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# TYPOLOGICAL AND COMPARATIVE GRAMMAR OF UTO-AZTECAN: I (PHONOLOGY)

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# INTRODUCTION

Ever since Whorf asserted that Shoshonean was not a 'linguistic unit' (1935)—i.e. not a major branch within the Uto-Aztecan family—others publishing comment (as opposed to data) on comparative Uto-Aztecan have said more or less explicitly that they 'agree with Whorf' (e.g. Language 37.187, 1961). Similarly, another major branch—Sonoran—has been asserted out of existence. The third major branch of Uto-Aztecan, consisting of Aztec languages (often called collectively 'Nahuatlan') rests uneasy—since Whorf suggested that it be enlarged by the inclusion of some Sonoran languages into an Aztecoid branch.

Recognition of the three major branches may be said to be the traditional viewpoint of comparative Uto-Aztecan. Denial of the three major branches may be said to be the modern viewpoint.

If any one of the three major branches—say, for example, the traditional Shoshonean branch—cannot be confirmed by phonological developments peculiar to it, the sub-branches within it will have to be restated as direct and coordinate branches of Uto-Aztecan. Thus, in the traditional view, there are four sub-branches of Shoshonean, two represented by single languages (Hopi and Tübatulabal) and two represented by about a half dozen languages in each (Plateau Shoshonean and Southern California Shoshonean). These four sub-branches were correctly recognized by Kroeber in 1907, in the context of a major Shoshonean branch of Uto-Aztecan whose correctness is in question.

Labels for the last two sub-branches, as listed, are embarrassing to the modern view, since they include unwanted terminological implications of the possibility of 'Shoshonean' as a major branch. Hence, Sydney Lamb has proposed the label 'Numic' to replace 'Plateau Shoshonean', and Wick Miller has proposed the term 'Takic' to replace 'Southern California Shoshonean'. Our critical reaction to these proposed innovations is that the first is possible, while the second is impossible. Sydney Lamb's 'Numic' would provide an adequate Shoshoneless term—a virtue if it turns out that the traditional Shoshonean branch cannot be supported by comparative evidence. And 'Numic' is appropriate since it is derived from the term for *person* (i.e. *Indian*) in the languages to which it applies—as is customary in Americanist innovations for language branch labels. The first of these virtues is shared by Wick Miller's proposal; the second is not. It is not appropriate to call the Southern California Shoshonean languages 'Takic' since the derivational basis of this term is not restricted to the languages to which it is intended to apply—the 'Tak-' of 'Takic' appears not only in Southern California Shoshonean languages, but also in Hopi (tá·qa *man*) and in Aztec languages (ta·ka-t, ƛa·ka-ƛ, and teke-t).

Whether appropriate or not, both proposals to employ Shoshoneless terms are made in anticipation that comparative techniques—as such and self-sufficiently—need only wait for 'new descriptive materials' (*op. cit.*) to finally attest the modern view (that Hopi, Tübatulabal, Numic, and Takic are coordinately and directly descended from Proto Uto-Aztecan, without the intermediary of a major Shoshonean branch). And if the 'new descriptive materials' are of question-

able reliability but are the only materials available for a particular language, they are nonetheless accepted as suitable for comparative techniques: that grammars can be good for historical work even if they do not provide good linguistic analyses is argued by Wick Miller in his review of *The Sparkman Grammar of Luiseño* (in Language, as cited above). The modern view in comparative Uto-Aztecan, then, envisages a method for attaining results, as well as the results or conclusions to be attained. The latter, as already mentioned, includes denial of a low number of major branches, but with recognition that new descriptive materials are needed to make the denial demonstrable. And if new materials which are 'of doubtful value to the field of linguistics' (Miller quoting Malécot, *op. cit.*) still have value for historical work, this implies a method for attaining results in historical work with comparative techniques which are self-sufficient—in some way not dependent on 'an understanding of the language' (*op. cit.*, and see also below), perhaps in the sense of being independent of synchronic linguistics. The traditional view in comparative Uto-Aztecan does not differ from this modern view on both counts but only on the first, holding instead that three major branches will someday be demonstrated.

Of the three branches, the one given greatest credence in the traditional view was Shoshonean (that Hopi, Tübatulabal, Plateau Shoshonean, and Southern California Shoshonean, *qua* sub-branches, are coordinately but secondarily descended from Proto Uto-Aztecan through an intermediary stage of development —Proto Shoshonean). In order to finally attest this traditional view, something less than knowledge of synchronic linguistics was called for, if we may take Kroeber as an exemplar of the traditional view—as well we may, since he was one of its principal authors. 'Kroeber undoubtedly was interested in making a contribution to Uto-Aztecan rather than a contribution to the understanding of language' (*op. cit.*, but see above, where comparative techniques that are self-sufficient—not dependent on 'an understanding of language'—are taken in the sense of being independent of synchronic linguistics). We conclude this part of our Introduction without citing further corroborating evidence to show that—in the traditional view, as in the modern view of comparative Uto-Aztecan work—results anticipated (whatever they were or are) seem to be attainable by comparative techniques which are self-sufficient.

The present monograph introduces a third viewpoint in comparative Uto-Aztecan work. It is new in this particular field, but is not new in the world of scholarship; nor is it new to linguistic thinking. In its scientific-philosophical use by Huston Smith, the 'post-modern' is identified as questioning the monolithic orderliness of the 'modern'.

In science, an interesting consequence of the 'modern' adherence to a single or monolithic orderliness was its tendency to take the acceptance of a new theory as spelling the death of its predecessor theory. An interesting consequence of the 'post-modern' tolerance of non-monolithic explanations is the continuity of old theory beside new theory. Thus, in post-modern science, light can both travel as a particle in a straight line and also be a wave—it need not alternatively be



either one or the other. By contrast, in the 'modern' account of the formation of ice ages, for example, preference would be felt for finding that the evidence favored one or another of the following alternatives: that ice ages can be explained as (i) a consequence of the sun giving off less heat; if not, (ii) that less heat would reach the earth as its orbit went further from the sun; if not, (iii) that dust, of volcanic or other origin, lessened the sun's heat reaching earth; if none of these alternatives, then as (iv) a consequence of more snow falling over successive years than melts during summers, with the necessary implication that adjacent unfrozen seas supply the moisture precipitated as snow during winters.

In a parallel way, 'modern' philosophy has been called post-Kantian philosophy, seeking a single metaphysical system among alternatives, whereas 'post-modern' philosophy is multidimensional in its problem: for example, tolerating rather than opposing both the logical positivists' truth (from science) and the existentialists' truth (from the humanities).

In a parallel way, the possibility of continuing the 'modern' linguistic adherence to a monolithic orderliness was questioned by Y. R. Chao's demonstration that there exist non-unique solutions to phonemic problems which characteristically serve as models for morphological and syntactic problems. This question is certainly alive in synchronic linguistics, with all its enabling devices for discovering and describing and isolating the structure of a given language or dialect or idiolect; and if it turns out that a given structure appears superficially to be not the only structure possible for describing a language, some seek the old monolithic security by applying evaluation procedures which will reveal a single 'best' structure for a given language. The popularity of structural restatement linguistics also shows that the question raised by Chao is very much alive; a flood of linguistic papers in the past few decades strive not to add new information to what is known about the languages treated but, rather, to discover better ways of structuralizing these languages (e.g. Joos' *Readings in Linguistics*, where more than half of the papers reprinted are concerned in part or wholly with what we call 'structural restatements'). This telling label—structural restatement—was first applied in the titles of Zellig Harris' journal articles (IJAL) on languages whose structures are sufficiently known to be restructurable, without new data. And the central theme of the same author's *Methods in Structural Analysis* is the consideration of alternative solutions to structural problems in particular languages.

The question raised by Chao might be said to animate structural restatement linguistics; it is also relevant to other fields of linguistics. If, in Weinreich's sense of the term, any two languages are 'in contact'—as languages are more often than not—then they influence each other sufficiently so that neither can be set up as an isolated monolithic structure. But dialects can be unified and languages typologized in such a way that diversity can be incorporated in density range typology. The 19th century typology was monolithic (not reflecting range within the structures typologized); it was centered in the comparison of non-related languages—in sharp contrast to the 19th century 'comparative

method' which was restricted to comparing none too remotely related languages. We have been influenced by our predecessors to associate 'typology' as well as structural analysis with synchrony, and the 'comparative method' with diachrony; and, more generally, to distinguish sharply between synchronic and diachronic linguistics.

A counter-influence to this association is beginning to be exerted by Henry Hoenigswald's diagrammatic typology for *Language Change and Linguistic Reconstruction*, based on 'patterns of replacement' between a parent language, $L_1$ (whether written or reconstructed), and its own lineal descendent, $L_2$. Since 'patterns of replacement' require just as exact structural information on lineally descended languages for purposes of diachronic analysis as for purposes of synchronic analysis, something like a confluence of the two analyses can be discerned; and in this discernment, reconstructive techniques are not self-sufficient. This awareness amounts to a counter-influence to the sharp segregation of the 'comparative method' from synchronic linguistics. (Conversely, an extreme expression of the latter as an analysis of structure frozen for a moment of time—but long enough to permit delineation of its monolithic features—is being re-expressed.)

This 'post-modern' discernment, this counter-influence, has been fully appreciated neither by Hoenigswald's reviewer in Language, nor by his reviewer in IJAL.[1] But still, when the latter (Householder) says 'that morphemes are more absolutely and unconditionally independent of morph-shape than phonemes are of phonetic substance', it would be hard to tell—out of context—whether the reviewer is commenting on structural analysis in synchronic linguistics, or on the construct of morphemic permanence behind morph-replacement in diachronic linguistics.

We hope that the present monograph will give some additional impetus, though from a different direction, to the counter-influence originating in the camp of the comparativists. What is meant here by 'from a different direction' is the application of structural typology (reflecting range within the structures typologized) not to the comparability of unrelated languages, but to the comparability of related languages—the application of such typology in conjunction with the employment of reconstructive techniques.

[1] In fairness to these reviewers, we must admit that Hoenigswald does not spend much space explicating this discernment, but instead seems to take it all for granted in LCLR. He is, however, more explicit in his IJAL Notes on Change and Reconstruction (Vol. 28 No. 1): "In the twenties and thirties the woods were full of anti-neogrammarians who proclaimed the fundamental unity of all change processes." (fn. 5). This is to be taken in the context of what Hoenigswald has done in LCLR, a few decades later: he has found focus for typologizing separate change processes by using the construct of synchronic linguistics as a point of departure. If 'modern' proponents of 'the fundamental unity of all change processes' were to typologize what in their view is unified or monolithic, that too would be interesting. There is really nothing controversial in the 'post-modern' LCLR; questions of apparent differences simply hinge on what one is used to, or what one can take for granted—e.g. "In grammar everybody is by now used to defining form classes by the distribution of their members . . ." (*op. cit.*, IJAL, fn. 3).



A minor interest in the present monograph is the bafflingly belabored question of 'remote' relationships, as between the Uto-Aztecan family and the Tanoan family. A language family is defined as a group of languages which may be reconstructed from daughter languages both in phonology and, in large measure, in morphology and syntax. A 'remote' relationship is defined as the relationship between two language families such that the phonologies of the two may be (in part) reconstructed, while what is sometimes called the 'grammar' of the two—the morphosyntax—is so divergent as to defy reconstruction. It would certainly be next to impossible to reconstruct the grammar of both Uto-Aztecan and Tanoan, and wholly impossible to reconstruct the 'grammar' of Macro-Penutian in which the Uto-Aztecan family and the Tanoan family are sometimes included. But as between Uto-Aztecan and Tanoan, phonological reconstructions are possible and reasonable, though morphosyntactic reconstructions are not. Typologically, the phonology of Tanoan is quite homogeneous but does not even resemble the phonologies typologized in the Uto-Aztecan family. This suggests a negative or extremely complex correlation between typologized phonologies and reconstructed phonologies which are remotely related; and the correlation between typology and reconstruction within one family—as Uto-Aztecan—is far from simple.

Since some correlation between typologizing and reconstructing emerges, the two are taken as paired dimensions in the comparison of the Uto-Aztecan languages. Quantification introduces at least three additional dimensions or parameters.

The correlation between phoneme frequencies (expressed as rank-orders) and branches or sub-branches (attested by reconstructive procedures) is often surprisingly clear cut.

Glottochronology has to be discussed as a relevant parameter for Uto-Aztecan languages, since two independent sources give us two separate sets of dates for time of separation among languages in this family. This discussion was written at a propitious moment in our collaboration—just after we received galley proof on Knut Bergsland's and Hans Vogt's paper (On the Validity of Glottochronology) from the editor of *Current Anthropology*, together with an invitation to write a Comment to be published with the Validity paper in *Current Anthropology*. As will be apparent, the two tasks proved to be reciprocally influencing. The Comment is in large part an adaptation from Chapter 4; Chapter 4, in turn, was written with an awareness that our subsequent Comment would raise the question as to whether or not the Bergsland-Vogt counter-examples would stimulate transformational effort—work to transform the old glottochronology (with its constant rate of change for all the world's languages) into a new glottochronology (whatever that may be). It all depends, of course, on how one reacts to counter-examples. Experimental scientists can be said to be not wholly intolerant of counter-examples insofar as they vary the experiment—rather than throw out the experiment—when counter-examples are encountered. The reaction of mathematicians appears to be that a single counter-example invalidates a

postulate. Hence the old joke told by friends of mathematicians at the expense of experimental physicists: the postulate that all odd numbers are primes is supported by the fact that 3 is a prime, 5 is a prime, 7 is a prime; but 9 is an experimental error.

It is possible that glottochronology will be discouraged (as a consequence of the counter-examples) from further pursuit of the one and only constant rate of change for all languages of the world in respect to its 100 word or 200 word test list, and instead be encouraged to employ this admirably contrived test list for lexicostatistic purposes. Lexicostatistics, as adapted to Uto-Aztecan languages, compares cognate densities (a) as computed by the lexically restricted test list, and (b) as computed by the relatively unrestricted dictionaries of the daughter languages. We hope that something like Sneath's computer taxonomy of bacteria may, before too long, be incorporated in lexicostatistics.

Part I of this study of Uto-Aztecan is concerned with three interrelated approaches to language change; typological, reconstructive, and quantitative. A fourth approach—concerned with cultural domains—is scarcely touched upon in Part I, but will be quite visible in subsequent parts of this monograph.

It was hard for us to imagine how any of the three approaches as listed above, might be in conflict with each other, since in our collaboration we held no brief that, when languages began to separate after Proto Uto-Aztecan times, the cleavage was necessarily sharp and final, on the one hand, or on the other hand, that groups of languages necessarily—and in all areas—remained in contact and kept borrowing from each other. It seemed to be our job to assemble interpretable data to show where one or the other of these things may have happened in Uto-Aztecan; or both but at different times—sharp cleavage and continuing contact. We were not unaware of the possibility that one or two of the three traditional branches—denied in the modern view of Uto-Aztecan—might be supported as language groups in the linguistic area sense, or that evidence might support neither a low number of branches nor a low number of areal groupings, or that evidence might revive the traditional three major branches, supplemented perhaps by many smaller areal groupings. These considerations imply a bidimensional tolerance (which Hjelmslev and others might unify under topology)—not exclusively for the HIERARCHAL FAMILY TREE MODEL (generating branches and sub-branches) but also for a languages-in-contact or AREAL GROUPING MODEL (generating other constructs discussed below).

The well established linguistic area or areal linguistic plan of research differs from our AREAL GROUPING MODEL in that it characteristically looks for diffusion, attested by shared structural features, among non-related languages—rather than among related languages—as in Franz Boas' early treatment of glottalized stops in the Northwest Coast of the New World, or as in Murray Emeneau's recent survey, beginning with the observation that retroflex consonants are found in all languages of the Dravidian family but only in those Indo-European languages that are spoken in India; and then observing other features shared by non-related languages in India, in the Far East, and in Oceania; and then ending



with the observation that features may overlap between Old World and New World linguistic areas. Areal linguistics is thus very much like phylum linguistics, concerned with 'remote' relationships which are demonstrable by lexical correspondences, rather than by isolated features of structure. But the minimum scope of areal linguistics and phylum linguistics is the same: two language families. Both characteristically go on from there to continental boundaries, and neither fears to postulate intercontinental connections.

Our areal grouping model adapts constructs which may have originated in dialect geography, or in areal linguistics, or in phylum linguistics, or in comparative method linguistics; but these constructs—with all their waves, and drifts, and L-complexes, and networks of isoglosses, and chains which mesh by a new principle—are restricted to one language family. They need to be described and distinguished from reconstructions which make possible the family tree model—with its branches and sub-branches—also restricted to one language family.

