la” (“hand, finger”)
(Russell, 1914) [gundu:mu]

5 = + [4, 1] = mu = (nu:wu:bu:miro:dula...miro:dola − mi)ro:dola − n

4 + 1 = 5

“ma:.....::ry:diolo:” (“five”)
(Hunter, 1795) [cora]

“ma:.....::ro:la” (“hand, finger”)
(Russell, 1914) [gundu:mu]
Thus we have a quinary system, involving recursive arithmetical additions of the form $+ [a, b] = a + b$, as in

$$+ [ + [ + [ + [1, 1], 1], 1], 1] = 1 + 1 + 1 + 1 + 1 = 5$$

and generally

<table>
<thead>
<tr>
<th>Addition lexemes (numerals)</th>
<th>$T$</th>
<th>$\bar{c}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 = bulara</td>
<td>6</td>
<td>13/6 = 2.166666</td>
</tr>
<tr>
<td>3 = wurula</td>
<td>9</td>
<td>23/9 = 2.555555</td>
</tr>
<tr>
<td>4 = nurola</td>
<td>12</td>
<td>33/12 = 2.75</td>
</tr>
<tr>
<td>5 = murula</td>
<td>15</td>
<td>43/15 = 2.866666</td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td>53/18 = 2.944444</td>
</tr>
<tr>
<td>7</td>
<td>21</td>
<td>63/21 = 3</td>
</tr>
<tr>
<td>8</td>
<td>24</td>
<td>73/24 = 3.041666</td>
</tr>
<tr>
<td>9</td>
<td>27</td>
<td>83/27 = 3.074074</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>93/30 = 3.1</td>
</tr>
<tr>
<td>$\ldots$</td>
<td>$\ldots$</td>
<td>$\ldots$</td>
</tr>
<tr>
<td>$n$</td>
<td>$3n$</td>
<td>$(3 + 10(n - 1))/3n$</td>
</tr>
</tbody>
</table>

where, as these arithmetical lexemes increase in size, their mean condensation $\bar{c}$ converges to the value

$$\lim_{n \to \infty} \left[ \frac{3 + 10(n - 1)}{3n} \right] = \frac{10}{3} \approx 2\varepsilon_{Zipf}$$

in accordance with the prediction of the numerical model.

![Graph](image)

**Fig. 3.** As morphemes are added (i.e. as $T$ increases) the troughs can drop no lower, so increasing condensation $\bar{c}$ manifests as ever higher crests in the Hamming frequency-distributions of successive numerals.
These distinctive numerals occurred in arithmetical expressions such as

\[3 = + [1, 2] = (\ldots) - \left( \frac{mi(\text{ru}) \cdot dola}{dola \cdot (mi \text{ru})} \right) \frac{bu \cdot la \cdot (\text{ru})}{2} - n\]

\[
\frac{1}{1 + 2} = 3
\]

\[\text{";dy:rra::la::n" (Mathews, 1881) \{dharruk\}} \quad \text{";mi:ttala::lec::" (Larmer, 1853) \{dorga\}}\]

and

\[3 = + [2, 1] = (\ldots) - \frac{bu \cdot la \cdot ru - mi(\text{ru}) \cdot du (la)}{2} - n
\]

\[
\frac{2 + 1}{2 + 1} = 3
\]

\[\text{";bu:lla:ra:mi:dto:ng" \quad \text{";bu:lla::ma:tu:ng" (Munima, 1863) \{darwul\}} \quad \text{";bu:lla::ma:tu:ng" (Larmer, 1853) \{dorga\}}\]

also

\[4 = + [3, 1] = bu - \frac{wu:ru:la}{3} - \frac{m(\text{ru}) \cdot dola - n}{1} \rightarrow \quad \text{"wo:wo:r:lyu:m::" (Munima, 1863) \{darwul\}}\]

and

\[4 = + [2, 2] = (\ldots) - \frac{bu \cdot la \cdot ru - bu \cdot la \cdot ru}{2} - (n)
\]

\[
\frac{2 + 2}{2 + 2} = 4
\]


also

\[5 = + [4, 1] = nu:ru:la - n - \frac{bu}{4} - \frac{(mi) \cdot du (la)}{1} \rightarrow \quad \text{"u::llu:ng:b:ro:tha" (Larmer, 1853) \{dorga\}}\]

and

\[5 = + [2, 2, 1] = + [4, 1] =
\]

\[\ldots - \frac{bu \cdot la \cdot (u)}{2} - \frac{bu \cdot la \cdot (u)}{2} - bu - \frac{mi(\text{ru}) \cdot du (la)}{1} - n.
\]

\[
\frac{2 + 2}{2 + 2} = 4
\]

\[
\frac{4 + 1}{4 + 1} = 5
\]

5 The optimization problem

For the Lagrangian

$$L(H, \dot{F}(H)) = \frac{1}{2} g(H) \dot{F}^2(H)$$

where

$$g(H) = \frac{-(H+\alpha)^2((H+\beta)^2+\sigma)^2}{A((H+\beta)^2+\sigma)^2+2B(H+\beta)(H+\alpha)^2}$$

a necessary condition for the functional

$$\mathcal{J} = \sum_{i=0}^{6} L(H, \dot{F}(H))$$

to be minimized is that $F(H)$ must satisfy the Euler Equation

$$0 = \frac{d}{dH} \left( \frac{\dot{L}}{\dot{F}} \right) = \frac{d}{dH} (g\dot{F}) = g\ddot{F} + g\dot{F}$$

hence

$$F(H) = \kappa + \frac{A}{H+\alpha} + \frac{B}{(H+\beta)^2+\sigma} \quad \text{for } H \in [0, 6]$$

The limit as $B \to 0$ makes $\kappa = 0$ and $g(H) = -{(H+\alpha)^2}/A$, reducing $F$ to the Zipf function $A/(H+\alpha)$, in which event $A = 1$ and $\alpha = H + \alpha$ gives $g = x^2$ and $L = -\frac{1}{2}x^2\dot{F}^2$ corresponding to the power-law $x^{-1}$ as discussed in the abstract of this paper. Conversely in the limit as $A \to 0$, $g(H) = -{(H+\beta)^2+\sigma})^2/(2B(H+\beta))$, reducing $F$ to the van der Waals function $\kappa + B/(H+\beta)^2+\sigma)$. On a philosophical level, the Lagrangian is a pure ‘kinetic-energy’ term describing lexeme motion/evolution in Hamming space. This optimization problem shows that our proposed van der Waals perturbation, to the Zipf distribution, is the most efficient (optimal) way for diachronic lexeme-condensation (= new morpheme creation) events to occur.

Acknowledgements

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NOTE

1. The veteran journalist John Gale (1913) recorded ‘a woman’s breasts’ = ‘goyan: g:bera’, deriving from gυn: g:να: -baro = extremely either-side. He also stated that the place-name Canberra meant ‘a woman’s breasts … deriving from the two eminences now known as Black Mountain and Mount Ainslie …’. And, indeed, the above permutations of the word ‘one’s breast[s]’ do quite match the earliest written versions of this place-name, even quite unfamiliar versions such as ‘pial:i:go’. 
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Lexogenesis in ancestral south-east Australian Aboriginal language


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Phono-genesis and the Origin of Accusative Syntax in Proto-Australian Language

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ABSTRACT: It is claimed that a set of 62 known (Illert, 2003) ancient Aboriginal words constitute a representative sample of the original proto-Australian lexicon whose maximum likelihood (Fisher, 1912) ‘power law signature’ is determined and shown to precisely fit genetically related ‘modern’ lexicons from south-eastern Australia. This measure of ‘sameness’ builds the confidence required to justify inter-lexicon diachronic word-frequency comparisons which provide a powerful new statistical tool capable of revealing important features of ancestral grammar. This paper supplies the first ever published modern translations of authentic traditional language documented in obscure literary and archiral sources which have, until recently, been lost (Dawes, 1790b; Wood, 1924; Troy, 1992) or overlooked (Evetit et al., 1900; Illert, 2001) for centuries. These newly found examples of accusative syntax supported by word-frequency data may come as quite a surprise to some linguists (Dixon, 1980; Osmond, 1989; Troy, 1992; Nichols, 1993) who, in the absence of adequate evidence, seem to have long-imagined that language from this region—if not the entire continent—simply had to be inherently and at the core ergative. On the contrary we find that changing word-frequencies, from proto-Australian to modern times, supply overwhelming evidence of the emergence of ancient accusative prefixes which have even survived into recent centuries in the Sydney region. Additionally it is found that, over millennia, words die-off in a lexicon, replaced by others, according to the famous ‘mortality law’ of Gompertz (1825) which also describes the likelihood of death of biological organisms within populations and is the basis for modern actuarial science (Bowers et al., 1997). Just as disease and epidemics can wipe out entire cohorts of creatures from a population, so too can syntactic change annihilate word-classes in an evolving lexicon.

KEY WORDS: Maximum-likelihood, frequency analysis, Gompertz law, morpho-statistics, linguistics

Introduction

The Aboriginal ‘eora’ dialect from Sydney is perhaps the oldest documented remnant language from anywhere in mainland Australia. Two centuries ago—along with ‘thurrawal’ supposedly from the Illawarra, and ‘dhurqa’ from the Shoalhaven—it was part of a strip of similar language extending for hundreds
of kilometres along the New South Wales coastline. Adjoining them inland, to
the west, were the Blue Mountains ‘dharruk’ and ‘gundungurra’ dialects, which
were different from coastal counterparts. However, regardless of any differences,
traditional language has long been lost throughout the entire region and it is
only by considering this entire block of dialects collectively that there is sufficient
literary and archival material to salvage and reconstruct a meaningful quantity
of words and grammar.

In a previous paper, Illert (2003) discussed the orthographic decrepitude of
some relevant 18th and early 19th century ‘word-lists’. Out of this old-fashioned
literary tradition came a rather jumbled paper, by Robert Hamilton Mathews
(1903, pp. 275–279) containing a 428-word ‘thurrawal’ lexicon. And, more
recently, a phonetically lovely 321-word ‘dhurga’ lexicon was recorded from ‘the
last living speakers’ by a modern linguist Diana Kelloway Eades (1976). These
two lexicons jointly provide a net vocabulary of about 750 Aboriginal words
including verbs, adjectives and nouns, all from roughly the same geographical
region.

Of course, there are other relevant word-lists (e.g. Rowley, 1875; Malone, 1875;
Munima, 1863; Nathan, 1848; Quoy & Gaimard, 1826; Collins, 1798; Hunter,
1793); however, in order to avoid differing orthographic notations and varying
standards of reliability, this present study focuses upon the thurrawal word-list
of Mathews (1903) and the dhurga word-list of Eades (1976). We will rigorously
compare these two ‘modern’ Aboriginal lexicons with a proposed 62-word proto-
Australian lexicon most of which has already been previously published by Illert
(2003, Tables 1(a) and 1(b)).

The genetic relatedness of all three languages is self-evident, both of the
modern lexicons being awash with common roots, Mathews’ (1903) thurrawal
word-list alone attesting to more than half of the 62 known ancestral words (see
Appendix A). In addition Eades’ (1976) dhurga lexicon provides evidence for
roots such as the conjugate pairs *gara*→‘gara’ (‘nasal mucous’) and *gura*→‘bura’
(‘stone, rock’), *bura*→‘bura’ (‘kangaroo’) and *bara*→‘bara:l’ (‘wallaby’), also
‘*mula*’ (‘head lice’), *wara*→‘wara:ga:’ (‘boomerang’), *wuri*→‘wari:n’ (‘child’)
and *wurula*→‘wula:n’ (‘money’).

At present, there is good evidence for the existence of 14 proto-Australian
words commencing with the consonant *m*, 11 with *g*, ten with *b*, six with *n*, six
with *w*, five with *g*, three with *d*, three with *j*, three with *d* and one with *g*. All
these words, ranked according to respective word-initial consonant frequencies,
can be displayed as the histogram in Figure 1—for which even visual inspection
suggests some kind of power-law arising from entropy.

It is possible likewise to count manually the frequencies of word-initial
consonants in both the thurrawal and dhurga lexicons, and to plot similar
histograms for them too. The data for all three lexicons, presented in Table 1,
seem fairly much in keeping with previous work in the field. For example, Dixon
(1980, Section 6.6.2, p. 167) examined the phonotactics of 40 recent Australian
languages, ‘virtually all those for which adequately detailed phonological descrip-
tions have been provided’, finding that

the most frequent word-initial segments are, in every language, the peripheral stops and
nasals … [whilst] apicals are always the rarest stops and nasals in that position ….
Figure 1. The 62 known words of a proposed proto-Australian lexicon, ranked according to their respective word-initial consonants. These ancient roots were the building-blocks from which ‘modern’ south-east-Australian vocabulary was constructed—see Appendix A.

... in *wargamay* for example

25% of the entries in the dictionary begin with *g* and 12% with *m*, ... [whilst] only 2% of the roots begin with *d*, and a minuscule 0.5% with *n*, ...

... in every language

semi-vowels may occur initially ... peripheral *w* begins rather more words than does laminal *y*, although both are common,

... also

[word-initial] laminal stops and nasals occur quite frequently ... [with] the laminal nasal *ny* ... well attested initially but ... not so common finally ... It could be that pA had a single phoneme, realised as *[ny]* initially and as *[y]* finally.

Word-initial-consonant frequencies in Table 1 reflect these basic phonotactic features, and analysis of variance shows all three data sets to be indistinguishable to the 0.01 level of statistical confidence regardless of whether we study the raw or normalized values. Such basic measures of ‘sameness’ are important if the proposed set of 62 proto-Australian words are collectively to be viewed as a representative sample of (albeit ancestral) south-east-Australian vocabulary. Additionally, we will study the ‘power law’ signature ¹ of these lexicons to build the confidence that is required to justify inter-lexicon comparisons of word frequencies, as in Table 2, providing a powerful new statistical tool capable of revealing important information about ancestral grammars which differed in the way they marked the subject and object in a sentence—ranging between *ergative* syntax which generally employed a suffix to mark a noun as the *agent* of a transitive process, and *accusative* syntax which could manifest as an affix marking
Table 1. Lexical-frequencies of word-initial-consonants. \( N \) is the total number of words with any specified word-initial-consonant, in each of three different languages. The corresponding lexical frequencies in each language, respectively equal to \( 100 \times \frac{N}{62} \) (proto-Australian), \( 100 \times \frac{N}{321} \) (dhurga) and \( 100 \times \frac{N}{428} \) (thurrawal), are expressed as approximate percentages with a rounding error of ±0.07%.

<table>
<thead>
<tr>
<th></th>
<th>proto-Australian (Illert, 2003) total of 62 words</th>
<th>dhurga (Eades, 1976) total of 321 words</th>
<th>thurrawal (Mathews, 1903) total of 428 words</th>
</tr>
</thead>
<tbody>
<tr>
<td>word-initial consonant</td>
<td>( N )</td>
<td>( f(%) )</td>
<td>( N )</td>
</tr>
<tr>
<td>( m )</td>
<td>14</td>
<td>22.6</td>
<td>85</td>
</tr>
<tr>
<td>( g )</td>
<td>11</td>
<td>17.8</td>
<td>62</td>
</tr>
<tr>
<td>( b )</td>
<td>10</td>
<td>16.1</td>
<td>45</td>
</tr>
<tr>
<td>( p )</td>
<td>6</td>
<td>9.7</td>
<td>36</td>
</tr>
<tr>
<td>( w )</td>
<td>6</td>
<td>9.7</td>
<td>26</td>
</tr>
<tr>
<td>( s )</td>
<td>5</td>
<td>8.1</td>
<td>19</td>
</tr>
<tr>
<td>( d )</td>
<td>3</td>
<td>4.8</td>
<td>14</td>
</tr>
<tr>
<td>( n )</td>
<td>3</td>
<td>4.8</td>
<td>12</td>
</tr>
<tr>
<td>( g )</td>
<td>1</td>
<td>1.6</td>
<td>8</td>
</tr>
<tr>
<td>( d )</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( y )</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( r )</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>( l )</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Changes in lexical frequencies of word-initial-consonants

\[
\Delta f = F^* - f^* = \int_T^t F(t) \, dt = \int_T^t \frac{dF}{dt} \, dt = \frac{dF}{dt} \bigg|_{t=T} - \frac{dF}{dt} \bigg|_{t=0}
\]

where \( t = 0 \) corresponds to present-time and \( T \) is the age of the ancestral proto-Australian lexicon.

<table>
<thead>
<tr>
<th>Diachronic change</th>
<th>proto-Australian ( \rightarrow ) dhurga</th>
<th>proto-Australian ( \rightarrow ) thurrawal</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta f_m )</td>
<td>14 - 22.6 = 8.6%</td>
<td>15 - 22.6 = -7.6%</td>
</tr>
<tr>
<td>( \Delta f_g )</td>
<td>26.5 - 17.8 = 8.7%</td>
<td>18.5 - 17.8 = 0.7%</td>
</tr>
<tr>
<td>( \Delta f_b )</td>
<td>4.4 - 8.1 = -3.7%</td>
<td>8.2 - 8.1 = 0.1%</td>
</tr>
<tr>
<td>( \Delta f_p )</td>
<td>19.3 - 16.1 = 3.2%</td>
<td>21.7 - 16.1 = 5.6%</td>
</tr>
<tr>
<td>( \Delta f_w )</td>
<td>0.9 - 9.7 = -8.8%</td>
<td>1.4 - 9.7 = -8.3%</td>
</tr>
<tr>
<td>( \Delta f_s )</td>
<td>11.2 - 4.8 = 6.4%</td>
<td>10.7 - 4.8 = 5.9%</td>
</tr>
<tr>
<td>( \Delta f_d )</td>
<td>2.5 - 0 = 2.5%</td>
<td>5.8 - 0 = 5.8%</td>
</tr>
<tr>
<td>( \Delta f_y )</td>
<td>3.8 - 4.8 = -1%</td>
<td>2.8 - 4.8 = -2%</td>
</tr>
<tr>
<td>( \Delta f_r )</td>
<td>5.9 - 0 = 5.9%</td>
<td>1.4 - 0 = 1.4%</td>
</tr>
<tr>
<td>( \Delta f_l )</td>
<td>0 - 1.6 = -1.6%</td>
<td>1 - 1.6 = -1.6%</td>
</tr>
<tr>
<td>( \Delta f_0 )</td>
<td>3.4 - 4.8 = -1.4%</td>
<td>4.9 - 4.8 = 0.1%</td>
</tr>
<tr>
<td>( \Delta f_r )</td>
<td>8.1 - 9.7 = -1.6%</td>
<td>8.6 - 9.7 = -1.1%</td>
</tr>
</tbody>
</table>

The Power Law for Lexicons

At any given time, the contribution to a lexicon’s entropy, due to the relative frequencies of $H$ different word-initial consonants, is defined as

$$S = \sum_{h=0}^{H-1} f_h \ln(f_h)$$  \hspace{1cm} (1)

subject to normalization

$$\sum_{h=0}^{H-1} f_h = 1 = 100\%$$  \hspace{1cm} (2)

and Hamming’s constraint on the mean

$$\sum_{h=0}^{H-1} h f_h = \mu$$  \hspace{1cm} (3)

which is essentially a statement of the constancy of south-east-Australian phonology, over the millennia, since ancient times. For entropy to be maximized, subject to these constraints, the entire functional

$$J = \left[ \sum_{h=0}^{H-1} f_h \ln(f_h) \right] + \lambda_1 \left[ 1 - \sum_{h=0}^{H-1} f_h \right] + \lambda_2 \left[ \mu - \sum_{h=0}^{H-1} h f_h \right]$$

must satisfy

$$0 = \frac{\partial J}{\partial f_h} = \sum_{h=0}^{H-1} \left[ \ln(f_h) + 1 - \lambda_1 - \lambda_2 h \right]$$

hence the exponential frequency distribution

$$f_h = e^{\lambda_1 - 1} e^{\lambda_2 h} = f_0 x^h$$  \hspace{1cm} (4)

for $h=0, 1, \ldots, H-1$, where the two Lagrange multipliers are defined as $\lambda_1 = 1 + \ln(f_0)$ and $\lambda_2 = \ln(\alpha) < 0$.

If we select

$$f_0 = \frac{1-x}{1-x^H} \Rightarrow f_h = \left( \frac{1-x}{1-x^H} \right) x^h$$  \hspace{1cm} (5)

for $h=0, 1, 2, \ldots, H-1$ then the normalization constraint (2) holds trivially, for any value of $x$, because it becomes the sum of a geometric progression to $H$ terms.
The precise value of $\alpha$, that best fits the proto-Australian data, can be calculated as follows using Fisher’s (1912) ‘Method of maximum likelihood’. The ‘actually observed’ word-frequencies, $f_h$ in Table 1, were calculated from discrete countable quantities $N_h$ that cannot be negative, so it makes sense to assume Poisson (not Gaussian) error—in which event, the probability of obtaining these ‘actually observed’ word-frequencies individually is

$$p_h = \frac{(\omega_h)^{N_h}}{(N_h)!} e^{-\omega_h}$$

(6)

the distribution ascribed to Simeon Denis Poisson (1781–1840) where the respective means $\omega_h$, one for each data point, are required to exactly follow the ideal ‘power law’ (equation (5))

$$\omega_h = \frac{62}{100} f_h = \frac{62}{100} \left( \frac{1 - \alpha}{1 - \alpha H} \right) x^h$$

(7)

for $h = 0, 1, 2, \ldots, H - 1$. Thus, the ‘likelihood’ of obtaining the entire set of 14 ‘actually observed’ proto-Australian word-frequencies collectively is

$$\ell = \prod_{h=0}^{H-1} p_h = \prod_{h=0}^{H-1} \left( \frac{62}{100} f_h \right)^{N_h} \left( N_h! \right)^{-1} e^{-\left(62/100\right) \sum f_h}$$

(8)

where $H=14$.

Taking the logarithm of both sides gives

$$\ln(\ell) = \sum_{h=0}^{H-1} \left[ N_h \ln(f_h) + N_h \ln\left( \frac{62}{100} \right) - \frac{62}{100} f_h \ln(N_h) \right]$$

where $H=14$ and, for ‘maximum likelihood’, we require $\alpha$ such that

$$0 = \frac{\partial \ln(\ell)}{\partial \alpha} = \sum_{h=0}^{H-1} \left[ \frac{N_h}{f_h} - \frac{62}{100} \right] \frac{\partial f_h}{\partial \alpha}$$

(9)

where $H=14$. There are three ways that this could occur.

(1) we could have $N_h = 62f_h/100$ corresponding to the case where all the observed data-points lie precisely along the ideal curve (equation (5)) with no scatter (as is almost the case with Eades’, 1976, dhurga data in Figure 2);

(2) or it might happen that

$$0 = \frac{\partial f_h}{\partial \alpha}$$
Figure 2. The ‘maximum likelihood’ curve \( f_h \) generated from proto-Australian data, assuming that \( H = 14 \), and plotted along with all three data sets from Table 1. This curve cuts the vertical axis at \( f_0 = 25.49\% \), above the proto-Australian data point \( f_m = 22.6\% \) but below the dhurga data point \( F = 26.5\% \). Also, the tail-end of the curve, \( f_{13} = 0.6\% \), is close to the zero-frequency of word-initial-\( I \) in all three languages given in Table 1. Note how this ‘maximum likelihood’ curve—generated from proto-Australian data scattered above and below it—is nevertheless closely hugged along its entire length by data points corresponding to the ‘modern’ dhurga lexicon of Eades (1976).

as with the zero-slope associated with the string of zero-frequencies \( f_h \) in the tail of the distribution for all integers \( h > H - 1 \) (as in Figure 3).

(3) or it may happen that only the sum in its entirety equals zero—the ‘Solution of Maximum Calculational Difficulty’—in which event we proceed by defining

\[
\frac{\partial^2 \ln (f)}{\partial x^2} = \sum_{h=0}^{H-1} \left[ \frac{-N_h}{f_h} \left( \frac{\partial f_h}{\partial x} \right)^2 + \left( \frac{N_h}{f_h} - \frac{62}{100} \right) \frac{\partial^2 f_h}{\partial x^2} \right] \tag{10}
\]

where \( H = 14 \).

Less than five iterations of the Newton/Raphson formula

\[
x_{\text{new}} = x_{\text{old}} - \frac{Y(x_{\text{old}})}{Y'(x_{\text{old}})}
\]

yields the value

\[
x \approx 0.7496 \pm 0.0005 \tag{11}
\]
Figure 3. The ‘maximum likelihood’ curve \( f_h \), generated assuming that \( H = 10 \), is a much better fit to the ancient proto-Australian data from Table 1. This curve cuts the vertical axis at \( f_0 \approx 22.94\% \), close to the proto-Australian data point \( f_0 = 22.6\% \), whilst the tail-end of this curve beyond the step \( (h > H - 1 = 9) \) corresponds precisely to the ‘observed’ proto-Australian zero-frequencies in Table 1. It would seem that ancestral language had a smaller alphabet for the proto-Australian data in Table 1. Substituting this ‘maximum likelihood’ value into equation (5) then gives

\[
f_0 \approx 0.2549 \text{ decreasing to } f_{13} \approx 0.0060
\]

whilst, from equation (3), the mean is

\[
\mu = \sum_{h=0}^{H-1} h f_h = \frac{13 f_{13}}{\ln a} + \frac{f_0 - f_{13}}{(\ln a)^2} \approx 2.7254
\]

The resulting ‘maximum likelihood’ curve (Figure 2) was calculated from data in Table 1 on the assumption that \( H = 14 \). Certainly ‘modern’ languages such as dhurga and thurrawal were based upon a phonology of 14 consonants all of which could appear word-initially, although word-initial-\( l \) and word-initial-\( r \) were so rare that their ‘observed’ zero-frequencies in Table 1 are unsurprising. One example of word-initial-\( l \), \( l a r y g o \) (‘oyster’), was recorded in dhurga language by the French explorers J. R. C. Quoy and J. P. Gaimard in 1826 when their ship, the Astrolabe, was anchored in Jervis Bay (Illert, 2003, example 4). In addition, important examples of word-initial-\( r \) are the condensed ‘numeral’ \( r o l a \) (Illert, 2003, example 6) and its fuller form \( r o d o l a \), which was probably the origin of the \( r d \) intervocalic retroflex stop in some ‘modern’ central Victorian languages (Illert, 2004). But proto-Australian was phonologically simpler than the two
Figure 4. The changing maximum likelihood ‘power law’ for $9 \leq H \leq 14$

modern languages in Table 1, possessing nowhere near 14 consonants. Dixon (1980, p. 177) has suggested that there were only 10 or 11 consonants in early proto-Australian, leading to 13 or 14 at a later stage. And we see from Figure 3 that the ‘maximum likelihood’ curve generated from the value $H=10$ does provide a better fit to the actual proto-Australian data alone.

For each different value of $H$ the ‘maximum likelihood’ calculation (equation (11)) generates slightly different values of $\alpha$, hence slightly different ‘power law’ curves. Over the range of immediate interest $H=9\rightarrow 14$, from proto-Australian to modern language, there is an approximate relationship

$$\alpha \approx 0.901 - 0.011 \times H$$

(14)

Accordingly, Figure 4 shows how the ‘power law’ changed over millennia as south-east-Australian phonology became more complex. This meaningful and linguistically important progression is easily described by the model, and important insights into accompanying phonotactic changes can be gleaned by asking why the word-frequencies in Table 1 changed during this process as in Table 2. It will be argued that such facts are explained by the existence of accusative-prefixes which arose in ancient times and survived into modern language within the Sydney region. In support of this proposition, seven newly translated sentences will be given as examples—four chosen from Mary Everitt’s (1900) gundungurra grammar, which has been overlooked by scholars for 100 years (Illert, 2001), and three from fragments of the eora dialect recorded in the diaries of the First Fleet officer, Lieutenant William Dawes (1790a, b), which were lost for 200 years and only recently found in a London library (Wood, 1924; Troy,
1992). All seven examples are especially noteworthy being the first ever published modern translations of material from either of these primary sources. The observed accusative syntax, supported by word-frequency data, may come as a surprise to some linguists who, in the absence of adequate evidence, seem to have imagined that language from the Sydney region—if not the entire continent—simply had to be inherently and at the core ergative (Eades, 1976; Dixon, 1980; Osmond, 1989; Troy, 1992; Nichols, 1993).

The Ancient Verb-Phrase mi/n

It is well known that there were ancient determiners with both indefinite and interrogative significance: mi/n = pim = which/what/who (singular), and pun/ŋuŋ = something/someone (dual or plural). In this respect, Dixon (1980, pp. 372–377) noted

It appears that *'who' /'what' and also *'what' → 'who' are common meaning shifts in Australia . . . [and that the] indefinite-interrogative form . . . mina/ 'what' . . . is found in almost every language in New South Wales and in some from Victoria, South Australia and Queensland (excepting the far north) . . . [though] not . . . in any western language, and that

There are usually separate forms 'who, someone', with human reference, and 'what, something', with non-human reference . . .

but he goes too far asserting that

mina always means 'what', never 'who', and appears to inflect like a nominal; there is no hint of it being related to a monosyllabic root, at any stage of development,

which is contradicted by James Dawson’s (1881) chaap whuuring word ‘winyaar’ ('who, whose, whom'). The problem here lies with Dixon’s methodology—so often drawing inferences from the most transformed living languages located to the far-west or north, instead of going directly to where the answers can most reasonably be expected to exist, in the more ancient and least changed—though extinct—languages recorded along the south-east-Australian seaboard. No doubt this is due to the relative ease of studying living as compared to extinct language. However, analysis of south-east-Australian data is still possible and quite capable of yielding meaningful information.

We can assume that ancient adjectival roots did not usually contain the vowel i, which was reserved as a tense-marker on verbs. Additionally mi/n and pim seem to have been used interchangeably, suggesting an ancient verb-phrase that was a loose cluster of fundamental morphemes:
$m(olo):i \rightarrow \text{nun} \rightarrow$

\[= \text{WHICH or WHAT}\]

\[\text{``miːn̪ːaŋ'' (``what'')}\]
\[\text{Sharpe (1994), bundjalung}\]
\[\text{``miːn̪ːa' (``what''), gundungurra}\]
\[\text{``miːn̪̞ː' (``what''), dharruk}\]
\[\text{Mathews (1901a,b)}\]
\[\text{``miːn̪ːē' (``what'')}\]
\[\text{(``what (nom., acc.); sing., dual, pl.'')}\]
\[\text{Meyer (1843)}\]
\[\text{coorong, lower murray}\]

or

\[\text{nun} \rightarrow i:\text{mo(lo)} \rightarrow\]

\[\text{some[thing]} \rightarrow \text{show, indicate}\]

\[= \text{WHICH or WHAT}\]

\[\text{``nanːma' (``what'')}\]
\[\text{Bulmer in Smyth (1876), kurnai}\]
\[\text{``naː' (``what'')}\]
\[\text{Ferguson in Holmer (1964), bundjalung}\]
\[\text{``nːiːn̪ (``what'')}\]
\[\text{Dawson (1881), (``what'')}\]

\[\text{hence who(m)}\]

\[η(ɖula) \rightarrow \left(\eta(ʊŋ):i:m(olo)\right) \rightarrow\]

\[\text{person} \rightarrow \text{which/what}\]

\[= \text{WHO (singular)}\]

\[\text{``uŋːn̪ːiːm' (``who'')}\]
\[\text{Mathews (1901b), thurrawal}\]
\[\text{``wːiːn̪ːyaːr'' (``who, whose, whom'')}\]
\[\text{Dawson (1881), (``who, whose, whom'')}\]
or

\[
\begin{align*}
\text{punji (mulo)} & \quad \rightarrow \quad \text{ŋ:fo} (ka) \\
\text{which/what} & \quad \rightarrow \quad \text{person} \\
\end{align*}
\]

\[= \text{WHO (singular)}\]

\[
\begin{array}{ll}
\text{‘ngan:i:n:de’ (‘who’), kurnai} & \quad \text{‘ngan'i:i:ng:a’ (‘who, interrogative’) } \\
\text{‘nyan::da’ (‘who’), dharruk} & \quad \text{Everitt (1900), gundungurra} \\
\text{‘ngunn::ung’ (‘who’), tharraval} & \quad \text{‘ngan::dhí’ (‘who is’) } \\
\text{‘ngan::’ (‘who’), dharkinung} & \quad \text{‘ngan:::dhu’ (‘who does something’) } \\
\text{Mathews (1902, 1901a, b, 1903)} & \quad \text{McNicol & Hosking (1994), wiradjuri} \\
\text{‘nan::’ (‘who’)} & \quad \text{‘naŋg:e::’ (‘who’) } \\
\text{Bulmer in Smyth (1876), kurnai} & \quad \text{Meyer (1843), coorong, lower murray} \\
\end{array}
\]

and generally

\[
\begin{align*}
\text{punji: (olu)} & \quad \rightarrow \quad \left( \begin{array}{l}
\text{do(ə:a)} \\
\text{bula(ə:a)} \\
\text{w(ə)ək(a)a} \\
\end{array} \right) \\
\text{which/what} & \quad \rightarrow \quad \text{person[s]} \\
\end{align*}
\]

\[\text{person[s]} = \text{WHO (singular, dual, plural)}\]

\[
\begin{array}{ll}
\text{‘unnag:a::’ (‘who?, singular’)} & \quad \text{Mathews (1901a), gundungurra} \\
\text{‘unnag:a::wula:’ (‘who?, two’)} & \quad \\
\text{‘unnag:a::m:ul:an’ (‘who?, several’)} & \quad \\
\end{array}
\]

\textbf{Accusative Prefixes: miŋ, nun/nup, pun}

In accusative languages the object of a sentence can have a prefix, such as \textit{miŋ} (singular, animate or inanimate) or \textit{pun} (dual/plural, inanimate), to distinguish it from the subject—as in the following sentences
These examples illustrate the fact that living creatures are the natural perpetrators of actions and that people speak largely about themselves, thus—unless it is specifically indicated to the contrary—the subject of any sentence in an accusative language is probably an un-affixed (‘free-form’) pronoun, which can usually be entirely omitted whilst still leaving the meaning of the sentence intuitively obvious (Silverstein, 1976). Thus, the two previous examples could be paraphrased as ‘give some tobacco’ and ‘give some grease for the spear’. It is still obvious, from the human context, who the omitted recipient happens to be.

Conversely, nouns are the natural objects of actions, making it also intuitively obvious that any noun or proper noun occurring in an accusative sentence is probably the object—even when not accusatively marked. Indeed, it is not uncommon for sentences lacking both a pronominal-subject, and also the accusative prefix for their inanimate object, to still have a clear overall meaning.
However, in the ‘noteworthy’ event that an accusative sentence contains a pronominal-object, an accusative-affix becomes essential to distinguish it from the subject/agent. Thus, compact pronominal-objects are generally prefixed as follows:

There can be no mistaking these prefixed-object[s] with unprefixed pronominal-subjects; not even in reflexive sentences, characterized by subject = object, which omit pronominal-subject leaving their accusatively prefixed pronominal-object serving a dual role

as in the sentences:

(3) [I (reflexively implied singular SUBJECT/AGENT)] am-beating myself (singular OBJECT):

\[
\eta u(ru):b\ell(\ell):i \quad \text{mi} \quad \eta u
\]

\[
= \text{am – beating (pres. tense, verb)}
\]

\[
\text{who}(m \text{- self}) \quad I
\]

\[
= \text{myself (compact, 1st pers. sing. pronominal OBJECT)}
\]

\[
'\text{ngod}:b\ell:ee \quad \text{mi} \quad \text{y\ddot{a}}
\]

\[
(\text{‘I am beating myself’})
\]

(\text{Ecevitt et al., 1900) \{\text{gënd gm\ddot{a}}\}}

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(4) [We (reflexively implied dual subject/agent)] are-beating ourselves (dual object):

\[ \text{ŋu(\text{ru}):\text{bul(i)}:} - \text{ŋun} - \text{bul(\text{ala})}:\eta \]

\[ = \text{are-beating} \]

\[ = \text{(pres. tense, verb)} \]

\[ \text{some-(selves)} \]

\[ \text{us/we (dual)} \]

\[ = \text{ourselves} \]

\[ \text{compact, 1st pers. sing. pronominal OBJECT} \]

\[ \rightarrow \text{‘ngoo’:bil:ee—yang—eel:oong'} \]

\[ \text{REFLEXIVE} \]

\[ \text{‘We two beat ourselves’} \]

\[ \text{(Everitt et al., 1900) {gùnduŋara}} \]

A number of syntactic circumstances (including a split subject) can prompt the expansion of a compact-pronominal-object, necessitating a third accusative marker ŋun, as follows:
as in the sentence:

(5) [we] flanking pair [will-escort] Burung

\[
\begin{align*}
\text{buru} &\rightarrow ^{\text{yemmerrawanne cited by Dawes, 1790}} \text{booroong part of the way home'} \\
\text{wu} &\rightarrow ^{\text{mi}} \text{left hook at left'} \\
\text{di} &\rightarrow ^{\text{yu}} \text{part of the way home'}
\end{align*}
\]

or a dual/plural object

(6) We (dual) shall seek them (dual)—Ngulgear [and] Tugear.

\[
\begin{align*}
\text{mo(la):i:bu} &\rightarrow ^{\text{bula(la)}} \text{shall/will see (future tense verb)} \\
\eta &\rightarrow ^{\text{us/we (compact dual SUBJECT)}} \text{use/we (SUBJECT)}
\end{align*}
\]
Of course the accusative prefix ŋun is not used in association with subjects (either compact or expanded),

(7) They (plural)—Major Ross, Mr Clark & Mr Faddy—went to Norfolk Island

'Maj. Ross, Mr Clark and Mr Faddy went to N.I.'

(Dawes, 1790) {eora}
Hypothesis: $-\Delta f_m \approx -\Delta f_n > -\Delta f_g$

The previous examples show how the south-east Australian language, in recent centuries, employed the accusative markers *mip*, *pun/pun* and *gun*. From publications such as Alexejew et al. (1968) we have long known that the most frequently used words, even in European languages are ‘the’ {English}; ‘de’, ‘le(a)’ {French}; and ‘der’, ‘die’ {German}. So it is clear that *mip*, *pun/pun* and *gun* would likewise have been amongst the most commonly spoken words in SE-Australian language over a large geographical area for a very long time.

Thus, in order to minimize confusion—given that these accusative markers generally were prefixes, respectively beginning with the consonants *m*, *p* and *g*—we might expect the relative frequencies of words beginning with these particular consonants to have decreased across time in the general SE-Australian lexicon. Specifically, if *mip* and *pun/pun* were used with about equal frequency in natural language, and *gun* less so, then we would expect proportionate decreases in the relative lexical frequencies of word-initial-*m*, word-initial-*p* and word-initial-*g*—the emergence of accusativity within ancestral language leaving this distinctive, measurable, phonotactic signature upon the subsequent collective SE-Australian lexicon. Because the fundamental root(s) *pun/pun* obviously pre-existed the lexeme *m*(u)u:*pun(u)* = *mip*, we might expect the decrease in relative frequency of word-initial-*p* to be just slightly greater than that for word-initial-*n*, but not much more because syntactic accusativity generally requires both markers. Also, assuming that compact pronominal objects are used about twice as often in normal speech as fully expanded ones, it would seem reasonable to assume the decrease in relative frequency of word-initial-*g* to be approximately half that for word-initial-*m*—refer to the values of $\Delta f_m$, $\Delta f_p$ & $\Delta f_g$ in Table 2.

It is important to realize that the emergence of accusative syntax in ancestral language had these phonotactic consequences, for the collective SE-Australian lexicon, that are predictable even in the absence of data! Without actual data we might not be able to guess absolute magnitudes of individual frequency changes but, on syntactic grounds, we do have a good idea of their relative magnitudes. It has never before been possible reliably to obtain such numbers describing change through time because, until now, there was no demonstrably representative proto-Australian lexicon to be compared with modern counterparts.

The Lexical Signature of Accusativity

Normalization of the lexical frequencies in Table 1 required that 100%

$$\sum_{i} f_i = (f_m + f_p + f_n + f_d)/(f_m + f_p + f_n + f_d)$$

Corrections

$$\sum_{i} F_i = (F_m + F_p + F_n + F_d)/(F_m + F_p + F_n + F_d)$$

$$= \sum_{i} f_i = (f_m + f_p + f_n + f_d) + (f_m + f_p + f_n + f_d)$$

$$= \sum_{i} F_i = (F_m + F_p + F_n + F_d) + (F_m + F_p + F_n + F_d)$$

$$= \sum_{i} F_i = (F_m + F_p + F_n + F_d) + (F_m + F_p + F_n + F_d)$$

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where these terms have been grouped into three stable lexical blocks which retain their relative sizes. Words commencing with peripheral nasals and stops are one such stable block, constituting the bulk of all three lexicons, such that

$$f_m + f_g + f_p + f_b \approx F_m + F_g + F_p + F_b \approx 64\%.$$  (16)

Words commencing with lamino-palatals are another stable block within all three lexicons such that

$$f_m + f_s + f_r \approx F_m + F_r + F_s \approx 15.3\%.$$  (17)

The remainder, words commencing with apico-alveolar and lamino-interdental stops and nasals as well as the peripheral semi-vowel, collectively constitute a third stable block within all three lexicons such that

$$f_m + f_s + f_n + f_p + f_r + f_b \approx F_m + F_s + F_n + F_p + F_r + F_b \approx 20.3\%.$$  (18)

Yet below this mirage of constancy there have been dramatic changes in lexical frequencies of word-initial consonants $F_m$, $F_s$ throughout each of these three lexical blocks (see Table 2), during the transition from proto-Australian to dhurga. Both modern lexicons exhibit large net decreases in word-initial nasals, largely balanced by increases in word-initial stops, with word-initial semi-vowels compensating for any lexical residues (see Table 3).

The transition proto-Australian→dhurga most clearly illustrates the reciprocal nature of relationships between the changing frequencies of word-initial peripheral nasals and stops

$$\Delta f_m = -\Delta f_r \text{ and } \Delta f_r = -\Delta f_m.$$  (19)

In addition, both modern lexicons exhibit a large word-initial decrease in the nasal $n$, variously compensated by the other lamino-palatals, most clearly illustrated by the transition proto-Australian→dhurga for which

$$\Delta f_p = -\Delta f_d - \Delta f_y.$$  (20)

Table 3. Pattern of replacement of word-initial nasals by stops, approximately as occurred in the dhurga lexicon, with word-initial semi-vowels compensating for residual lexical discrepancies.

<table>
<thead>
<tr>
<th>Table 3.</th>
<th>Pattern of replacement of word-initial nasals by stops, approximately as occurred in the dhurga lexicon, with word-initial semi-vowels compensating for residual lexical discrepancies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral</td>
<td>Apico</td>
</tr>
<tr>
<td>Labial</td>
<td>Dorsal</td>
</tr>
<tr>
<td>Stop</td>
<td>b</td>
</tr>
<tr>
<td>Nasal</td>
<td>m</td>
</tr>
<tr>
<td>Semi-vowel</td>
<td>w</td>
</tr>
</tbody>
</table>

Corrections

$$f_m + f_g + f_p + f_b \approx F_m + F_g + F_p + F_b \approx 64\%.$$  (16)

$$f_p + f_d + f_r \approx F_p + F_d + F_r \approx 15\%.$$  (17)

$$f_n + f_d + f_r \approx F_n + F_d + F_r \approx 20.3\%.$$  (18)
perhaps largely due to cumulative phonetic drift of ancestral /*n*/ into the other lamino-palatals: *ny*—*n/** into the other lamino-palatals: *ny*—*n/**. This general pattern, of word-initial nasals turning into or being replaced by stops, continues to a lesser extent (closer to the level of statistical noise) into the third main block of words (commencing with apico-alveolars and lamino-interdentals as well as the peripheral semi-vowel) with both modern lexicons suggesting a relationship

\[
\Delta f_w \approx -(\Delta f_m + \Delta f_\theta) - (\Delta f_a + \Delta f_\phi)
\]  

(21)

and Table 3 providing a good way to visualize all these changes.

Generally, transfers (‘leakages’) between the three stable lexical blocks

\[
\varepsilon_3 = \int_{-\tau}^{0} \dot{f}_w + \dot{f}_a + \dot{f}_\theta + \dot{f}_\phi \, dt
\]

\[
\varepsilon_3 = (\Delta f_w + (\Delta f_m + \Delta f_\theta) + (\Delta f_a + \Delta f_\phi))
\]  

(22)

such that \(\varepsilon_1 + \varepsilon_2 + \varepsilon_3 = 0\), are all an order-of-magnitude-greater for proto-Australian→thurrawal, as compared with proto-Australian→dhurga, suggesting that the thurrawal lexicon of Mathews (1903) is actually more-decrepit and less-authentic [despite being recorded at most a century earlier] than the dhurga lexicon of Eades (1976).

This may seem surprising given that Robert Hamilton Mathews (1841–1918), a Fellow of the Royal Society of New South Wales and author of over 170 published papers, undoubtedly had access to proficient Aboriginal linguistic informants. However, he was a 19th century amateur obsessed with publishing papers and prone to plagiarism (Illert, 2001), who ‘tended to doctor and normalise his notes for publication’ (Dixon, 1980, p. 15) on occasions simply
inventing linguistic material (see Appendix A), so much so that we can now provide the above arithmetical measures quantifying the extent of errors and ‘doctoring’ within his published data.

At the other extreme, Diana Kelloway Eades (1976)—an expert phonologist with modern linguistic training—largely through sheer competence (notwithstanding the misgivings of Breen, 1980) achieved an order-of-magnitude-better job with her dhurga lexicon, despite the handicap of working in this field 75 years later, at a time when

Dharawal and Dhurga are not being kept alive in any active way. It is certainly only with a few of today’s oldest generation that words from the languages are surviving at all. . . . for the past ten years, there have only been a handful of old people who remember any Dharawal and Dhurga words. There have been no fluent speakers in this time, although a few have remembered isolated hints of grammar from time to time. . . . as these people in fact never spoke the languages fluently, and only use occasional words from Dharawal and Dhurga, it is unrealistic to expect anything but complete abandonment of any use of the languages over the next decade.

Non-zero values of $\varepsilon_1$, $\varepsilon_2$ and $\varepsilon_3$ are largely due to Anglicization of Aboriginal words by English-speakers. For example the values of $\Delta f_d$ in Table 2 show that Mathews (1903) grossly under-recorded word-initial-$g$s by an order of magnitude. Sometimes he misrecorded them as $b$s, as in $\text{goru:goru} \rightarrow \text{birra:birra}$ ('light, not heavy') and its converse $\text{guru:guru} \rightarrow \text{burri:burri}$ ('whale'), this latter phonetic error echoing the distinctively wrong and previously published word 'purri:burry' ('whale') (Munima, 1863) {thurrawal}. Otherwise Mathews (1901) misrecorded word-initial-$g$s as lamino-palatal stops, giving $\text{goru:guru} \rightarrow \text{jarra:jarra}$ ('lean') {dharruk}, again echoing another distinctive previously-published phonetic-error $\text{goru} \rightarrow \text{jerr$ \text{'}$ ('thin') (Mann, 1840s) {eora}. Such transfer of word-initial peripheral-dorsal stops, to lamino-palatal stops or semi-vowels, also partially accounts for the excessive values of $\varepsilon_1$, $\varepsilon_2$ and $\varepsilon_3$ with Mathews’ thurraval data.

Another factor contributing to his excessive value of $\Delta f_s$ is the way that English-speakers tend to ‘hear’ the word-initial lamino-interdental-stop (especially when followed by a long vowel) as some exotic vowel-cluster often involving the lamino-palatal semi-vowel, as in $\text{dola:wi$p$} \rightarrow \text{yello:wna}$ ('moon') (Mann, 1840s) {eora} or $\text{dola:ma(lo):n} \rightarrow \text{hila:ma:n}$ ('shield') (Rowley, 1875) {dhurug}, ‘ilee:mo$n$ ('shield') (Tench, 1788) {eora} and ‘yila:ma:n’ ('spear'??) (Eades, 1976) {dhurga}. Such a transfer, word-initial lamino-interdental stop to lamino-palatal semi-vowel, also partially explains the excessive values of $\varepsilon_2$ and $\varepsilon_3$ with Mathews’ thurraval data.

For her part, Eades (1976) was weakest at distinguishing apico-alveolar and lamino-interdental stops. The value of $\Delta f_s$ associated with her dhurga data seems greater than we might expect so, probably, some of the words commencing with $d$ in her dhurga lexicon should actually have commenced with $d$. In fairness to Mathews, his 1903 thurraval lexicon contained a good sample of verbs and adjectives as well as nouns, whereas the 1976 dhurga lexicon of Eades was all nouns. To the extent that accusative markers only prefix nouns and pronouns one may expect their impact to be more apparent in Eades’ dhurga lexicon. But one is still inclined to dismiss as unrealistic Mathews’ values of $\varepsilon_1$, $\varepsilon_2$ and $\varepsilon_3$ in the several percent range, whilst suspecting that Eades’ values in the
range of fractions of a percent may correspond to real effects in need of further study, because all these effects are at least one order of magnitude smaller than the huge net decrease in lexical frequency of word-initial nasals in both lexicons

\[
\int_{-T}^{0} \left( f_m + f_n + f_p + f_q + f_r \right) dt
\]

\[
= \Delta f_m + \Delta f_n + \Delta f_p + \Delta f_q + \Delta f_r
\]

(25)

balanced by a net increase in word-initial stops in both lexicons

\[
\int_{-T}^{0} \left( f_g + f_h + f_i + f_j + f_k \right) dt
\]

\[
= \Delta f_g + \Delta f_h + \Delta f_i + \Delta f_j + \Delta f_k
\]

(26)

Clearly, one fifth of the entire ancestral lexicon—mainly words commencing with \( m, n \) or \( q \)—experienced a 'great die-off' when modern languages came into being. This lexical effect of truly major proportions left a residual phonotactic 'signature', on modern south-east-Australian lexicons, which seems to be well explained by the emergence in ancestral language of \( m\text{in}, n\text{ug} \) and \( q\text{un} \) as accusative prefixes.

The Diachronic Optimization Problem

Our problem requires minimization of the lexical transfer functional

\[
\Theta = \varepsilon_1 + \varepsilon_2 + \varepsilon_3 = \int_{-T}^{0} \sum \dot{f}_w dt
\]

(27)

with respect to word-frequencies \( f_w \in \Gamma \) such that

\[
\Gamma \equiv \{ f_w(t) \in C[[-T,0]: \sum f_w = 100\% \forall t \in [-T,0] \},
\]

\[
f_w(-T) = f^* \text{ and } f_w(0) = F_0 \text{ as defined in Table 1}
\]

subject to the physical condition that frequency changes (as in Table 2) each generate lexical Entropy

\[
\dot{f}_w = \kappa f_w \ln (f_w)
\]

(28)
The appropriate formal constraint

\[ \Phi = \int_{-\gamma}^{0} \sum_i \left[ \frac{1}{2} \dot{f}_i^2 + \frac{1}{2} \kappa_i^2 (f_i \ln (f_i))^2 \right] dt \] \hspace{1cm} (29)

gives the full Lagrangian

\[ L = \sum_i f_i \dot{f}_i + \lambda \sum_i \left[ \frac{1}{2} \dot{f}_i^2 + \frac{1}{2} \kappa_i^2 (f_i \ln (f_i))^2 \right] \] \hspace{1cm} (30)

which satisfies the Euler Equations

\[ 0 = \frac{\partial L}{\partial f_i} - \frac{d}{dt} \left( \frac{\partial L}{\partial \dot{f}_i} \right) \] \hspace{1cm} (31)

provided the respective frequencies are all Gompertz functions

\[ f_i(t) = e^{-e^{ct} \cdot e^{-\kappa_T t}} \] \hspace{1cm} (32)

where

\[ c_i = \ln (\ln (F_i)) \] and \[ \kappa_i = \frac{[\ln (\ln (F_i)) - \ln (\ln (f_i))]}{T} \] \hspace{1cm} (32)

Since the time of Gompertz (1825) this function (equation (32)) has been used as a ‘mortality law’, specifying the likelihood of death of biological organisms within populations, making it the basis for modern actuarial science (Bowers et al., 1997). But it likewise describes the extinguishing of word-classes within an evolving lexicon, and its respective constants, calculated from the frequency data in Table 1, are presented in Table 4—although it is not possible to calculate individual values \( \kappa_i \) without knowing the value of \( T \).

Appendix B supplies the first ever published mathematical model describing phonogenesis over the last 120,000 or so years. During this time, human phonologies worldwide increased in size and complexity, by an entire order of magnitude, evolving over tens of millennia into modern sound-systems varying in complexity from Rotokas in the Solomons (which has 11 forms) to Khmer (which has 74). As ‘modern’ dhurga had 14 consonants, compared to 10 in proto-Australian, we estimate that the proto-Australian lexicon in Table 1 may be about 40,000 years old—hence the time constant in our equations is \( T \approx 40,000 \) years. Its precise value will no doubt be subject to ongoing debate but our estimate at least provides a start, based upon some genuine phonological data, in a field where researchers have so far been unable to refute even the absurd proposition that proto-Australian may only be a few thousand years old.