When Uto-Aztecan is the 'one language family' under consideration, AREAL GROUPINGS and BRACHIATION are not easily distinguishable. What we see, when we first look at Uto-Aztecan, is a reticulum—a pattern which, though complex, is apparently orderly; yet the surface ordering of this pattern does not reveal the distinctions which we seek.

We have been working toward finding and attesting sub-surface distinctions in Uto-Aztecan, as identified above. In our procedure, we have reconstructed where we had evidence to reconstruct, typologized whether or not reconstruction was possible, and quantified rather casually wherever quantification promised to be interpretable. In reporting on what emerged from following these procedures, we were bothered by the controversy already noted—between the 'traditional' and 'modern' viewpoints in comparative Uto-Aztecan—and wanted no part of it. Though we were disinterested in our working procedures, it was still hard to avoid the misleading appearance of taking sides in the report of our work—a report which we hoped would cumulatively lead to interpretation rather than have some controversial anticipation defended. To accomplish this we debated the possibility of using only language names—a score or more—and avoiding labels both for AREAL GROUPS of languages, and for BRANCHES within UA (in the earlier chapters of our report), but decided that that would make for difficult exposition. We also considered using the terms 'Northern UA' for Shoshonean, 'Middle UA' for Sonoran, and 'Southern UA' for Aztec languages, but decided that too would be misleading, if it were taken as a linguistic commitment to AREAL GROUPS *vs.* BRANCHING. The style which we did adopt for the early chapters of our report was to discuss similarities between two or more languages under traditional branch labels for the languages in question, but to be punctilious in specifying each time that the 'branch' was the 'traditional' one rather than one which we were ready to support.

The first four chapters which follow—with their references to 'traditional' branches—are published in the approximate order in which we wrote them last

summer at the Museum of Northern Arizona. Our collaboration was greatly facilitated by the opportunity to work together at the Field Station for Linguistics and Ethnology, sponsored jointly by the Museum and by Indiana University; and we thank the administrators chiefly responsible for making possible this efficient arrangement: Doctors Harold S. Colton and Edward B. Danson, of the Museum, and the Dean of the Graduate School, Vice-President John W. Ashton of Indiana University. Our indebtedness on the substantive side is equally great: to the late A. L. Kroeber and his collaborator George Grace for their kindness in letting us examine their Lusieño grammar in manuscript a few years ago; also a few years ago, and again last summer, to Sydney Lamb who allowed us to use his highly reliable description of Mono (Ph.D. thesis); to Hansjakob Seiler who has sent us invaluable manuscript materials on Cahuilla; to Sven Liljeblad whose extraordinarily extensive manuscript materials on Bannock have likewise been put at our disposal; and to Joseph Casagrande for most interesting manuscript materials on linguistic acculturation in Comanche. The report which follows would have been impossible without this unpublished information, and other unpublished information on other Uto-Aztecan languages based on field work by the collaborators. More specific detail on our use of manuscripts and a bibliography of published sources used in this part of our Uto-Aztecan study is given in **2.3**.

A final word on the final chapter: it did not turn out as we had planned it. As we were writing the first four chapters in Arizona, we would ask ourselves whether a given problem should be summarized in Chapter 5 in order to support and characterize AREAL GROUPING in Uto-Aztecan, or in order to support HIERARCHAL FAMILY TREE BRACHIATION—the latter, of course, only when reconstructions permitted statements of descent to particular daughter languages. After a brief break—on returning to the task of writing Chapter 5—it appeared that much of the phonological information appropriate for areal grouping would be more interpretable if combined with morphosyntactic information. It also appeared that some of our phonological information from the daughter languages, which we reconstructed in the earlier chapters *qua* Proto Uto-Aztecan, could also be reconstructed *qua* major branches. As a final decision, then, we decided to impoverish the last chapter in one respect, and enrich it in another: to omit a systematic summary of AREAL GROUPING from Chapter 5 (and to include this, instead in Part II); and to reconstruct Proto Aztec, Proto Shoshonean and Proto Sonoran—for the first time—in Chapter 5.

September, 1961.

# CHAPTER 1

## PHONEMIC SYSTEMS TYPOLOGIZED



**1.0.** The phonemic inventory of each language is described independently. Though this entails an inevitable repetition in the use of much the same technical terminology and explications from language to language, it does make it possible to consult the inventories in a different order than that given, or to select any one inventory for special reference without systematic reference to the others.

In the technical exposition of one phoneme in a given language—e.g., Papago—we use one symbol /t/ even though the Papago /t/ is produced in a more fronted position than the /t/ which is recorded, without change in phonemic orthography, for sister languages. This is usual practice. As long as a language does not make a contrast between [t̪] and [t] and [t̠], one phonemic /t/ is used to represent any of the three phonetic [t]'s.

However satisfactory this usual procedure may be for one language, it leaves something to be desired when two or more languages are under phonemic comparison in terms of synchronic structures (**1.2**) rather than in terms of point for point correspondences for reconstruction, as in the chapter after this. In **1.2** we want to say that the Papago phoneme /t/ is like /t/ phonemes in some sister languages, and also note—at the same time—that the Papago instance is more fronted than some others. To do this, we first assign the number (2) to all t's and other consonants produced by tongue-tip; the number (3) to all consonants produced by tight or loose contact with tongue-blade; the number (4) to consonants whose production involves the dorsal region of the tongue, and so on—but this is not enough. However, this does permit typological matching—but without non-distinctive phonetic differences indicated for labial consonants (1), and for apicals (2), laminals (3), dorsals (4), and laryngeals (5). Some non-distinctive phonetic differences are also indicated by adding diacritics to a number, as (2̂) for fronted apico-dental /t/ in Papago—but (2), without diacritic, for apico-alveolar /t/ in Tübatulabal. In general, we give specification of allophonic range both in instances like this and in related instances of intralanguage consonant matching—e.g. between Nahuatl stops and nasals, since allophones of the latter are found in positions which are contrastive for stops.

For the most part, the numbers (1), (2), (3), (4), (5) are used to indicate positions of articulation, as indicated. But additional diacritics are also juxtaposed to these numbers, as (4) *vs.* (4̣), when phonemic contrasts are made in neighboring positions, as /k/ *vs.* /q̣/; and also when phonemic contrasts are made—generally once only in a given series (of stops, for example)—by combination of a distinctive component, as labialization, with the consequence that

phonemic contrast will occur in the same position; thus, where /k$^{w}$/ contrasts with /k/, both are at dorso-velar position, but at different linear distinction points: (4°) and (4), respectively. Labialization is the source of an additional linear distinction in most UA languages (as (4°)), but combines with three stops in Cora and in this system functions as a Series Generating Component, since it generates a new line or series of stops.

The section which follows (**1.1**) can be read advantageously with paper and pencil in hand. Tabular arrangements possible are so numerous, and so diversely suitable for diverse purposes, that they have been deliberately avoided in print—or rather, the technical exposition of each phonemic system is deliberately arranged to facilitate the reader's own plotting or reordering of the phonemes.

The fact that we consistently match glottal stop and near-open contact /h/ at laryngeal position (5) may seem to be insensitive to the general correlation of the lingual articulation of /h/ with adjacent vowels; this kind of correlation has been rather overstated for one of the Nahuat languages: 'The point of articulation of the /h/ varies according to the tongue position of the vowels contiguous to it' (IJAL 24.109, 1958). The 'point of articulation' at which the turbulence of air originates is surely in the larynx; to obtain consonantal turbulence some constriction greater than fully open is called for (hence 'near-open contact'); vowels are distinguished from consonants precisely in being more open—one might say fully open, but of course the matter of openness is relative. As a continuant, [h] correlates with adjacent vowels in lingual movement—but whispered vowels in Southern Paiute and Comanche, for example, are not a consequence of juxtaposition or coincidence of /h/ and vowels. It is quite possible for [h], in its association with lingual movements, to be as fully open as an adjacent vowel, and yet say that—in its consonantal aspect—[h] is less open than vowels laryngeally; hence the consonantal 'point of articulation' of /h/ is at (5). The glottal stop, also at (5), appears in allophonic alternation with [h] in some of the daughter languages.

The rank-orders are given in descending order for the relative frequency of two or more phonemes in a given series (or among unit phonemes combined with SGC). For single phonemes in a series, and for vowels generally, we divide the total number of rank-orders of all unit phonemes (both vowels and consonants) by four, and specify the quartile—first, second, third, or fourth, in descending order of frequency—in which the single consonant or set of vowels appears. This gives only the roughest approximation of differential functional load among the phonemes in a given language, since our sample for the frequency count is about 100 words, taken either from the already published lexicostatistic list (IJAL 25.114–21, 1959), or from the first 100 words in a text (or in a structural paper cited in the bibliography of sources).

**1.1.** The order of presentation is from greater to less number of linear distinctions in the stop series of the phonemic systems typologized in our **1.1** sample, namely:
8 linear distinctions among stops in Nahuatl, Southern Paiute, and Mono;



7 linear distinctions among stops in Hopi, Bannock, Cahuilla and Luiseño, with the last pair typologized in a single statement to emphasize the phonological closeness—and shared peculiarities—of these two languages (and though a few Aztec languages appear with 7 linear distinctions among stops—Zacapoaxtla, Mecayapan, and Tetelcingo alias Matlapa—they are not separately typologized in **1.1**, but are discussed in **1.2** ff; where the so-called 'saltillo' is phonemicized as a glottal stop, as in the Nahuatl dialect which does appear in our typological sample, there are 8 linear distinctions; where /h/ is used in transcriptions and /ʔ/ is not, there are 7 linear distinctions among stops);
6 linear distinctions among stops in Tübatulabal, Comanche, Yaqui-Mayo, Huichol, Cora (and also in Shoshone, Kawaiisu, Pipil, and Pochutla which are not separately typologized in **1.1**, but are discussed in **1.2** ff); and finally,
5 linear distinctions among stops in Tarahumara and Papago.

### Nahuatl (Milpa Alta)

No language in the UA family includes more stops in a single series (uncombined with SGC) than eight. This maximization of distinctions among stops is a consequence of pairs of stops being produced at about the same position for each pair; in terms of linear distinctions the eight Nahuatl stops occur at (1); (2), (2$^{+}$); (3), (3$^{+}$); (4), (4°); (5).

Since the distinguishing component for a given pair in Nahuatl is in no instance identical with that for any other pair, none of the distinguishing components can be taken as a Series Generating Component. The pairs of stops in question occur at:
(2) and (2$^{+}$): apico-alveolar without off-glide for /t/, but with fricative off-glide for /c/ (here the superscript in (2$^{+}$) indicates the fricative off-glide component);
(3) and (3$^{+}$): lamino-alveolar with fricative over-the-blade off-glide for /č/, but with spirantal lateralized off-glide for /x̌/ (here the superscript in (3$^{+}$) indicates the lateralized component in the off-glide);
(4) and (4°): dorso-velar (here the superscript in (4°) indicates the labialization component which distinguishes /k$^{w}$/ from /k/).
In addition to these six stops, two non-paired stops also occur—at (1), bilabial /p/, and at (5), laryngeal /ʔ/ (the so-called 'saltillo', an aspirated glottal stop, [ʔ$^{h}$], which is sometimes transcribed as [h] because the glottal check is very lenis in utterance-final, though fortis enough to be always heard in utterance-medial where, however, flanking voiced phonemes are never intensified in voicing). The rank-order is /k x̌ t p k$^{w}$ c ʔ č/.

Matching with stop consonants is double for the fricative series, for the nasal series, and for the glide series, but single for the lateral series.

Loose-contact fricative /s/ matches at (2$^{+}$), /š/ at (3). The rank-order is /s š/.

The phonemic orthography shows that nasal consonants match stop consonants at two positions: /m/ at (1), /n/ at (2). Since the allophones of Nahuatl /n/ occur not only [n] at (2) but also [ŋ] at (4), while the stop consonants at (2) and at (4) are phonemically contrastive, the matching between stops and

nasals is not entirely symmetrical. The disturbance to the symmetry of matching due to the non-adjacent allophones of the /n/ phoneme raises a question as to how to count the score so that any one phoneme is coordinate with any other phoneme in terms of matching, and at the same time to recognize in the total score the phonetic fact of allophonic extension. The matching between stop and nasal at position (1) is not disturbed by allophonic considerations; a second phonemic matching must be counted to relate two nasal phonemes to stops; but a third matching must be phonetically recognized to relate three stop phonemes to nasal phonemes and allophones. The total score of matching between stop and nasal consonants is accordingly stated as '2 ± 1' (= double phonemic matching plus-or-minus one allophonic extension). The rank-order is /n m/.

Glide /w/ matches at (1), /y/ at (3). The rank-order is /w y/.

To say that lateral /l/ matches lateralized stop /ƛ/ at (3+) accounts for only one allophone of /l/, namely voiceless [l̥], which is made with tongue-blade contact. To account for the other allophone of /l/, namely voiced [l], made with tongue-tip contact, the matching would be said to be at (2). The matching score actually given for both allophones of the single phoneme /l/ is '1 ± 1' (= single phonemic matching plus-or-minus one allophonic extension). This lateral falls in the second quartile of rank-orders for all phonemes.

The vowel inventory is typologized as 2(FB)—as vowels contrasting at two tongue heights, with F (front) and B (back) contrasts occurring at each tongue height: two high vowels /i o/ and two low vowels /e a/. Each vowel is combinable with an SGC of length.

The short vowels all fall in the first quartile of rank-orders for all phonemes, /i a o e/ (in that order); of the long vowels, /a· i·/ fall in the third, and /e· o·/ in the fourth quartile.

## Southern Paiute

Our older source (Sapir) is extremely detailed but pre-phonemic in presentation, and our present informants exhibit some idiolectic variety. Our information for Southern Paiute shows much intralanguage variability—generational differences as well as differences among individuals in the same generation. Intralanguage variability in general tends to increase alternative possibilities in phonemicizing; for Southern Paiute the chief alternative is whether to set up an SGC—or more than one—to combine with plain stops, thereby generating more than one series of stops; or to set up a single series of plain stops. We incline to the latter and give, to begin with, the positions in which this single series of voiceless stops occur, and say that for each position it is possible to cite a cluster with preceding /x/. It would have been possible formerly to cite glottal stops also in cluster with all oral stops—but not all stops are glottalized in the speech of present day Southern Paiutes, though such glottalized stops have been cited from the speech of informants in the first decade of this century.

The eight linear distinctions among stops are produced at a half dozen positions, as follows:
(1) bilabial /p/;



(2) and (2+) apico-alveolar /t c/, the latter with loose-contact fricative off-glide (at tongue-tip);
(3) lamino-alveolar /č/, with loose-contact fricative off-glide (at tongue-blade);
(4) and (4°) medial dorso-velar /k kʷ/, respectively; labialization distinguishes /kʷ/ (4°) from /k/ (4)—fronted, since Sapir's day, from (4̣ᵒ) to (4°);
(4̣) back dorso-velar /q/;
(5) laryngeal /ʔ/. The rank-order is /p t q, k and kʷ, ʔ and č, c/.

Nasal and fricative series quadruply match stop consonants in each series; the glide series matches stop consonants doubly, the flap series singly.

Nasal /m/ matches at (1), /n/ at (2), and /ŋ ŋʷ/ at (4) and (4°), respectively. The rank-order is /n m ŋ ŋʷ/.

Fricative /v/, being always labio-dental at (1̣), only partially matches bilabial stops at (1); loose-contact fricative /s/ fully matches stops at (2+); loose-contact fricatives /x xʷ/ match at /4 4°/, respectively, but one of the allophones of /x/ is almost open-contact [h]—matching at (5) rather than (4). To account for this asymmetry, the score given is '4 ± 1' (= four matchings plus-or-minus one allophonic extension). The rank-order is /x v s xʷ/.

Glide /w/ matches at (1), /y/ at (3).

Flap /r/ (rather than glide /r/ found elsewhere in UA) matches at (2).

The vowel inventory is typologized as dual level (FCB) over N—as vowels contrasting at a higher tongue height in respect to F (front) /i/, C (central) /ɨ/ and B (back) /u/, and with one vowel at a lower tongue height, /a/, which is neutral (N) in respect to (FCB) contrasts. Long vowels are phonemicized as clusters of two identical vowels; SGC of stress is combinable with all vowels (in an alternation of stress system).

In the rank-orders of all phonemes, the short vowels /a i ɨ u/ (in that order) fall in the first quartile; the long vowels in the last quartile.