We have no way of telling whether proto-Australian was spoken 30,000 years or longer ago, or much more recently than that. … [it] could have been spoken by the dingo-bearing people four millennia ago. . . . Although we shall probably never be able to offer any proof, it is likely that proto-Australian was spoken a considerable time ago; probably some time before proto-Indo-European, which is dated at around 3000 B.C. (Dixon, 1980, p. 19)
Table 4. The Gompertz constants, calculated from the data in Table 1, describing how the frequencies of individual word-initial-consonants changed from proto-Australian times \((t = -T)\) to the present \((t = 0)\). Infinite values arise here from the zero frequencies in Table 1 but, if one is unhappy with the notions that \(e^{-r} = 0\) and \(e^{1-r} = 1\), then it is possible to replace the zero-frequencies in the tail of the distribution with their corresponding small but finite ‘maximum likelihood’ values from equation (5) giving

\[
\kappa_1 T = c_1 - \ln(-\ln(f_0)) \quad \text{and} \quad \kappa_0 T = c_0 - \ln(-\ln(f_0)).
\]

Also, for proto-Australian → dhurga, we obtain

\[
\kappa_1 T = c_1 - \ln(-\ln(f_0)) \quad \text{and} \quad \kappa_0 T = c_0 - \ln(-\ln(f_0)).
\]

\[
\begin{array}{cccc}
\text{proto-Australian→dhurga} & \text{proto-Australian→thurrawal} \\
\hline
f_a(t) & \kappa_1 T & c_1 & \kappa_0 T & c_0 \\
\hline
f_\text{d/h} & 0.2779 & 0.7654 & 0.2445 & 0.6420 \\
f_\text{d/d} & -0.2634 & 0.2843 & -0.0231 & 0.5245 \\
f_\text{d/f} & 0.2185 & 1.1418 & -0.055 & 0.9178 \\
f_\text{d/g} & -0.1040 & 0.4973 & -0.1783 & 0.4230 \\
f_\text{d/h} & 0.6936 & 1.5418 & 0.6028 & 1.4510 \\
f_\text{d/d} & -0.3251 & 0.7830 & -0.3059 & 0.8022 \\
f_\text{d/f} & -\infty & 1.3062 & -\infty & 1.0439 \\
f_\text{d/g} & 0.0818 & 1.1898 & 0.1165 & 1.2738 \\
f_\text{d/h} & -\infty & 1.3092 & -\infty & 1.4510 \\
f_\text{d/h} & \infty & \infty & 0.1242 & 1.5418 \\
f_\text{d/g} & 0.1079 & 1.2160 & -0.0046 & 1.1035 \\
f_\text{d/h} & 0.0734 & 0.9216 & 0.0472 & 0.8954 \\
\end{array}
\]

and that, without written records, we may as well give up because

... proto-Australian may well prove to be unreconstructable in principle, if it ever existed ... linguists would be better off for some time yet continuing to chip away at the lower levels of reconstruction, and offering the results of their work to archaeologists for interpretation ... (Crowley, in McConvell & Evans, 1997, p. 295)

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Notes

1. Since the time of G. K. Zipf, linguists have meant by a ‘power law’ any curve that even looks like \(1/x\), whilst statisticians have come to use it only for curves of the form \(x^{-b}\). The present paper models a geometric distribution \(x^a\) which, because \(a\) is a decimal number between zero and unity, looks like a \(1/x\) Zipf curve and is therefore a ‘power law’ to linguists. There seems no reason why we should not persist with traditional linguistic terminology, so long as ‘power law’ is written with inverted commas.
2. Mathews (1904) recorded a wiradjuri word for grease/fat/wax, ‘:wa:mmo’ (‘fat’), deriving from (gurr): wu(rula)-gu(rul) = retarded oscillations (=viscous) [substance] … hence also ‘be:wa:n-b:ang’ (‘fat’) (Mathews, 1904) {guruwu} deriving from gu(n):wu(rula)gu(rul)bu3:ŋa=t(stomach-fat, and also ‘ga:w:ga;’ (‘honey’) (Mathews, 1904, 1908) {paru} deriving from gu(n):wu(rula): y(uru-wi-gurul)=viscous-shiny [substance]. Viscous substances like grease or honey contrast with water which is a flowy (= bula-li:xi:uru:guurul) shiny (=i:guru) [substance].

3. The expression gu(la):mu(raj)=greatly-deadly refers to a [spear with a] barb … hence the words ‘nooroca:my’ ([a long] spear with one barb) (Collins, 1798) {cura} and ‘ka:ma’i’ (‘reed spear’) (Mathews, 1908) [paru] both deriving fromuru-gurul:mu(raj)=empty hollow (tubular barbed [spear]) or, conversely, ‘maia:guurul’ (‘spear’) (Malone, 1875) {daru} deriving from mu(raj):guurul-uru(uru).

4. R. H. Mathews’ allegedly plural word ‘yuin-bula:la’ (‘man, collectively’) is wrong. The numeral bula:la only denotes the dual case (two people), whilst the correct suffix for several or many people is wurula.

Additionally, it is quite difficult to imagine either wurula or bula:la being misheard as ‘bula:la’ by any competent observer. This simultaneous mis-phoneticization and mis-semantization, ‘bula:la’ being used as plural, is a rather distinctive error which originated in the story of ‘The Nut Gatherers (two women) at Bendithually (=be:na:guurul), as recorded at the Shoolhaven on 17 June 1872 by the Reverend Andrew Mackenzie and published two years later in The Journal of the Anthropological Institute of Great Britain and Ireland, volume 3, pages 255–6 (1874).

exterior — exterior = outside pair
(split dual adjective)

<table>
<thead>
<tr>
<th>daru</th>
<th>daru</th>
<th>m:i:guula</th>
<th>wi:ro:gu</th>
</tr>
</thead>
<tbody>
<tr>
<td>(tribal name)</td>
<td></td>
<td>(women)</td>
<td>evil</td>
</tr>
</tbody>
</table>

In this story there were two women and the word for woman (singular) was m:i:go or m:i:guula (‘good-looking’), hence women (dual) was m:i:guula-bula:la which Mackenzie recorded well enough as ‘megaaolali’. But he did not realize that m:i:go and m:i:guula were equivalent and must have thought that the suffix was ‘megaaolali’ hence, with an imagined soft b and some vocalic metathesis, we have the now infamous ‘bula:la’. Mackenzie obviously rechecked with his Aboriginal informant, Lizzy Malone, who then gave him the correct numerals bulu(la)-‘bulur’ and wurula=‘werulla’ or ‘wowulli’ as published in subsequent articles, including p. 113 of Rev. William Ridley’s book Kamilaroi and other Australian Languages’ in 1875. Thus, Mackenzie had a morphological reason for originally making this mistake and subsequently corrected it. On the other hand Mathews (1903) had no such excuse and his misogynist error, turning a correct feminine suffix into a wrong masculine counterpart, is so bizarre that it illustrates how Mathews ‘topped-up’ his 1903 thurrrawal vocabulary by plagiarizing and cobbling lexical items—errors and all—from previously published sources. In the process he unknowingly skewed the statistical features of his data set in various tell-tale ways.

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Appendix A. Examples of Readily Recognizable Ancestral Roots in the Thurrawal Lexicon of Mathews (1903)

**baro** → ‘birra’ (‘cheek’ = opposing sides [of the mouth]),
‘dhaum:bara’ (‘spread’ = things greatly apart),
**bura** → ‘burru:n:ggal’ (‘clitoris’ = thing between undulations/labia),
‘bur:n:da’ (‘penis’ = thing between legs),
‘win:burra’ (‘whistle’ = blow between [lips]),
‘bin:burra’ (‘suck’ = suck between [lips]),
‘min:burra’ (‘kiss’ = obstructing [air-flow] between [lips]),
‘bura:i’ (‘night’ = between [sun-shine]ing[s]),
‘burri:wurri’ (‘morning’),

**buru** → ‘burru’ (‘tired’), ‘berru:nj’ (‘mist’),
**buru** → ‘burru’ (‘kangaroo’ = hoppy/bouncy [creature]),
‘buru:nj’ (‘vagina’),
**bara** → ‘burrarah’ (‘wallaby’ = ambling [creature]),
**bulo** → ‘bullia’ (‘dead’), ‘bulli:nj’ (‘die’),
‘bull:ma’ (‘fight’), ‘bu:milla:nj’ (‘beat’),
‘gula:t:bu:njara’ (‘break’),

**bulala** → ‘bullu’ (‘labia majora’ = pair [of things]), ‘billuli’ (‘wide’),
‘yuin:bulolali’ (‘man, collectively’), ???*

**gon** → ‘gai:an’ (‘large’ = very [big]), ‘gaian:wilai’ (‘grow’),
‘ban:gan(jg)’ (‘an old man’ = very [old] man),
‘karu:gan(gj)’ (‘common magpie’ = very noisy),
‘gula:gan(gj)’ (‘short’ = very hunched),
‘gur:gan(gj)’ (‘pigeon, bronze-wing’ = very [flutterly]),
‘dhurra:gan(gj)’ (‘large stream, river’ = very flowy),
‘dhurra:gan:gan(gj)’ (‘little stream, creek’ = slightly flowy),
‘gun:gun(gj)’ (‘sleepy’ = slightly [awake]),

**garo** → ‘gara’ (‘tell’ = [sound] from),
‘karu:gan(gj)’ (‘common magpie’ = very noisy),
‘kurru:gaia’ (‘shout’ = very noisy),
‘jan:qaiiri’ (‘silent’ = NOT [sound] from),
‘minji:garri’ (‘sky’ = the source [of light]),
‘ga:mung’ (‘talk’), ‘bes:gara:nj’ (‘vomit’),

**gura** → ‘gur:i’ (‘ear’ = receptacle [for sound]),
‘yuru:nj’ (‘jealous’ = possessive [person]),
‘kura:n:garra’ (‘steal’ = enhanced receiptment),

**gura** → ‘gura’ (‘hail’ = hard), ‘gura:bung’ (‘stones’ = firm),
‘walla:n:garra’ (‘rocks’ = firm),

**garu** → ‘kuru’ (‘clouds’ = fluffy),

**guro** → ‘gurea:n’ (‘fat; adj.’), ‘kura:nyung’ (‘fat; noun’),
‘gura:warra’ (‘opossum’ = chubby),
‘burri:burri’ (‘whale’ = rotund),
‘mura’ (‘testicles’ = convex [things]),

**guru** → ‘birra:birra’ (‘light, no heavy’ = slim),
**gula** → ‘gula:n:gula:n’ (‘crooked’),
'gulla:ng:ggulla:ng' ('large locust[s]').
'kull:ia' ('cut'), 'gulla:nya' ('kill'),
'gula:t:bu:ngara' ('break'),
'winnana:gala:ng' ('clever-man' = shaman, sorcerer),
galu→ 'gali' ('crane, slate-coloured' = harmless),
muro→ 'murra:dha' ('small' = small thing),
'murra:mul' ('fingers, hand' = small five-things = fingers),
'murra:ura:n' ('hair on pudenda' = numerous short things),
'g:u:in:ma' ('twist' = gently rotate),
mora→ 'dhulli:n:mu'ra' ('husband'), 'm:iga:mu'ra' ('wife'),
'mural' ('noisy'), 'kunna:mu'ra' ('burn'),
'nhu:mu'ra' ('pretend'), 'bul:ma' ('fight'),
'nuggungg:ba:mu:ra' ('praise'),
murala→ 'mu'ra:mul' ('fingers, hand' = small five-things = fingers),
malo→ 'mili' ('eyes when shut' = obstructed [vision]),
'mullar:ura' ('blind'),
molu→ 'mei' ('eye'), 'mulya:n' ('eagle-hawk'),
mula→ 'milama:ng' ('vulva' = [source of] menstrual-droplets),
'mulya:n' ('morning star'), 'mulla:mul:na'g' ('Pleadies'),
mulu→ 'mula:yi' ('soft'), 'mul:da:ha' ('old woman'),
'guru→ 'ngurri:i' ('shin' = wiggly), 'nhuru:ng' ('arm' = wiggly),
'ngu:mun'g' ('knee' = wiggly),
'ji:lla:ngurri:i' ('centipede' = wiggly little [legs]),
'gur:ga:na'g' ('pigeon, bronze-wing' = very fluttery),
'wullu:nya' ('swim' = lots-of flailing),
'ngur:nu'i' ('throat' = undulatory [tube]), 'guru' ('neck'),
'buru:ng' ('vagina'),
'nguru:ng:gal' ('a woman' = sexually mature),
'ngauu' ('blood'),
'nguru:ng:nguru:ng' ('red' = pulsating/throbbing [blood]),
'gula:t:bu:ngara' ('break'),
'nguru:nd:e' ('hear' = [sound] oscillations),
gulu→ 'ngulu' ('forehead') = corrugated, 'ngulur' ('sweat'),
'burru:ng:gal' ('clitoris' = thing between corrugations/labia),
'ngullu:ng' ('sit' = hunched/folded [legs]),
'gula:yan:na'g' ('short' = very hunched),
warala 'wurri' ('far'),
wori→ 'waru:waru' ('straight'),
'wure' ('sun') hence 'wuri:wure' ('sunlight, light of a fire'),
wurola→ 'wallu' ('chin, beard' = numerous [hairs]), 'wollar' ('head'),
'wullu:ng:gu'ra' ('rocks' = numerous round/convex things),
'wullu:nya' ('swim' = lots-of flailing),
'gaian:wilai' ('grow'), 'wurrrai:ri' ('play, dance'),
para→ 'nyiir' ('scales of fish' = top/surface [things]),
'birra:nu'ng' ('toe-nails, finger-nail'),
pora→ 'nyirra' ('navel' = middle [thing] = belly-button),
'nyirri:chi' ('navel-string'), 'ngura:nhung' ('afterbirth'),
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nora→ ‘yenda’ (‘walk’) hence ‘yendea narrea’ (‘go’ = walk yonder),
‘nharra:wa:n:gai’ (‘lightning’ = yonder distant flash),

thura→ ‘thura:ra’ (‘sting or stab’ = [penetrating] through),
‘dhurra:gan(g)’ (‘large stream, river’ = very [strongly flows] through [the landscape]),
‘dhurra:gan:gan(g)’ (‘little stream, creek’ = gently [flows] through [the landscape]),

ji→ ‘ji:rrar’ (‘hair of head, fur of animals’ = numerous tiny-[hair]s),
‘ji:ra:nq’ (‘leaves of trees’ = numerous tiny-[leaves]s),
‘ji:lli:nurr:i’ (‘centipede’ = numerous tiny-wiggly-[leg]s),
‘ji:bbir:nq’ (‘dew’),
‘dyi:dyi:rr’ (‘dry’ = little [water] through [creek]).

Appendix B. Phono-genesis

We have seen how the proto-Australian ‘power law’ of Figure 3, extrapolated tens of millennia forward through time as in Figure 4, actually fitted ‘modern’ dhurga quite closely as in Figure 2. We should likewise be able reliably to extrapolate tens of millennia backward, from proto-Australian times, to study how human phonology evolved over the greater part of the last 100 000 years. Equations (8) and (9) permit this. We need only choose $H$, the approximate number of consonants in the alphabet during any given era, calculating the

![Power-law curves, describing increasingly complex sound systems, as human language developed over the last 120 000 years.](image)

$$f_h = \frac{1}{2^H} 
\begin{array}{|c|c|c|}
\hline
H & \alpha & f_h(\%) \\
\hline
2 & 0.7857 & 56 \\
3 & 0.8417 & 39.21 \\
4 & 0.7803 & 34.92 \\
5 & 0.7958 & 29.99 \\
6 & 0.8049 & 26.80 \\
7 & 0.7925 & 25.82 \\
8 & 0.7955 & 24.35 \\
9 & 0.8059 & 23.72 \\
10 & 0.7932 & 22.94 \\
11 & 0.7758 & 23.89 \\
12 & 0.7698 & 24.58 \\
13 & 0.7599 & 25.10 \\
14 & 0.7496 & 25.49 \\
\hline
\end{array}$$

Figure 5. Power-law curves, describing increasingly complex sound systems, as human language developed over the last 120 000 years.
corresponding value of $x$ with equation (11). The $H=2$ stage (the first ‘step’ shown in Figure 5) represents the earliest spoken human language, a system of snorts and grunts arising from mutation of the FOXP2 gene, prior to 120000 years ago when the full range of necessary improvements to the larynx and the chest muscles controlling the diaphragm came into being, and the human thoracic spinal chord increased in size facilitating the requisite precise cortical control over breathing required for speech. We know that languages such as dhurga had evolved a phonology of $H=14$ by recent times $t=0$. Assuming that average phonological complexity $H$, increased linearly with time $t$ (in years), we have

$$t = 10000 \times H - 140000$$

which means that proto-Australian, with $H=10$, corresponds to a time-constant in equations (27) to (32) of about $T=40000$ years. The true value could be closer to 60000 years, as proto-Australian came originally through south-east Asia and predated human occupation of Australia. Our estimate uses the fewest assumptions but, certainly, by 45000 years ago, proto-Australian would have spread throughout all Australia.
Origins of Linguistic Zonation in the Australian Alps. Part 1 – Huygens’ Principle

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ABSTRACT The hitherto poorly recorded boundaries of extinct traditional south-east-Australian Aboriginal languages can now be redetermined with greatly improved precision using an entropy-maximizing phonetic-signature calculated from existing data sources, including old word-lists and census forms, that have, until now, largely been considered informationally worthless. Having thus determined traditional Aboriginal language zones to a previously unimaginable degree of geographical precision, it is argued that these boundaries should not be viewed merely as a static ‘snapshot’ but, instead, as the end-product of a knowable dynamic process (Gillieron wave propagation) governed by well-known physical rules (such as Huygens’ principle and Snell’s Law) and operating over ‘deep’ time-scales more familiar to the archaeologist than the linguist. Although this initial study is limited to south-eastern Australia, the new methodology provides the first real hope of obtaining a detailed understanding of language dispersal throughout the entire continent over the past 60,000 years.

KEY WORDS: Lexical signature, deep linguistics, Gillieron wave propagation, Huygens’ Principle

Introduction

It is clear that there were different Aboriginal languages throughout south-eastern Australia two centuries ago. Charles MacAlister (1907), for example, told how ‘...inland people found it hard to understand the Tablelanders or the coastal tribes’. But throughout this entire region indigenous language was extinguished so rapidly – before studies of appropriate scientific calibre were made – that today we have only fragmentary information about traditional linguistic boundaries. Accordingly, Terry Crowley (1997: 289–291) complained

... one serious problem that faces us in reconstructing the linguistic history of northern New South Wales is the nature of the data that we are forced to operate with ... the descriptive materials range from moderately good in some cases ..., fragmentary in others ..., appalling in other areas ..., to completely non-existent ... [there are] areas for which we have names but no information ... languages that have disappeared without trace. ... Even the best described languages ... may well represent very poor shadows of their former selves ... much of the lexical richness has disappeared without trace. In Bundjalang, I was unable to
record more than 1000 lexical items, not for want of trying . . . [and] this is the situation for one of the better described languages of the region . . .

Norman Tindale (1974) pointed out the relevance of traditional tribal boundaries, noting that a ‘common bond of language’ is one of the criteria that makes a group of people a tribe, though there does not have to be a language barrier to mark a tribal boundary. Additionally, Diana Eades (1976: 3) commented that

. . . because of the limited amount of work done in the area, we have to use all available material as best as possible to work out how many languages were spoken and where . . . we must consider grammar, phonology and vocabulary, as well as geographical factors and native speakers statements about intelligibility. It is impossible to be clear on the situation of dialects,

which raises the issue of degrees of linguistic relatedness within dialect-chains of the kind mentioned by Crowley (1992/3/4/6: 247)

. . . on the border between Queensland and New South Wales where cognate counts in the basic vocabulary of a number of neighbouring speech communities are relatively high and where the two varieties are mutually intelligible. However . . . [for] the speech communities at the extreme ends of this chain . . . mutual intelligibility is not conceivable.

Such geographically vast dialect chains, sometimes extending continuously for thousands of kilometres, obviously came into being over time-scales that are simply beyond existing linguistic methodologies. And ultimately there are the questions of deep linguistics as articulated by Crowley (1992/3/4/6: 305)

. . . are the modern Australian Aboriginal languages all descended from a single proto-language that may have been spoken 40,000 (or even 60,000) years ago? Or are they descended from the language of the people who introduced the dog [dingo] about 5,000 years ago? Or are some of the languages descended from the older, original language, and others descended from the more recently introduced language? Until linguists are able to carry their reconstructions further back in time than we are able to do at the moment, these questions will have to remain unanswered . . .

Australianists do need to stop muddling the time-scales of shallow linguistics (mere thousands of years) with those of deep linguistics (tens of millennia). And, contrary to the protestations of Dixon (1980: 37), over deep linguistic time-scales one cannot place much reliance upon the grammatical features of recent languages. Probably just about everything currently known about Aboriginal grammar is burnt-off at time depths beyond 5000 years and therefore largely irrelevant. On the other hand, the phonological constancy and consistency, throughout Australian languages generally, suggests that basic phonotactic information conceivably just might provide a reliable account of language change over truly deep time-scales. In principle, we might delve ever further back through time, simply by collecting lexical data over a ‘sufficiently large’ geographical study-area. Even the size of Australia is not the ultimate limiting factor because, long ago, proto-Australian arose originally from other continents.

A previous paper (Illert & Allison, 2004) noted the existence of three diachronically ‘stable phonetic blocks’ (small sets of word-initial consonants), which seem to mutually interact and compensate in accordance with the physical principle of entropy maximization, within traditional south-east-Australian lexicons. This being so, the associated ‘lexical transfer vector’ might profitably be used as a kind of linguistic ‘DNA signature’ identifying broad ancestral language families. This hypothesis is now tested using 37 historic word lists collectively containing 7601 Aboriginal words, and nine early census lists
('Blanket Registers') collectively containing 445 traditional names, gathered from known geographical locations chosen as uniformly as possible throughout our south-east Australian study area (see Appendix 1).

‘Lexical Signature’ as a Tool for the Determination of Linguistic Boundaries

Previously (Illert & Allison, 2004) a lexical-transfer vector was defined

\[ \varepsilon = (\varepsilon_1, \varepsilon_2, \varepsilon_3) \]

quantifying diachronic ‘phonetic leakage’ between three reasonably stable blocks of word-initial consonants within the collective traditional south-east-Australian lexicon such that

\[ \varepsilon_1 = \int_{-T}^{0} \dot{f}_m + \dot{f}_g + \dot{f}_q + \dot{f}_k \, dt \]
\[ = (\Delta f_m + \Delta f_q + \Delta f_k) \]
\[ \varepsilon_2 = \int_{-T}^{0} \dot{f}_n + \dot{f}_d + \dot{f}_s + \dot{f}_t \, dt \]
\[ = \Delta f_n + \Delta f_d + \Delta f_s + \Delta f_t \] (2)

\[ \varepsilon_3 = \int_{-T}^{0} \dot{f}_w + \dot{f}_n + \dot{f}_d + \dot{f}_a + \dot{f}_s + \dot{f}_t + \dot{f}_r + \dot{f}_r \, dt \]
\[ = \Delta f_w + \Delta f_d + \Delta f_s + \Delta f_t + \Delta f_r \]

where

\[ \varepsilon_1 + \varepsilon_2 + \varepsilon_3 = 0 \] (3)

for word-initial consonant frequencies

\[ f_\alpha \in \Gamma = \{ f_\alpha(t) \in C^1[-T, 0] : \sum f_\alpha = 100\% \quad \forall t \in [-T, 0] \} \]

\[ f_\alpha(-T) = f_\alpha \quad \text{and} \quad f_\alpha(0) = F_\alpha \quad \text{as defined in Appendix 1} \] (4)

\[ f_\alpha(-T) = f_\alpha \quad \text{and} \quad f_\alpha(0) = F_\alpha \]

It is also useful to define the magnitude of this lexical-transfer vector as

\[ \varepsilon = \text{sgn}(\varepsilon_3) \sqrt{\varepsilon_1^2 + \varepsilon_2^2 + \varepsilon_3^2} \] (5)

where we distinguish between negative and positive values of \( \varepsilon_3 \) because \text{sgn}(\varepsilon_3) = + indicates an expanding phonology, whereas \text{sgn}(\varepsilon_3) = - can indicate phonological simplification, and we need to know the direction of phonogenesis. All these quantities, calculated from the raw data in Appendix 1, are summarized in Table 1.

In the second part of this paper ‘Type-A’ and ‘Type-B’ language will be rigorously defined in terms of the different solutions to a quadratic equation arising from what is com-
Table 1. Components of the lexical-transfer vector

<table>
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<th>Geographical region</th>
<th>$e_1$</th>
<th>$e_2$</th>
<th>$e_3$</th>
<th>$e$</th>
<th>Language type</th>
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<td>-7</td>
<td>-2</td>
<td>-11.576</td>
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<td>-1.1</td>
<td>-8.1</td>
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<td>-12.1</td>
<td>-22.37</td>
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<td>-4.2</td>
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<td>-13.565</td>
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<td>-4.1</td>
<td>-5.3722</td>
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<td>'thurraval' (=nuval) wordlist R.H. Mathews, 1903</td>
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<td>pt. dalrymple wordlist Joseph Gaimard, 1826</td>
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<tr>
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<tr>
<td><strong>Blue Mountains</strong></td>
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<td>kamilaroi wordlist Rev. W. Ridley, 1875</td>
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<td>gundungara wordlist M.M. Everitt, 1900</td>
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<td>gundungara wordlist William Russell, 1914</td>
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<td>−10.8</td>
<td>0*</td>
<td>15.274</td>
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<td>−8.9</td>
<td>6.9</td>
<td>11.438</td>
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</table>

*Note: William Russell’s wordlist appears to have come from the boundary between Gundungara ($e_3 > 0$) and Tharumba ($e_3 < 0$) zones, hence we find $e_3 = 0$. 
monly called Snell’s Law (Weinstock, 1952). However, the magnitudes of the numbers in Table 1 are unimportant for present purposes. For now what actually matters are

1) the signs of the respective numbers $e_i$, and
2) the empirical ‘brute-fact’ that the 46 historic word/name lists in Appendix 1 all possess clear signatures placing them in one or other of the basic language families shown in Table 2, and that
3) by plotting these signatures from Table 1, according to the respective geographical locations of each of the 46 historic word/name lists, we discover distinct language zones extending throughout south-eastern-Australia. Interpolation of associated linguistic boundaries can be manually accomplished, to an accuracy of approximately $\pm 25$ km, as in Figure 1.

Of course, hypothetically, there are eight possible signatures

$$\pm \times \pm \times \pm = 2 \times 2 \times 2 = 8$$

but $+++$ and $---$ are strictly forbidden by equation (3). Thus, having only six of these eight signatures, there is the possibility of ‘signature-doubling’ as with the pre-Wolgalu languages Original-A and Turuwal or the post-Wolgalu languages Midthung and Tharumba. This follows from the conjecture (Guthrie, 1852), only recently proven (Appel & Haken, 1977, 1978), that four colours/signatures are sufficient to colour/label any planar map such that no adjoining regions are the same colour/signature. Figure 1 is visually complicated but it has two main areas: the interior and the exterior of an oblong region in the Australian Alps, which we hereafter call the Huygens Circle. The four different pre-Wolgalu language zones are clearer in Figure 3(a), whilst the four different post-Wolgalu language zones within the Huygens Circle are apparent in Figure 3(b). We will return to this later.

Comparison with Previous Cartography

An instructive map of traditional south-east-Australian tribal boundaries was provided in Lyall Gillespie’s (1984) book ‘Aborigines of the Canberra Region’. In contrast, one of the earliest accounts was James Fraser’s (1892) ‘Map of New South Wales, as occupied by the

<table>
<thead>
<tr>
<th>$e_3 &gt; 0$ original (pre-Wolgalu) primary languages</th>
<th>Language type</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>$+++$</td>
<td>Original-A</td>
<td>Kamilaroi, Dharginyung, Dharug, Gundungara</td>
</tr>
<tr>
<td>$---$</td>
<td>Original-B</td>
<td>Wiradjuri, Eora, Wadi-Wadi Birdhawal, Tasmanian</td>
</tr>
<tr>
<td>$+++$</td>
<td>Southern-B</td>
<td>Dhurga, Kurnai, Wemba-Wemba</td>
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<tr>
<td>$+++$</td>
<td>B</td>
<td>Turuwal</td>
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</table>

<table>
<thead>
<tr>
<th>$e_3 &lt; 0$ Australian Alps collision zone (Huygens Circle) languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>$+++$</td>
</tr>
<tr>
<td>$++$</td>
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Native Tribes' supplied in the preface of his 1892 compilation of Rev. L.E. Threlkeld's works. Fraser's map is so wrong, in places, that many scholars still avoid citing it – though it is clear that they have actually studied this 1892 map, often faithfully parroting its errors.

Fraser's map shows the Blue Mountains 'Original-A' language, in Zone VIII ('Kurig-gai'), correctly linking up with Zone I ('Kamalarai'). And William Albert Cuneo (1860–1942), writing in the Picton Post and Advocate newspaper in 1893, even referred
to Burragorang Valley to the south-west of present-day Sydney as ‘the headquarters of the Kamileroi tribe that claimed sovereignty over a tract of country much larger than the present county of Camden’ (Illert, 2001). However, contrary to the maps of both Fraser (1892) and Dixon (1980: 241, map 7), the present study shows that Blue Mountains language, such as Gundungara and Dharug, never extended eastward to anywhere near the Sydney coastline where Original-B (‘Eora’) language was spoken. Additionally, Original-A and Original-B were apparently so different that an intermediary layer of ‘Turuwul’ pidgin seems to have occurred between coastal and mountain people.

This contrasts with James Kohen’s (1993: 22) now demonstrably false proposition that ‘two dialects of the Dharug language were the Eora dialect along the coast and the inland dialect . . .’. Even the title of his book asserted that the ‘Dharug’ were ‘the traditional owners of the Sydney region’. Twenty years previously, Arthur Capell made similar reference to the existence of ‘coastal Dharug’ people, probably also influenced by the same error in Fraser’s (1892) map. In fact the ‘Dharug’ seem to have been a mountain tribe who came from the north and arrived in the Blue Mountains to the west of present-day Sydney tens of millennia after Original-B speakers, such as the coastal ‘Eora’.

There is no possibility whatsoever of ‘Eora’ being ‘a dialect of Dharug’, and we have now empirically demonstrated the paucity of phonetic evidence supporting a traditional ‘Dharug’ presence even on the western Sydney plains much beyond the immediate base of the Blue Mountains. The — + ‘Eora’ signature was ubiquitous about present-day Sydney, whilst the only other ‘Dharug-like’ + — + signature that I have so far found anywhere near Sydney was that of John Malone’s ‘Turuwul’ pidgin. These present findings vindicate Anne Ross (1988: 49–52) who challenged contrary views originally proposed by Capell (1970: 21–22), Dixon (1980: 241, map 7), Kohen & Lampert (1987: 345) which are apparently still supported by Walsh (1991) and Kohen (1993).

Another common error, one that can also probably be traced back to Fraser’s 1892 map, follows from his Zone IX (‘Murrin-jari’), which depicted a single strip of ‘coastal language’ extending from Cape Howe to Wollongong. Ignoring the fact that this strip of Original-B coastal language actually continued on north (well beyond Sydney, through part of Fraser’s Zone VIII), the 1892 map gave no indication of an adjoining Hinterland strip of Southern-B language running along the eastern bank of the Shoalhaven River parallel to the coast. The 1976 map of Eades likewise showed a single strip of ‘Dhurga’ language along the coast, between Jervis Bay and Wallaga Lake, extending continuously from the sea to the eastern bank of the Shoalhaven River near Braidwood – an error parroted by Dixon (1980: map 7, page 241). Our present analysis clearly shows ‘Dhurga’ to have been a Southern-B hinterland language traditionally spoken at Braidwood, genetically related to Gippsland ‘Kurnai’ and west-Victorian ‘Wemba Wemba’ but quite different to the ancient Original-B traditionally spoken along the coastal strip from St Georges Basin to Cape Howe.

In places, Southern-B may possibly have extended eastward almost to the coast: for example, the 1839 census at Twofold Bay showed an Original-B speaking coastal tribe, whilst the wordlist of Johnny Weymann collected at Eden Jail on 14 October 1864 was clearly provided by a Southern-B speaker. The Illawarra Mercury, 9 March 1860, provides the additional information that

*Jackey Weyman, an Aboriginal, was placed in the lock-up at this place on Tuesday charged with stealing two pounds from a person . . . [and] forwarded this morning to . . . Eden for greater security. . . . a very intelligent black, speaking English considerably better than many Englishmen of our acquaintance . . . [who] having had a reduced quantity of rum compared with the share his companions had imbibed, his head was clearer than theirs, and, while his victim was sleeping, it is said he picked his pocket.*
The picture emerges of Aboriginal people dwelling on the fringes of European settlements, and learning to speak English, whilst still retaining a sense of traditional tribalism. Weyman, a Southern-B speaker from the hinterland, seems to have had little compunction over stealing from coastal Aboriginals but probably would not have behaved that way with his own tribesmen. The fact that his Southern-B wordlist was obtained on the coast probably is more a reflection of his wanderings than of traditional tribal boundaries.

Although Fraser’s Zones IX and VIII both fail to indicate the parallel adjoining strips of coastal and hinterland language found in this present study, there is independent evidence from other primary sources. Baron Field, during his visit to Five Islands (Wollongong) on 22 October 1823, observed that ‘the Aborigines of New Holland were strictly divided into two classes, the [hinterland] hunters and the [coastal] fishers’. Likewise, Thomas Kendall, who settled at Narrawallee Creek in 1828, noticed that Shoalhaven Aborigines were divided into a coastal tribe, and a Pigeon House tribe whose territory extended inland as far west as Braidwood (Cambage, 1916; Hilder, 1982). Similar observations were also made by A.W. Howitt (1904).

Despite causing quite major contemporary misunderstandings over traditional tribal boundaries, Fraser’s 1892 map nevertheless contains some unique and valuable information that is unavailable in other sources. For example it gives perhaps the only correct account of the ‘Tharumba-Midthung’ zone’s traditional northern boundary (through Picton), extending round to the west of Yass, perhaps all the way to the headwaters of the River Murray – as suggested in the present study by the 1834 Tuggeranong census, an 1853 Sutton Forest wordlist, an 1842 Picton census, and also by the 19th century oral testimony of Alex Murdoch in his legend of ‘the first bushfire’, cited by C.W. Peck (1925: 56–57), to the effect that

somewhere in the south, perhaps over in Victoria, there lived a great king. His tribe was very numerous, for he imposed his will upon other tribes and welded them together. . . . He must have come as far north as the Burrogorang – if, indeed, he did not come further – for the Hunter River natives have a story somewhat similar to this

This all meshes nicely with Rev. William Ridley’s (1875: 143) observations that

Tharumba is spoken on the Shoalhaven River . . . by the Wandandian Tribe. Thurawal in another part of the same district, south of the Illawarra where Wodi Wodi is spoken. Thurawal appears to be the same word as Turrabul and Turawal, the names of the languages spoken at Moreton Bay and Port Jackson.

Until this present study it was not possible to answer even simple questions such as was ‘Tharumba’ different to ‘Midthung’, were they pidgins, where how and why did they come into being? And, notwithstanding a brief late account of ‘Tharumba’ grammar by Mathews (1902), for centuries the total known vocabulary of this language amounted to a mere six words from Sutton Forest, the names of artefacts and objects scribbled at the bottom of a drawing by Louisa Atkinson in 1853, supplemented by an additional 28 words recorded in the Shoalhaven in 1872 by Rev. Andrew Mackenzie. Then, recently, Keith Vincent Smith of Macquarie University (pers. comm.) located Thomas Mitchell’s 96-word ‘Stonequarry’ wordlist and John Dunmore Lang’s 46-word ‘Argyle’ wordlist, both bearing the distinctive Tharumba-Midthung signature + − −, thus confirming the geographical boundaries and producing a fivefold increase in the known lexicon.

Fraser’s Zone X (‘garego’) is approximately correct for the parigul zone (albeit swallowing up Walgalu), although to be consistent it should extend northward, along the western bank of the Shoalhaven River up to Lake George, encompassing the ñunawal region. The linguistic boundaries given by Dixon (1980: map 7, p. 241), likewise wrong by hundreds
of kilometres, depict an overlarge block of ‘ngarigo’ extending continuously from Omeo to Picton, completely engulfing and losing the quite distinctive and important ‘Wolgalu’ language and its adjoining ‘Midthung-Tharumba’ pidgin zones. These major blunders show precisely what can happen when linguists overstress the value of fragmentary grammatical accounts for deep linguistic work, brashly claiming (Dixon, 1980: 37) that

\[\ldots\] in every case I have investigated it is a relatively easy matter to decide whether a particular tribal boundary is a boundary between different languages, or whether it just separates off dialects of one language \ldots Even when dealing with long-extinct tribes of the south-east, where only scanty written records are available, there is never any difficulty in deciding what was one language \ldots as elsewhere in Australia, there is no difficulty in distinguishing between language and dialect.

This view is now discredited (Clark, 1990: 3) and, whereas Dixon’s (1980: map 7, p. 241) linguistic boundaries were largely subjective and drawn only to an accuracy of $\pm$ 200 km (wrongly showing ‘ngarigu’ extending 300 km north all the way to Picton, and Blue Mountains Dharug extending 100 km all the way east to the coast), our Figure 1 is at least an order of magnitude more precise and based upon a transparent reproducible objective methodology employing known and readily available data. Figure 1 is also in far better agreement with traditional tribal boundaries to the extent that they are known (Gillespie, 1984; Tindale, 1974; Howitt, 1904).

The kinds of arguments that might arise from uncertainties in the boundaries in our Figure 1 are more subtle. For example we have, within the stated error-bounds, drawn the type-A language zone extending into Wiradjuri territory perhaps 15 km further west than the signatures in Table 1 might suggest. This is an intentional compensation for suspected skewing of post-European-contact data arising from depletion of traditional inland Aboriginal communities, and associated large-scale eastward movement of Aboriginal peoples to the coast, as European farmer settlers increasingly occupied the countryside. Today a quarter of all Australians who consider themselves to be ‘Aboriginal’ live along the south-eastern coast, particularly in the Illawarra and the Shoalhaven.

Thus, it is not particularly worrying that Nelly Hamilton (1825–1897), long described as ‘the Queen of Queanbeyan \ldots the last remnant of the once numerous and powerful ngunawal tribe’ (Gillespie, 1984: 56), in 1887 supplied the local magistrate with a word-list featuring a clear Original-B signature; the very same $\ldots$ signature found in Queanbeyan and Goulburn censuses circa 1840 and also in the 1904 Wiradjuri wordlist collected by R.H. Mathews. Clearly, by the 1840s, Wiradjuri tribes had been displaced eastward, shunting the ACT’s original punawal tribe ahead of them toward the coast. This is evidenced by our spectacular new finding that the [Wandandian] ‘Thurrawal’ wordlist of R.H. Mathews (1903), with signature $\ldots$, is not a coastal language at all but, instead, punawal language from Lake George. Likewise, even as early as 1872, Rev. Andrew Mackenzie spoke of ‘Midthung or Tharumba, spoken by the Aborigines of Braidwood, Ulladulla, Moruya and Jervis Bay’, and R.H. Mathews (1902) opined ‘the Tharumba language is spoken on the coast of New South Wales, between the Shoalhaven River and Ulladulla, reaching inland to the Dividing Range. This tongue is a dialect of Thoorga, spoken to the south of Ulladulla \ldots’. Clearly, these were all refugees, originally from the Southern Highlands, largely via Kangaroo Valley.

In addition, some of the tribal names and geographical locations are misunderstandings. The [northern] ‘ngarrugu’ wordlist of R.H. Mathews (1908), with signature $\ldots$, has actually to be Wolgalu. The [southern] ‘ngarigu’ wordlist of Louise Hercus (1969) is actually true ‘ngarigu’ which, with signature $\ldots$, seems to be exactly the same language as Lake George ‘punawal’. The point is that, for the first time, these signatures provide a rational objective basis upon which finally to decide such matters.
Gillieron Waves and Deep Linguistics

The linguist Jules Gillieron (1854–1926), in a 13 volume treatise published between 1902 and 1910, pioneered the study of individual phonological changes in dialects, within a single language zone, over small distances (tens of kilometres), over very shallow time-scales (less than a few centuries). His view of linguistic change, today called the wave model of lexical diffusion, emphasized that every word in a language has its own individual history, and that sound changes do not operate simultaneously on every word in a language over very shallow time-scales. More recently Crowley (1992/4/6: 246) has explained that

‘the wave model of linguistic change has gained respectability in modern linguistics through recent work on lexical diffusion . . . [it] implies that instead of sharp linguistic splits, change takes place like waves spreading outward from the place where a stone is dropped into water, travelling different distances with different stones, and crossing with waves caused by other stones. So, instead of a tree diagram of language relationships . . . [we have] a number of different dispersal points’.

Interesting as this all may be, there is no reason why it should not be equally valid for deep linguistics to consider collective transfers between stable phonetic blocks, within scores of genetically related languages, over trans-continental distances (thousands of kilometres), over truly deep time-scales (tens of millennia). In such cases, the propagating Gillieron wavefronts represent the movements and interactions of language super-families giving rise not just to mere dialect-chains but, instead, to genetically related language-chains. Accordingly we do not have to view the boundaries in Figure 1 as static empirical facts devoid of meaning. Instead we can think of them as the end-product of a knowable dynamic process – Gillieron wave propagation – occurring over deep time-scales.

One key feature of Figure 1 is the coastal strip of Original-B language from Ulladulla to Cape Howe, which is separated from the larger inland body of Original-B, modern-day Wiradjuri territory, by an intermediary zone with a Southern-B flavour typically with word-initial-\(r\) and word-initial-\(l\) as in Gippsland Kurnai and Dhurga. The obvious dynamic explanation is that, initially, all language throughout south-eastern Australia was Original-B and that Southern-B subsequently arose, spreading eastward from central Victoria, along the River Murray to its headwaters in the Australian Alps, crossing the ‘Menero’ Tablelands \(mi\-\)\(nu\)-\(ra\) meaning the middle [of the journey], thereafter following the Shoalhaven River north, just as the Murray had previously been followed. Throughout this epic migration, depicted in Figure 2, Southern-B speakers remained river-people and hinter-landers unable to out-compete the pre-existing Original-B speakers who, over long periods of time, had already developed specialized fishing technology for surviving along the coastal strip and also other specialist skills for surviving in the desert regions of far western New South Wales.

Interestingly, we can even tentatively date these events. The Earth went through a ‘glacial era’ from 60,000 to 10,000 years ago, the coldest period being from 34,000 to 18,000 years ago. As this Ice Age drew to a close, the polar ice caps began melting, the world’s oceans rose by 150 m, Australia’s coastlines moved inland by about 20 km and between 15,000 and 12,000 years ago the present island of Tasmania became separated from mainland Australia by Bass Strait. Thus, notwithstanding the opinions of Crowley (1992/4/6: 304–5)

‘of course, the relationship of the Tasmanian languages will forever remain a mystery because the last fluent speaker of any of these languages died in 1876, and the information that was recorded on these languages before then was so poor that it will never be possible to do anything useful with it in terms of linguistic reconstruction’,
the clear Original-B signature (see Table 1) on the Tasmanian wordlists of J.P. Gaimard ('Port Dalrymple' = Georgetown, 1826) and J.J.H. de La Billardiere (Research Bay, 1793) immediately refutes Wurm’s (1972: 174) view that Tasmanian languages were unrelated to those on the mainland;

(2) refutes previous notions that modern south-eastern languages might have been bought to Australia a mere 4000 years ago, by the people who introduced the dingo, as suggested by Dixon (1980: 19); Crowley (1992: 305) and others; and

(3) means that Original-B language is older than 15,000 years and that, accordingly, our signatures chronicle truly deep time-scales.
Given this third point, we are able to make an informed guess as to when and why the proposed eastward migration of Southern-B speakers occurred. Mungo is one of a chain of now-dry lakes along Willandra Creek, to the west of the Lachlan River. Although they have long been dry, a mere 36,000 years ago they were full of water, fish and shellfish, supporting flourishing Aboriginal communities whose remnant camp-sites are still preserved in the Willandra sand-dunes.

But whatever happened to these flourishing communities of river-landers? Well, about 26,000 years ago, as the Ice Age approached its climax, it became colder and drier throughout south-eastern Australia. The Willandra Lakes began to dry up and the Southern-B speakers, understandably seeking water, migrated upstream to the headwaters of the River Murray in the Australian Alps. Those who remained behind in the vicinity of the Darling River, in sustainable low numbers, had to adapt to the extremely arid conditions that prevailed till about 13,000 years ago. So the obvious proposition is that the eastward-propagating Gillieron wavefront in Figure 2 chronicles an overland mass migration, of Southern-B speakers, driven from the Willandra Lakes and Darling River system by drought.

As it moved, this wavefront progressively separated pre-existing coastal and inland Original-B speakers, displacing some southward across the Ice Age land-bridge into Tasmania (Figure 2). The wavefront’s progress is chronicled by the Original-B speakers, with word-paradigms similar to mainland Birdhawal and heavily influenced by Southern-B, who first arrived in Tasmania about 23,000 years ago. For example, Cave Bay Cave, in north-western-Tasmania, contains their 22,500 year old bone-points and needles used for making fur cloaks, nets and baskets. Slightly more recent is Kutikina Cave, 100 km further south, the world’s most southern Ice Age site. Occupied for 5000 years dating from 20,000 years ago, and containing an estimated ten million artefacts, it is Australia’s richest site (Jones, 1987).

All this suggests that Southern-B language is perhaps 30,000 years old and, as it would have arisen from Original-B, this means that Original-B must be even older. How much older? Well, a male human skeleton intentionally buried in a grave at Lake Mungo, and still showing evidence of ochre ornamentation, has recently been dated by Alan Thorne of the Australian National University as 62,000 years old. This estimate is hotly contested by Jim Bowler of Melbourne University who argues that it is only 40,000 years old (Grose, 2003).

Whatever the true age happens to be, it is likely that Mungo Man was a speaker of Original-B, familiar with all of the 62 root words previously published in Illert & Allison (2004) and most of the various leximorphs published in Illert (2003). He perceived morning as ‘orbiting-thing [=sun] rising up’, evening as ‘orbiting-thing [=sun] going down’, bivalved shell as ‘opposing pair of gently spiralling things’, and had a quinary system of numerals based upon recursive arithmetic, all attesting to his cognitive processes and showing just how like us Mungo People were perhaps 45,000 years ago.

Of course, Original-B speakers would have occupied all of south-eastern Australia at that time, and not just Lake Mungo. For example coastal ‘Eora’ people from the vicinity of present-day Sydney were also Original-B speakers, and their 42,000 year old stone artefacts have been discovered in gravel beds now buried under sands and silts, at Cranebrook Terrace in the Penrith/Castlereagh area adjacent to the Nepean River, on the coastal plain to the west of Sydney.

When the Original-B speakers who made these artefacts first arrived, in the Sydney region, the landscape and the animals were quite different. Megafauna (animals and birds up to 3 m tall) still roamed the countryside. There were giant kangaroos such as the Protemnodon and Procoptodon, rhinoceros-sized grazing creatures such as Diprotodon, carnivores such as Thylacine (Tasmanian Tiger) and Thylacoleo, and a leopard-sized tree dweller related to possums. We are only just beginning to understand this prehistory.
Perhaps the oldest signs of human occupation in the Blue Mountains occur west of present-day Sydney at Kings Table at Wentworth Falls. The location has many axe-grinding grooves and markings on the walls of a rock shelter on its eastern side. Excavations have shown that this particular shelter was in use 22,000 years ago at the very height of the coldness and dryness of the ice age, at about the same time that Tasmania was being colonized. Further south, in the Canberra region, the earliest definite evidence of human occupation is a rock shelter in the grounds of the Birrigai Recreation Centre at Tidbinbilla dating to 15,000 years ago. Thus, although Original-B speakers had well and truly occupied south-eastern-Australia 45,000 years or so ago, they preferred coastal and riverland locations and it was not till about 23,000 years ago that Aboriginal people started seriously to occupy the rugged mountainous regions that lay between.

Eugene Stockton (1993/6: 48) has opined

We are never likely to know when Aborigines began to live in the Blue Mountains nor the direction from which they came. A north or south approach is improbable because of the more rugged terrain. The likelihood of an eastern or western approach is affected by the current debate about the original dispersal of Aborigines in Australia. Those who argue for an Aboriginal movement around the coast, would imply an eastern approach to the Blue Mountains, whereas those who argue for inland dispersal would suggest an entry from the west.

Yet, given the self-evident nature of Figure 2, let us see if there is an equally sensible dynamic explanation for the rest of the boundaries of Figure 1 in terms of Gillieron wavefronts propagating over deep timescales. The 22,000 years of human occupancy at Kings Table shelter, and 15,000 years at Tidbinbilla shelter, jointly suggest southward propagation of Original-A language along the Blue Mountains chain itself during and slightly after the climax of the Ice Age, perhaps all the way from central Queensland, at much the same time that Southern-B was propagating northward along the Shoalhaven River as in Figure 3(a). But whereas Original-B and Southern-B were both type-B languages with similar signatures, it is clear that Original-A, with increasing word-initial usage of peripheral consonants ($e_1 > 0$), was so different from the pre-existing type-B linguistic substrate in this region that it required a boundary-layer of ‘Turuwul’ pidgin for mutual comprehensibility.

Perhaps about 15,000 years ago when the wavefronts of Southern-B and Original-A eventually collided in the Canberra region, creating the Wolgalu language, an encircling boundary-layer of new pidgins (such as Midhung/Tharumba and ɲarigu/ɲunawal) exploded into existence. Over millennia this pidgin shockwave expanded away from the primary Wolgalu collision zone, increasingly as if from a point source in accordance with Huygens’ Principle (Sears & Zemanski, 1966: 786; McCarthy, 1968: 34–39), constrained on the east by landscape features such as the Shoalhaven River as in Figure 3(b).

Most college textbooks on optics and physics provide simple accounts of the principle of wave propagation which is generally ascribed to Christian Huygens (1629–1695). For example, Sears & Zemanski (1966: 786) explain that

Huygens’ Principle is a geometrical method for finding, from the known shape of a wave front at some instant, what the shape will be at some later instant. The Principle states that every point of a wave front may be considered the source of small secondary wavelets,
which spread out in all directions with a velocity equal to the velocity of the \{parent\} waves. The new wave front is then found by constructing ... the envelope of the\{se secondary\} wave[let]s.

A physical consequence of this principle, one that could perhaps be more often emphasized, is that these envelopes asymptotically tend to become circular – eventually radiating outwards as if from a single point – regardless of the irregular shape of any actual extended object (such as a stone) which may have initially (by falling
into a pond) caused the disturbance. Thus, in the present context, although the Wolgalu collision zone is an extended region bounded by two arcs, the surrounding pidgin wavefront (‘Huygens Circle’) became increasingly circular as it expanded outward and away – over time ‘forgetting’ the irregular shape of the Wolgalu zone that initially caused it. In the asymptotic limit we might have expected an outgoing circular wavefront, propagating as if from the centre of mass of the Wolgalu zone, just as Newton’s laws predict radially symmetric gravitational fields at large distances from massive objects irrespective of their actual shapes. However, constrained by the north-south

Figure 3b. Linguistic map of post-Wolgalu south-eastern Australia, no more than 15,000 years ago. By this time the polar ice-caps were melting, the world’s oceans were rising, and Tasmania was separating from the mainland, producing the familiar modern coastline shown above. The collision of Southern-B and Original-A wavefronts, in the Australian Alps, created the entirely new Wolgalu language and a pidgin ‘shockwave’ which expanded outward from the collision-zone in accordance with the principle of Huygens. All language within this circular shock-wave, the Huygens Circle, is characterized by $\varepsilon_5 < 0$. Compare this dynamic model with the empirically observed static boundaries shown in Figure 1.
nature of the Blue Mountains chain and also the Shoalhaven River Gorge to the east, the expanding pidgin wavefront (which we call the Huygens Circle in Figure 3(b)) was quite understandably distorted into a sausage shape, extending from Omeo in the south to Picton in the north (as in Figure 1).

The entire language region subsequently enclosed by this expanding ‘Huygens Circle’ shockwave, including the primary Wolgalu collision zone itself, is characterized by signatures with $r_3 < 0$. The original Turuwul pidgin was shunted eastward to the coast in the Shoalhaven, whilst vanishing entirely along the western side of the Blue Mountains. From all this we see how Huygens’ Principle rationally explains the empirically observed language boundaries of Figure 1 and accounts for important dates independently established by archaeology.

Tree Diagram of Australian Language Super-Families

When the landscape is already occupied by various peoples speaking different languages, migrating across each-other’s territories, competing for space and interacting in complex ways that create new languages and pidgins, then one needs a Gillieron wave model. However when proto-Australian speakers first entered the continent more than 60,000 years ago, it was entirely possible for languages to split and drift apart, into the vast open spaces of a new continent, free to evolve in isolation with minimal interaction. Under such conditions the deep-linguistic equivalent of the Brugmann & Leskien (1870s) postulates (Bynon, 1979: Chapter 4, pp. 173–97) do hold – making a tree diagram, based upon the signatures in Table 2, an appropriate way to classify the ancient language super-families.

We note that Turuwul and Original-A both have precisely the same signature, $+ - +$, suggesting that they are daughter-language super-families, which branched at the same time directly from proto-Australian. This would have been the origin of type-B and type-A language during the dawn of human occupation of mainland Australia. Following Turuwul, the next ‘most similar’ type-B signature, $- - +$, is that of Original-B. And in its turn the next ‘most similar’ signature, $- + +$, is that of Southern-B. All these relationships between pre-Wolgalu language super-families are easily depicted by a tree diagram (Figure 4).

Making the usual assumption of roughly equal time-intervals (in this case 15,000 years) between successive nodes of our tree, we obtain the respective age-estimates: Wolgalu (15,000 years), Southern-B (30,000 years), Original-B (45,000 years), Turuwul and Original-A (60,000 years). These deep linguistic estimates, based upon the relative similarity of respective signatures, fit rather well with all known evidence and data. And the tree diagram merges believably into the previously discussed Gillieron wave description of language change throughout south-eastern Australia into ‘more recent’ times.