## Mono

Of the alternative possibilities in the phonemicization of Mono, we incline to setting up a single series of plain stops (with voiced as well as voiceless allophones) and stating that all the oral stops appear in cluster after /h/—after which the stops are voiceless and lengthened—rather than deriving a second series of unit stops in combination with an SGC of preaspiration or gemination. In addition to the single stops at (1) /p/ (bilabial) and at (5) /ʔ/ (laryngeal), linear distinctions among the remaining six stops appear in three pairs, at:
(2) and (2+): /t c/ (apico-alveolar);
(4) and (4°): /k kʷ/ (medial dorso-velar);
(4̣) and (4̣°): /q qʷ/ (back dorso-velar).
Rank-order is /p t ʔ, k and q and c, kʷ qʷ/.

Matching with stop consonants is triple for the fricative series, double for the nasal series, single for the glide series.

Fricative consonants match at three positions: /s/ at (2+), /x/ at (4̣) and /h/ at (5); of the environments in which /s/ and /x/ appear, one is in cluster after

/h/; indeed, /s x/ occur medially only after /h/. The rank-order shows /h s/ with /x/ lacking in our frequency sample.

Nasal consonants match stop consonants at two positions /m/ at (1) and /n/ at (2); both appear in clusters after /h/, as well as in other environments. The rank-order is /n m/.

Of the two glide consonants /w/ matches stops at position (4°), but /y/ at position (3) is unmatched, unless indeed the allophonic range of stop at 2+ extends to (3).[2] The rank-order is /w y/.

The vowel inventory is typologized as 2(FCB)—as vowels contrasting at two tongue heights and at three positions: F (front) /i e/, C (central) /ɨ a/, and B (back) /u o/. Length is phonemicized by cluster solution; stresses are said to be non-phonemic since their placement can be stated in environmental terms.

The rank-orders show that vowels fall in the following quartiles of all phonemes: /a i/ in first, /o ɨ/ in second, /u e/ in third, and long vowels in the fourth quartile.

## Hopi

The half dozen oral stops in Hopi might, as an alternative phonemicization, be said to be combinable with an SGC of preaspiration, thereby generating a total of a dozen oral stops. But it would turn out that plain stops are consistently combined with preaspiration in only one Second Mesa village; that in other dialects, the presence or absence of such preaspiration is fixed for some morphemes but is a matter of free morphophonemic alternation for others; that there are idiolects, rather than whole-village dialects in which such preaspiration is almost completely avoided. In anticipation of a unified Hopi structure, we analyze the preaspiration /h/, when it occurs, as the first member of a consonant cluster (with close or open cluster transition characterizing idiolects and dialects). The second member of the cluster may be any of the half dozen oral stops, but not the glottal stop.

All seven Hopi stops are voiceless; they occur at the following linear distinction points: (1) /p/ bilabial; (2) /t/ apico-alveolar; (2+) ~ (3) /c/ is apico-alveolar (women speaking) or lamino-alveolar (men speaking), with fricative off-glide for both sexes;[3] (4) and (4°) /k kʷ/, respectively, are both dorsal-velar, with diacritic (small o in 4° and small ʷ in kʷ) indicating a simultaneous component of labialization (and /kʷ/ is more stable than /k/ which palatalizes at (4͡) before some vowels, most frequently in the sequence [kʸa]); (4̣) /q/ back and unpalatalizable dorso-velar; (5) /ʔ/ laryngeal. The rank-order of stops is /p t k ʔ q c kʷ/.

[2] Something like this must lie behind Sydney Lamb's statement that he would match frontal (tongue-blade) /y/ with apico-alveolar stops; and more generally, he says: 'For Mono one can combine apico-alveolar and frontal into a single position which I call simply front.' [personal communication]; as for /w/ matching /kʷ/ rather than /p/, this again is on the authority of Sydney Lamb, who says '/w/ has both dorsal-velar and labial articulation'.

[3] Men quite occasionally lapse into the tongue-tip articulation of women, but women pretty completely avoid tongue-blade articulation characteristic of men.



The nasal series matches stop consonants quintuply, while the glide series triply matches and the fricative series doubly matches the stops.

Nasal /m/ matches at (1), /n/ at (2), /ŋ ŋʷ/ at (4 4°), respectively; and a fifth nasal consonant, /ŋʸ/, may be said to be convergently matched or, in another sense, to be only partially matched with any stop consonant—when the allophone of /k/ is palatalized at (4͡). The rank-order of nasals is /m n ŋʷ ŋ/, with /ŋʸ/ not appearing in our frequency sample.

Glide /w/ matches at (1), and glide /r/ (not to be confused with the more common flap series /r/ in other languages) matches at (2); glide /y/ matches at (3), man speaking, but is unmatched in the idiolect of women in which /y/ is the only laminal consonant. The rank-order is /w y r/.

Fricative /s/, loose-contact, matches at (2+)—woman speaking—or (3)—man speaking; and /h/, almost open-contact fricative, matches at (5). The rank-order is /s h/.

The vowel inventory is typologized as symmetrically as possible—though it has also been characterized as wholly asymmetrical. In the symmetrical view, Hopi vowels are dual level (F BB°) over (FF° B). That is to say, contrasts at an upper tongue height are /i ɨo/—three vowels which distinguish F (high front unrounded) from B (mid to high, central to back unrounded) from B° (mid to high back rounded). So also but inversely (in respect to placement of the feature of rounding: FF° instead of BB°), contrasts at a generally lower tongue height are /e ö a/—three vowels which distinguish F (mid to low front unrounded) from F° (the same, rounded) from B (central to back unrounded). These vowels, having the value of one mora, are combinable with SGC of additional morae of length, and also with stress (in an alternation of stress system).

Our frequency count shows that /a i ɨ o/ (in that order) fall in the first quartile, /ö/ in the third and /e/ in the fourth quartiles of rank-orders for all phonemes. Long vowels all fall in the third and fourth quartiles.

## Bannock

In addition to the glottal stop /ʔ/ at (5), there are six oral stops which are voiceless. Of these, one pair occurs at distinction points (2) and (2+), /t c/—the latter with fricative off-glide; another pair at (4) and (4°), /k kʷ/—the latter with labialization component. Unpaired voiceless stops appear at (1) and (3): /p/ and /č/, respectively. All the oral stops save /č/ are combinable with a voiced-obstruent SGC, thereby generating an additional series of five rather than six obstruents (plosives alternating with fricatives—so /b/ and /g/ freely alternate as [b] ~ [β] and [g] ~ [γ]); the matching of voiced and voiceless oral stops does not occur at (3) /č/ (lamino-alveolar), but does occur at:

(1) /p b/ (bilabial);
(2) and (2+) /t d/ and /c ʒ/ (apico-alveolar);
(4) and (4°) /k g/ and /kʷ gʷ/ (dorso-velar).

The rank-order of the eleven oral stops and the glottal stop /ʔ/ at (5) is /k t p b ʔ d č, kʷ and g, gʷ/, with /c ʒ/ not appearing in our frequency sample.

The nasal series matches stop consonants triply, the fricative series matches doubly, and the glide series singly.

Nasal consonants match stop consonants at three linear distinction points: /m/ at (1), /n/ at (2), and /ŋ/ at (4). The rank-order is /n m ŋ/.

Though stops with loose-contact fricative off-glide are distinguished at tongue-tip (2⁺) and at tongue-blade (3), this distinction is not made by the fricative series; tongue-tip fricative /s/ matches stop at (2⁺) and the more open-contact fricative /h/ matches stop at (5). The rank-order is /s h/.

Glides /w y/ match stops at (1) and (3), respectively. The rank-order is /w y/.

An attempt is made to state the vowel contrasts as symmetrically as possible for a system in which there are three vowels, /i ɨ u/, at a higher tongue height than two other, rather than three other vowels—namely, /a o/. It is possible to say that there are two contrasts in tongue height even though the /a/ ranges lower than the opposing /o/, and even though the /ɨ/ ranges from mid to high—and high alone is the tongue height for the flanking /u/ and /i/. The latter alone—that is, /i/—does not contrast with a lower tongue height F (front) vowel. Accordingly the vowels are typologized as dual level F + 2(BB°), with B (back to central unrounded) contrasting with B° (back rounded) at each tongue height—relatively high /ɨ u/ and relatively low /a o/. SGC combinable with vowels are length, stress and tone.

The vowels /a i u ɨ/ appear (in that order) in the first quartile, /o/ in the second, and long vowels in the third and fourth quartiles of rank-orders for all phonemes.

## Cahuilla and Luiseño

Stops and glides are identical in Cahuilla (Ca) and Luiseño (Lu).

The fricatives occur at six linear distinction points in Cahuilla, but at seven in Luiseño. The nasal series includes four unit phonemes in Ca, but only three in Lu. The lateral series includes two unit phonemes in Ca, one in Lu. The flap series includes one phoneme in Lu, none in Ca. The Lu vowel inventory and the inventory for long vowels in Ca are typologized in the same way—2(FB) over (N); but a coexistent short vowel system in Ca is briefer and more symmetrical —2(FB).

Seven linear distinctions among stops are produced at: (1) bilabial /p/; (2) apical /t/; (3) lamino-alveolar /č/; (4) and (4°) medial dorso-velar /k kʷ/, respectively; (4) back dorso-velar /q/; and (5) laryngeal /ʔ/. Rank-order of stops in Ca is /ʔ t k p q č kʷ/, derived from our 100 word list; the fact that the frequency count for Lu was based on the first hundred words in the first text in our source may in part account for the rather strikingly different rank-order in Lu: /p k t ʔ č q/, with /kʷ/ not occurring in our Lu frequency sample.

The fricative series matches stop consonants sextuply. The nasal series matches stop consonants triply in Lu, quadruply in Ca. The lateral and glide series match stops doubly in Ca, and doubly for glides but singly for lateral in Lu. The flap series matches stop singly in Lu; this series is lacking in Ca.

Fricative /v/ matches at (1), /s/ at (2), /š/ at (3), /x xʷ/ at (4 4°), /h/ at (5). The rank-order of fricatives in Ca is /s š x h v/; compare the Lu rank-order: /š, x and h, v s/, with /xʷ/ appearing neither in our Ca nor in our Lu frequency sample; fricative /ð/ at (2) is likewise infrequent in Lu rank-order, and absent from the Ca inventory.



Nasal /m/ matches at (1), /n/ at (2), /ŋ/ at (4); and Ca /nʸ/, lacking in Lu, matches at (3). Rank-order for nasals is /m n ŋ/ in both Lu and Ca (with /nʸ/ not appearing in our frequency sample).

Lateral /l/ matches at (2), and Ca spirantal /ɬ/, lacking in Lu, matches at (3). Ca /l/ falls in the second quartile of rank-order for all phonemes; /ɬ/ did not appear in the frequency sample.

Glide /w/ matches at (1), /y/ at (3). In both Lu and Ca, /w/ falls in the second quartile, /y/ in the third (Lu) or fourth (Ca) quartiles of rank-orders.

Lu flap /r/ matches at (2). The flap series is lacking in Ca. And cognates with Lu instances including /r/ are also lacking. In Lu, both /l/ and /r/ (in that order) fall in the fourth quartile of rank-orders for all phonemes.

The Lu vowels, whether or not combined with SGC of length, and the Ca long vowels are typologized as triple level 2(FB) over N: as vowels contrasting at three tongue heights of which the two higher tongue-height contrasts are at F (front) short /i e/ or long /ii ee/ and at B (back) short /u o/ or long /uu oo/, over a third tongue height (N)—i.e., all other vowels are at a higher tongue height than short /a/ or long /aa/, neutral or non-contrastive in respect to (FB). A coexistent vowel system for short vowels in Ca is typologized as dual level 2(FB)—as four rather than five vowels contrasting at two rather than three tongue heights: F /i e/ and B /u a/. Vowels in both Ca and Lu combine with SGC of stress.

Lu vowels /a o i u/ (in that order) appear in the first quartile, /e iː aː/ in the third, and /oː eː uː/ in the fourth quartile of rank-orders. A few Ca vowels do not appear in our frequency sample; those which do show /a i e/ in the first, /u/ in the second, and /ee/ in the fourth quartile of rank-orders.

## Tübatulabal

Five voiceless oral stops combine with a Series Generating Component (SGC) of voicing, thereby yielding ten oral stops. It would also be possible to phonemicize the previously analyzed cluster sequence 'homorganic nasal before stop' as SGC of nasalization combinable with the voiced stop series, thereby yielding an additional set of five unit stops. Doing this now, we say the first set of five stops is voiceless, the second set is combined with one SGC (voicing), while the third set is combined with two SGC (nasalization and voicing).

The uncombined or plain stops and the corresponding unit phonemes combined with one or two SGC, occur at the same linear distinction points:

(1) /p b ⁿb/ bilabial;
(2) /t d ⁿd/ apico-alveolar;
(2⁺) /c ʒ ⁿʒ/ also apico-alveolar, but with fricative off-glide;
(3) /č ǯ ⁿǯ/ lamino-alveolar, and also with fricative off-glide;
(4) /k g ᵑg/ dorso-velar.

The glottal stop /ʔ/ at (5) does not combine with SGC. Rank-order is /t ʔ p k g b, č and ⁿg and ⁿz̨, d and ⁿb and z̨ and c and ⁿd/, while /b ⁿž̨/ did not turn up in our frequency sample.

The matching of stops with nasals and fricatives is triple in each series; it is double with the glide series and single with the lateral series.

The nasal series matches at (1) for /m/, at (2) for /n/, at (4) for /ŋ/, with a fourth nasal also at (4°), namely /ŋʷ/—but without matching labialized stop at (4°). The rank-order is /m n ŋ ŋʷ/.

The fricative series matches at (3) for loose-contact /š/; at (4) for /ⁿh/ (with loose [x] to almost open-contact [h] off-glide after the tight-contact nasal [ŋ]; and at (5) for almost open-contact /h/. Alternatively, if /ⁿh/ were phonemicized as a consonant cluster /ŋh/, /h/ would be said to have an allophonic range from [x] to [h]. The rank-order is /š h ⁿh/.

The glide series matches at (1) for /w/ and at (3) for /y/. The rank-order is /w y/.

Lateral /l/ matches at (2), and falls in the first quartile of rank-orders for all phonemes.

The vowel inventory is typologized as dual level 2(FCB)—that is, as vowels contrasting at two tongue heights since front, central, and back contrasts occur at each tongue height—three high vowels /i i̱ u/ and three low vowels /e a o/. Positional allophones of mid to high central /i̱/ are all unrounded—often, indeed, produced with spread lips. Some allophones of low to mid central /a/—generally lower than other low vowels—are unrounded, some slightly rounded when raised. Both back vowels /u o/ are consistently rounded. SGC combinable with each of the six vowels are length and stress (in an alternation of stress system).

Most short vowels fall in the first quartile of rank-orders for all phonemes, in the order /a, i and u, i̱ and e/; short /o/ falls in the third quartile, as do long vowels which turn up in our frequency sample—/u· o· i·/.

### Comanche

Since all oral consonants may be preceded by either of the two laryngeals, /ʔ h/, the possibilities of alternative phonemicizations are obvious; in our phonemicization, the sequence of laryngeal consonant ($C_5$) and oral consonant (C) is analyzed as a $C_5C$ cluster of two unit phonemes.

The six linear distinctions among stops are produced at four positions, as follows:

(1) bilabial /p/;
(2) and (2⁺): apico-alveolar /t c/ (the latter with tongue-tip fricative off-glide);
(4) and (4°): dorso-velar /k kʷ/;
(5) laryngeal /ʔ/.

The rank-order for stops is /p ʔ t k c kʷ/.

The fricative series matches stops triply, the nasal matches stops doubly; there is a single matching with stop in each of the two remaining continuant series—flap and glide.



Fricative /v/, being bilabial, fully matches bilabial stop at (1); loose-contact fricative /s/ matches stop at (2⁺); near open-contact /h/ matches stop at (5). The rank-order is /h s v/.

Nasals /m n/ match stops at (1) and (2), respectively. The rank-order is /n m/.

Flap /r/ matches stop at (2); /r/ falls in the fourth quartile of rank-orders for all phonemes.

Glide /w/ matches at (1), but glide /y/ at (3) remains unmatched, unless the allophonic range of stop at (2⁺) extends to (3). The rank-order is /y w/.

The vowel inventory is typologized as dual level 2(FCB): one set of three vowels at higher tongue height—/i i̱ u/—than another set—/e a o/, but each set distinguishing front /i e/ from central /i̱ a/ from back /u o/.

The rank-order for short vowels is /a i̱ i o u e/, that for long vowels is /aa uu i̱i̱, ii and ee, oo/. All short vowels (except /e/) fall in the first two quartiles, and all long vowels (except /aa/) fall in the fourth quartile of rank-orders for all phonemes.