Dating Leximorphs

Example 1. 60,000 years old

When a semantic concept is common to leximorphs from Original-A, Turuwul and Original-B, then the Tree Diagram suggests that it is extremely ancient – arising from
proto-Australian perhaps 60,000 years ago. One-such example is ‘hand’ = five-fingers

Figure 4. The degree of similarity between respective signatures is the basis for this tree diagram, showing the relatedness of Australian language super-families over deep time scales

proto-Australian perhaps 60,000 years ago. One-such example is ‘hand’ = five-fingers

mur = n'dula – (mu)'nu'(la)  
small thing=five]  
finger=five]=hand

'marrow::diolo:'('five')  
Capt. J. Hunter (1795) eora

'mrä::ta::ra'('hand')  
Rev. L.E. Threlkeld (1834) awabakal

'murray::toolo:'  
D. Collins (1798) eora

'mu::dje::ra'('hand')  
J.F. Mann (1840s) kuringgai

'mur::tal:'('hand')  
J. Rogers (1899) eora

µopô, ('baby' = small thing), greek minute, minimal, English

or

du'(la) – mur = n – mur'(la)  
small thing=five]

NORTHERN REGION
Example 2. 15,000 years old
In contrast, leximorphs restricted to the Huygens Circle are unlikely to be older than about 15,000 years: for example "hand" = five-small-wigglers
Example 3. 23,000 years old

There are also distinctive exclusively-southern leximorphs, which presumably became established in Southern-B language and diffused into adjoining Original-B coastal language (such as Birdhawal at Cape Howe) thence, into Tasmania, across the landbridge from the mainland approximately 23,000 years ago. One-such example is 'hand' = *either-side five-fingered thing*

\[
\text{baro} \rightarrow \text{do(la)} \rightarrow \text{mu(r)o}:n:murol(a)
\]

\[
= \text{either-side thing} \quad \text{five-fingered}
\]

**SOUTHERN REGION**

\[
\begin{align*}
\text{pa}:m:me & \quad (\text{'un' = 1[hand]}) \\
\text{doig} & \quad (\text{'doigt' = finger}) \\
\text{j.p. gaimard} & \quad (1826) \\
\text{tasmania,} & \quad \text{georgetown} \\
\text{nerd dalrymple} & = \text{georgetown}
\end{align*}
\]

Rev. F.A. Hagenauer (1876)  
J.P. Gaimard (1826)  
Kurnai  

Rev. J. Bulmer (1876)  
J.P. Gaimard (1826)  
Turaul  

R.H. Mathews (1907)  
Birdhawal  

I. Nathan (1848)  
Illawarra

\[
\begin{align*}
\text{beru} & \quad (\text{'jou' = cheeks}) \\
\text{jervis bay, new south wales} & \\
\text{beru} & \quad (\text{'jou' = cheeks}) \\
\text{port dalrymple} & = \text{georgetown}
\end{align*}
\]

Rev. J. Bulmer (1876)  
J.P. Gaimard (1826)  
Turaul  

R.H. Mathews (1902)  
Bracchium, Latin  

\[
\begin{align*}
\text{bre:t} & \quad (\text{'hand'}) \\
\text{bracchium} & , \text{Latin} \\
\text{brachiere} & , \text{French} \\
\text{breast, English}
\end{align*}
\]

**Conclusion**

It appears that Gillieron wavefronts do describe language propagation by ancient human populations, who migrated across the land through deep time-scales, creating extended Original-A and Southern-B regions most clearly shown in Figure 3(a). Over many millennia, contiguous dialects within such zones could well have differentiated into separate languages – such as Blue Mountains gundungara, dharruk, dharginyung and kamilaroi – whilst the initial Huygens Circle pidgins evolved into distinctive languages even with sub-dialects. If so we need to start thinking in terms of extended chains of genetically related modern languages, instead of mere dialect-chains.
At the very least, our dynamic model of Gillieron wave propagation fits the dates established independently by archaeology and geography, explaining traditional tribal boundaries to the extent that they are known, and we certainly have reason to be reassured by the fact that the boundaries in Figure 1, based entirely upon empirically obtained phonotactic signatures, seem also to coincide with the semantic boundaries apparent from ancestral leximorphs associated with basic nouns such as ‘hand’.

The signatures of the respective language super-families also tell stories. The $+-+$ signature of Original-B suggests decreasing word-initial usage of peripherals and lamino-palatals from proto-Australian times (Illert & Allison, 2004). In contrast, Southern-B, with signature $-++$, had an increasing inventory of lamino-palatalts and possible oddities such as word-initial $l$ and $r$. The $\pm\pm\pm$ signatures, within Huygens Circle languages, suggest understandable phonological simplifications in the confusion arising from the collision of Gillieron wave-fronts.

In addition, it is most useful being able to randomly select any historic Aboriginal word-list or census-form from anywhere in south-eastern Australia and, after a simple frequency count and signature-calculation, being able to say with confidence what language those people spoke and where they came from. This methodology is the beginning of rational scientific thinking in this field.

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Note

1For an excellent map refer to pages 2 and 3 of the Atlas of New South Wales, edited by R.J. Harriman & E.S. Clifford (1987), produced by the Central Mapping Authority, Department of Lands, NSW.

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MacAlister, C. (1907) *Old Pioneering Days in the Sunny South* (Sydney, Australia).


Nathan, I. (1848) *Recorded in the Notebooks of William Dawes* (unpublished student paper, Department of Linguistics, Australian National University, Canberra, Australia).

Appendix 1

The relative frequencies of word-initial consonants within proto-Australian have previously been published and discussed by the author. These present tables – quantifying the situation for numerous ‘modern’ south-east Australian languages – were painstakingly
compiled from 37 historic word-lists collectively containing 7601 Aboriginal words, and
nine early census lists (‘Blanket Registers’) collectively containing 445 traditional names,
on the assumption that phonotactic frequencies in traditional Aboriginal languages would
have been much the same for proper names as for words in natural language. Despite the
repetitive larger wordlists recorded in a few language zones near major centres of Euro-
pean settlement, the more remote languages were poorly documented throughout entire
geographical regions. For example, the Sutton Forest wordlist has only six words, but it
is used because we have nothing else from there and are grateful to have any data at all
from the Midthung/Tharumba region. One can see why it is necessary to try to supplement
wordlists with census data that are often the only written information from most geo-
 graphical locations in early times. Even so, notwithstanding the fact that eight of the
lists cited here have fewer than 30 words or names, it is good to actually have them –
and their signatures do seem to be sensible, suggesting robustness of our analysis even
with small sample sizes. Manually counting each word or name was a laborious task,
with the author’s judgement frequently being exercised when old handwriting proved dif-
ficult to read. Words beginning with fricatives or vowels, or digraphs such as QU or CH or
SH, were generally ignored. The respective geographical categories used herein – e.g.
‘Western Inland Region’, ‘Australian Alps’, ‘Blue Mountains Region’, ‘Coastal Hinter-
land’ and ‘Eastern Coastal Region’ etc – are only intended to be meaningful in relation
to the study area as defined in Figure 1. In these tables, \( N \) is the total number of words/
names with any specified initial-consonant in each different source. The corresponding
lexical frequencies are also expressed as approximate percentages, rounded to one
decimal place, subject to the constraint of normalization which is essential if the different
data sets are to be compared with each other on an equal footing. Rounding the frequencies
(either up or down) to one decimal place precision, whilst requiring normalization of all
data sets, can produce odd results as, for example, in the Sutton Forest wordlist, where
three words out of six have to be taken as 49.9\% (instead of 50\%) so that each of the
other three words can have frequencies of 16.7\% (instead of 16.6666666\%).
### Western Inland Region

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| dharruck wordlist,  
R.H. Mathews, 1901  
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### East Coast (Central Region)

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| g | 6 | 16.2 | b | 20 | 16 | d | 5 | 17.1 | g | 20 | 18 | g | 7 | 23.3 |
| m | 6 | 16.2 | m | 20 | 16 | g | 4 | 13.8 | m | 20 | 18 | m | 3 | 10 |
| b | 5 | 13.5 | w | 12 | 9.6 | w | 4 | 13.8 | w | 13 | 11.7 | d | 3 | 10 |
| d | 4 | 10.8 | g | 11 | 8.8 | b | 3 | 10.3 | n | 11 | 9.9 | w | 2 | 6.7 |
| n | 3 | 8.2 | y | 11 | 8.8 | q | 2 | 6.9 | y | 7 | 6.3 | n | 2 | 6.7 |
| d | 2 | 5.4 | n | 10 | 8 | d | 2 | 6.9 | g | 6 | 5.5 | d | 2 | 6.7 |
| d | 2 | 5.4 | d | 5 | 4 | y | 1 | 3.5 | d | 5 | 4.5 | y | 1 | 3.3 |
| y | 1 | 2.7 | d | 4 | 3.2 | d | 1 | 3.5 | y | 4 | 3.6 | d | 1 | 3.3 |
| r | 1 | 2.7 | d | 4 | 3.2 | d | 1 | 3.5 | y | 4 | 3.6 | d | 1 | 3.3 |
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| n | 0 | 0 | p | 0 | 0 | n | 0 | 0 | n | 0 | 0 | n | 0 | 0 |
| n | 0 | 0 | l | 0 | 0 | l | 0 | 0 | l | 0 | 0 | l | 0 | 0 |
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John Malone, 1875
total of 54 words
Jervis Bay turnwul
Joseph Gainard, 1826
total of 144 words

South Coast Hinterland
berrima census
1st September, 1840
total of 52 names
coolangatta William Bothong,
1900 total of 64 words
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List of Symbols for the typesetter

Greek: \( \varepsilon \), \( \varepsilon_1 \), \( \varepsilon_2 \), \( \varepsilon_3 \), \( \varepsilon_i \), \( \alpha_1 \), \( \alpha_2 \), \( \alpha_3 \), \( \alpha_i \), \( \lambda \), \( \psi \), \( \Theta \)

Roman: \( F_* \), \( f_* \), \( f_* \), \( \bar{f}_* \), \( T \), \( t \), \( t \), \( s \), \( N \), \( H \)

phonetic: \( w \), \( y \), \( r \), \( m \), \( b \), \( g \), \( \eta \), \( n \), \( n \), \( l \), \( l \)

\( d \), \( d \), \( d \), \( q \), \( a \), \( u \), \( i \), \( o \)

mathematical: \( \int_{-T}^{0} \cdots dt \), \( \frac{\partial \Theta}{\partial f_*} \), \( \sum \cdots \), \( \Delta f_* \)

\( \sqrt{\ldots} \), \( < \), \( > \), \( = \), \( + \), \( - \), \( \pm \), \( \times \)

where the subscript * denotes individual phonetic symbols as listed above and specified in the text.
Origins of Linguistic Zonation in the Australian Alps. Part 2 – Snell’s Law1

CHRISTOPHER R. ILLERT

University of Western Sydney, New South Wales, Australia

ABSTRACT  In this second paper, analysing archival SE-Australian Aboriginal word/name lists, Snell’s Law is used to deduce the likely minimal sound-systems of pre Ice-Age language superfamilies – some probably dating back beyond the first occupation of Australia by humans. The deduced ‘Turuwal-like’ ancestral sound-system is then used as a basis for reconstructing deictic forms apparently so ancient that they seem to even unify ‘PamaNyungan’ and ‘non-PamaNyungan’ language within a single system of formal logic which, having apparently provided the semantic basis for at least 60,000 years of speech throughout the entire Australian continent, deserves to be called proto-Australian regardless of whether or not it arose in SE-Asia tens of millennia before. Whatever the exact age of this reconstructed proto-Australian, presented here for the first time, it is an order of magnitude older than any known human language and, as such, a ‘Rosetta Stone’ for human languages worldwide. It also provides an unprecedented window into human consciousness and perception of the world up to 75,000 years ago, which is especially significant given that humans can only have engaged in finely controlled speech and fully modern language since chance mutation of our FOXP2 gene about 120,000 years ago. These truly ancient deictic forms dating halfway back to the beginning of modern human speech, retrieved only through modern statistical analysis, provide insight into our very origins and as such are perhaps amongst the most precious cultural treasures that humanity currently possesses.

KEY WORDS: Phonotactic signatures, archaeo-linguistics, proto-Australian, Snell’s Law

Snell’s Law across Phonological Boundaries in South-East Australia

Linguists have long needed a practical and objective method for calculating exactly how many, and what kinds of, consonants existed in the respective languages represented by data-samples of the kind appearing in Appendix 1. Every researcher in this field for two centuries seems to have put forward some or other personally favoured alphabet (Dawes, 1790; Mathews, 1900’s, Everitt, 1900; Eades, 1976; Osmond, 1989; Troy, 1993) – in recent years based upon no new evidence, the last native-speakers having died generations ago. However the ‘lexical-transfer’ signature is indeed new. It is actually a precision tool drawing upon archival sources including censuses and wordlists, some containing as few as six lexical items, which generations of researchers have considered informationally worthless. Yet, in Tables 1 and 2, clear entropy maximising signatures

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DOI: 10.1080/02664760500450160
seem to shine through even from the most decrepit handwritten documents dating back centuries.

To harness the statistical power of this phonotactic information we need only realise that when, in the course of time, an Aboriginal language increased its phonology by one more consonant (capable of appearing word-initially) it altered the trajectory of the lexical-transfer vector (equation (1) – see Part 1 of this paper) just as a light-ray is refracted when crossing the boundary between two contiguous blocks of glass of differing densities. Opticians call this Snell’s Law (see Weinstock, 1974, pp. 67–70) and, in the present context, it requires us to minimise equation (5) subject to the constraint (3). As a first step we combine the two expressions into a single Lagrangian term:

$$Q = \frac{1}{C_0 l} (\frac{1}{C_0} + 1 + \frac{1}{C_0})$$

(6)

based upon three stable blocks of potential word-initial consonants, such that

$$\frac{\partial \Theta}{\partial f_m} = \frac{\partial \Theta}{\partial f_g} = \frac{\partial \Theta}{\partial f_n} = \frac{\partial \Theta}{\partial f_b} = \frac{T \varepsilon_1}{\varepsilon} - \lambda T$$

$$\frac{\partial \Theta}{\partial f_p} = \frac{\partial \Theta}{\partial f_d} = \frac{\partial \Theta}{\partial f_l} = \frac{T \varepsilon_2}{\varepsilon} - \lambda T$$

$$\frac{\partial \Theta}{\partial f_w} = \frac{\partial \Theta}{\partial f_n} = \frac{\partial \Theta}{\partial f_d} = \frac{T \varepsilon_3}{\varepsilon} - \lambda T$$

(7)

However, as these consonants do not all occur in every language, real-world minimisation requires:

$$0 = \sum \frac{\partial \Theta}{\partial f_s}$$

$$= \frac{T}{\varepsilon} (\alpha_1 \varepsilon_1 + \alpha_2 \varepsilon_2 + \alpha_3 \varepsilon_3) - (\alpha_1 + \alpha_2 + \alpha_3) \lambda T$$

(8)

for integers $\alpha_i$ representing the respective number of realised consonants (i.e. those actually occurring word-initially) from each of the three stable lexical blocks: $\alpha_1$ being the number of peripherals, $\alpha_2$ the number of lamino-palatals, and $\alpha_3$ the number of others.

Choosing a Lagrange Multiplier $\lambda = 1/(\alpha_1 + \alpha_2 + \alpha_3) = 1/H$, the reciprocal of the total number of realised word-initial consonants, gives:

$$\varepsilon = \alpha_1 \varepsilon_1 + \alpha_2 \varepsilon_2 + \alpha_3 \varepsilon_3$$

$$=(\alpha_1 - \alpha_2) \varepsilon_1 + (\alpha_3 - \alpha_2) \varepsilon_3 = t \varepsilon_1 + s \varepsilon_3$$

(9)

for integers $t = \alpha_1 - \alpha_2$ and $s = \alpha_3 - \alpha_2$, this last simplification following because of equation (3).

Additionally if we select $\alpha_1 = 4$ and $\alpha_2 = 3$, as seems to be the case with Original-B and Southern-B language, then $t = 1$ giving the relationship:

$$\varepsilon = \varepsilon_1 + s \varepsilon_3$$

(10)
which, subject to equation (3), has an exact ‘type-A’ theoretical solution

\[ e_1 = \left( s - 1 + \sqrt{(s - 1)^2 + s^2 - 2} \right) e_3 \]

\[ e_2 = -\left( s + \sqrt{(s - 1)^2 + s^2 - 2} \right) e_3 \]

\[ e_3 = \frac{\varepsilon}{\sqrt{6s(s - 1) + (4s - 2)s + s^2 - 2}} \]

Figure 5. A family of pre-Wolgalu “type-B” signatures given by equations (12), for different values of \( s > (1 + \sqrt{3})/2 \approx 1.366 \), assuming that \( \alpha_1 = 4 \) and \( \alpha_2 = 3 \), hence \( t = 1 \). As phonologies require discrete numbers of consonants we are mainly interested in those values of \( s \) that are integers. Clearly Southern-B evolved from Original-B, increasing its phonology by a single non-peripheral non-laminopalatal consonant (i.e. \( s \) increased from 2 to 3), in the process changing signature from \(- - + \) to \(- + + \). Subsequently, at eastern and western extremities of the Southern-B zone, Bothong’s Coolangatta and Hercus’ Wemba-Wemba wordlists both (with \( e_2/e > e_3/e \)) are better described by assuming \( s = 5 \), hence \( \alpha_3 = 8 \) suggesting phonologies with two additional consonants (probably retroflexives absorbed from adjoining Original-A zones). The actual age of proto-Australian \( T \) cancels out of equation (8) but from the Tree Diagram, assuming a linear relationship between \( s \) and past time, the age of each signature is estimated above.
Figure 6. A family of pre-Wolgalu `type-A` signatures given by equations (16), for different values of $s > \sqrt{3/2} \approx 1.225$, assuming that $\alpha_1 = \alpha_2 = 4$, hence $t = 0$. As might be expected from Table 5, the special case $s = 2$ corresponds to the distinctive Original-A signature given by equations 18. Also, because $\alpha_2 = 4$, it follows that Original-A had word-initially (denoted here by $l_o$), which tends to occur in Australian languages along with the retroflexives rd, rn, rl (respectively denoted $\partial$, $\eta$, $\eta'$) originally from the continent’s north-western ‘non-Pama-Nyungan’ language zone, subsequently in the Blue Mountains (see Figure 9), and also in western-Victoria (judging by the large consonant-inventory of Wemba-Wemba in Figure 5).

Figure 7. A family of ‘type-B’ signatures given by equation (19), for different values of $s > 0$, assuming that $\alpha_1 = 4$ and $\alpha_2 = 2$, hence $t = 2$. As expected from Table 5, the special case $s = 1$ gives the distinctive Turuwal signature given by equations (20) belonging to Turuwal. Table 3 even provides evidence of a more recent Turuwal, barely distinguishable from Original-B, with signature given by $s = 2$ in equation (19).
and also an exact ‘type-B’ theoretical solution

\[ e_1 = \left( s - 1 - \sqrt{(s - 1)^2 + s^2 - 2} \right) e_3 \]
\[ e_2 = -\left( s - \sqrt{(s - 1)^2 + s^2 - 2} \right) e_3 \]
\[ e_3 = \frac{e}{\sqrt{6s(s - 1) - (4s - 2)\sqrt{(s - 1)^2 + s^2 - 2}}} \]

where the arbitrary constant \( e \) is \( \pm \), determining sgn \( (e_3) \), according to whether we are considering pre or post Wolgalu language. By choosing the integer \( s \), so as to best fit one or other of equations (11) and (12) to the experimental data in Table 1, we can obtain a reliable estimate for \( \alpha_3 = s + \alpha_2 = s + 3 \) which otherwise can only be guessed at due to difficulties judging where the tail of the entropy-maximising ‘power-law’ actually truncates (Illert & Allison 2004, Figures 2 and 3).

**Example 1.** Original-B: \( \alpha_1 = 4, \alpha_2 = 3, \alpha_3 = 5 \)
(Five non-peripheral, non-lamino-palatal consonants capable of appearing word-initially)

For pre-Wolgalu language, substituting \( s = 2 \) into equations (12) gives theoretical values for the respective components of a ‘type-B’ unit-vector

\[ \frac{e_1}{e} = \frac{1 - \sqrt{3}}{\sqrt{12 - 6\sqrt{3}}} = -0.578 \]
\[ \frac{e_2}{e} = \frac{-2 + \sqrt{3}}{\sqrt{12 - 6\sqrt{3}}} = -0.211 \]
\[ \frac{e_3}{e} = \frac{1}{\sqrt{12 - 6\sqrt{3}}} = 0.789 \]

which may be compared with ‘experimentally observed’ values, as presented in Table 3, calculated from the respective Original-B word/name-list signatures assembled in Table 1.
Example 2. Southern-B: $\alpha_1 = 4$, $\alpha_2 = 3$, $\alpha_3 = 6$

(Six non-peripheral, non-lamino-palatal consonants capable of appearing word-initially)

For pre-Wolgalu language, substituting $s = 3$ into equations (12) gives theoretical values for the respective components of a ‘type-B’ unit-vector

\[
\begin{align*}
\frac{\varepsilon_1}{\varepsilon} &= \frac{2 - \sqrt{11}}{\sqrt{36 - 10\sqrt{11}}} = -0.782 \\
\frac{\varepsilon_2}{\varepsilon} &= \frac{-3 + \sqrt{11}}{\sqrt{36 - 10\sqrt{11}}} = 0.188 \\
\frac{\varepsilon_3}{\varepsilon} &= \frac{1}{\sqrt{36 - 10\sqrt{11}}} = 0.594
\end{align*}
\]  

which may be compared with ‘experimentally observed’ values, as presented in Table 4, calculated from the respective Southern-B word/name-list signatures assembled in Table 1.
Our assumption of four peripheral consonants capable of occurring word-initially \( \alpha_1 = 4 \) seems well founded in all traditional language throughout south-eastern-Australia and, indeed, even in ancestral proto-Australian. However, the Turuwal and Original-A language-zones in our study area seem to have possessed phonologies with unusual numbers of lamino-palatal consonants capable of appearing word-initially (within the range \( \alpha_2 = 1, 2, 3, 4 \)) as permitted by the general equation (9) which only simplifies to equation (10) in the special case \( \alpha_2 = 3 \).

We can usefully rearrange equation (9) as follows:

\[
 s = \frac{e - (\alpha_1 - \alpha_2)e_1}{e_3} \tag{15}
\]

enabling us to use the experimental data from Table 1 to estimate \( s \), corresponding to hypothetical values of \( \alpha_2 \), as in Table 5. Clearly, the ‘experimentally observed’ Original-A data sets nearly give a positive integer value for \( s \) when we assume four lamino-palatals capable of occurring word-initially \( \alpha_2 = 4 \). In contrast, the ‘experimentally observed’ Turuwal data sets nearly give a positive integer value for \( s \) when we assume one or two lamino-palatals capable of occurring word-initially \( \alpha_2 = 1 \) or 2.

**Figure 10.** We can model the ‘Pama-Nyungan’ signature transition Turuwal → Original-B → Southern-B by superimposing Figures 5 and 7. The Turuwal trajectories \( e_i/e \) given by equations (19) are sensible for positive values \( s > 0 \). Also for \( s > 1.3 \) the trajectories given by equations (12) can be viewed as perturbations upon ancestral Turuwal trajectories (dashed curves) following a causal event, about 53,000 years ago (corresponding to \( s \approx 1.3 \)), when \( t \) decreased from 2 to 1 (i.e. \( \alpha_2 \) increased from 2 to 3).
In the event that $\alpha_1 = \alpha_2 = 4$ then $t = 0$ and equation (9), subject to equation (3), has an exact ‘type-A’ theoretical solution:

$$e_1 = 0.5 \times \left( -1 + \sqrt{2s^2 - 3} \right) e_3$$

$$e_2 = -0.5 \times \left( 1 + \sqrt{2s^2 - 3} \right) e_3$$

$$e_3 = \frac{e}{s}$$

and also an exact ‘type-B’ theoretical solution

$$e_1 = 0.5 \times \left( -1 - \sqrt{2s^2 - 3} \right) e_3$$

$$e_2 = -0.5 \times \left( 1 - \sqrt{2s^2 - 3} \right) e_3$$

$$e_3 = \frac{e}{s}$$

where the arbitrary constant $e$ is $\pm$, determining $\text{sgn} (e_3)$, according to whether we are considering pre or post-Wolgalu language.

Table 3. Experimental values for Original-B word/name lists, calculated from the data in Table 1. Compare these with the expected theoretical values (equation (13))

<table>
<thead>
<tr>
<th>Source</th>
<th>$e_1/e$</th>
<th>$e_2/e$</th>
<th>$e_3/e$</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.H. Mathews (1904)</td>
<td>-0.458</td>
<td>-0.356</td>
<td>0.814</td>
</tr>
<tr>
<td>Nelly Hamilton (1887)</td>
<td>-0.527</td>
<td>-0.277</td>
<td>0.804</td>
</tr>
<tr>
<td>Queanbeyan census (1841)</td>
<td>-0.472</td>
<td>-0.341</td>
<td>0.813</td>
</tr>
<tr>
<td>Goulburn census (1837)</td>
<td>-0.408</td>
<td>-0.408</td>
<td>0.816</td>
</tr>
<tr>
<td>Dawes/Osmond (1790)</td>
<td>-0.595</td>
<td>-0.186</td>
<td>0.781</td>
</tr>
<tr>
<td>Jakelyn Troy (1993)</td>
<td>-0.509</td>
<td>-0.298</td>
<td>0.807</td>
</tr>
<tr>
<td>John Rowley (1878)</td>
<td>-0.576</td>
<td>-0.213</td>
<td>0.789</td>
</tr>
<tr>
<td>James Bowman (1830s)</td>
<td>-0.127</td>
<td>-0.635</td>
<td>0.762</td>
</tr>
<tr>
<td>Bong bong census (1836)</td>
<td>-0.685</td>
<td>-0.043</td>
<td>0.728</td>
</tr>
<tr>
<td>Wollongong census (1834)</td>
<td>-0.585</td>
<td>-0.200</td>
<td>0.785</td>
</tr>
<tr>
<td>Lizzy Malone (1875)</td>
<td>-0.368</td>
<td>-0.447</td>
<td>0.815</td>
</tr>
<tr>
<td>A. Mackenzie, 1872</td>
<td>-0.593</td>
<td>-0.189</td>
<td>0.782</td>
</tr>
<tr>
<td>Richard Dawsey (1887)</td>
<td>-0.352</td>
<td>-0.462</td>
<td>0.814</td>
</tr>
<tr>
<td>Saint georges basin census, 4 July (1836)</td>
<td>-0.174</td>
<td>-0.604</td>
<td>0.778</td>
</tr>
<tr>
<td>Ulladulla (1853)</td>
<td>-0.648</td>
<td>-0.106</td>
<td>0.754</td>
</tr>
<tr>
<td>Batemans bay (1853)</td>
<td>-0.198</td>
<td>-0.587</td>
<td>0.785</td>
</tr>
<tr>
<td>Percy Mumbla (1980s)</td>
<td>-0.599</td>
<td>-0.181</td>
<td>0.780</td>
</tr>
<tr>
<td>Twofold bay census (1839)</td>
<td>-0.168</td>
<td>-0.608</td>
<td>0.776</td>
</tr>
<tr>
<td>Birdhawal wordlist (1907)</td>
<td>-0.602</td>
<td>-0.177</td>
<td>0.779</td>
</tr>
<tr>
<td>Port Dalrymple (1826)</td>
<td>-0.367</td>
<td>-0.448</td>
<td>0.815</td>
</tr>
<tr>
<td>Research bay (1793)</td>
<td>-0.367</td>
<td>-0.448</td>
<td>0.815</td>
</tr>
<tr>
<td>Average</td>
<td>-0.447</td>
<td>-0.343</td>
<td>0.790</td>
</tr>
</tbody>
</table>
Example 3. Original-A: $\alpha_1 = \alpha_2 = 4$, $\alpha_3 = 6$
(Four lamino-palatal consonants capable of appearing word-initially)

Following on from Table 5, we substitute $s = 2$ into equations (16) giving theoretical values for the respective components of a pre-Wolgalu ‘type-A’ unit-vector

$$
\frac{e_1}{\varepsilon} = \frac{-1 + \sqrt{5}}{4} = 0.309
$$

$$
\frac{e_2}{\varepsilon} = \frac{-1 - \sqrt{5}}{4} = -0.809
$$

$$
\frac{e_3}{\varepsilon} = \frac{1}{2} = 0.5
$$

(18)

which may be compared with ‘experimentally observed’ values, as presented in Table 6, calculated from the respective Original-A word/name-list signatures assembled in Table 1.