### Yaqui—Mayo

Six stops are said to be in a single series even though five are voiceless and one is voiced; their linear distinction points are: at (1) and (1°): bilabial /p pʷ/, with the latter distinguished from the former by a complex component of labialization and voicing; at (2) /t/ (apico-dental); at (3) /č/ (lamino-alveolar); at (4) /k/ (dorso-velar) (and though /k/ occurs before /w/, we analyze the sequence as a consonant cluster rather than as a labialized unit phoneme); and finally at (5) /ʔ/ (laryngeal). The rank-order is /ʔ p t k č pʷ/.

Matching with stop consonants is triple for the fricative-obstruent series; double for both the nasal and glide series; single for both the lateral and flap series.

The fricative-obstruent /v/ matches at 1 (bilabial), with allophone fricative [β] more recurrent than allophone stop [b]—the latter after homorganic nasal; /s/ matching at (2) and /h/ matching at (5) are fricatives (and since additional fricative-obstruents at (2) and (4) occur only in Spanish loans, they are not included in our matching score). The rank-order is /s v h/.

Nasal /m/ matches at (1); but /n/ matches phonetically at (2), and (4), since the allophones of /n/ are [n̪] and [ŋ]. The matching score is given as '2 ± 1' (= double phonemic matching plus-or-minus one allophonic extension). The rank-order of the two phonemes is /m n/.

Glide /w/ matches at (1), /y/ at (3). The rank-order is /w y/.

Lateral /l/ matches approximately at (2), as does flap /r/. Both the lateral and flap (in that order) fall in the fourth quartile of rank-orders for all phonemes.

The vowel inventory is typologized as triple level 2(FB) over N—as /i e/ for front vowels and /o u/ for back vowels, with high-mid tongue-height contrasts in each pair; and a third tongue height contrast distinguishes low /a/ which is neutral (N) in respect to (F-B) contrasts. Long vowels are phonemicized as clusters of two identical vowels; SGC of alternating stress is combinable with vowels.

The short vowels /a i e/ fall in the first, and /o u/ in the second quartile of rank-orders for all phonemes; all long vowels fall in the fourth quartile.

### Huichol

Of the half dozen Huichol stops, two pairs occur with the first distinguished from the second in each pair by simultaneous or off-glide component:
(2) and (2+): /t/ (apical) and /c/ (apical, with very lenis stop—only approximating tight-contact—followed by loose-contact fricative off-glide);
(4) and (4°): /k/ (dorso-velar) and k$^{w}$ (the same position, but with component of simultaneous labialization). And two stops occur at (1) and (5)—/p/ (bilabial) and /ʔ/ (laryngeal), respectively. The rank-order is /t k ʔ c p k$^{w}$/.

Matching with stop consonants is double for two series (fricative and nasal), and single for two series (glide and flap).

The loose-contact fricative /š/ has an allophonic range from [ʂ] (retracted apical) to [š] (laminal), and hence is only partially matched with stop consonant at (2+); the almost open-contact fricative /h/ matches at (5). The rank-order is /š h/.

Nasal consonants match stop consonants at (1) and at (2): /m n/. The rank-order is /m n/.

The glide /w/, whether in almost open-contact allophone [w] or in loose-contact fricative allophone [β], fully matches stop at position (1); the glide /y/ is partially matched with fricative /š/ (see above), but unmatched with stop consonant.

The flap /r/ at (2), being retroflex, is only partially matched with the non-retroflex apical stop at (2). This flap falls in the second quartile of rank-orders for all phonemes.

The Huichol and Cora (*q.v.*) vowel inventories are both typologized as dual level 2(FB) + B°. This type is the inverse of the Papago type (*q.v.*), since the asymmetrical high vowel is rounded back (B°) in Co-Hu but unrounded front (F) in Papago. In addition to the Co-Hu rounded back (B°) /u/ at one tongue height (high)—there are four vowels that show contrasts at two tongue heights: front (F) /i e/ and central to unrounded back (B) /ɨ a/. SGC combinable with vowels are length and stress.

The vowels /a i e/ (in that order) fall in the first, and /ɨ u/ in the second quartile of rank-orders for all phonemes; all long vowels fall in the fourth quartile.

### Cora

The six linear distinctions among Cora stops are at (1), (2), (2+), (3), (4), and (5).

Three stops are combinable with an SGC of labialization which yields a labialized series of three stops beside the six plain stops; the two series are matched in the following paired positions (with superscript in 1°, 3°, 4° for positions 1, 3, 4 respectively, plus labialization SGC):
(1) and (1°) /p p$^{w}$/ (bilabial);
(3) and (3°) /č č$^{w}$/ (lamino-alveolar);



(4) and (4°) /k k$^{w}$/ (dorso-velar).
Three other stops—never combined with SGC of labialization—are produced at (2) and (2+): /t c/ (both apical, the first without, the second with loose-contact fricative off-glide); and at (5): /ʔ/ (laryngeal). The rank-order is /ʔ t k c č, p and k$^{w}$, p$^{w}$ č$^{w}$/.

Nasal and fricative series triply match the stop consonants in each series; the glide series doubly matches the stop consonants; the lateral series matches a stop consonant position fully, the flap series does so partially.

Nasal /m/ matches at (1), and is combinable with the SGC of labialization which permits matching of /m$^{w}$/ at (1°); /n/ at (2) is never combined with the SGC of labialization. The rank-order is /n m m$^{w}$/.

Fricative voiced /v/ fully matches at (1), assuming /v/ to be bilabial; so also, voiceless /s/ matches at (2+), /h/ at (5). The rank-order is /h s v/.

Glide /w/ matches at (1°), without the usual trace of convergence in systems with (1) but not (1°); /y/ matches at (3). Both appear in the fourth quartile of rank-orders for all phonemes.

Lateral /l/ matches fully at (2); but flap /r/, being retroflex, is only partially matched at (2).

The vowel inventory is typologized as dual level 2(FB) + B°—as three vowels at a higher tongue height, /i ɨ u/, and two at a lower tongue height, /e a/; but full symmetry nevertheless obtains for the four vowels which are distinguished both by contrastive tongue heights and contrastive frontness /i e/ and backness /ɨ a/. However, /u/ is contrastive only by virtue of being back rounded (B°) rather than back unrounded (B) at high tongue height. Vowels are combinable with SGC of stress; long vowels are phonemicized as clusters of identical vowels.

The vowels /a i u e/ (in that order) fall in the first, and /ɨ/ in the second quartile of rank-orders for all phonemes; all long vowels appear in the fourth quartile.

### Tarahumara

Half of the oral stops in Tarahumara are combinable with an SGC of voicing; the uncombined or voiceless series then matches the voiced series at:
(1) /p b/ (bilabial);
(4) /k g/ (dorso-velar).
Half of the oral stops also appear uncombined with SGC of voicing, as does the glottal stop; the majority of all stops, therefore, appear only as voiceless stops: at (2) /t/ (apical), at (2+) /c/ (apical with fricative off-glide), and at (5) /ʔ/ (laryngeal). The rank-order is /k ʔ, c and s, b, t and g, p/.

The nasal and fricative series certainly match the stop consonants at two positions in each series, and the glide series probably so also; the lateral and flap series match at one position each.

Nasal /m/ matches at (1), /n/ at (2). The rank-order is /m n/.

Fricative /s/ matches at (2+), /h/ at (5).

Glide /w/ matches fully at (1), but /y/ matches only partially at (3), and then only if the allophonic range of /c/ extends from tongue-tip (2+) to tongue-

blade (3), as the orthography of our source suggests it might. The rank-order is /w y/.

Both lateral /l/ and flap /r/ match at (2); the latter includes single flap and multiple flap (trill) allophones. Flap /r/ falls in the first quartile of rank-orders for all phonemes, while the lateral does not turn up in our frequency sample.

The vowel inventory is phonemicized as triple level 2(FB) over N—as vowels contrasting at two tongue heights (high and mid) for front /i e/ and back /o u/, and with /a/ at low tongue height. Long vowels are phonemicized by cluster solution; SGC of stress is combinable with vowels.

The vowels /a i e o/ (in that order) appear in the first quartile of rank-orders for all phonemes; /u/ appears in the second quartile; and long vowels are found either in the fourth quartile or do not turn up in our frequency sample.

### Papago

There are five fortis stops in Papago (always voiceless), and five lenis stops (sometimes voiced but more often voiceless); when voiceless, lenis stops are distinguished from oral fortis stops either by a lack of pre-aspiration (medially) or by a somewhat less intense articulation (initially). If the fortis set is taken as the set of plain stops, combinable with an SGC of lenition, then the fortis stop in position (5) (the glottal stop /ʔ/) is unmatched by a lenis stop; conversely, if the lenis set is taken as the set to be combined with an SGC of fortisness, then the lenis stop in position (2) (/d̲/ always apico-alveolar and in addition retroflexed in some idiolects) is unmatched by a fortis stop. Fortis and lenis stops do match at:

(1): bilabial /p b/;
(2̂): apico-dental /t d/;
(3): lamino-alveolar /č ǰ/;
(4): dorso-velar /k g/.

The rank-order for all stops is /ʔ g k č d t p ǰ d̲ b/.

The matching of stops with nasal series is triple, but double for fricative and glide series, and single for the lateral-flap series. The last is unique as a series in UA, which often distinguishes between lateral series and flap series. For Papago proper, the lateral is articulated with a single flap—but in a distant dialect (Pima Bajo) the corresponding morphemes show this phoneme to be a multiple flap /r/ without lateralization.

The phonemic orthography shows that nasal consonants match stop consonants in three positions: /m/ at (1), /n/ at (2̂), and /nʸ/ at (3). The allophones of /n/ are not only [n̲] (in most environments, including /n/ in cluster before /s̲/), but also [n̲] in clusters before stops and fricatives at (2). Even though these allophonic positions are adjacent, rather than non-adjacent as for nasals in Nahuatl (see above), we recognize the allophonic complication by giving the score of matching between stops and nasals in Papago as '3 ± 1' (= triple phonemic matching plus-or-minus one allophonic extension). Rank-order is /m, n and nʸ/.

Clear cut matching between stop consonants and fricative consonants obtains for the almost open-contact /h/ at (5). The matching between /s s̲/ and stops



may be stated as /s/ at (2), and /s̲/ unmatched. Since /s̲/ is more retracted than /d̲/, and is extremely retroflexed (while /d̲/ is slightly retroflex and so only in some idiolects), we conclude that /s̲/ is unmatched with stops (and indeed with other consonants). Rank-order is /h, s and s̲/.

Glide consonants match at (1) for /w/, at (3) for /y/. The rank-order is /w y/.

The lateral-flap /l/ matches stops at 2̲, and falls in the fourth quartile of rank-orders for all phonemes.

The vowel inventory is typologized as dual level F + 2(BB°)—as vowels contrasting at two tongue heights with one front vowel at one tongue height only, namely high /i/; in addition, back unrounded (B) and back rounded (B°) contrast at each of the two tongue heights—two high back vowels /ɨ u/ and two low back vowels /a o/ (with /a/ somewhat lower than /o/, and with /ɨ/ somewhat more central than /u/). SGC combinable with vowels are length, stress, and a length-stress component.

The vowels /a i/ fall in the first and /o ɨ u/ in the second quartile of rank-orders for all phonemes; long vowels fall in the third and fourth quartiles in the order /aa, ɨɨ and uu, oo, ii/.

**1.2.** In grouping languages by phonological criteria, we begin with the phonemic inventory of the parent language, as though it were another sister language, and group the daughter languages in reference to it.

### PROTO UA STOP CONSONANTS

Six linear distinctions among stops were produced at the following four positions:

(1): bilabial */p/;
(2) and (2⁺): apico-alveolar */t c/, respectively, the latter with fricative off-glide;
(4) and 4°): dorso-velar */k kʷ/, and the latter with labialization component;
(5): laryngeal */ʔ/.

More than half of the sister languages in the sample summarized in **1.1** also appear to have stops in a single series (without SGC). These include both Cahuilla and Luiseño, as representatives of the traditional 'Southern California sub-branch of Shoshonean';[4] Hopi, as the only exemplar of the so-called 'Pueblo sub-branch of Shoshonean'; Comanche, Mono and Southern Paiute as representatives of the traditional 'Plateau sub-branch of Shoshonean';[5] Cora and Huichol, and Yaqui-Mayo, as representatives of the traditional 'Sonoran branch';[6] and

[4] Some half dozen languages are usually ascribed to this branch (names connected by hyphens here are taken to be different dialects of the same language): 1, Luiseño-(Pauma-Rincón-Pala-Temecula)-Juaneño; 2, Cahuilla; 3, Cupeño; 4, Gabrielino-Fernandeño; 5, Serrano.

[5] Including besides 1, Mono ± Northern Paiute ± Bannock; 2, Shoshone-Panamint ± Comanche; 3, Southern Paiute ± Ute ± Chemehuevi-Kawaiisu. (± indicates traditional groupings which assert, without citing evidence, that some politically separate tribes speak mutually intelligible dialects. Our evidence from phonemic inventories and the like reveals important differences—e.g. Mono without SGC but Bannock with SGC of voicing.)

[6] Proposed by Buschman and Brinton as coordinate with the 'Shoshonean' sub-branches

Nahuatl (Milpa Alta) as representative of both Nahuat and Nahuatl languages in what we term the 'Aztec branch'.[7]

None of the languages listed above have fewer than six stops. This minimum appears identically distributed in two daughter languages (Huichol and Comanche) and in the reconstructed parent (Proto UA). Six linear distinctions among stops are also found in Yaqui-Mayo, but at five rather than at four articulatory positions, a consequence of the fact that only one pair of stops appears with componential distinction at the same position /p $p^w$/; the rest of the stops are produced at different positions. Though the total number of linear distinctions among stops is the same, the component of labialization appears in different positions with the consequence that (1°) contrasts with (1) in Yaqui-Mayo, but (4°) contrasts with (4) in Huichol, Comanche and Proto UA. In rank-order, /$k^w$/ is least frequent among the Huichol and Comanche stops, and /$p^w$/ least so among the Yaqui-Mayo stops.

Some other UA languages, not included in our **1.1** sample, also appear to have six stops. Pochutla, divergent member of the traditional Aztec branch, has six stops at four articulatory positions, differing from Comanche-Huichol-Proto UA in having /č/ as an additional stop at (3), and in lacking laryngeal at (5). The so-called 'saltillo' of Nahuatl is explicitly said to be absent in Pochutla, and so does not appear in the transcription either as /ʔ/ or as /h/.

Hopi is like Proto UA in its distribution of six linear distinctions among stops—at (1), (5), (2 $2^+$) and (4 $4^o$); but Hopi introduces an additional positional distinction—at (4̇) for /q/—making a total of seven stops in single series. The same additional distinction and the same inventory total for stops appear in both Cahuilla and Luiseño which, however, produce their affricate stops with tongue-blade (3) rather than with tongue-tip ($2^+$). In rank-order, /q/ is relatively infrequent among the stops of all three languages; the affricate stops are

to the north, and the 'Aztec' sub-branches to the south, the 'Sonoran' branch has been stigmatized until recently as a linguistically meaningless group of geographically intermediate languages; very recently lexicostatistic computation has revealed one kind of information which suggests the possibility of finding other evidence which might permit a regrouping of the fragmented branches into one attested 'Sonoran branch' with three sub-branches:

1, 'Piman-Tepehuan sub-branch of Sonoran' extending from Arizona to central Mexico;

2, 'Tarahumaran-Cahitan (or Taracahitan) sub-branch of Sonoran' extending westward from the Tarahumara in Chihuahua, east of the Sierra Madre, to the Yaqui and the Mayo (on rivers of the same names) in Sonora;

3, 'Cora-Huichol sub-branch of Sonoran' centering in the mountains of Nayarit (with modern Huichol spoken east of the present-day Cora) between the preceding sub-branch of Sonoran (Tarahumaran-Cahitan) and the Aztec sub-branches to the south. Indeed, it has been suggested by Whorf that the relationship with the latter is closer than with other Sonoran sub-branches. If Cora-Huichol were merged in the Aztec branch, an Aztecoidan sub-family would emerge.

[7] Instead of the proposed 'Nahuatlan branch' which is confusing since it includes in the cover-term the distinguishing -tl suffix, but also means to classify under it the kinds of languages which employ the suffix -t corresponding to -tl. Our term 'Aztec branch' covers the divergent Pochutla of Oaxaca, as well as the Nahuatl and Nahuat languages—but this is merely a matter of labeling and does not bear on the merits of this traditional branch.



consistently in the rank before the last; and Hopi and Luiseño (but not Cahuilla) share almost the same relative order for the four highest ranks.