Table 4. Experimental values for Southern-B word/name lists, calculated from the data in Table 1. Compare these with the expected theoretical values (equation (14))

<table>
<thead>
<tr>
<th></th>
<th>$e_1/\varepsilon$</th>
<th>$e_2/\varepsilon$</th>
<th>$e_3/\varepsilon$</th>
</tr>
</thead>
<tbody>
<tr>
<td>berrima census 1 September 1840</td>
<td>-0.726</td>
<td>0.04</td>
<td>0.686</td>
</tr>
<tr>
<td>coolangatta wordlist William Bothong (1900)</td>
<td>-0.817</td>
<td>0.412</td>
<td>0.405</td>
</tr>
<tr>
<td>dhurga wordlist Diana Eades (1976)</td>
<td>-0.784</td>
<td>0.196</td>
<td>0.588</td>
</tr>
<tr>
<td>braidwood wordlist James Larmer (1853)</td>
<td>-0.719</td>
<td>0.024</td>
<td>0.695</td>
</tr>
<tr>
<td>moruya wordlist Herbert Hale (1846)</td>
<td>-0.793</td>
<td>0.228</td>
<td>0.565</td>
</tr>
<tr>
<td>Twofold bay wordlist Johnny Weyman (1864)</td>
<td>-0.782</td>
<td>0.189</td>
<td>0.593</td>
</tr>
<tr>
<td>gippsland wordlist Louise Hercus (1969)</td>
<td>-0.756</td>
<td>0.112</td>
<td>0.644</td>
</tr>
<tr>
<td>Wemba wemba wordlist Louise Hercus (1969)</td>
<td>-0.796</td>
<td>0.554</td>
<td>0.242</td>
</tr>
<tr>
<td>Average</td>
<td>-0.771</td>
<td>0.219</td>
<td>0.552</td>
</tr>
</tbody>
</table>

Table 5. Estimates of integer $s$, corresponding to hypothetical values of $\alpha_3$, based upon equation (15) and experimental data from Table 1. It seems most likely that $s = 1$ for Turuwal and $s = 2$ for Original-A

<table>
<thead>
<tr>
<th></th>
<th>$s$</th>
<th>$\alpha_1 = 4$</th>
<th>$\alpha_1 = 4$</th>
<th>$\alpha_1 = 4$</th>
<th>$\alpha_1 = 4$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\alpha_2 = 1$</td>
<td>$\alpha_2 = 2$</td>
<td>$\alpha_2 = 3$</td>
<td>$\alpha_2 = 4$</td>
</tr>
</tbody>
</table>

Turuwal
jervis bay wordlist Joseph Gaimard (1826) | 0.788 | 1.078 | 1.368 | 1.658 |
turruwull wordlist John Malone (1875) | 1.278 | 1.338 | 1.398 | 1.458 |

Original-A
kamilaroi, wordlist Rev. W. Ridley (1875) negative | 0.577 | 1.423 | 2.269 |
dharginyung wordlist R.H. Mathews (1903) negative | 0.651 | 1.401 | 2.151 |
dharruk, wordlist R.H. Mathews (1901) negative | 0.665 | 1.398 | 2.131 |
gundungara wordlist M.M. Everitt (1900) negative | 0.870 | 1.370 | 1.871 |
So far, we have not considered the possibility of $t = 2$ in equation (9), which would allow a ‘type-B’ pidgin of the form

$$e_1 = 0.5 \times (-2s + 1 + \psi)e_3$$

$$e_2 = 0.5 \times (2s - 3 - \psi)e_3$$

$$e_3 = \frac{2e}{\sqrt{(-2s + 1 + \psi)^2 + (2s - 3 - \psi)^2 + 4}}$$

where

$$\psi = \sqrt{(2s - 1)^2 - 2(s^2 - 2)}$$

(19)

Example 4. Turuwal: $\alpha_1 = 4$, $\alpha_2 = 2$, $\alpha_3 = 3$

(Two lamino-palatal consonants capable of appearing word-initially)

Following on from Table 5, we substitute $s = 1$ into equations (19) giving theoretical values for the respective components of a ‘type-B’ unit-vector

$$\frac{e_1}{e} = 0.5 \times \frac{-1 + \sqrt{3}}{\sqrt{3}} = 0.211$$

$$\frac{e_2}{e} = -0.5 \times \frac{1 + \sqrt{3}}{\sqrt{3}} = -0.788$$

$$\frac{e_3}{e} = \frac{1}{\sqrt{3}} = 0.577$$

(20)

which may be compared with ‘experimentally observed’ values, as presented in Table 7, calculated from the respective Turuwal word-list signatures assembled in Table 1. Note how the experimental average values $e_i/e$ in Table 7 are each better-fitted by equation (20) than by equation (18). Furthermore, looking back at Table 3, the theoretical ORIGINAL-B values of

<table>
<thead>
<tr>
<th></th>
<th>$e_1/e$</th>
<th>$e_2/e$</th>
<th>$e_3/e$</th>
</tr>
</thead>
<tbody>
<tr>
<td>kamilaroi wordlist Rev. W. Ridley (1875)</td>
<td>0.373</td>
<td>-0.814</td>
<td>0.441</td>
</tr>
<tr>
<td>dharginyung wordlist R.H. Mathews (1903)</td>
<td>0.349</td>
<td>-0.814</td>
<td>0.465</td>
</tr>
<tr>
<td>dharruk wordlist R.H. Mathews (1901)</td>
<td>0.344</td>
<td>-0.813</td>
<td>0.469</td>
</tr>
<tr>
<td>gundungara wordlist Mary M. Everitt (1900)</td>
<td>0.267</td>
<td>-0.802</td>
<td>0.535</td>
</tr>
<tr>
<td>Average</td>
<td>0.333</td>
<td>-0.811</td>
<td>0.478</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$e_1/e$</th>
<th>$e_2/e$</th>
<th>$e_3/e$</th>
</tr>
</thead>
<tbody>
<tr>
<td>jervis bay wordlist Joseph Gaimard (1826)</td>
<td>0.041</td>
<td>-0.727</td>
<td>0.686</td>
</tr>
<tr>
<td>turruwul wordlist John Malone (1875)</td>
<td>0.175</td>
<td>-0.778</td>
<td>0.603</td>
</tr>
<tr>
<td>Average</td>
<td>0.108</td>
<td>-0.753</td>
<td>0.645</td>
</tr>
</tbody>
</table>

Table 6. Experimental values for Original-A word/name lists, calculated from the data in Table 1. Compare these with the expected theoretical values (equation (18))

Table 7. Experimental values for Turuwal word-lists, calculated from the data in Table 1. Compare these with the expected theoretical values (equation (20))
\(e_1/e\) and \(e_2/e\) given by equation (13) seem to be interchanged in the cases of the word/name lists of James Bowman, St. Georges Basin, Batemans Bay and Twofold Bay. So perhaps they were not ORIGINAL-B at all but, instead, a more recent kind of TURUWAL described by \(s = 2\) in equation (19) as shown in Figure 7. This makes sense for the 1836 St Georges Basin census collected just south of Jervis Bay where J.P. Gaimard had, a decade before, obtained his distinctly TURUWAL wordlist. Likewise, James Bowman’s wordlist, from south-west of present-day Sydney, comes from a region where we would have expected to find a TURUWAL influence. In addition, isolated pockets of TURUWAL influence along the coast, extending as far south as Tasmania, are quite explainable in terms of post-Ice-Age coastal fishing communities migrating by canoe southward from Jervis Bay simply following summer East Australian Currents.

**General Solutions**

To this point we have only studied special cases. But if we place no restrictions on the integers \(s\) and \(t\) and commence by re-defining

\[
\psi = \sqrt{(ts - 1)^2 - (t^2 - 2)(s^2 - 2)}
\]

then equation (9), subject to the constraint (3), has a general pre-Wolgalu solution of ‘type-A’

\[
\begin{align*}
\varepsilon_1 &= \frac{(-ts + 1 - \psi)e_3}{t^2 - 2} \\
\varepsilon_2 &= \frac{(-t^2 + ts + 1 + \psi)e_3}{t^2 - 2} \\
\varepsilon_3 &= \frac{-(t^2 - 2)e}{\sqrt{(-ts + 1 - \psi)^2 + (-t^2 + ts + 1 + \psi)^2 + (t^2 - 2)^2}}
\end{align*}
\]

Table 8. Experimental values of \(a_i\) for each of the language superfamilies, and one modern dialect, from Examples 1 to 4. These values tell us how many, and what kinds of, word-initial consonants existed in each traditional language superfamily

<table>
<thead>
<tr>
<th></th>
<th>(a_1)</th>
<th>(a_2)</th>
<th>(a_3)</th>
<th>(s = a_3 - a_2)</th>
<th>(t = a_1 - a_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turuwal</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Original-B</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Original-A</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Southern-B</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Wemba-Wemba</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
and a general pre-Wolgalu solution of ‘type-B’

\[
e_1 = \frac{(-ts + 1 + \psi)e_3}{t^2 - 2}
\]

\[
e_2 = \frac{(-t^2 + ts + 1 - \psi)e_3}{t^2 - 2}
\]

\[
e_3 = \frac{(-t^2 + 2)e}{\sqrt{(-ts + 1 + \psi)^2 + (-t^2 + ts + 1 - \psi)^2 + (t^2 - 2)^2}}
\]

as well as a ‘type-B’ pidgin

\[
e_1 = \frac{(-ts + 1 + \psi)e_3}{t^2 - 2}
\]

\[
e_2 = \frac{(-t^2 + ts + 1 - \psi)e_3}{t^2 - 2}
\]

\[
e_3 = \frac{+(t^2 - 2)e}{\sqrt{(-ts + 1 + \psi)^2 + (-t^2 + ts + 1 - \psi)^2 + (t^2 - 2)^2}}
\]

As far as the previously discussed special cases are concerned: when \( t = 0 \) equations (21) simplify to equation (16) whilst equations (22) simplify to equation (17); when \( t = 1 \) equations (21) simplify to equation (11) whilst equations (22) simplify to equation (12); also, when \( t = 2 \) equations (23) simplify to equation (19).

**Original-A (‘non-Pama-Nyungan’)**

Previous researchers (Troy, 1994, p. 23; Osmond, 1989, pp. 4–5) have speculated about the possible existence of a laminal-lateral \( \text{ly} \) (denoted here by \( l_\text{O} \text{y} \)) within ‘the Sydney language’ and Dixon (1980, p. 158) has suggested its possible genesis along the lines

\[ld_\text{s} \rightarrow \text{ly} \, d_\text{s} \rightarrow l_\text{s}.\]

Without much discussion Troy included this laminal-lateral in the phonology of her ‘Sydney language’ which, in fact, corresponds to no real language that ever existed. It is merely a melange-lexicon that misguidedly muddles coastal Original-B (‘eora’) and inland Original-A (Blue Mountains ‘dharug’) vocabularies – only including John Rowley’s historic (Original-B) wordlist in the mistaken belief that it was ‘dharug’, whilst excluding Lizzy Malone’s historic (Original-B) wordlist in the arbitrary and equally mistaken belief that it was a form of Turuwal.

Troy’s melange-lexicon fortuitously gives the correct Original-B signature, but only by the happy accident that the small number of actual ‘dharug’ words that she used were swamped by the sheer size of the ‘eora’ wordlists collected by First Fleeters and their contemporaries such as David Collins, William Dawes, John Hunter, Phillip Gidley King, Arthur Phillip, Watkin Tench, Daniel Southwell and Daniel Paine. In our present analysis, the frequency distributions in Illert (2005, Appendix 1) were all normalised so no single source could have this kind of disproportionate influence simply due to its size. In addition, our wordlists were selected from uniformly spaced locations throughout an extended geographical region, instead of all being clustered about the single centre (Sydney) in Troy’s study.

From Example 1 in the present paper it is clear that Sydney’s coastal ‘eora’ language was definitely Original-B, containing three \((\alpha_2 = 3)\) lamino-palatals (as in Table 9) but
Table 9. Likely minimal systems of word-initial (peripheral, lamino-palatal and other) consonants, associated with pre-Wolgalu language super-families, based upon the values \( \alpha \), in Table 8 inferred from Snell’s Law.

**Turuwal** \( (H = 9) \)
4 stops, 4 nasals, 1 semi-vowel

<table>
<thead>
<tr>
<th>stops</th>
<th>nasals</th>
<th>semi-vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>( g )</td>
<td>( n )</td>
<td>( w )</td>
</tr>
<tr>
<td>( d )</td>
<td>( p )</td>
<td>( y )</td>
</tr>
</tbody>
</table>

\( \alpha_3 = 3 \quad \alpha_2 = 2 \quad \alpha_1 = 4 \)

**Original-B** \( (H = 12) \)
5 stops, 5 nasals, 2 semi-vowels

<table>
<thead>
<tr>
<th>stops</th>
<th>nasals</th>
<th>semi-vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d )</td>
<td>( n )</td>
<td>( w )</td>
</tr>
<tr>
<td>( d )</td>
<td>( p )</td>
<td>( y )</td>
</tr>
<tr>
<td>( g )</td>
<td>( a )</td>
<td>( \alpha )</td>
</tr>
</tbody>
</table>

\( \alpha_3 = 5 \quad \alpha_2 = 3 \quad \alpha_1 = 4 \)

**Original-A** \( (H = 14) \)
5 stops, 5 nasals, 2 semi-vowels, 2 laterals

<table>
<thead>
<tr>
<th>stops</th>
<th>nasals</th>
<th>semi-vowels</th>
<th>laterals</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d )</td>
<td>( n )</td>
<td>( w )</td>
<td>( l )</td>
</tr>
<tr>
<td>( d )</td>
<td>( p )</td>
<td>( y )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>( g )</td>
<td>( a )</td>
<td>( \alpha )</td>
<td>( \gamma )</td>
</tr>
</tbody>
</table>

\( \alpha_3 = 6 \quad \alpha_2 = 4 \quad \alpha_1 = 4 \)

**Southern-B** \( (H = 13) \)
5 stops, 4 nasals, 2 semi-vowels, 1 lateral, 1 rhotic

<table>
<thead>
<tr>
<th>stops</th>
<th>nasals</th>
<th>semi-vowels</th>
<th>lateral</th>
<th>rhotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d )</td>
<td>( n )</td>
<td>( w )</td>
<td>( l )</td>
<td>( r )</td>
</tr>
<tr>
<td>( d )</td>
<td>( p )</td>
<td>( y )</td>
<td>( \alpha )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>( g )</td>
<td>( a )</td>
<td>( \alpha )</td>
<td>( \gamma )</td>
<td>( \delta )</td>
</tr>
</tbody>
</table>

\( \alpha_3 = 6 \quad \alpha_2 = 3 \quad \alpha_1 = 4 \)

no laminal-lateral. However, our Tables 5 and 9 demonstrate that there did exist a fourth lamino-palatal \( (\alpha_3 = 4) \), which can only have been a lateral, in adjoining Original-A language from the Blue Mountains further to the west and far north-west of present-day Sydney. Troy’s misguided inclusion of Original-A ‘mountain’ words, in ‘coastal’ lexicons, has contributed to the apparently false notion of a laminal-lateral in coastal language.
It is also worth noting that, at the southern-most extremity of this Blue Mountains language zone, William Russell’s ‘gundungorra’ (which was omitted from Tables 5 and 6) had a distinctive type-A signature (with $e_1/e > e_3/e$) which is better described by the theoretical values

$$
\frac{e_1}{e} = 0.663, \quad \frac{e_2}{e} = -0.748, \quad \frac{e_3}{e} = 0.085
$$

obtained by substituting $s = 4$ into equation (11), implying that

$$\alpha_1 = 4, \quad \alpha_2 = 3, \quad \alpha_3 = 7$$

Thus, the southern-most extremity of Original-A, the zone most influenced by surrounding Type-B language, had clearly lost its laminal lateral by the early 1900s – in contrast to dharug dharginyung and kamilaroi off to the north, which seem to have retained it, judging by Table 5.

In any event, Yallop (1982, p. 66, Table 3.4) has shown that languages with a laminal-lateral usually also have a series of retroflexive consonants rd, rn, rl (respectively denoted $d$, $n$, $l$) as in the basic inventory proposed for Original-A in our present Table 9. Accordingly, we conclude that at least some of the word-initial apico-alveolar consonants occurring in the Original-A wordlists in Illert (2005, Appendix 1) are, or perhaps derive from, ancient retroflexives. Australian languages with this type of consonant inventory – including anindilyakwa, kitja, bardi, garawa, pintupi, nyungumarda, walmatjari, warlpiri and alyawarra – feature prominently in a region of far north-western Australia; about 10% of the total continent referred to as the ‘non-Pama-Nyungan’ language zone (Dixon 1980, pp. 20–21 and Map 3), which was first identified by Wilhelm Schmidt (1919) through a careful study of word-final-sounds, which Dixon described as ‘quite superficial features . . . seldom good criteria for genetic grouping’.

Original-A (‘non-Pama-Nyungan’) is also said to be ‘prefixing’ because subsequent researchers (Capell, 1956; Hale, 1961–3] noticed that such language also tends to use prefixes as well as suffixes, unlike most language throughout the rest of Australia, which tends to rely on suffixes alone. The unexpectedly complex system of prefixing and suffixing in the ‘Sydney language’ recorded by William Dawes (1790), as translated in Illert & Allison (2004, examples 1–7), could thus reflect an Original-A (‘non-Pama-Nyungan’) syntactic influence on the isolated strip of Original-B along the south-eastern seaboard. This is
consistent with our present study of word-initial-sounds, which establishes a surge of Original-A along the Blue Mountains chain, as far south as the Huygens Circle in the Australian Alps, at the height of the Ice Age (see Figure 9).

Presumably, this Gillieron wavefront propagated through south-western Queensland (where there are modern languages such as Pitta-Pitta (Dixon 1980, pp. 160–161) with retroflexives and a laminal lateral) originating from the ‘non-PamaNyungan’ ‘prefixing’ epicentre first identified by Schmidt (1919) in the north-west of the continent.

Pre-Wolgalu Type-B (‘Pama-Nyungan’)

Throughout nearly 90% of Australia – Schmidt’s ‘southern’ portion – we find a substrate of pre-Wolgalu Type-B (‘Pama-Nyungan’) Aboriginal language. Our present Gillieron wave analysis suggests that all language throughout Australia may have originally been of this type dating back at least 60,000 years, whilst Original-A (‘non-Pama-Nyungan’) may have arrived in north-western Australia as recently as the Ice Age (when there were land-bridges throughout much of south-eastern Asia) eventually spreading southward through Australia over the top of a long-pre-existing Type-B linguistic substrate. If so, for ‘PamaNyungan’ and ‘non-PamaNyungan’ languages to have had common origins, proto-Australian may have arisen in southeast Asia – somewhere between Australia and the Indian subcontinent – up to 75,000 years ago.

The present analysis cannot go back quite that far but it does extend to the Turuwal signature, which is arguably about 60,000 years old and phonologically similar to proto-Australian itself, and we can usefully work forward in time from that. Having determined values $a_i$ in equation (9) which seem to best account for the ‘experimentally observed’ signatures in Table 1 – hence the ‘likely’ minimal consonant inventories in Table 9 we can now model the evolution of pre-Wolgalu Type-B signatures, as in Figure 10, assuming a simple linear relationship

$$\text{time (years)} \approx 15,000 \times s - 75,000 \quad \text{for } s > 0$$

The intersection of our two sets of signature-curves (19) and (12), between $s = 1$ and $s = 2$, corresponds to $a_2$ increasing from 2 to 3 with the emergence in Turuwal (about 53,000 years ago) of an additional lamino-palatal consonant that modified subsequent trajectories $e_i/e$. Graph 5 clearly shows how this injection of word-initial-y into pre-Wolgalu Type-B language caused $e_2/e$ to lift above the corresponding Turuwal trajectory, requiring the trajectories $e_1/e$ and $e_3/e$ to both compensate by dropping below their respective Turuwal counterparts for all $s > 2$, in accordance with equation (3). Even so, for $s > 1.3$ the subsequent Original-B and Southern-B signatures given by equation (12) are only slight perturbations from ancestral Turuwal trajectories (19), showing the relatedness of all pre-Wolgalu Type-B language. Thus, word-initial-y did not exist in proto-Australian but arose in Turuwal, about 53,000 years ago, spreading from there into Original-B possibly – but not necessarily – within Australia.

The Semantic Basis of Proto-Australian

Table 9 supplies the distinctive minimal consonant-inventories of ancient language superfamilies whose existence and relatedness have been inferred from phonotactic information extracted from old word/name-lists. But if there actually was a single proto-language that gave birth to some or all pre-Wolgalu language, if our Tree Diagram is even approximately true, then cognate words from different language superfamilies must have had
common origins in adducible ancestral leximorphs (Illert, 2003) whose very existence would provide tangible semantic evidence corroborating the claimed genetic relationships between proposed language superfamilies. But where would we look for the requisite archaeo-semantic-exemplars?

Deictic expressions are the linguistic equivalent of vectors, usually with the speaker as the origin of the frame of reference. The word ‘deixis’, meaning linguistic pointing, is used in relation to a speaker ‘pointing’ at particular places, times and individuals (Lyons, 1968, pp. 275–280). We are engaging in the use of deixis whenever we use positionals such as ‘this’, ‘that’, ‘here’, ‘there’, ‘hither’, ‘thither’, or temporals such as ‘before’, ‘now’, ‘after’, ‘soon’. Because they are so fundamental and essential, deictics can persist relatively unchanged through timescales so deep that all else in language may change beyond recognition. Thus, if we want to know about ancestral proto-Australian language, to the extent that anything may be known, then we might profitably start by seeking deictics which seem universally to underlie Australian languages.

In this spirit, Geoff O’Grady and Susan Fitzgerald (1997, pp. 352–353) supplied some ‘broad-brush’ evidence for the existence of an ancestral deictic, here (in space or time), proposing a proto-Pama-Nyungan root yiya signifying "now, today" with vocalic metathesis occurring in … [some] languages’. But, if this or any other proto-Australian word commenced with y, it could contradict our previous finding that word-initial-y arose in Turuwal 53,000 years ago. Fortunately the ‘broad-brush’ case for word-initial-y is unconvincing in comparison with the survey below of relevant cognates from pre-Wolgalu superfamilies throughout south-eastern-Australia. This present evidence of ancestral word-initial-w (instead of y) is over-whelming. Additionally, the hypothesis of vowel-interchangement (‘vocalic metathesis’) is also wrong. All relevant cognates clearly arose from the ancestral semantic notions

\[
\text{some near-[place]} = \text{HERE} \\
\text{some near-[thing]} = \text{THIS}
\]

by means of the agglutination and fusion of a pair of permutable proto-Australian roots as follows:

\[
\begin{array}{c}
\text{\underline{\text{nun}} - \underline{\text{jin}}} \\
\text{some near (place, thing)} \\
\end{array}
\quad \Rightarrow \quad \begin{array}{c}
\text{\underline{\text{ORIGINAL-A}}} \\
\text{HUYGENS CIRCLE} \\
\text{SOUTHERN-B}
\end{array}
\]

\[
\begin{array}{l}
\"ngun : na\", ("in here"), ngunnawal \\
\"ngu : na\", ("here"), gundungara \\
R.H. Mathews: 1904, 1901 \\
(HUYGENS CIRCLE) (ORIGINAL - A)
\end{array}
\quad \begin{array}{l}
\"n̂go : n̄n\", ("here") \\
M.M. Everitt, 1906, gundungara \\
(ORIGINAL - A)
\end{array}
\]

\[
\begin{array}{l}
\"ya : yi\", mirriny \\
\"ye : y\", nyungar \\
\"y : yi\", wadjik \\
G. O'Grady & S. Fitzgerald, 1997 \\
("now, today")
\end{array}
\quad \begin{array}{l}
\"nju : qa\", ("around here, now") \\
L.A. Hercus, 1969, wemba wemba \\
(SOUTHERN - B)
\end{array}
\]

\[
\begin{array}{l}
\"nya : ni\" \\
("place name meaning 'find'") \\
S.J. Endacott, 1924
\end{array}
\]
Accordingly, there existed a present-tense temporal
some near-present-time = SOON, NOW
as in

\[
\text{\textit{pin} - \textit{nun}} \quad \text{= HERE, THIS} \quad \text{ORIGINAL-A, TURUWAL}
\]
\[
\text{\textit{njin} - \textit{njun}} \quad \text{= \textit{ja}, ("this, near here")}
\]
\[
\text{\text{"kin : ggnan", ("here")}} \quad \text{J. Dawson, 1881, chaap whurrong}
\]
\[
\text{\text{"i : nyun", ("here")}} \quad \text{W. Dawes, 1790, eora.}
\]
\[
\text{\text{\"bi : ja ", ("here")}} \quad \text{J. Rowley, 1875, cowpastures}
\]
\[
\text{(coastal ORIGINAL-B)}
\]
\[
\text{\text{"ngi : na ", ("here, this"), wiradjuri}} \quad \text{S. McNicol & D. Hosking, 1994}
\]
\[
\text{(inland ORIGINAL-B)}
\]
\[
\text{\text{"kuin : bu ", ("near")}} \quad \text{Rev W. Ridley, 1875, kamilaroi}
\]
\[
\text{(ORIGINAL-A)}
\]
\[
\text{\text{"ngowwu", ("here")}} \quad \text{G. O'Grady & S. Fitzgerald, 1997}
\]
\[
\text{("now, today")}
\]

\[
\text{\textit{njun} - \textit{i -\textit{pi(n)}} \quad \text{some near-present-time = SOON, NOW} \quad \text{= \textit{ja}, ("this, close proximity")}
\]
\[
\text{\text{\"gin : ja", ("this, close proximity")}} \quad \text{L. A. Hercus, 1969, wemba wemba}
\]
\[
\text{(SOUTHERN-B)}
\]
\[
\text{\text{"nyi : nya", ("this one right here")}} \quad \text{J. Malone, 1875}
\]
\[
\text{(TURUWAL)}
\]

\[
\text{\text{"yee : ye", ("here")}} \quad \text{G. O'Grady & S. Fitzgerald, 1997}
\]
\[
\text{("now, today")}
\]

\[\frac{\text{\text{\textit{pi}} - \textit{i -\textit{pi(n)} - \textit{nun}}}{\text{some near-present-time = SOON, NOW}}\]
Also, language superfamilies throughout south-eastern-Australia featured the future-tense

\[
\text{bulan} - i
\]

ORIGIN-A

\[
\text{future - tense}
\]

ORIGIN-B

SOUTHERN-B

"bál:ee"

M.M. Everitt, 1900, gundungara.