Southern Paiute and Mono and Nahuatl are like Proto UA in their distribution of six linear distinctions among stops—at (1), (5), (2 $2^+$), and (4 $4^o$). But each of these languages adds two additional linear distinctions—at (3) and at (4̇) in Southern Paiute; at (4̇ $4^o$) in Mono; at (3 $3^+$) in Nahuatl. In rank-order, the affricates are lowest in Southern Paiute and Nahuatl, and lowest but for one order, that of labialized stops ($4^o$ 4̇°), in Mono.

This concludes our sample of languages whose stops occur in single series, strictly speaking. Grouping these languages—but only in respect to the total number and the distribution of linear distinctions among stops—brings together the following:

Huichol and Comanche (both identical with Proto UA), and Yaqui-Mayo and Pochutla—six stops each;

Hopi and Cahuilla and Luiseño—seven stops each;

Southern Paiute and Mono and Nahuatl—eight stops each.

For Nahuatl, the score of eight stops is obtained from the phonemicization of the Milpa Alta dialect which includes /ʔ/ but lacks /h/; in the Tetelcingo dialect of Nahuatl, the phonemicization gives /h/ but not /ʔ/. These are not really alternative phonemicizations, but rather alternative transcriptions of the so-called 'saltillo' described for Nahuatl in **1.1.**

Cora and one of the Aztec languages (Zacapoaxtla) might also or alternatively be said to be without SGC; but only the latter includes stops in a single series while stops in Cora appear in two series, according to the criterion that one particular component (as voicing in Zacapoaxtla) which generates only one additional unit phoneme is not an SGC, while any component combinable with three plain stops, for example (as labialization in Cora), is a Series Generating Component.

The seven stops of the Zacapoaxtla are /p/ at (1), /t c/ at (2 $2^+$), /č/ at (3), /k $k^w$/ at (4 $4^o$)—but, at (4) also, /g/ is distinguished from /k/ by the component of voicing—hence three linear distinctions are made at the dorso-alveolar position, (4) and ($4^o$) and ($4^v$): /k $k^w$ g/.

In the case of Cora, a clear alternative appears: to list six uncombined stops

| (1) | (2) | ($2^+$) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| /p | t | c | č | k | ʔ/ |

and say that exactly half—those at (1) (3) (4)—are combinable with a labialization SGC, thereby generating a labialized series /$p^w$ $č^w$ $k^w$/; or else to arrange the labialized stops in a single series with the others, thereby maximizing the number of pairs at same position—namely at (1 $1^o$), (2 $2^+$), (3 $3^o$) and (4 $4^o$), beside unpaired /ʔ/ at (5).

Languages of our sample in **1.1** in which plain stops are generally combinable with SGC are Papago, Tarahumara, Tübatulabal[8] and Bannock (alternatively

[8] Tübatulabal is the only exemplar of the traditional 'Kern River sub-branch of Shoshonean', just as Hopi is the only exemplar of the 'Pueblo sub-branch of Shoshonean'.

also, Cora); and of languages beyond this sample, Shoshone (dialect at Owyhee, Nevada), Kawaiisu, and some Aztec languages, as Pipil and Mecayapan.

Specifically, one SGC is PRE-NASALIZATION (homorganic nasal, with stop release, as a unit phoneme) which is described as an environmental allophone of medial stops in Pochutla, but as attested for phonemic contrast in the same environment in Tübatulabal and Shoshone. Another SGC is either FORTISNESS or LENITION (depending on which series is taken as having plain or uncombined stops) in Papago. For Kawaiisu, Tarahumara, Bannock and the Aztec languages listed above, and including Tübatulabal for a second time, the SGC is VOICING, and (alternatively) for Cora it is LABIALIZATION. The fact that some other languages with single series of stops permit consonant clusters which might be rephonemicized as unit phonemes with SGC—e.g. Southern Paiute, Mono, Hopi, and Comanche—has something to do with the patterning of consonant clusters and, therefore, takes this single *vs.* multiple series distinction—with and without SGC—beyond the exclusive concern of stops and into the wider problem of INTERPHONEMIC SPECIFICATION, to which we turn in Chapter 3.

One interesting consequence of SGC formation of more than one series of stops is that the number of stop matchings with consonants in other series is not thereby increased. This means that the number of linear distinctions made in languages with SGC can be stated irrespective of the number of additional unit phonemes produced by SGC; the range of additional phonemes is, however, given for each group in the integrated groupings of languages below.

In order to include in integrated groupings the kinds of languages whose stops are in single series (without SGC), as well as those whose stops fall in more than one series (with SGC), we set up formulae for linear types. In the formula for each linear type, the first digit specifies the number of distinctions made in the plain or uncombined series; these are called LINEAR DISTINCTIONS because they summarize, by a single number, the sum of distinctions listed in the plain series line—both those at same positions made by addition of component, as (4 4°) for /k kʷ/, as well as those of the /p t k/ kind, produced at different articulatory positions.

After the first digit giving the sum of linear distinctions, the languages without SGC are specified as '−SGC' (that is, 'minus series generating component'). If Cora is analyzed as distinguishing stops without SGC, its linear type is 9—SGC. See above, where the nine Cora stops are given in single series: /p pʷ t c č čʷ k kʷ ʔ/ (but as one of two possible alternative analyses).

After the first digit giving the number of linear distinctions, languages with SGC are specified as '+SGC' (that is, 'plus series generating component'). If Cora is analyzed as distinguishing stops by combination with SGC, its linear type is 6+SGC:3, with the digit after SGC indicating the number of additional unit phonemes generated—namely, three—by combining the SGC of labialization with plain stops at three articulatory positions. And in general, the number of different positions at which SGC is combined equals the number of unit phonemes to be counted in addition to those distinguished by linear distinctions. The total number of stops in languages with SGC is then the sum of the numbers



before and after '+SGC:'—six plus three or nine stops in the case of Cora. This score is obtained when Cora stops are alternatively analyzed as falling in two series: /p t c č k ʔ/
/pʷ čʷ kʷ /; both this analysis and its alternative may now be succinctly expressed in formula: the linear type of Cora is either 9−SGC or 6+SGC:3.

The order followed in listing linear types begins with stop systems making the fewest number of linear distinctions, which is five rather than six, though six is the minimum number of stops for the whole of any stop inventory in Uto-Aztecan languages. The inventory number of stops is the same as the number of linear distinctions in languages without SGC, but is greater than the number of linear distinctions in languages with SGC. It is interesting to note that linear types with the fewest linear distinctions appear only with SGC; never without SGC. Examples of both possibilities are always found in the middle ranges: the same number of linear distinctions are exemplified by some languages with SGC and by other languages without SGC. For linear types with the highest number of linear distinctions, the inverse of the fewest holds: the linear type 8−SGC lacks any parallel instance of 8+SGC. Languages with the maximum number of linear distinctions never appear with SGC.

Exemplars of the linear range type 5+SGC:2 . . . 5 are Tarahumara and Papago. The digits after '5+SGC:' in this formula ('2 . . . 5') give the minimax range of additional unit phonemes generated by SGC. The minimum is two. There are two additional unit phonemes in the voiced series of Tarahumara, /b g/; so, the linear type of Tarahumara may be stated, without indication of range for the integrated type, as 5+SGC:2 (with the inventory number of stops being seven, five in the voiceless series, two in the voiced series). The maximum number of additional phonemes generated by SGC is five. There are five additional unit phonemes in the lenis series of Papago, /b d ḏ ǯ g/; so, the linear type may be stated exclusively for Papago as 5+SGC:5 (with the inventory number of stops being ten, five in the fortis series, and five also in the lenis series, but with an asymmetry in matching, already noted in **1.1**).

Exemplars of linear type 6−SGC may be integrated with the closely similar linear range type 6+SGC:3 . . . 10, bringing together single series languages—Proto-UA, Huichol, Comanche, Yaqui-Mayo, Pochutla—with Pipil (6+SGC:4) and with both Kawaiisu and Shoshone (6+SGC:5), though the SGC is for voicing in Kawaiisu, and for prenasalization in Shoshone; and also with Tübatulabal (6+SGC:5+5) for which the inventory number of stops is sixteen, six in the voiceless series and, additionally, five in the voiced series plus five in the prenasalized-voiced series. As already mentioned in different contexts, an alternative analysis permits the inclusion of Cora here, as linear type 6+SGC:3—and this is the analysis which is arrived at when our criteria are followed.

Exemplars of linear type 7−SGC, may be integrated with the similar linear range type 7+SGC:4 . . . 5, bringing together single series languages—Hopi, Cahuilla, Luiseño, and Zacapoaxtla, Tetelcingo—with Mecayapan (7+SGC:4) and Bannock (7+SGC:5).

For linear type 8−SGC (not to mention again the alternative linear type 9−SGC for Cora), there is a complete lack of a parallel 8+SGC type; the three exemplars of the 8−SGC linear type are Mono, Southern Paiute and Nahuatl.

The rank-orders of inventory stops in languages represented by the linear range types 5+SGC:2 . . . 5, 6+SGC:3 . . . 10, and 7+SGC:4 . . . 5 have more than one interest. First, they show that in Papago, where the question of which series (lenis or fortis) is the plain or uncombined series and which is combined with SGC (of fortisness or lenition), greater frequency does not favor one series or the other; the rank-order alternates on the whole between the two series: the most frequent stop is fortis /ʔ/, the next in frequency is lenis /g/, the next pair are fortis /k č/, the next is lenis /d/, the next pair are fortis /t p/, followed by lenis /ǩ ḏ b/. Second—and in contrast to this—the rank-orders show that in general the stops with SGC are less frequent than the plain stops (without SGC)—in languages where it is possible to say unambiguously which series is plain or uncombined, and which series of stops is generated by SGC. Thus, stops with SGC trail after all plain stops in the rank-orders of Mecayapan Nahuat, Tarahumara, Tübatulabal and Cora (typologized as 6+SGC:3). Or stops with SGC are found lower in rank-order than the plain stop at the same linear distinction point: for example, rank-order of /k/ is higher than that of /g/, and /k$^{w}$/ is higher than that of /g$^{w}$/ in Pipil and Bannock.

The preceding review shows that the UA range in linear distinctions among stops extends from five to eight—some with and some without SGC. When daughter languages are grouped according to the number of linear distinctions among their stop consonants (±SGC), the groupings are remarkable chiefly for the fact that in general, they correlate neither with the three traditional branches of UA nor with the traditional sub-branches (see fn. 4 to 8, inclusive). This may be more clearly realized if we list the linear types under the traditional orachiating scheme for UA.

The Shoshonean branch is represented by the following linear types: 6−SGC (Comanche); 6+SGC:5 (Kawaiisu, Shoshone); 6+SGC:5+5 (Tübatulabal); 7−SGC (Hopi, Cahuilla, Luiseño); 7+SGC:5 (Bannock); 8−SGC (Southern Paiute, Mono). Indeed, the whole spread or range of linear types for the entire family is almost covered by languages in the Plateau sub-branch—all except the minimum (5+SGC) linear type in UA—from the 6−SGC type of Comanche to the same number of linear distinctions (but with SGC) of Shoshone and Kawaiisu, to seven linear distinctions of the Bannock type (with SGC), to eight linear distinctions of the Southern Paiute and Mono type (without SGC). The linear types do not correlate well with Shoshonean as a major branch of UA; but if their diversity were to be taken as a counter-example to this traditional major branch, then similar diversity would likewise have to be taken as a counter-example to recognizing one of the sub-branches (Plateau). In Plateau (Numic), Southern California, Hopi, and Tübatulabal—and similar groups to the south—structural diversity is found whenever there are several languages in one sub-branch. Not much can be adduced by comparison to argue for the homogeneity



of a group having a membership of one language, as Hopi and as Tübatulabal. The latter makes six linear distinctions (but adds unique elaboration with SGC:5+5); the Hopi sub-branch and the Southern California sub-branch share one linear type (7−SGC).

The traditional Sonoran branch is represented by the following linear types: 5+SGC:2 (Tarahumara); 5+SGC:5 (Papago); 6−SGC (Huichol, Yaqui-Mayo); 6+SGC:3 (Cora). The restricted range of linear types above—essentially 5+SGC or 6±SGC—is remarkable, and also the fact that fewer than Proto UA linear distinctions—five rather than six—have a unique occurrence in two Sonoran languages. But diversity is not lacking. Thus, one sub-branch (Tarahumaran-Cahitan) is represented by two linear types (5+SGC:2 for Tarahumara and 6−SGC for Yaqui-Mayo). Another sub-branch (Cora-Huichol) is likewise represented by two different but similar linear types (6−SGC for Huichol, but 6+SGC:3 for Cora). The third sub-branch (Pima-Tepehuan) is consistent in showing fewer linear distinctions than Proto UA—for example, five in Papago (included in our sample) and four in Tepecano, /p t k ʔ/, with the Papago /č/ corresponding to Tepecano /t/ (both < *t, as shown in **2.2,** below). However, this minimum of linear distinctions among stops—fewer than for Proto UA with its 6−SGC type—is not restricted to Papago and its close relatives in Piman-Tepehuan, it is also found in another sub-branch—Tarahumaran-Cahitan. Yet there is a curious difference between the Papago and Tarahumara coincidence in reduction of linear distinctions to five. The Tarahumara reduction is an instance of merger (Proto UA */k$^{w}$ w/ > /w/); the Papago reduction is a consequence of replacement without split or merger (Proto UA *k$^{w}$ > /b/), thereby serving as one of the points for the lenis-fortis contrast in Papago: /p b/ etc. In an important sense, the SGC of fortisness (or, alternatively, of lenition) in Papago is only a synchronic SGC—not a diachronic doubling of a single stop series by SGC combinability with plain stops. But reflexes of Proto UA stops in the Papago lenis series are restricted to the case of /b/ < *k$^{w}$. That is to say, Papago lenis stops descend from Proto UA stops only in the single instance cited; in all other instances, Papago stops in the lenis series are derived from the glide series or the lateral series of Proto UA (cp. **2.2,** below). In the other daughter languages with SGC, however, both members of a reflected pair (±SGC) are descended from a Proto UA stop; accordingly, for all such languages, SGC is not only synchronically stateable, but diachronically traceable as an elaboration of an earlier stop system without SGC.

The traditional Aztec branch is represented by the linear types: 6−SGC (Pochutla); 6+SGC:4 (Pipil); 7−SGC (Nahuatl dialects of Tetelcingo and Matlapa, and Zacapoaxtla); 7+SGC:4 (Mecayapan); 8−SGC (Nahuatl dialect of Milpa Alta). The difference in linear type among Nahuatl dialects—either 7 or 8−SGC—is trivial, since it is a consequence of different ways of transcribing the laryngeal 'saltillo' (cp. Nahuatl, **1.1**). Differences in linear type among Nahuat languages range from 6+SGC:4 to 7+SGC:4. Pochutla, like Nahuatl, is without SGC, but there are fewer linear distinctions among stops in Pochutla than in Nahuatl.

In the phonemicizations of the score or more of languages available for this study, VOICING and PRENASALIZATION and LABIALIZATION, as well as FORTISNESS or LENITION are taken to be SGC only when generally combinable with plain stops; plain stops are identified, in circular fashion, as stops uncombined with SGC. Though an occasional component combines with a single continuant—a consonant in some other series than the stop series—and thereby produces another unit phoneme (as VOICING combined with /s/ producing /z/ in Kawaiisu; or as LABIALIZATION combined with /m/ producing /m$^{w}$/ in Cora), such a component, though combinable with a given plain continuant, would not generate another series—but only one more unit phoneme—unless the SGC in combination appeared at multiple linear distinction points. But increase in the sum of unit phonemes by componential combination is rarely found in the continuant series of the UA daughter languages.

## PROTO UA CONTINUANT CONSONANTS

In Proto UA, the linear distinctions for each series of continuants appeared at:
(1), (2), (4) for nasals */m n ŋ/;
(1), (2), (3) for glides */w r y/;
(2$^{+}$), (5) for fricatives */s h/;
(2) for lateral */l/.

For purposes of matching stops with continuants, it does not in general matter whether or not the stops are combinable with SGC. The linear type formula specifies the sum of linear distinctions among the plain series of stops as its first item of information. For Proto UA, the formula for linear type—6−SGC—indicates that a total of six linear distinctions occurred among stops (without SGC: hence a total of six stops); by comparing these with the linear distinctions among consonants in the nasal series (N for 'nasal'), we see that the two series match at three linear distinction points—at (1) */p m/, at (2) */t n/, and at (4) */k ŋ/. The score so far is that of a half dozen stops matching three nasals (in formula, 6−SGC matching $^{3}$N). By comparing the linear distinctions among consonants in the fricative series (F for 'fricative') with those among stops, we see that these two series match at two linear distinction points—at (2$^{+}$) */c s/ and at (5) */ʔ h/. The stop and glide series (G for 'glide') also match at two linear distinction points, though at different points—at (1) */p w/ and at (2) */t r/. And in addition */y/ is unmatched in the stop series—glide */y/ at (3) but no stop at (3)—as is shown in formula by subscript number after G. In formula, $^{2}G_{1}$ then means that there are three glides of which two, */w r/, match at the linear distinction points at which stops occur, while one, */y/, does not. Such matching is, in effect, a measure of linear distinction symmetry for a given language. The matching may be lacking at one point, as for */y/ above; or there may be only one consonant in a given series to match with a stop, as at (2) for */t l/ in the lateral series of Proto UA (but in Cahuilla there are two phonemes in the lateral series, /l ɬ/); or the matching may be at two points, as for fricatives and glides, shown in formula by superscript number before parentheses—$^{2}(FG_{1})$; or it may be at three points, as for nasals (see above).



The total score for all Proto UA consonants is then given in the following formula: 6−SGC matching $^{3}N^{2}(FG_{1})$ L. From this formula the sum of unit consonant phonemes can be seen by inspection to be 15 by adding 6 stops and 3 nasals and 2 fricatives and 2 matching glides and 1 non-matching glide and 1 lateral.

A review follows of the diversity range in UA of five continuant series—N, F, G, and L already noted, and also R for both single 'flap r' and multiple flap or 'trill r'. This single or multiple flap R is distinguished, as a tight contact continuant, from glide */r/; the latter, like other continuants in the glide series, ranges from near open contact to loose contact.

Non-matching between a continuant series and a stop series, and non-occurrence of a continuant series as such are importantly different. Three of the five continuant series—N, F, and G—occur in all the languages. Either L or R—or both—may be non-occurring; or both may occur in the same language.

Continuants in Mono, Kawaiisu, and Bannock are restricted to three series (N, F and G), since neither the L series nor the R series occurs in these three languages.

Conversely, both the L series and the R series are represented in Tarahumara, Yaqui-Mayo, Cora, and also in one of the traditional Shoshonean languages (Luiseño). Hence, the maximum total of five series occur in these four languages.

In Southern Paiute, Comanche, Shoshone (and in the three languages mentioned which lack both L and R), the L series is non-occurring. This non-occurrence of L is therefore a characterizing feature of the northern or Plateau languages, as opposed to the other sub-branches of Shoshonean (Hopi, Tübatulabal, and Southern California) in which the L series is found. But the non-occurrence of L is not exclusive to the northern languages; the L series is also non-occurring in Huichol, while between L and R only one series can be counted in Papago. But the classification of this series—L or R—is indeterminate, since the lateralized flap in Papago represents a phonetic convergence of the criteria which serve to distinguish the flap R series from the lateral L in the other languages.

The R series is non-occurring not only in the three languages mentioned which lack both R and L, but is also non-occurring in the majority of daughter languages and in Proto UA where* /r/ is reconstructed as a glide (G series); The maximum number of continuant series remaining, therefore, is four (N, F, G, L). The R series is non-occurring in Hopi—Hopi /r/ belongs to the G series; in Tübatulabal; and in most but not all of the languages in the Plateau subbranch of Shoshonean. So also, for the Southern California sub-branch, R is non-occurring in Cahuilla (but found in Luiseño). And the non-occurrence of the R series is a characterizing feature for the traditional Aztec branch of UA. Among the Aztec languages, all show non-occurrence of R—all dialects of Nahuatl, as Milpa Alta, Tetelcingo, Mitlapa; Pipil, Mecayapan, Zacapoaxtla; even Pochutla.

Conversely, the R series is taken to be a characterizing feature of the traditional Sonoran branch as a whole, since R is (without real exception) represented

in all Sonoran languages: in Cora, Huichol, Tarahumara, Yaqui-Mayo and—unambiguously—in the Pima Bajo dialect of Papago.

In matching between any continuant series and stops, the density of matching closely approximates the density of linear distinctions in any one continuant series, since there are only a few instances of non-matched continuants. The non-matched /y/ at (3)—without stop at (3)—has already been noted for Proto UA, and is found similarly in Comanche and Huichol. Other sporadic instances of non-matching are a third fricative in Papago (two others do match) and in some Aztec languages (Pipil, Zacapoaxtla, Tetelcingo-Matlapa, where the so-called 'saltillo' is transcribed as /h/ rather than as /ʔ/); and a fourth nasal in Tübatulabal (three others do match).

The density range of continuants in any given series extends from six nasals, and from four or five fricatives to a minimum of two in each series; so also, it extends from three glides to one; and again, from two L and only one R to non-occurrence of L or R—as follows:

$^{6}$F for Cahuilla and Luiseño;
$^{4\pm1}$F for Southern Paiute;
$^{5}$N for Hopi;
$^{4}$N for Luiseño and Southern Paiute;
$^{3\pm1}$N for Papago;
$^{3}$G for Hopi and Proto UA;
$^{3}$F for Mecayapan, Cora, Yaqui-Mayo, Comanche, Tübatulabal;
$^{3}$N for Cahuilla, Bannock, Tübatulabal, and Proto UA.
Double matching for most other continuants: all $^{2}$N, and all $^{2}$F, and most $^{2}$G, but not most $^{2}$L (Cahuilla alone);
Single matching for all R, most L, but not most G (only Bannock and Huichol).

A measure of symmetry in matching is obtained when two or more different continuant series match the linear distinctions of stops the same number of times, though not necessarily at the identical points in the linear distinctions.

By this measure the following languages are exceptionally symmetrical, since these show three (rather than the average of two) different continuant series—inclosed by parentheses in the formula—to be matching linear distinctions of stops the number of times specified by superscript number before the parentheses. In all the examples which follow, the superscript number before the parentheses happens to be two, that is $^{2}$( ), with the same three series specified within each parentheses, namely NFG. But for some languages there is an allophonic extension of the two matching nasals /m n/ such that [ŋ] matches phonetically as well, and this is indicated by a superscript $^{\pm1}$N. For some languages there are three fricatives of which two match linear distinctions of stops while one fricative is non-matching, and is so indicated by subscript $F_1$. The exceptionally symmetrical languages are:
Shoshone and Kawaiisu, with linear type 6+SGC:5, matching $^{2}$(NFG)R (with R only in Shoshone, not in Kawaiisu);
Tarahumara, with linear type 5+SGC:2, matching $^{2}$(NFG)LR;
Pochutla, with linear type 6−SGC, matching $^{2}$($^{\pm1}$NFG)L;
Pipil, with linear type 6+SGC:4, matching $^{2}$($NF_1G$)L;



Zacapoaxtla, and Tetelcingo-Matlapa with linear type 7−SGC, matching $^{2}$($F_1$NG)L;
Nahuatl (Milpa Alta), with linear type 8−SGC, matching $^{2}$($^{\pm1}$NFG)$^{\pm1}$L.
Symmetry, by this measure, increases from sporadic instances in the north, to such dense exemplification among the Aztec languages that we are tempted to say that exceptional symmetry in matching continuant series is another characterizing feature of the traditional Aztec languages.

A converse measure of symmetry—that is, asymmetry in matching—is obtained when not a single continuant series of N or F or G matches linear distinctions of stops the same number of times as one other N or F or G in the same language. By this measure, the following languages are exceptionally asymmetrical:
Hopi, with linear type 7−SGC, matching $^{5}$N$^{3}$G$^{2}$FL;
Luiseño, with linear type 7−SGC, matching $^{6}F_1{}^{3}$N$^{2}$GL;
Bannock, with linear type 7+SGC:5, matching $^{3}$N$^{2}$FG;
Mono, with linear type 8−SGC, matching $^{3}$F$^{2}$N$G_1$;
Comanche, with linear type 6−SGC, matching $^{3}$F$^{2}$N$G_1$.
Exceptional asymmetry, by this measure, is found clustered exclusively in the northern languages, just as exceptionally symmetrical systems are densely distributed in the south.

Other instances that are neither exceptionally symmetrical nor exceptionally asymmetrical show an average of two out of the three series (N F G) matching linear distinctions of stops the same number of times. Such an average type of matching for continuant series pairs is rare among the Aztec languages (uniquely for Mecayapan), but common enough among the languages north of the traditional Aztec branch:
Mecayapan, with linear type 7+SGC:4, matching $^{3}$F$^{2}$($^{\pm1}$NG)L;
Papago, with linear type 5+SGC:5, matching $^{3\pm1}$N$^{2}$($F_1$G)R;
Southern Paiute, with linear type 8−SGC, matching $^{4}$($^{\pm1}$FN)$^{2}$GR.

Symmetry and convergence in matching are distinguished in our typology. We use matching scores to obtain criteria for symmetry, but state convergence without giving a score for convergence. The matching between two affricate stops with one fricative—either tongue-tip /s/ or else tongue blade /š/—shows a kind of convergence. Thus, Tübatulabal matches /š/ at (3) and Bannock and Southern Paiute and Cora match /s/ at (2⁺), with two affricates, /c č/ at (2⁺) and (3), respectively. Matching between one affricate stop and one fricative is without convergence, but not especially symmetrical, as such. But non-convergent matching of two affricate stops, /c č/, with two fricatives, /s š/, is notably symmetrical; it is found in all Aztec languages, including Pochutla, and in no other branch of the UA family. This is a more particular aspect of exceptional symmetry in matching which is taken, above, to be a characterizing feature of the traditional Aztec branch.

## PROTO UA VOWELS

The vowel inventory in Proto UA shows that distinctions are made at two levels: between two vowels at a lower tongue height */a o/, and between three

vowels at a higher tongue height */i ɨ u/. For dual level vowel systems in general, a central vowel is set up in our typology if it is flanked by a front and back vowel at both levels; but if, as here, the */ɨ/ is so flanked at the higher level while, at the lower level, the */a/ is unflanked by a front vowel and opposed to one back rounded vowel, the three way contrast is abandoned for both levels. Instead, we typologize high */i/ as the only front (F) vowel; high */ɨ u/ as back unrounded (B) and back rounded (B°), respectively; low */a o/ again as back unrounded (B) and back rounded (B°). There is then complete symmetry among the back vowels at two tongue heights—2(BB°)—but the high front vowel is not matched by low front vowel. All this is specified in the formula for Proto UA vowels: dual level F+2(BB°) type. Series generating components which are specified for the daughter languages, as LENGTH and one of three kinds of STRESS—predictable stress, word stress, alternating stress—remain to be reconstructed for Proto Uto-Aztecan.

We have set up some half dozen vowel types, none of which entail association with any particular linear type of stops with matching continuants. It would be possible to strive for further consonant-vowel integration—for example, between labialized stops at (1°) and at (4°) and front rounded vowel (F°), as in Hopi, and back rounded vowel (B°), as above. But comparison of such obvious features as these can be left to inspection when the formula for consonant type and vowel type are juxtaposed. Such juxtaposition, then, is all that is attempted to summarize the phonemic inventory type of each language (see below).

The vowel type already given in formula represents not only the Proto UA vowel system but also that in Papago (± LENGTH, WORD STRESS), and that in Bannock (± LENGTH, WORD STRESS, TONE). The phonemic inventory types of these three languages differ by virtue of juxtaposing three different linear types for consonants to the same vowel type:
Proto UA, linear 6−SGC, matching $^{3}N^{2}(G_{1}F)L$, with dual level F+2(BB°);
Papago, linear 5+SGC:5, matching $^{3\pm1}N^{2}(F_{1}G)R$, with dual level F+2(BB°);
Bannock, linear 7+SGC:5, matching $^{3}N^{2}FG$, with dual level F+2(BB°).

The inverse of the preceding vowel type is the dual level 2(FB)+B° ± LENGTH, WORD STRESS of Cora and Huichol. Compare the preceding $\begin{vmatrix} i & u \\ a & o \end{vmatrix}$ for 2(BB°) and the corresponding part of Cora and Huichol—$\begin{vmatrix} i & ɨ \\ e & a \end{vmatrix}$ for 2(FB). Compare the front (F) high vowel /i/, non-contrastive for tongue height in the preceding vowel type, and the back-rounded (B°) high vowel /u/, non-contrastive for tongue height in the phonemic inventory type for Huichol, linear 6−SGC, matching $^{2}(NF)G_{1}R$, with dual level 2(FB)+B°, and for Cora, linear 6+SGC:3, matching $^{3}(NF)^{2}GLR$, with dual level 2(FB)+B°.

Both the F+2(BB°) vowel type (for Proto UA, Papago, and Bannock) and its inverse, the 2(FB)+B° vowel type (for Cora and Huichol) are representative of average symmetry for vowel types in the UA family: two pairs of vowels matched at two tongue heights, with one remainder at one tongue height—F and B°, respectively.



Another kind of average or partial symmetry appears in the triple level vowel type 2(FB) over N—perhaps the most widely spread vowel type in languages of the world but not in languages of the Uto-Aztecan family, where it is restricted to Tarahumara ± LENGTH, WORD STRESS; to Pochutla, without phonemic length but ± PREDICTABLE STRESS; to Yaqui-Mayo ± LENGTH, ALTERNATING STRESS; and to Luiseño ± LENGTH (and to long vowels in Cahuilla) ± WORD STRESS in both Lu and Ca. The three levels of this type are symmetrical insofar as front (F) vowels contrast with back (B) vowels at two tongue heights—high FB /i u/ and mid FB /e o/; but at low tongue height, /a/ is non-contrastive or neutral (N) in respect to frontness and backness. This 2(FB) over N vowel type is associated with different linear types of stops and their continuant matchings:
Tarahumara, linear 5+SGC:2, matching $^{2}(NFG)LR$, with 2(FB) over N;
Pochutla, linear 6−SGC, matching $^{2}(^{\pm1}NFG)L$, with 2(FB) over N;
Yaqui-Mayo, linear 6−SGC, matching $^{3}F^{2}(^{\pm1}NG)RL$ with 2(FB) over N;
Luiseño and Cahuilla, linear 7−SGC, matching $^{6}F^{4}N$ [but $^{3}N$ in Ca]L[but $^{2}L$ in Ca]$^{2}GR$[R only in Lu], with 2(FB) over N [only with long vowels in Ca].

In contrast to the average symmetry noted above, moderate asymmetry appears in Hopi vowels typologized as dual level: rounding distinguishes B° from B—back vowels at the higher tongue height as well as one front vowel—(FBB°); and rounding distinguishes F° from F—front vowels at the lower tongue height as well as one back vowel—(FF°B). The vowel contrasts /i ɨ u/ over /e ö a/, appear in the following association: linear 7−SGC, matching $^{5}N^{3}G^{2}FL$, with (FBB°) over (FF°B) ± LENGTH, ALTERNATING STRESS.

In contrast to the dual level vowel type of Hopi, which is relatively asymmetrical, complete asymmetry appears in Southern Paiute vowels typologized as (FBB°) over N—a three-way contrast at a higher tongue height /i ɨ u/, with /a/ at a lower tongue height being neutral or non-contrastive in respect to frontness and backness; ± LENGTH, ALTERNATING STRESS. This vowel type appears in association with linear 8−SGC, matching $^{4}(^{\pm1}FN)^{2}GR$, with (FCB) over N. If any dialects in Southern Paiute are encountered that make a phonemic distinction between /o/ and /u/, their vowel type would be F+2(BB°).

In contrast to the average symmetry in vowel type and the two asymmetrical vowel types, the remaining instances show complete symmetry in vowel type, either 2(FCB) or 2(FB).

2(FCB) vowel type is exemplified by Comanche ± LENGTH, WORD STRESS, DEVOICING; Mono ± LENGTH, PREDICTABLE STRESS; and Tübatulabal ± LENGTH, ALTERNATING STRESS. The two levels of this type make front-central-back contrasts /i ɨ u/ at a higher tongue height and at a lower tongue height: a/ e o/. Three different linear types for consonants are juxtaposed to this same vowel type:
Comanche, linear 6−SGC, matching $^{3}F^{2}NG_{1}$ with 2(FCB);
Mono, linear 8−SGC, matching $^{3}F^{2}NG_{1}$, with 2(FCB);
Tübatulabal, linear 6+SGC:5+5, matching $^{3}(N_{1}F)^{2}GL$, with 2(FCB).