"yila :", ("... any near time ... future")

Rev. W. Ridley, 1875, kamilaroi

(ORIGINAL - A)

"baou: " or "bow: " or "bo:"

("the termination of future tense verbs")

W. Dowes, 1790, cora

(coastal ORIGINAL - B)

"bal: "

("the future tense meaning 'will'")

Rev. J. Bulmer, 1850's/1876, kurnai

(SOUTHERN - B)

"bhu :", ("to be"), sanskrit

"po( st ) : ", latin

hence there existed a future-tense temporal

some near-future-time = SUBSEQUENTLY, AFTER

as in

\[
\text{pun} - \left( \frac{\text{bo} (\text{lu}):i}{\text{i}:\text{bo} (\text{lu})} \right) - \text{ni} (n)
\]

SUBSEQUENTLY, AFTER

HUYGENS CIRCLE

"ken: doo :: na", ("after")

Rev. W. Bulmer, 1850's/1876 kurnai

(SOUTHERN - B)

"jan: bo : i : ", ("slowly")

" : i : dha : nyi :", ("quickly")

R.H. Mathews, 1901

"thurrawal = ngunawal

(HUYGENS CIRCLE)

or

\[
\text{bulan} - \text{ni} (n) - \text{pun}
\]

SUBSEQUENTLY, AFTER

ORIGIN-A

ORIGIN-B

"kulla : e : ki : tto ", kuurn kopan noot

"kullo :: :: ", peek whurrong

J. Dawson, 1881, ("after")

"yela :: du ", ("now, immediately")

Rev. W. Ridley, 1875, kamilaroi.

(ORIGINAL - A)

"dhala :: :: n ", ("soon"), wiradjuri

S. McNeol & D. Hosking, 1994

(inland ORIGINAL - B)
Also, the past-tense was generally

\[ i - (bu)lo \]

\[ \text{past-time} \]

hence there existed a past-tense temporal

some near-past-time = PREVIOUSLY, BEFORE

as in

\[ \text{nun} - \left\{ i:(bu)lo \right\} - \text{ni(n)} \]

\[ \text{past-time near} \]

= PREVIOUSLY, BEFORE

"non::lo:ngi", ("before")
J.F. Mann, 1840's, eora
(coastal ORIGINAL-B)

"yan:b:i:", ("then")
M.M. Everitt, 1900, gundungara
(ORIGINAL-A)

"nu::lla:", ("before"), kurmai
Rev. W. Bulmer, 1859's/1876
(SOUTHERN-B)

"non:b:ee:", chaap wurong
"chuum:buu::k", chaap wurong
"tuum:buu::k", peek wurong, kurn kopan noot
J. Dawson, 1881, ("this or that") ("before")

"mu::na", ("before"), kaurna
Tiecheidmann & Schurmann, 1840

"::pr:e::", latin
"::pralaya::", ("rest, dissolution"), sanskrit

or

\[ bulu : i - \text{nin} - \text{nun} \]

\[ = \text{PREVIOUSLY, BEFORE} \]

"bull : i : nin:", ("before")
M.M. Everitt, 1900, gundungara
(ORIGINAL - A)

"kila::yi:tya", ("long ago")
Mala::mi:ya", ("long ago")
L. Hercus, 1994, wemba wemba
(SOUTHERN - B)

These newly deciphered deictics, featuring the consonant p, for the first time enable modern translations to cut through the orthographic ‘static’ that has accumulated over
centuries in archival accounts of poorly understood and long extinct Australian
languages – as in the following sentences:

**ORIGINAL-B (‘PamaNyungan’) example**

\[ \text{go} \quad \text{miro} \quad \text{ni(n)} \quad \text{bo(lu):i:nu(n)} \]

**ORIGINAL-A (‘non-PamaNyungan’) example**

\[ \text{bul(u):i:nu:n} \quad \text{nu} \]

The antiquity of these deictics is apparent from their universality – occurring in both
Original-A (‘non-PamaNyungan’) and pre-Wolgalu Type-B (‘PamaNyungan’)
languages – from which our Tree Diagram (Illert, 2005, Figure 4) indicates that they prob-
ably arose in proto-Australian more than 60,000 years ago. That they subsequently propa-
gated into Ice-Age Australian languages, in accordance with Figure 10, is illustrated by the
following.

**ORIGINAL-B (‘PamaNyungan’) example**

Wait! Wait! Wait! I [shall] remember LATER

\[ \text{gwu!} \quad \text{gwu!} \quad \text{gwu!} \quad (\text{nu}) \quad \text{ni(n):nun:win:gor(a):i:bo(lu)} \]

... which features the allative case marker, used as an interjection, arising from the
expression [attention] TO [me] = “wait” or “stop”.

\[ \text{“go go go [...] yā:gun-gn:gār-a:baou”} \]

("Stop, Stop, Stop, don't tell me, I shall think of it directly")

Burnung, cited by W. Dowes, 1790, eora

(coastal ORIGINAL-B)
SOUTHERN-B (‘PamaNyungan’) example

The Yelta People’s Moon Song, recorded by Reverend John Bulmer in the 1850s, occurs wrongly transcribed and mistranslated on page 431 of R.B. Smyth’s (1876) book. A correct translation is as follows: Die [moon]! Between-cycles [you] shall disintegrate. [You] NOW waxing moon, LATER [will] wane.

\[
\begin{align*}
\text{bulo} & \quad = \text{Die!} \\
\text{bu(lala:pura):da(\tau o:n)} & \quad = \text{Between cycles} \\
\text{mula:n} & \quad = \text{dust} \\
\text{i:bo(\tau u)} & \quad = \text{[you] shall be} \\
\text{\[thing = MOON\]} & \\
\text{ni(n):pu(n)-i} & \quad = \text{NOW, presently} \\
\text{b(ulu):i-\{do(\tau a):n - bo(\tau u)\}} & \quad = \text{rising-up, commencing, new = “waxing”} \\
\text{ni(n):pu(n)-i:bo(\tau u)} & \quad = \text{AFTERWARD, later} \\
\text{bul(\omega:i):gar(\omega)-bul(\omega:i):garo} & \quad = \text{going-down, going-down = “waning”}
\end{align*}
\]

There has long been folklore to the effect that Aboriginal people supposedly ‘cannot count higher than two’ (Sir John Lubbock, cited by John Fraser FRS, 1893) and possess such poor comprehension of abstract concepts like time that they ‘will sell their blanket in the morning – though not at night – because they forget that it will be needed again after sunset . . .’ (Isabelle M. Pagan, 1937, p. 61). The former proposition was refuted by Illert (February 2003, Example 6) whilst the latter proposition, surprisingly enough, being argued by Aboriginal people currently involved in linguistic salvage, takes the form that south-eastern languages such as Bundjalung lacked a full range of temporal deictics. The January 1998 issue of Voice of the Land, published by the Federation of Aboriginal and Torres Strait Islander Languages (FATSIL), ran a front-page story.

Festival’s Bundjalung presentation a world first. Audiences who attended the Sydney Festival of Dreaming in September were first to see a play translated and performed in an Aboriginal language. Samuel Beckett’s ‘Ngundalelah Godatgai’ (Waiting for Godot) was translated into Bundjalung by Elders from the Northern Rivers region of New South Wales . . . supervised by Mick Walker . . . Beckett’s play deals with the frustration of his two central characters, stranded in a barren landscape and forced to grapple with abstract concepts of time . . . With no specific words for past or present in the Bundjalung language, the group members were required not only to translate, but to interpret the script into equivalent Aboriginal concepts . . . in the Galibal dialect of the Clarence River region.

Specifically in relation to the past tense, in Bundjalung, it should suffice to think back 40 years to when the Bundjalung Elder Ken Gordon explained that his traditional legends
were called [tales] from-long-ago

\[
\text{bu (l0: i)} - \overline{\text{dura}} - \overline{\text{garu}} - \overline{\text{mu (ra)}} = \text{from}
\]

\[
\text{greatly through} = \text{"long"}
\]

\[
\text{bu : d : gerə : m }, \text{("away back, from the beginning")}
\]
\[
\text{bu : thera : m }, \text{("sacred stories")}
\]

Ken Gordon, 1969's, bundjalung

\[
\text{"nu : dyi : ma" } \text{("long ago")}
\]

R.H. Mathews, 1904, ngunawal

Whereas dura means through or interior, the conjugate adjective daru means about or exterior; hence, the proto-Australian expression some exterior-things (eg. leaves, fish-scales, bird-feathers, echidna-spikes, as in Figure 11)

\[
\text{daru - wurola : n - pun} \rightarrow \text{some ORIGNAL-A ORIGINAL-B}
\]

= exterior-things [inanimate plural noun-stem]

\[
\text{"dhura : dhural : ", "thurrawal" = ngunawal}
\]
\[
\text{g : wirrel : ", kamilaroi (ORIGINAL-A)}
\]
\[
\text{girri : gul : ", wiradjuri (ORIGINAL-B)}
\]

R.H. Mathews: 1903, 1903, 1904
("spines of hedgehog/porcupine")

\[
\text{"terra : l : ", "feather ornament for the head",}
\]
\[
\text{P.G. King, 1793, eora}
\]

(coastal ORIGINAL-B)

\[
\text{"willi : neung ",}
\]
\[
\text{("porcupine spikes")}
\]
\[
\text{J. Dawson, 1881,}
\]
\[
\text{kuurn kopun noot, peek whurrong}
\]

\[
\text{"wirril : ", "feathers of birds",}
\]
\[
\text{R.H. Mathews, 1903, kamilaroi}
\]
\[
\text{(ORIGINAL-A)}
\]

\[
\text{Figure 11. Some exterior things}
\]
the singular case being the exterior-thing

\[
\text{da( rō-
\text{dola}): n} \rightarrow \text{mip} \quad \text{ORIGINAL-A}
\]

\[
\begin{array}{c}
\text{inanimate singular} \\
\text{noun-stem}
\end{array}
\]

However the absence of an affix such as mip leaves open the syntactic possibility of a possessive noun-stem, hence the interpretation thing’s exterior or surface-layer (e.g. skin, fingernail, clothing, tree-bark, name, surface of the Earth, as in Figure 12)

\[
\begin{array}{c}
\text{daro} \rightarrow \text{n:du( la)} \quad \text{ORIGINAL-A} \\
\text{thing’s} \\
\text{singular noun-stem} \\
\text{implied possessive}
\end{array}
\]

\[
\begin{array}{c}
\text{ORIGINAl-B} \\
\text{SOUTHERN-B}
\end{array}
\]

\[
\begin{array}{c}
\text{"du::n::", ("tail of animal")} \\
\text{R.H. Mathews, 1901, dharruk} \\
\text{(ORIGINAl-A)}
\end{array}
\]

\[
\begin{array}{c}
\text{"du::n::", ("fish")} \\
\text{Lizzy Malone, 1875, wadi wadi} \\
\text{(coastal ORIGINAl-B)}
\end{array}
\]

\[
\begin{array}{c}
\text{"daru::n::da(g)\", ("bark")} \\
\text{D.K. Eades, 1976, dhurrga.}
\end{array}
\]

\[
\begin{array}{c}
\text{"thara::", ("name")} \\
\text{Rev. J. Bulmer, 1850s/1876, kurnai.} \\
\text{(SOUTHERN-B)}
\end{array}
\]

\[
\begin{array}{c}
\text{"tuuro:n:y\", ("bark of tree")} \\
\text{J. Dawson, 1881, kuurn kopan noot}
\end{array}
\]

\[
\begin{array}{c}
\text{"dhura:n:y\", ("bark of trees")} \\
\text{R.H. Mathews, 1904, wiradjuri} \\
\text{(inland ORIGINAl-B)}
\end{array}
\]

\[
\begin{array}{c}
\text{"ta:n\ti", "traya::ti", "ta:n\tra"} \\
\text{("expansion, liberation"), Sanskrit}
\end{array}
\]

\[
\begin{array}{c}
\text{"tūrā::", ("bark")} \\
\text{Rev. W. Ridley, 1875, kumilari} \\
\text{(ORIGINAl-A)}
\end{array}
\]

\[
\begin{array}{c}
\text{"tirri::", ("nails of fingers or toes")} \\
\text{Rev. L.E. Threlkeld, 1834, awabakal}
\end{array}
\]

\[
\begin{array}{c}
\text{"taura::"} \\
\text{("territory or hunting ground")} \\
\text{J. Fraser, 1892}
\end{array}
\]

\[
\begin{array}{c}
\text{"tiora::", ("land or country")} \\
\text{S. Bennett, 1867, eora.} \\
\text{(coastal ORIGINAl-B)}
\end{array}
\]

\[
\begin{array}{c}
\text{"(ex)terior", "terri::tory", "english"} \\
\text{"terra", latin} \\
\text{"terre", french}
\end{array}
\]
The fundamental root was combined with daru in proto-Australian, creating the concept away-exterior or surrounding-region (=neighbourhood, vicinity), as in [you] shall-come [to] Sydney’s vicinity (see Figure 13).

This example shows that, notwithstanding the intrinsic meanings of its constituent individual morphemes, the cluster wuru:n:daru is a deictic idiom meaning surrounding-region hence neighbourhood, vicinity. And this meaning can vary.
pragmatically, as in [we] shall-row some-where

\[
\begin{align*}
\text{bu} (\text{lu}) & : \text{gu} (\text{ru}) - \text{wuru} : \text{n} : \text{daru} - i : \text{bu} (\text{lu}) - \text{\_nun} \\
\text{neighbourhood, vicinity} & = \text{SOMEBODY, WHEREVER} \\
\text{coastal ORIGINAL-B} \\
\end{align*}
\]

\["\text{ba\_nga:::dara::ba\_ngoong"}
\]

\[W. \text{Dawes, 1790, eora}\]

which finally explains a 215 year old mystery articulated by William Dawes in his notebook:

\[\ldots\text{ We think it relates to bringing Booroong to Dara, in which case it appears that they put words sometimes between the root and the termination. They were not speaking of Dara, for since, I have heard them repeat dara in the same word when I think they could not refer to that place. It seems to me to be peculiarly used when it is spoken of as rowing to a certain place to bring back another with you. But this is mere conjecture.}\]

Dawes had made a major syntactic discovery, the intersplicing of positional deictic (‘some-where’) and verb-phrase (‘shall-row’) within a sentence (see also Illert, 2003, examples 1 to 5), and was clearly hearing the word daru. Yet philologists such as Jim Kohen (1998, p. 240) cite these writings in support of a view that ‘\ldots the root word is ‘ora’, meaning place or country’, apparently unaware that Aboriginal words simply do not commence with nor contain vowels such as o. Kohen continued on to make the more seriously wrong connection

\[\ldots\text{ the prefix ‘e-e’ is listed in Southwell (1788) \ldots [as] the word for ‘yes’ \ldots The use of the words for ‘yes’ and ‘no’ to distinguish tribes and subtribes has frequently been recorded in the literature for south-eastern Australia (Tindale 1974, p. 42) \ldots The Eora then were the people from the country where the word for ‘yes’ was ‘e-e’, that is the Sydney coastal region.}\]
Actually, the correct word for ‘yes’, occurring in all language superfamilies throughout south-eastern Australia, happens to be

\[
\eta \text{un} = \text{YES}
\]

\[
\text{ORIGINAL-A, TURUWAL}
\]

\[
\text{ORIGINAL-B, SOUTHERN-B}
\]

\[
"\text{ngaayn}'\text{'}, \text{ wiradjuri} \\
\text{S. McNicol & D. Hosking, 1993} \\
(\text{inland ORIGINAL-B})
\]

\[
"\text{yuin}'\text{'}, \text{ cowpastures} \\
\text{J. Rowley, 1875.}
\]

\[
"\text{gē}'\text{'}, \text{ wadi wadi} \\
\text{Lizzy Malone, 1875.}
\]

\[
"\text{cē}'\text{'}, \text{ eora} \\
\text{D. Southwell, 1788.} \\
\text{Rev. L.E. Threlkeld, 1834.} \\
(\text{coastal ORIGINAL-B})
\]

\[
"\text{au}'\text{'}, \text{ jervis bay} \\
\text{J.P. Gaimard, 1826} \\
(\text{TURUWAL})
\]

whilst the standard animate-plural is

\[
\eta : \text{wurula} = \text{creatures, people} \\
\text{[animate plural]}
\]

\[
\text{ORIGINAL-A} \\
\text{TURUWAL} \\
\text{ORIGINAL-B}
\]

\[
"\text{gīn jōur}'\text{'}, \\
("\text{ascidie} = \text{a colony of ascidians}\) \\
\text{J.P. Gaimard, 1826, jervis bay} \\
(\text{TURUWAL})
\]

\[
"\eta : \text{yēllu}'\text{'}, \\
("\text{we three only}\) \\
\text{W. Dawes, 1790.}
\]

\[
"\text{eeōra}'\text{'}, \\
("\text{Aboriginal people}\) \\
\text{W. Dawes, 1790.}
\]

\[
"\text{ēōrāh}'\text{'}, \\
("\text{people}\) \\
\text{D. Southwell, 1788.} \\
(\text{coastal ORIGINAL-B})
\]

\[
"\text{naī}'\text{'}, \text{dhurga} \\
\text{J. Larmer, 1853} \\
(\text{SOUTHERN-B})
\]

… occurring commonly within superlative adjectival expressions, as in the following
ORIGIN-A (‘non-PamaNyungan’) examples

the black(est) crow in [the] flock

\[ \frac{wu:goi:i:n}{\text{crow (subject)}} \quad \frac{\text{-black(est)}}{-} \quad \frac{bora:bora}{\text{the}} \quad \frac{= \text{AMONGST, WITHIN}}{=} \quad \frac{nura - g:wur(ola)}{\text{centre - creature}} \quad \frac{-pi(n)}{\text{near - flock}} \]

"wà:goi:i:n - nin boôra:boôra ngeèra:n:barr:ijjee"

(= "that crow black whole lot among")

Bessy Simms, cited by Mary Everitt, 1900, gundungara

the bad(est) boy in [the] group

\[ \frac{\text{centre - creature}}{nura} \quad \frac{g:wur(ola)}{\text{near - flock}} \quad \frac{-pi(n)}{\text{near - flock}} \quad \frac{\text{min - bu:bul}}{\text{the - boy (subject)}} \quad \frac{= \text{bad(est)}}{=} \quad \frac{go:g:no}{\text{go - group}} \]

"ngeèra:n:bâr:ijjee nin - boô:bâl gu:dâ:bât"

(= "among whole lot that boy bad, or, that boy is the worst of the crowd")

Bessy Simms, cited by Mary Everitt, 1900, gundungara

based upon the idiom

near-centre = AMIDST, AMONGST, WITHIN

given that the root \( nura \) = middle/centre is well documented in expressions meaning ‘belly-button/navel’ (as in Figure 14)

\[ \frac{\text{min - nura}}{\text{the - middle}} \quad \frac{= \text{ORIGIN-A}}{=} \quad \frac{\text{ORIGIN-B}}{=} \quad \frac{\text{HUYGENS CIRCLE}}{=} \]

"mîn:birri "
R.H. Mathews, 1901, dharruk (ORIGIN-A)

"mc:nëro"
Dr. J. Lhotski, 1834, ngarigu

":nyurr"a"
R.H. Mathews, 1904, ngunawal (HUyGens-CIRCLE)

"mûn:duru"
"mû:nuru"
W. Dawes, 1790, eora.

"moo:nëroh"
D. Southwell, 1788, eora.

"moo:nûro"
D. Collins, 1798, eora. (coastal ORIGIN-B)
Clearly the supposed name of the Sydney tribe ‘Eora’ was nothing more than a contraction of the standard animate plural, with unheard word-initial-ŋ and soft-w. Kohen was confusing dâr with dâr u, and the word ŋun was simply irrelevant.\(^2\) His erroneous chain of speculation, ‘ee-ora’ supposedly meaning ‘[people from the] country [where] “ee” [means yes]’, followed largely from word-initial consonants being consistently mis-heard or unrecorded by early observers and unrestored by centuries of subsequent philology.

In any event, William Dawes had stumbled upon the positional

\[ \text{some vicinity } = \text{WHERE} \]

as in

\[ \text{ORIGINAL-A} \]

\[ \text{ORIGINAL-B} \]

\[ \text{SOUTHERN-B} \]
or

\[
\begin{array}{c}
w(u(ru)) : n:da(ru) - \ \frac{mip}{{\text{the/a}}} \\
\quad \frac{nu(n)}{{\text{some}}} \\
\quad = \text{WHERE}
\end{array}
\]

hence the following.

**ORIGINAL-B (‘PamaNyungan’) examples**

<table>
<thead>
<tr>
<th>English</th>
<th>Original-B (‘PamaNyungan’)</th>
<th>Australian English</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;wá:tu:mi&quot;, (&quot;when&quot; ??)(^3)</td>
<td>&quot;wa::tua::ngga&quot;, (&quot;where&quot;)</td>
<td>dhurrak (ORIGINAL-A).</td>
</tr>
<tr>
<td>W. Davies, 1790, era</td>
<td>&quot;wu::ddha:&quot; , (&quot;where&quot;)</td>
<td>&quot;thurraval&quot; = ngunawal, (HUYGENS CIRCLE)</td>
</tr>
<tr>
<td>(coastal ORIGINAL-B)</td>
<td>&quot;wu:n'dee::nee&quot;,</td>
<td>R.H. Mathews: 1901, 1904, 1901</td>
</tr>
<tr>
<td>(\text{SOUTHERN-B})</td>
<td>(&quot;where, where to&quot;)</td>
<td>M.M. Evertt, 1900, gundungara</td>
</tr>
<tr>
<td>&quot;um:de: &quot;, latin</td>
<td>&quot;wa:n::di::nu::be&quot;</td>
<td>(ORIGINAL-A)</td>
</tr>
<tr>
<td>(&quot;where&quot;)</td>
<td>(&quot;where are you going to?&quot;)</td>
<td>J.F. Mann, 1840s, era</td>
</tr>
<tr>
<td>(english)</td>
<td></td>
<td>(future-tense)</td>
</tr>
</tbody>
</table>

Likewise there was a temporal

\[\text{some temporal-proximity} = \text{WHEN}\]
as in

\[ \text{wu}(ru) : nd(aro) - j - \text{nu}((n)) \]

- WHEN

\[ \frac{\text{proximity}}{\text{temporal}} \]

\[ \text{min} \frac{\text{the/a}}{\text{some}} \]

\[ \text{ORIGINAL-A} \]

\[ \text{SOUTHERN-B} \]

\[ \text{HUYGENS CIRCLE} \]

"wu:n:d:i:n", ngunawal
"yu:n::nun", "thurrwał" = ngunawal
R.H. Mathews: 1904, 1901, ("when")
(HUYGENS CIRCLE)

"uu:n:da::", ("when")
kuurr kopan noot, peek whurrong
J. Dawson, 1881.