2(FB) dual level vowel type makes front-back contrasts /i o/ at a higher tongue height and at a lower tongue height: /e a/. All the Nahuatl dialects, and

most other Aztec languages, as Mecayapan, Pipil, and Zacapoaxtla (all ± LENGTH, PREDICTABLE STRESS) are exemplars of this type; but not Pochutla whose vowel type has been given above as the less symmetrical 2(FB) over N. Nevertheless, the 2(FB) vowel type appears to be a characterizing feature of Aztec languages. It is not represented beyond the Aztec branch, except for one of two coexisting vowel types in Cahuilla—2(FB) over N for long vowels, but 2(FB) for short vowels. Six different linear types for consonants are juxtaposed to the same vowel type:

Cahuilla, linear 7−SGC, matching $^{6}F^{3}N^{2}(LG)$, with 2(FB) for the coexisting short vowel set;

Pipil, linear 6+SGC:4, matching $^{2}(NF_{1}G)L$, with 2(FB);

Zacapoaxtla, linear 7−SGC, matching $^{2}(F_{1}NG)L$, with 2(FB);

Nahuatl (Milpa Alta), linear 8−SGC, matching $^{2}(^{\pm 1}NFG)^{\pm 1}L$, with 2(FB);

Tetelcingo (another Nahuatl dialect) linear 7−SGC, matching $^{2}(NF_{1}G)L$, with 2(FB) ± MORA having effect of raising vowels (rather than ± LENGTH) so that /i/ plus extra mora is [iˆ]; /o/ plus extra mora is [u]; /e/ plus extra mora is [ie]; /a/ plus extra mora is [ɔ].

There is good comparative evidence to argue that the 2(FB) vowel type was also exemplified by Classical Nahuatl, as spoken three centuries ago when it was recorded; but Günter Zimmermann and Hansjakob Seiler raise the question (in press, IJAL) as to whether Classical Nahuatl made a phonemic distinction between /o/ and /u/. If so, its vowel type would have been 2(FB) over N which is a type represented by one Aztec language—Pochutla, as noted above. If the vowel type represented by Classical Nahuatl is instead—as we say—2(FB), then the orthographic fluctuation between [o] and [u] is allophonic. And indeed, for all languages with the 2(FB) vowel type, it is a matter of indifference whether the vowel symbolized by B for the higher of the two levels is transcribed phonemically /o/ or /u/: the four vowels of the 2(FB) type are sometimes written as $\begin{vmatrix} i & u \\ e & a \end{vmatrix}$, sometimes as $\begin{vmatrix} i & o \\ e & a \end{vmatrix}$.

The comparative evidence alluded to is the fact that the reflex of Proto UA *u is /i/ in Classical Nahuatl; on the other hand, the reflex of *o remains in Classical Nahuatl as phonemic /o/, but fluctuates between [o] and [u] allophonically.

The comparative evidence also explains the divergent vowel type 2(FB) over N for Pochutla, while all other languages in the Aztec branch exemplify the 2(FB) type. The reflex of Proto UA *u remains as a back rounded vowel in Pochutla. (See **2.2** below.)

**1.3.** The relationship between the Kiowa language and the Tanoan family is so close that Kiowa may be regarded as a divergent member of the Kiowa-Tanoan family. The relationship between this Kiowa-Tanoan family and the Uto-Aztecan family is 'remote', in the sense in which 'remote' relationships are identified in our Introduction. Cognates appearing to connect remotely related language families permit the reconstruction of some micro-phylum, meso-phylum, or macro-phylum phonemes, but not the reconstruction of a parent 'grammar' for the phylum.



Granted that some phonemes may be reconstructed in the 'remote' proto phylum in question, it would still not be possible to reconstruct for Proto KT-UA the linear distinctions and associated SGC's—of the stop subsystem and of the various continuant subsystems—nor to reconstruct the Proto KT-UA vowel type with the degree of completeness that is attainable in reconstructing for Proto Uto-Aztecan—and that would be attainable for Kiowa-Tanoan even more readily, since the daughter languages of the Kiowa-Tanoan family are less differentiated phonologically than the daughter languages of the Uto-Aztecan family.

Though the linear distinctions (with associated SGC) and the vowel types in the Uto-Aztecan daughter languages are as diverse as the inventories (**1.1**) and group summaries (**1.2**) have demonstrated them to be, the differences are still orderly. They represent diversifications from the reconstruction of Proto Uto-Aztecan attested in Chapter 2.

The linear distinctions (with associated SGC) and the vowel types in Kiowa-Tanoan are relatively homogeneous, but differ strikingly from those in reconstructed Proto Uto-Aztecan, and differ also from those in any particular Uto-Aztecan daughter language.

The following brief typology of Kiowa-Tanoan phonemic inventories—when compared with the UA inventories given above—gives evidence to support these general statements.

### TIWA BRANCH OF TANOAN:

### TAOS

Of the six linear distinctions among plain stops, the glottal stop at (5) remains unmatched with stops in three other series. The first of these other series, generated by SGC of GLOTTALIZATION, matches all plain oral stops. The second of these, generated by SGC of VOICING, matches plain stops at three linear distinction points—(1), (2), (4). The third of these, generated by SGC of ASPIRATION, matches plain stops at (1) and (2). To summarize, matching among stops in three series (generated by SGC's) with plain oral stops occurs at five of the six linear distinction points: ,

(1): bilabial /p p' b $p^{h}$/;

(2): apico-alveolar /t t' d $t^{h}$/;

($2^{+}$): apico-alveolar /c c'/ (with fricative off-glide);

(4): dorso-velar /k k' g/;

($4^{o}$): dorso-velar /$k^{w}$ $k'^{w}$/ (with labialization component);

(5): laryngeal /ʔ/ (unmatched with other stops).

Fricatives match stops at four linear distinction points—/s/ at ($2^{+}$), /x/ at (4), /$x^{w}$/ at ($4^{o}$), and /h/ at (5), with a fifth fricative, /ɬ/ at (3), unmatched, Nasals match stops doubly—at (1) and (2): /m n/; glides and the voiced lateral match singly in each series—(ɬ) and (2): /w l/—with a second glide, /y/ at (3), though unmatched with stop does match fricative /ɬ/ at (3).

Those vowels which are combinable with SGC's other than nasalization are of the triple level type, 3(FB)—front-back contrasts at high /i u/, mid /e ə/ and low /a o/, tongue heights. A coexisting nasalized vowel system is also triple level but of the common type 2(FB) over (N)—hence less symmetrical than the 3(FB) type.

It is perhaps necessary to say that we have typologized the phonemes of Taos as structuralized by Trager in 1946, since other phonemicizations have been offered for the same language by the same author.

## Towa Branch of Tanoan:

### JEMEZ

The following is a summary of matching among stops in three series (generated by SGC's of GLOTTALIZATION, VOICING, and ASPIRATION); matching occurs at five of seven linear distinction points:
(1): bilabial /p p' b/;
(2): apico-alveolar /t t' d $t^h$/;
(3): lamino-alveolar /č č' ǰ/ (with fricative off-glide);
(4): dorso-palatal /$k^y$ $k'^y$ $g^y$ $k^{hy}$/;
(4): dorso-velar /k k' g/;
(4°): dorso-velar /$k^w$/ (unmatched with other stops when combined with labialization component);
(5): laryngeal /ʔ/ (unmatched with other stops).

Six fricatives match stops at four linear distinction points—/ɸ/ and /v/ at (1), /s/ and /z/ at (2), /š/ at (3), /h/ at (5) (with /$h^w$/ at (5°) unmatched—unmatched with stop when laryngeal fricative is combined with labialization component). Nasals match stops doubly—at (1) and (2); so also glides—at (1) and (3); but the lateral matches singly—at (2). Of these continuants, not only the fricative at (3), but also both nasals and both glides appear in cluster with the glottal stop—as does the lateral (and in addition with /h/)—in non-initial environments: /ʔš ʔm ʔn ʔw ʔy lʔ lh/; and fricatives at (1) and (2) combine with SGC of voicing: /v z/.

Triple level vowel type, 3(FB), is derived from front-back contrasts at three tongue heights: high /i ɨ/, mid /e o/ (with allophones of /o/ ranging up to [u]), and low /æ a/ (with allophones of /a/ ranging up to [ɔ]). In this 3(FB) vowel type, rounded [B°] at mid-level and unrounded [B] at high-level overlap allophonically in respect to tongue height, but are kept phonemically distinct by virtue of the plus-minus feature of rounding. SGC's combinable with this single 3(FB) system are length and nasalization, and differential tones and stresses.

## Tewa Branch of Tanoan:

### ARIZONA TEWA

Utilizing the same SGC's that appear in Taos and Jemez, above, but distributing them differently—e.g. generating more aspirated than voiced stops—Arizona Tewa matches three series of SGC-combined-stops with plain stops at five of seven linear distinction points:



(1): bilabial /p p' $p^h$ b/;
(2): apico-alveolar /t t' $t^h$ d/;
(2+): apico-alveolar /c c'/ (with fricative off-glide);
(4): dorso-palatal /$k^y$ $k^{hy}$/;
(4): dorso-velar /k k' $k^h$ g/;
(4°): dorso-velar /$k^w$ $k'^w$ $k^{hw}$/ (with labialization component);
(5): laryngeal /ʔ/ (unmatched with other stops).

Four fricatives match stops at three linear distinction points—/v/ at (1), /s/ at (2+), and /h/ at (5) (with /$h^w$/ at 5° unmatched). Nasals match stops doubly at (1) and (2): /m n/ (with allophonic extension of the latter to (4), since one allophone of /n/, namely [ŋ], matches dorso-velar stops). So also, there is double matching for glides—at (1) and (4): /w y/; but single matching for the lateral /l/ at (2).

Front-back contrasts of vowels at high /i u/, mid /e o/, and low /ɛ a/ yield a triple level 3(FB) vowel type. SGC's combinable with these six vowels are length and nasalization, and differential tones and stresses.

### KIOWA

All three branches of Tanoan combine SGC's of GLOTTALIZATION, ASPIRATION, and VOICING with plain stops. So does Kiowa. The matchings occur at five linear distinction points in Tanoan languages. In Kiowa, they occur at four linear distinction points:
(1): bilabial /p p' $p^h$ b/;
(2): apico-alveolar /t t' $t^h$ d/;
(2+): apico-alveolar /c c'/ (with fricative off-glide);
(4): dorso-velar /k k' $k^h$ g/;
(5): laryngeal /ʔ/ (unmatched with other stops).

Three fricatives match stops at two linear distinction points—/s/ and /z/ at (2+), and /h/ at (5). Nasals match stops doubly—at (1) and (2): /m n/. There is, unlike Tanoan, only one glide in Kiowa, unmatched /y/ at (3); and unlike Taos, but like Jemez and Arizona Tewa, Kiowa lacks a fricative /ɬ/, having only a matching voiced /l/ at (2).

The 3(FB) vowel type in Kiowa—high /i u/, mid /e o/, low /a ɔ/—makes distinctions like those in Tanoan languages, with combinable SGC's of nasalization, length, and tones.

# CHAPTER 2

## LANGUAGE CHANGE FROM RECONSTRUCTED UA



**2.0.** The order in which languages are presented in Chapter 2 differs from that in Chapter 1, since it is influenced by different considerations of technical exposition.

In **2.1**, reflexes of Proto UA phonemes are given without cognate exemplification; when more than one phoneme descends from a single phoneme in the parent language these are listed without mention of the conditions under which the different reflexes appear.

Both cognate exemplifications and the distributional conditions for multiple reflection are given in **2.2**.

A numerical summary of cognates is given in **2.3**, and a bibliography of sources used.

**2.1.** Languages are presented here, and in **2.2**, in the following order: Papago, Hopi, Huichol, Cora, Tarahumara, Aztec (with three Aztec languages treated separately in **2.2**: Zacapoaxtla Nahuat and Pochutla and Nahuatl), Tübatulabal, Southern Paiute, Comanche, Mono, Bannock (not treated in **2.2**), Luiseño, Cahuilla (not treated in **2.2**), Yaqui-Mayo.

### Papago

Three of the UA stops, */p t c/, are doubly reflected in Papago (i.e., with two different phonemes corresponding to a single UA phoneme): *p > /p w/; *t > /t č/; and *c > /ṣ s/. The three remaining stops in UA, */k $k^w$ ?/, have single reflexes in Papago: /k b ?/, respectively.

The two UA fricatives are *h and *s; *h is reflected in Papago by /?/ in one environment (see **2.2**) but is lost in other environments. UA *s has a single reflex in Papago, namely /h/.

The bilabial nasal *m remains in Papago as /m/, while the two lingual nasals */n ŋ/ merged into *n in pre-Papago; pre-Papago *n subsequently split into /n/ and /$n^y$/ in Papago.

What is orthographically set up as one lateral in UA has triple reflexes in Papago: *l > /d̲ l $n^y$/.

The first UA glide listed has a single reflex in Papago; the other two have dual reflexes: *w > /g/; *r > /d̲ l/ (attested by a pair of cognates which distinguish /d̲ l/ < *r from the better attested /d̲ l/ < *l); *y > /d ž/.

In most environments, the UA vowels are retained: */i i u a o/ > /i i u a o/, respectively. For instances in which UA vowels are lost, see **2.2**.

### Hopi

Two of the UA stops, */p k/, have dual reflexes in Hopi: *p > /p v/, and *k > /k q/. The four remaining stops in UA are singly reflected since they remain without change in Hopi: */t c kʷ ʔ/ > /t c kʷ ʔ/, respectively.

Of the two UA fricatives, *s remains in Hopi as /s/; *h is doubly reflected by /h/ and by zero.[9]

The three UA nasals remain in Hopi: */m n ŋ/ > /m n ŋ/.

The UA lateral is doubly reflected in Hopi: *l > /l n/.

Of the three UA glides, the first listed is triply reflected in Hopi; the two others remain: *w > /w l ŋʷ/; *y > /y/; *r > /r/ (attested by one known cognate; in relative frequency among Hopi phonemes, /r/ ranks low but is found in highly recurrent expressions).

The UA vowels */i i̱ u a o/ > /i i̱ o a ö/, respectively; but for additional, less regular, reflection see **2.2**.

### Huichol

The first UA stop listed has triple reflexes in Huichol; all other stops remain unchanged: *p > /h p/ and zero; */t c k kʷ ʔ/ > /t c k kʷ ʔ/, respectively.

Of the two UA fricatives, *s is reflected in Huichol by /š/; *h is doubly reflected, by /ʔ/ and zero.

UA *m remains in Huichol, and */n ŋ/ merge into /n/.

The UA lateral is doubly reflected in Huichol: *l > /n/ and zero.

UA *w is doubly reflected in Huichol: *w > /h w/. The other glides are singly reflected: */y r/ > /y r/.

UA *a is doubly reflected, by /a e/; UA */i i̱ u o/ > /i e i̱ u/, respectively.

### Cora

One of the UA stops is triply reflected in Cora: *p > /h p pʷ/; two are doubly reflected: *k > /k č/; *kʷ > /kʷ čʷ/. The remaining three stops remain in Cora: */t c ʔ/ > /t c ʔ/, respectively.

Of the two UA fricatives, *s remains in Cora as /s/, and *h is doubly reflected, by /ʔ/ and zero.

UA *m is doubly reflected in Cora: *m > /m mʷ/. The other two nasals, */n ŋ/, merge into /n/ in Cora.

Of the UA glides, *w is triply reflected in Cora, by /h w v/, and *y is doubly reflected, by /y/ and by zero.

The UA vowels */i i̱ u a o/ > /i e i̱ a u/, respectively.

[9] Though it is common practice in comparative linguistics to speak of a 'zero' reflex in a daughter language, this technical usage is in competition with the usage of 'zero' in reference to paradigmatic frames. Nothing more is meant by our comparative linguistic 'zero' than was meant by phonemic 'loss' in Papago, above. Similarly, there may be danger of conflict in the technical usage of 'remain': (1) when a phoneme in the parent language is said to 'remain' or 'remain as such'—i.e. not change to any other phoneme or to zero; (2) when a phoneme in the parent languages is said to 'remain' in the sense of being reflected in a one to one change in the daughter language, and hence preserved as an isomorphism of the parent language phoneme.



### Tarahumara

Two of the UA stops are singly reflected in Tarahumara: *c > /c/, and *kʷ > /w/. The remaining stops are multiply reflected: *p > /b p/; *t > /r t c/; *k > /k g/; *ʔ > /ʔ/ and zero.

UA *s remains in Tarahumara as /s/; *h is doubly reflected, by /h/ and zero.

UA *m remains in Tarahumara as /m/; *n and *ŋ merge into /n/ in Tarahumara.

UA *l > /r/.

The UA glides */w y/ are each doubly reflected in Tarahumara: *w > /w/ and zero; *y > /ʔy/ and zero.

UA *i̱ is doubly reflected, by /i e/; UA */i u a o/ > /i u a o/, respectively.

### Aztec

Two of the UA stops are doubly reflected in all Aztec languages: *p > /p/ and zero; *c > /c č/. One UA stop, *t, is singly reflected in Nahuat and Pochutla by /t/, and doubly reflected in Nahuatl by /t ƛ/. The remaining UA stops are singly reflected: *k > /k/; *kʷ > /kʷ/; *ʔ > zero.