"w::ce:muna", ("where" ??)**
"w::ce:manna", ("where are" ??)**
N.D. Pettit & W. Dawson, 1850's, kurnai.
(SOUTHERN-B)

"qua:n:do::", latin
"we:h:n:e::", "we:h:n::", english
"ro::t:e::", greek

"wu:n:d:i:n", ("when"),
"wu:n:da::", ("when"),
M.M. Everitt, 1906, gundungara.
"wiru:::", ("when"),
Rev. W. Ridley, 1875, kamilaroi.
(ORIGINAL-A)

"waur::i:mi ", ("where" ??)**
"w::i:ma ", ("where" ??)**
"waru::pa ", ("when")
W. Dowes, 1790, eora
(coastal ORIGINAL-B)

also

\[ \text{w(uru)} - i - nda(aro) - \text{nu}((n)) \]

- WHEN

\[ \frac{\text{temporal}}{\text{proximity}} \]

\[ \text{some} \]

"v:i:n:jah:gan", ("when")
M. Sharpe, 1994, bundjalung

"w::i::juu:ngga", ("when, how")
McNicol & Horking, 1994, wiradjuri
(inland ORIGINAL-B)

Another important positional was

some-near vicinity = this vicinity = HITHER
as in

\[
\begin{array}{c|c|c|c}
\text{nun - pin} & \text{wu(ru):darō:n} & \text{ORIGINAL-A} \\
\text{this/here} & \text{vicinity} & \text{TURUWAL} \\
\end{array}
\]

\[
\begin{array}{c|c|c|c}
\text{= HITHER} \\
\text{"ngam: bun: kuri: n", ("that one, quite close")} & \text{"yul: wu: kuri: n", ("here, near")} & \text{ORIGIN-B} \\
\text{M.M. Esseff, 1969, gundungara} & \text{"thar: n", ("here")} & \text{H.A. Horace, 1969, jinda - jidji, 1994 pascalayi} \\
\end{array}
\]

or

\[
\begin{array}{c|c|c|c}
\text{n(n) - nu(n) - wu(ri):da(ri):n} & \text{this/here} & \text{vicinity} & \text{SOUTHERN-B} \\
\end{array}
\]

\[
\begin{array}{c|c|c|c|c}
\text{= HITHER} \\
\text{"ki: ywe:ty: n", ("this way, hither")} & \text{"na: nu: muru: n", ("this one right here")} & \text{ORIGIN-B} \\
\text{H.A. Horace, 1969, weema:weema} & \text{ORIGIN-B} \\
\end{array}
\]

or

\[
\begin{array}{c|c|c|c}
\text{darō:nu(ri):n} & \text{n(n) - mi(n)} & \text{ORIGINAL-A} & \text{SOUTHERN-B} \\
\text{vicinity} & \text{this/here} & \text{ORIGIN-B} \\
\\end{array}
\]

\[
\begin{array}{c|c|c|c}
\text{= HITHER} \\
\text{"thi: mura", (place name meaning "beside")} & \text{"dhu: mura", ("that")} & \text{ORIGIN-A} \\
\text{S.J. Ender, 1924} & \text{R.H. Mathews, 1901, gundungara} & \text{SOUTHERN-B} \\
\end{array}
\]

or

\[
\begin{array}{c|c|c|c}
\text{nun - wu(ri):n:darō - nun} & \text{this/here} \\
\text{vicinity} & \text{ORIGIN-A} \\
\text{SOUTHERN-B} \\
\end{array}
\]

\[
\begin{array}{c|c|c|c|c}
\text{= this/here} \\
\text{"dun: wu: nu: da: n", ("about, here and there"), kurn kopan noo} & \text{"king: wu: nu: ja: n", ("about, here and there"), chaap wharong} & \text{ORIGIN-B} \\
\text{or} & \text{"teen: wu: nuung", ("about, here and there"), peek wharong} & \text{SOUTHERN-B} \\
\text{"wu: nu: da... nuung", (extracted from the word "whick"), kurn kopan noo} & \text{J. Dawson, 1881} \\
\end{array}
\]

hence the following.
C. R. Illert

ORIGINAL-B (‘PamaNyungan’) example

\[ \text{pin: pun} - \text{wur(u):n:da(ру)} \] 
\[ \text{g(ora):i} \] 
\[ \text{i:gor(i)} \]

= HITHER

\(\text{"k:wa:i:bi:dia:"}, \text{"(come here")}, J. \text{Rowley, 1875, cow passture} \)

\(\text{"k:ou:cc:"}, \text{"(come here")}, W. \text{Dawes, 1796, erea} \)

\(\text{"k:ou:ce:"}, \text{"D. \text{Paine, 1794, erea} \}

\(\text{":ou:th:e:"}, \text{"F. \text{Peron, 1802, erea} \}

\text{(coastal ORIGINAL-B)}

\(\text{\"dha:iny:a:na\", \"(come\"}, \text{B.H. \text{Mathews, 1994, wiradjuri} \}

\text{(inland ORIGINAL-B)}

\) from which derives \text{g: wur-i}, the famous ‘COOCE’ call of the Australian Bush, about which P. Cunningham (1827) noted how ‘in calling to each other at a distance, the natives make use of the word COO-CC, as do we with \text{hullo} prolonging the sound of the \text{COO}, and closing that of the \text{CC} with a small jerk...’. Likewise C. Griffith (1845) observed that ‘the \text{COOCE} is a call in universal use amongst the settlers... borrowed from the natives. The performer dells for about half a minute upon one note, and then raises his voice to the octave. It can be heard a great distance’. Erroneous spellings ‘CO-WEE’ (P.G. King, 1793, Capt. J. Hunter, 1793) and ‘KO-WE’ (D. Collins, 1798) arose historically because the ‘English ear’ finds it difficult to ‘hear’ \text{g: W} without instinctively inserting a vowel. Even as recently as 1993 the philologist Jakelin Troy proposed a spelling ‘gwa:W’ which is deictically as well as phonetically wrong because \text{gwa} means away-from instead of toward, hence go-there instead of come-here. Troy compounded this error by speculating that the expression meant ‘call them’, which is flatly contradicted by the historic primary sources cited above. Captain J. Hunter specifically wrote that ‘the word CO-WEE... signifies come here’ – making it exactly the same expression recorded by Rowley 80 years later. Rowley, Peron and Paine do not record an ‘A’ following word-initial-g and even the handwritten notes of Dawes, which Troy cites, have a clear arc underneath the whole ‘awu’ sound showing that it was the single syllable ‘wur’ and not ‘awu’.

Additionally we have the

ORIGINAL-B (‘PamaNyungan’) example

In the notebooks of William Dawes (1790) we find

\[ \text{d(ora): mu(ra)} \]

= porous

\[ \text{\"lī: ma\"} \]

= (to squeeze, as water out of a sponge)
and hence the sentence: [1] shall-long-stay here-abouts

A different but equally important strand of deictics were based upon the ancestral semantic notions

some yonder-[place] = THERE
some yonder-[thing] = THAT,

as follows:

"ngun':nâ" ("around, or round, meaning behind or the other side of")
M.M. Everitt, 1900, gundungara (ORIGINAL-A)

"mung':xe", ("there")
J. Dawson, 1881, peck whurrong

"nu: neëa", ("there")
W. Dawes, 1790, nnun (coastal ORIGINAL-B)

"go: ga", ("there")
J. Malone, 1875, (TURUWAL)
or

\[ \text{nora} - \text{pun} \quad \begin{tabular}{l}
\text{ORIGINA-L-A} \\
\text{THERE, THAT} \\
\text{HUYGENS CIRCLE}
\end{tabular} \]

\begin{itemize}
\item "mu:nqān", ("that")
  J. Rowley, 1875, cowpastures.
\item "gnorā:ng", ("place")
  D. Collins, 1798, cora.
  (coastal ORIGINAL-B)
\item "nga:nayn", ("over there in the distance")
  S. McNicol & D. Hosking, 1994, wiradjuri
  (inland ORIGINAL-B)
\item "nari:mung", ("over yonder")
  R.H. Mathews, 1901,
  "thurrawal" = ngunawal.
  (HUYGENS CIRCLE)
\item "nharra:", ("yonder")
\item "arri:go", ("there")
\item "urri:bā", ("far")
\item "gurri:.", ("there, in front")
  Rev. W. Ridley, 1875, kamlaroi
  (ORIGINAL-A)
\end{itemize}

as in

\[ \text{garu} - \ i:bu(\text{lu}) - \text{n}u(\text{ra}:\text{pun}) \quad \begin{tabular}{l}
\text{go} \\
\text{shall/will} \\
\text{THERE (distant)}
\end{tabular} \]

\begin{tabular}{l}
\text{yeere::be:nā::}
\text{"this way"}
\end{tabular}

W. Dawes, 1790, cora 
(coastal ORIGINAL-B)

The fundamental root

\[ \text{wara} \quad \begin{tabular}{l}
\text{far, distant} \\
\text{HUYGENS-CIRCLE}
\end{tabular} \]

\begin{itemize}
\item "wur'ra" or "war'ree"
  ("a long way off")
  M.M. Everitt, 1900, gundungara
  (ORIGINAL-A)
\item "para", ("beyond, far, distant"), sanskrit
\item "wurri", ("far")
  R.H. Mathews, 1903
  "thurrawal" = ngunawal
  (HUYGENS CIRCLE)
\end{itemize}

as in

\[ \text{wara-wuru} \quad \begin{tabular}{l}
\text{far - away} \\
\text{HUYGENS-CIRCLE}
\end{tabular} \]

\[ \text{wārā:wārā}, ("far away") \]

J. Rowley, 1875, cowpastures
(coastal ORIGINAL-B)

was combined with n:daro in proto-Australian to create the concept

\[ \text{wara-n:daro} = \text{distant place} \]

which, in turn, was combined with pun:nora giving the positional

\[ \text{some yonder distant place} = \text{THITHER} \]
as follows

\[
\begin{align*}
\text{pu(n)} & \rightarrow \frac{\text{nora:wa(ra)}}{\text{war:ora}} \rightarrow n: \text{daru} \rightarrow \text{turuwal} \\
& \text{some} \rightarrow \text{far-yonder} \rightarrow \text{place/location} \rightarrow \text{THITHER}
\end{align*}
\]

\begin{itemize}
\item ":p\ddot{a}r\ddot{a}:w\ddot{a}:n:" ("a great distance off, distant sea")
\item ":\ddot{a}r\ddot{r}\ddot{o}:w\ddot{a}:n:" ("distant")
\item ":k\ddot{a}:u:n:di:" ("away")
\item ":m\ddot{a}w\ddot{e}:t\ddot{y}:" ("thither")
\item ":w\ddot{a}:t\ddot{h}a:ra:" ("there")
\item ":p\ddot{a}r\ddot{o}:n\ddot{e}:t\ddot{a}:" ("about")
\item ":w\ddot{r}\ddot{o}:n\ddot{a}:n:dee:" ("over there yonder")
\item ":y\ddot{u}:n:da:" ("go away")
\item ":n\ddot{a}n\ddot{a}:r\ddot{a}:n:d\ddot{e}:r\ddot{a}" ("place of small lizards, goanna")
\item ":n\ddot{g}u:n\ddot{a}:y:" ("over there distant")
\item ":w\ddot{r}\ddot{o}:n\ddot{a}:r:" ("black rock" or uranium)
\end{itemize}

as in the following.
ORIGIN-B (‘PamaNyungan’) examples

Which further illustrate the splitting/intersplicing of positional deictics (such as HITHER and THITHER) about/with verbs.

**Soundshifts in Southern-B**

With R.H. Mathews (1901) recording nura → ‘nharra’ (‘yonder’) within the Huygens Circle, supported by other observers who, quite understandably, gave word-initial-\(n\) simply as \(n\) in surrounding language zones, there is a strong case for the common origin of \(n\) in proto-Australian. But equally evident in modern cognates involving THERE-THAT-THITHER are the soundshifts \(n\) → \(ŋ\) and \(n\) → \(m\) which probably arose,
about 30,000 years ago, at the birth of Southern-B language, which lost the nasal n (see Table 9) and had to compensate. This was part of the general decrease in frequency of word-initial-nasals in Southern-B

\[
\int_{-T}^{0} f_n + f_j + f_g + f_s + f_u \, dt = \Delta f_m + \Delta f_n + \Delta f_g + \Delta f_s + \Delta f_u \\
= -23.7\% \text{ (proto-Australian \rightarrow dhurga)}
\]

balanced by an increase in frequency of word-initial stops in Southern-B

\[
\int_{-T}^{0} f_g + f_b + f_a + f_d + f_n \, dt = \Delta f_g + \Delta f_b + \Delta f_a + \Delta f_d + \Delta f_n \\
= +22.8\% \text{ (proto-Australian \rightarrow dhurga)}
\]

associated with soundshifts b \rightarrow d or d, and g \rightarrow d or d, which are particularly apparent as one moves progressively inland, westward, away from the south-eastern coastal-strip (see Table 10).

**Examples of the Soundshift** \( g \rightarrow d \)

One example of the soundshift \( g \rightarrow d \) or \( d \) involves the proto-Australian root **VERY** (numerous/large/old/hot)

\[
gun \quad \rightarrow \quad {\text{VERY}} \quad \text{ORIGINAL-A} \quad \text{ORIGINAL-B} \quad \text{SOUTHERN-B}
\]

"koiyun", ("many"), awabakal  
Rev. L.E. Threlkeld, 1834  
"ki\'an", ("centipede")  
Rev. W. Ridley, 1875, kamilaroi  
(ORIGINAL-A)

"gayan", ("big")  
D.K. Eades, 1976, dhurga  
(SOUTHERN-B)

"gaian", ("large")  
R.H. Mathews, 1903,  
"thurrawal" = ngunawal  
(HUYGENS CIRCLE)
which, in its repeated form in the Southern-B language zone, was recorded by independent observers as

\[
\text{gun} \rightarrow \text{d} \quad \text{SOUTHERN-B} \\
\text{EXTREMELY} \\
\]

Another repeated proto-Australian root occurs similarly soundshifted in rainbow (= [contiguous coloured] arcs):

\[
gurū:n - gurū:n - gurū:n - g(\text{gurū}:n - ...) \\
\text{convex-thing} \quad \text{convex-thing} \quad \text{convex-thing} \quad \text{convex-[thing]} \\
= \text{arc} \quad = \text{arc} \quad = \text{arc} \quad = \text{arc} \\
\]

\[
= \text{arcs [inanimate plural]} \\
\]

\[
\text{gura}:n: \text{gura}:n:::g::...
\]

R.H. Mathews, 1908, ngarigu (HUYGENS CIRCLE)

\[
\text{tar}:n: \text{tar}:n::\text{paro}:t:::...", \text{kurn} \text{ kopan noot}
\text{taera::kaa::gur::k:::...", chaapwhurrung}
\text{tuura::n::n::...", peek whurrung}
\]

J. Dawson, 1881, (WESTERN VICTORIA)

hence the confusing transition between the eastern seaboard's \text{g} and western inland \text{d}. Also note the possible existence here of a west-Victorian retroflexive-nasal \text{η}, in what seems to be the word \text{dun}::\text{dun}:\text{duru}:\text{d}, within a language whose ascribed name (‘\text{kurn} kopan noot’) may itself contain a morpheme also terminating with the nasal \text{η}. If so, this distinctive coalescence of phonemes \text{run} \rightarrow \text{η} would have occurred since proto-Australian times.

**Examples of the Soundshift \(b \rightarrow d\)**

One clear example of the soundshift \(b \rightarrow d\) or \(d\) occurs in the Yelta people's ‘setting sun’ song (see R.B. Smyth, 1876, volume 1, p. 430)

\[
\text{wil}:n - \text{dola:(n)} \\
\text{orbiting thing} = \text{SUN} \\
\]

\[
\text{bul(o:i)-bul(o)} \\
\text{falling down} = \text{setting} \\
\]

\[
\text{"wane:dilya: tull::tull"} \\
\text{("sun... go down")} \\
\text{Rev. J. Bulmer, 1859's, kurnai} \\
\text{(SOUTHERN-B)} \\
\]

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Another example, one which shows Southern-B influence extending into adjoining language zones, is the already encountered temporal deictic

\[
\text{pun - i:bolu - pin} \quad \text{SUBSEQUENTLY, AFTER} \quad \text{SOUTHERN-B} \quad \text{b} \rightarrow \text{d}
\]

\[
\begin{aligned}
"::\text{dhal}:\text{n}" \text{,"soon"} \\
S. McNicol & D. Hosking, 1994 \\
\text{wiradjuri} \\
\text{(inland ORIGINAL-B)}
\end{aligned}
\]

\[
\begin{aligned}
"::\text{dha}:\text{nyi}" \text{,"quickly"} \\
R.H. Mathews, 1901 \\
"\text{thurrawal} = \text{ngunawal}" \\
\text{(HUYGENS CIRCLE)}
\end{aligned}
\]

Retroflexives Arising from Coalescence of Phonemes?

\[
\text{run} \rightarrow \eta, \quad \text{rod} \rightarrow \text{d}, \quad \text{rul} \rightarrow \text{z}
\]

We have documented a likely origin for a retroflexive nasal \(\eta\) in the above-cited Southern-B version of the word ‘rainbow’. Blake & Reid (1998) have also hypothesised the existence of a retroflexive stop \(\text{d}\) in the same NW-Victorian languages. They state:

following O’Grady’s suggested reconstruction for these sets we now think that the hypothesis that accounts best for the data is that \(\text{rt}\) is original, that it weakened in some Victorian languages to some kind of rhotic, probably a glide . . . and that it switched to a laminal in some western Victorian languages.

As evidence, they offer words supposedly meaning ‘big, important, man, old man’ but which are all probably just examples of the standard proto-Australian plural (Illert, 2002, example 6)

\[
3 = [2, 1] =
\]

\[
\begin{aligned}
\text{wu.-} (\text{bu:miro:dola:miro:dola} - \text{mi}) \text{ro:}(\text{do}) \text{la} - \text{n} \\
+ \quad \frac{2}{\text{2+1=3}} \\
\frac{1}{\text{2+1=3}}
\end{aligned}
\]

\[
\begin{aligned}
"\text{wu:-----r} \text{ai}: \text{I}.", \\
\text{bu:miro:dola:miro:dola} - \text{mi} \text{ro:}(\text{do}) \text{la} - \text{n} \\
\text{wu:--:ra:i:n}.", (\text{plural}) \\
A. Mackenzie, 1874, \\
"\text{wu:---} \text{wu:li}:", ("three") \\
L. Malone, 1875, wadi-wadi \text{(ORIGINAL-B)}
\end{aligned}
\]

\[
\begin{aligned}
\text{wu:-----ra:i:n}.", (\text{three}) \\
\text{wu:---ra:i:n}.", (\text{three}) \\
\text{wu:--:ra:i:n}.", (\text{plural}) \\
\text{wu:-----ra:i:n}.", (\text{plural}) \\
A. Mackenzie, 1874, \\
L. Malone, 1875, wadi-wadi \text{(ORIGINAL-B)}
\end{aligned}
\]

\[
\text{wu:-----ra:i:n}.", (\text{three}) \\
\text{wu:---ra:i:n}.", (\text{three}) \\
\text{wu:--:ra:i:n}.", (\text{plural}) \\
\text{wu:-----ra:i:n}.", (\text{plural}) \\
A. Mackenzie, 1874, \\
L. Malone, 1875, wadi-wadi \text{(ORIGINAL-B)}
\]

\[
\text{wu:-----ra:i:n}.", (\text{three}) \\
\text{wu:---ra:i:n}.", (\text{three}) \\
\text{wu:--:ra:i:n}.", (\text{plural}) \\
\text{wu:-----ra:i:n}.", (\text{plural}) \\
A. Mackenzie, 1874, \\
L. Malone, 1875, wadi-wadi \text{(ORIGINAL-B)}
\]

\[
\text{wu:-----ra:i:n}.", (\text{three}) \\
\text{wu:---ra:i:n}.", (\text{three}) \\
\text{wu:--:ra:i:n}.", (\text{plural}) \\
\text{wu:-----ra:i:n}.", (\text{plural}) \\
A. Mackenzie, 1874, \\
L. Malone, 1875, wadi-wadi \text{(ORIGINAL-B)}
\]

\[
\text{wu:-----ra:i:n}.", (\text{three}) \\
\text{wu:---ra:i:n}.", (\text{three}) \\
\text{wu:--:ra:i:n}.", (\text{plural}) \\
\text{wu:-----ra:i:n}.", (\text{plural}) \\
A. Mackenzie, 1874, \\
L. Malone, 1875, wadi-wadi \text{(ORIGINAL-B)}
\]
being used, in Southern-B, in the adjectival sense ‘lots of’ or ‘big’. The actual words
given by Blake & Reid are just a slightly different condensation of this same ancestral
arithmetical leximorph

\[
3 = +[2,1] = \frac{wu - (bu : miro : dola : miro : dola - mi )ro : dol (a - n)}{2 +1=3}
\]

In which case, the stop-sounds observed within \(wu:ru:dol\) or \(wu:ru:do\) or
\(wu:rd\) are easily explained as \(d\) arising from coalescence of the phonemes \(rUd\).

Unfortunately Blake & Reid did not systematically cite the original primary sources
from which each of their respective words supposedly came. They made the common
mistake of failing to understand that, in lexical taxonomy, as with any form of taxonomy,
it is the oldest original primary source that carries most weight – not the latest compi-
lation. Their lexical taxonomy all needs to be redone in a thorough scholarly fashion, spec-
ifying the oldest primary source from which each and every one of their cited words
came. However, for now, giving them the benefit of the doubt and taking their ‘findings’
at face value, their claim to have found a retroflexive-stop in the Southern-B region of
western Victoria is consistent with our discovery of a retroflexive-nasal. Collectively,
this suggests retroflexives in SE-Australian language, mainly within Southern-B, for any-
thing up to 30,000 years.

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University of Western Sydney, and Daniela Reverberi for software support.

Notes

1Equations 1 to 5, Tables 1 and 2, and Figures 1 to 4, occur in Part 1 of this paper.
References (continued from Part 1)


Endacott, S.J. (1924) Australian Aboriginal Words and Place Names and their Meanings (Melbourne: Acacia Press).


Martin, A.E. (1943) 1000 and more Place Names in New South Wales (Sydney: NSW Bookstall).


\[ In south-east Australian languages, the condensed root \( \text{mif} \) = ‘yes’ and the pronoun \( \text{mif} = ‘I, me’ \) provide a possible example of homonymy – two different words that just happen to have the same form – as in English where, for example, ‘bank’ denotes both a building (associated with a financial institution) and also an area of ground (along the side of a river). But it is interesting how English has the homophones \( \text{a} = ‘yes’ \) (as in ‘my Captain’) and \( \text{i} = ‘I, me’ \) both of which just might be directly condensed from proto-Australian: \( \text{nun} \rightarrow \text{mif} \rightarrow \text{o} \rightarrow \text{ai} \rightarrow \text{ai} = ‘yes’ \) or ‘I, me’.

Furthermore proto-Australian has the conjugate root \( \text{nun} = ‘no’, \) recorded as ‘naiyu’ (Malone, 1875), perhaps corresponding to ‘nen’ or ‘nun’ (ancient Egyptian) with the condensation \( \text{nun} \rightarrow \text{n} \) producing such modern cognates as ‘nei’ (Danish) and ‘nay’ or ‘no’ (English).

\[ Also see Example 1 in C. Illert (2003).

\[ 3This use of \( \text{mif} \) instead of \( \text{nun} \) in the expressions \( \text{WHERE} \) and \( \text{WHEN} \) (Dawes, 1790) and \( \text{HITHER} \) (Rowley, 1875) from the Sydney region, also \( \text{WHERE} \) (Bulmer, 1850s) and \( \text{WHEN} \) (Petitit & Dawson, 1850s) from Gippsland, are probably just errors.

\[ 4This use of \( mif \) instead of \( m \) in the expressions \( \text{WHERE} \) and \( \text{WHEN} \) (Dawes, 1790) and \( \text{HITHER} \) (Rowley, 1875) from the Sydney region, also \( \text{WHERE} \) (Bulmer, 1850s) and \( \text{WHEN} \) (Petitit & Dawson, 1850s) from Gippsland, are probably just errors.

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\[ 2In south-east Australian languages, the condensed root \( \text{mif} \) = ‘yes’ and the pronoun \( \text{mif} = ‘I, me’ \) provide a possible example of homonymy – two different words that just happen to have the same form – as in English where, for example, ‘bank’ denotes both a building (associated with a financial institution) and also an area of ground (along the side of a river). But it is interesting how English has the homophones \( \text{a} = ‘yes’ \) (as in ‘my Captain’) and \( \text{i} = ‘I, me’ \) both of which just might be directly condensed from proto-Australian: \( \text{nun} \rightarrow \text{mif} \rightarrow \text{o} \rightarrow \text{ai} \rightarrow \text{ai} = ‘yes’ \) or ‘I, me’. Furthermore proto-Australian has the conjugate root \( \text{nun} = ‘no’, \) recorded as ‘naiyu’ (Malone, 1875), perhaps corresponding to ‘nen’ or ‘nun’ (ancient Egyptian) with the condensation \( \text{nun} \rightarrow \text{n} \) producing such modern cognates as ‘nei’ (Danish) and ‘nay’ or ‘no’ (English).

\[ 3This use of \( \text{mif} \) instead of \( \text{nun} \) in the expressions \( \text{WHERE} \) and \( \text{WHEN} \) (Dawes, 1790) and \( \text{HITHER} \) (Rowley, 1875) from the Sydney region, also \( \text{WHERE} \) (Bulmer, 1850s) and \( \text{WHEN} \) (Petitit & Dawson, 1850s) from Gippsland, are probably just errors.

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\[ See Example 1 in C. Illert (2003).\]
1030  C. R. Illert


Appendix

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Chapter 2, corrections made

page 150:
In Table 2 label, replaced $\Delta f*$ = $F* - f*$ with $\Delta f* = \int_{-\tau}^{0} \dot{f}_* \, dt$
also please note Table 2 should be located on page 164

pages 164–165:
In equations (15), (16), (17), (18), & lines 13 & 15 replaced italic $f_*$ with plain $f_*$
and replaced italic $F_*$ with plain $F_*$

page 168:
4\textsuperscript{th} line from bottom
Replaced the boundary condition $f_*( -\tau) \equiv f*$ and $f_*(0) \equiv F*$
with $f_*( -\tau) = f*$ and $f_*(0) = F*$

Chapter 3, corrections made

page 181
9\textsuperscript{th} line from bottom
Replaced the boundary condition $f_*( -\tau) \equiv f*$ and $f_*(0) \equiv F*$
with $f_*( -\tau) = f*$ and $f_*(0) = F*$

page 204 for proto-Australian data column set only, replaced $F(\%)$ with $f(\%)$
pages 204 to 213 for all other data column sets, italic $F(\%)$ replaced with plain $F(\%)$

Chapter 4
please note

Table 3 on page 222, is associated with equations (13)
Table 4 on page 223, and Figure 5 on page 217, are associated with equations (14)
Table 6 on page 224, and Figure 6 on page 218, are associated with equations (18)
Table 7 on page 224, and Figure 7 on page 218, are associated with equations (20)
Table 8 on page 225, and Figure 8 on page 219, are associated with equations (21), (22) & (23)
Figure 9, on page 220, belongs with “Original-A (non-PamaNyungan)” on pages 226-229
Figure 10, on page 221, belongs with “Pre-Wolgali type-B (Pama-Nyungan)” on page 229
Table 10, on page 228, belongs with “Sound shifts in Southern-B” on pages 250-251

corrections made
In Table 9 on page 227, replaced $\dot{f}$ with $\eta$ and replaced $\dot{A}$ with $\dot{d}$
Table 9 is shown correctly on the following page.
**Turuwal (H = 9)**
4 stops, 4 nasals, 1 semivowel

\[
\begin{array}{ccc}
\text{stops} & d & d_2 \\
\text{nasals} & n & n \eta \\
\text{semi-vowel} & w & \eta m \\
\end{array}
\]

\(\alpha_3 = 3\)  \(\alpha_2 = 2\)  \(\alpha_1 = 4\)

**Original-B (H = 12)**
5 stops, 5 nasals, 2 semivowels

\[
\begin{array}{ccc}
\text{stops} & d & d_2 \\
\text{nasals} & n & n \eta \\
\text{semi-vowels} & w & y \\
\end{array}
\]

\(\alpha_3 = 5\)  \(\alpha_2 = 3\)  \(\alpha_1 = 4\)

**Original-A (H = 14)**
5 stops, 5 nasals, 2 semivowels, 2 laterals

\[
\begin{array}{ccc}
\text{stops} & d & d_2 \\
\text{nasals} & \eta & n \eta \\
\text{semi-vowels} & w & l \\
\text{laterals} & y & \eta \\
\end{array}
\]

\(\alpha_3 = 6\)  \(\alpha_2 = 4\)  \(\alpha_1 = 4\)

**Southern B (H = 13)**
5 stops, 4 nasals, 2 semivowels, 1 lateral, 1 rhotic

\[
\begin{array}{ccc}
\text{stops} & d & d_2 \\
\text{nasals} & n & n \eta \\
\text{semi-vowels} & w & y \\
\text{lateral} & l & \\
\text{rhotic} & r & \\
\end{array}
\]

\(\alpha_3 = 6\)  \(\alpha_2 = 3\)  \(\alpha_1 = 4\)

**TABLE 9:** likely minimal systems of word-initial (peripheral, lamino-palatal and other) consonants, associated with pre-Wolgalu language super-families, based upon the values \(\alpha_i\) in TABLE 8 inferred from Snell’s Law.

Correctly shown Table 9, from Chapter 4, page 227