The UA fricative *s is doubly reflected in Aztec by /s š/, and UA *h is singly reflected by zero.

The UA nasals */n ŋ/ merge into /n/ in Aztec. UA *m remains as /m/, though, morphophonemically, /m/ ~ /n/ word finally.

The UA lateral is doubly reflected in Aztec: *l > /n l/.

The UA glide *y is singly reflected in Aztec by /y/; the glide *w is doubly reflected by /w/ and by zero.

The UA vowels */i i̱/ > /i e/ in all Aztec. UA *u > /i/ in Zacapoaxtla Nahuat and /i e/ in Nahuatl, but is reflected by a back rounded vowel /o/ in Pochutla. UA *o > /o/ in Zacapoaxtla Nahuat and in Nahuatl, but is doubly reflected in Pochutla by /o u/. UA *a remains /a/ in Nahuatl, but is doubly reflected by /a e/ in Zacapoaxtla and Pochutla, with reflex /a/ being the more frequent in the former, /e/ more frequent in the latter.

### Tübatulabal

Three of the UA stops, */kʷ ʔ c/, have single reflexes in Tübatulabal: /w ʔ c/, respectively. However, additional cognates might well show that UA *c is reflected by more than one Tübatulabal phoneme. Sufficient cognates are available to show that UA */p t k/ are multiply reflected in Tübatulabal: *p > /p b ⁿb/; *t > /t d ⁿd l/; *k > /k g ᵑg h ᵑh/. It seems safe to assume furthermore that not only /c/ but all affricate stops in Tübatulabal, namely /c ʒ ⁿʒ č ǯ ⁿǯ/, represent a development involving multiple reflexes from UA—but see below.

Each of the UA fricatives */s h/ has dual reflexes in Tübatulabal: *s > /s ⁿʒ/, and *h > /ʔ/ and zero.

The UA nasals */m n ŋ/ remain in Tübatulabal as /m n ŋ/; morphophonemically, /ŋ/ ~ /n/ before -t.

The UA lateral has dual reflexes in Tübatulabal: *l > /l n/.

Of the UA glides, *w is doubly reflected in Tübatulabal, by /w ŋʷ/, and *y remains as /y/.

The UA vowels */i i̱ u o a/ > /i i̱ u o a/, respectively, but for less usual reflection, see **2.2.**

### Southern Paiute

The UA oral stops have, as one type of descent, unit phoneme stop reflexes in Southern Paiute: *p > /p/; *t > /t č/; *c > /c č/; *k > /k q/; *kʷ > /kʷ/. Four of these UA stops have, in addition, continuantized reflexes in Southern Paiute: *p > /v/; *t > /r/; *k > /x/; *kʷ > /xʷ/. Beside unit phoneme reflexes, cluster reflexes of four of the UA stops also occur in Southern Paiute: *p > /xp mp/; *t > /xt nt/; *k > /xk ŋk xq ŋq/; *kʷ > /xkʷ ŋkʷ/. UA *c > zero in one type of descent and by analogy we posit *c > /xc nc xč nč/, though cognates are lacking to attest this development.

The UA glottal stop is doubly reflected in Southern Paiute: *ʔ > /ʔ/ and zero.

Of the UA fricatives, *s is quadruply reflected in Southern Paiute, by /s xs ʔ/ and zero; *h is singly reflected by zero.

All three UA nasals are doubly reflected: *m > /m ŋʷ/; *n > /n/ and zero; *ŋ > /ŋ/ and zero.

The UA glides */w y/ are doubly reflected in Southern Paiute, by /w y/, respectively, and by zero.

UA *l > /n/, but morphophonemically, /n/ ~ /m/ before /p/ in Southern Paiute.

The UA back rounded vowels merge in Southern Paiute: */u o/ > /u/. The remaining vowels */i i̱ a/ > /i i̱ a/, respectively.

### Comanche

The first three UA oral stops listed have triple reflexes in Comanche; the other oral stops have dual reflexes: *p > /p hp v/; *t > /t ht r/; *c > /c hc/ and zero; *k > /k hk/; *kʷ > /kʷ hkʷ/. UA *ʔ remains in Comanche as /ʔ/ in some dialects; in others, it is doubly reflected, by /ʔ/ and by zero.

Of the UA fricatives, *s is quadruply reflected in Comanche, by /s hs h/ and zero; *h remains as /h/.

The UA bilabial nasal is doubly reflected in Comanche: *m > /m hm/. The lingual nasals have totally overlapping, dual reflexes in Comanche: *n > /n hn/; *ŋ > /n hn/.

The UA lateral has dual reflexes in Comanche, overlapping with reflexes of the lingual nasals: *l > /n hn/.

The UA glides */w y/ are doubly reflected: *w > /w/ and zero; *y > /y/ and zero.

The UA vowels */i i̱ u a o/ > /i i̱ u a o/, respectively. For less usual reflection, see **2.2.**



### Mono

The UA velar stop *k is quadruply reflected in Mono, by /k hk q hq/. Cognates occur to attest double reflection of *kʷ by /kʷ qʷ/, but we posit, by analogy, quadruple reflection of *kʷ paralleling that of *k.

Cognates occur to attest dual reflection of *t by /t ht/, but only single reflection for *p (Mono /p/) and for *c (Mono /c/); additional cognate data would probably also provide instances of Mono /hp/ < *p and of Mono /hc/ < *c.

The UA glottal stop is doubly reflected: *ʔ > /ʔ/ and zero.

Of the UA fricatives, one is triply reflected, the other is singly reflected: *s > /s hs c/; *h > /h/.

UA *m is triply reflected in Mono by /m hm w/. UA *n > /n/ and zero; UA *ŋ > /hm/ (attested by a single cognate).

UA *l > /n/.

UA *w remains in Mono as /w/; *y is doubly reflected by /y ʔ/.

The UA vowels */i i̱ u a o/ > /i i̱ u a o/, respectively. See **2.2** for less usual reflection of UA vowels.

### Bannock

Contrary to our usual practice of giving attestation by cognates in **2.2.**, we present the Bannock reflexes here, but without attestation in **2.2.**

All UA oral stops are doubly reflected in Bannock: *p > /p b/; *t > /t d/; *c > /c ʒ/; *k > /k g/; *kʷ > /kʷ gʷ/. The glottal stop is singly reflected: *ʔ remains /ʔ/.

The UA fricative *s is doubly reflected, by /s/ and zero, in Fort Hall Bannock; in other dialects, it is also doubly reflected, but by /s/ and by /ss/. The other UA fricative, *h, remains as /h/ in Bannock.

The UA nasals */m n/ are each doubly reflected in Bannock: *m > /m mm/; *n > /n nn/. By analogy, we postulate similar descent for UA *ŋ, i.e., *ŋ > /ŋ ŋŋ/, but data for this are uncertain.

UA *l > /n/.

Both UA glides */w y/ are doubly reflected in Bannock: *w > /w/ and zero; *y > /y č/.

The UA vowels */i i̱ u a o/ > /i i̱ u a o/, respectively.

### Luiseño

One UA stop is triply reflected in Luiseño: *k > /k q x/. Three are doubly reflected: *p > /p v/; *t > /t l/; *ʔ > /ʔ/ and zero. The remaining two are singly reflected: */c kʷ/ > /č kʷ/, respectively.

The UA fricatives */s h/ are singly reflected in Luiseño by /s h/, respectively.

The UA nasals remain without change in Luiseño: */m n ŋ/ > /m n ŋ/.

UA *l > /n/.

UA */w y/ remain in Luiseño as /w y/, respectively.

The UA vowels */i i̱ u a o/ > /i o u a e/, respectively. For other reflection, such as loss of final vowels, see **2.2.**

### Cahuilla

The following reflexes are offered, as in the Bannock case, without attestation by cognates in **2.2**.

Of the UA stops, two are doubly reflected in Cahuilla: *p > /p v/; *t > /t l/. One is triply reflected: *k > /k q x/. The remaining UA stops are singly reflected: */c $k^w$ ʔ/ > /č $k^w$ ʔ/.

The UA fricative *s is doubly reflected in Cahuilla; *h remains unchanged: *s > /s š/; *h > /h/.

The UA nasals remain in Cahuilla: */m n ŋ/ > /m n ŋ/, respectively.

The UA lateral is singly reflected in Cahuilla: *l > /n/.

UA */w y/ remain in Cahuilla as /w y/, respectively.

The UA back rounded vowels */u o/ merge into /u/ in Cahuilla; UA */i i a/ > /i e a/, respectively.

### Yaqui-Mayo

One of the UA stops, *p, is doubly reflected in Yaqui-Mayo; the others are singly reflected: *p > /v p/; */t c k $k^w$ ʔ/ > /t č k $p^w$ ʔ/, respectively. In addition, as a feature of secondary development involved with stress and length alternation, medial geminate reflexes of UA oral stops occur, thus *p > /pp vv/; *t > /tt/; *c > /čč/; *k > /kk/.

Both UA fricatives remain in Yaqui-Mayo: */s h/ > /s h/.

Of the UA nasals, *m remains as /m/ in Yaqui-Mayo, but */n ŋ/ merge into /n/.

The UA lateral is doubly reflected in Yaqui-Mayo: *l > /n r/.

UA *w > /w/ and zero; *y remains as /y/.

UA *a > /a e/; */i i u o/ > /i e u o/, respectively. For other, less usual reflection, see **2.2**.

**2.2.** For each language treated below, a number of reconstructed UA stems are cited to illustrate the particular way in which the language reflects the phonemes of the UA parent language. Upon its first appearance, each such reconstruction is given a gloss and a number; in subsequent appearances the gloss is omitted, but the gloss for the form in the descending or daughter language is given instead; even the latter is omitted upon repeated appearances of the form in the exposition of a particular language. (At the end of this monograph, in an Appendix, all reconstructions are relisted together with their descending forms in the daughter languages.)

The reconstructed UA phoneme inventory has been presented in **1.2** above, and will be recognized by the reader when he sees reconstructions in **2.2**. However, morphophonemic features in reconstructions and in diachronic phonology have not yet been explained—subscripts after vowels in certain reconstructed stems and vowel formulae—e.g. *p > /w/ in Papago after $*V_s$, but *p > /p/ in Papago after $*V_u$. The particular effects in diachronic phonology are as specified in **2.2**; but reconstructed morphophonemics is first treated systematically in Chapter 3. (Footnotes in Chapter 2 explain technical usages of particular orthographic devices, such as hyphens and parentheses.)



### Papago

Two separate but not entirely independent statements are needed to account for reflexes of UA *p in Papago. The first statement which follows accounts for instances in which *p occurs initially in UA words (*p-); the second for instances in which it occurs medially (*-p-). Medial reflexes are conditioned by preceding UA vowels specified as having one or another reflex-conditioning power—either unaltering ($*V_u$) or spirantizing ($*V_s$).

UA *p- > /w/: *pahi *three* (1) > wái-k; *$pa_s$ki *to enter* (2) > wáakì; *$pi_u$ ti *heavy* (3) > wíič; *po *road, path* (4) > wóo-g; *$pu_n$si *eye* (5) > wúhì. A secondary alteration of /w/ < *p- occurs in Papago reduplication—the reduplicated syllable begins in /w/, but in the remaining part of the theme, the original initial alters to /p/: *pi *breast* (6) > wípi (rather than wíwi); *po *body hair, fur* (7) > wópo; *$pa_s$ka *reed* (8) > wáapk.

UA *-p- > /p w/. The reflex /p/ appears after $*V_u$ (see **3**): *$ku_u$pa *headhair* (9) > kúup *scalp with hair attached*; *$ta_u$pa *to split it* (10) > táapa-n; *$si_u$(pi) *cold* (11) > híip.[10] The reflex /w/ appears after $*V_s$ (see **3**): *$pi_s$pa *tobacco* (12) > wíw; *$ci_s$pu *bitter* (13) > síw; *$si_s$-po *eyebrow* (a compound with *po *body hair, fur* as second member)[11] (14) > híhì—wo; *$mu_s$pi *nose* (15) > múuwi-ž *pointed*; *$na_s$pi *prickly pear cactus* (16) > náw; *$wi_s$pa *to whip* (17) > gíw.

Reflexes of UA *t are given in two statements. The first statement accounts for instances of *t before UA high vowels, and the second for instances of the same stop before UA low vowels.

UA *t > /č/ before $*V^{high}$: *$ti_s$ka *to put* (18) > číik *to put a sheet-like object down*; *$ti_u$ni *mouth* (19) > čín$^y$ (~čín$^y$);[12] *$ti_n$wa *to name* (20) > čiig-ig *name*, čiičig *to name*; *tíwa *to find* (21) > čiig; *$tu_u$ku *meat* (22) > čúuku-g; *$tu_u$(ku) *black* (23) > čúk; *ʔati *louse* (24) > ʔáaʔač; *mati *to know* (25) > máač; *$su_u$tu ~ *$si_u$tu *fingernail, claw* (26) > húuč.

UA *t > /t/ before $*V^{low}$: *$ta_u$ca *sun* (27) > táṣ; *tala *foot* (28) > táḍ; *$ta_s$ma *tooth* (29) > táatam; *toŋo *knee* (30) > tóon; *$to_u$sa *white* (31) > tóhà (~ túhà); *sita *ochre* (32) > hít.

Papago reflexes of UA *c are given in two statements, the first accounting for instances of *c before the UA front vowel *i, and the second for instances of the same phoneme before UA back vowels.

[10] Phonemic material which is reflected in some daughter languages but not in others is enclosed in parentheses in reconstructions of forms in the UA parent language.

[11] Hyphens flanked by reconstructed material mark what is considered to have been a morpheme boundary in the UA parent language. The members of a compound in modern Papago are separated by a dash (—); hyphens are used in Papago forms only to set off suffixes.

[12] Papago forms included in parentheses and preceded by the alternation sign are dialect variants. The significance of the alteration sign between final vowels in Proto UA forms is treated in **3.4**.

UA *c > /s/ before *V$^{front}$: *ci?i *to suck out* (33) > sí?ì; *ci$_s$pu (13) > síw; *ko$_s$c-i *sleep* (34b) > kóos; *k$^w$i$_s$ci *smoke* (35) > kúu-bs (kúu - < *ku *fire*); *ma$_s$ci *to appear* (36) > máas.

UA *c > /ṣ/ before *V$^{back}$: *coma *to sew* (37) > ṣóom; *co(ni)*head* (38) > ṣón$^y$- *head of instrument used for hitting or chopping*; *?aci ~ a *to laugh at* (39) > ?áṣ ~ ?ás-; *ta$_u$ca (27) > táṣ; *yaca *to set it down* (40) > dáaṣ; *ko$_s$ci ~ o *to sleep* (34) > kóoṣ *to sleep*.

Reflexes of the UA stops */k k$^w$ ?/ are given in successive statements. The reflex of each of these stops is the same in all environments.

UA *k > /k/: *kasi *leg* (41) > káhì(o); *ka$_s$ti *to sit* (42) > káač *to be in position, inan.*; *ki$_u$(?i ~ i) *to bite* (43) > kí?ì; *ki *house* (44) > kíi; *ko$_s$c-i (34b) > kóos; *koya *to kill pl.* (45) > kókda (< pre-Papago kóod); *ku$_u$pa (9) > kúup; *pa$_s$ki (2) > wáakì; *pu$_n$ku *dog* (46) > wá-wuk *raccoon* (wá- < *pa *water*); *ti$_s$ka (18) > číik; *na$_n$ka *ear* (47) > náak.

UA *k$^w$ > /b/: *k$^w$a(?a) *to eat* (48) > bá?a *to swallow, eat berries*; *k$^w$a- *eagle* (49) > bá?ag; *k$^w$a$_u$si ~ i *cooked, ripe* (50) > báhì *to ripen*, báhi-ẓid *to cook till done*; *k$^w$a$_u$si *tail* (51) > báhì; *k$^w$i$_s$(si) *to take, get* (52) > bíhì; *k$^w$i- *food* (53) > bí-i *food served up*, bía *to serve food*; *k$^w$i$_u$ta *excrement* (54) > bíit; *hik$^w$i(si) *to breathe* (55) > ?íibhi; *tok$^w$i *rabbit* (56) > tóobì *cottontail rabbit*.

UA *? > /?/: *?aki *arroyo* (57) > ?ákì; *?a$_u$ŋa *wing, feather* (58) > ?á?an; *?asi ~ i *to arrive* (59) > ?áhì, ?á?àhi *to complete a cycle, to reach, overtake*; *?ato *anus, bottom* (60) > ?át *anus*; *?oho *bone* (61) > *óo?o; *?oha *yellow* (62) > ?óa-m (~ ?úa-m); *?o$_s$ŋa *salt* (63) > ?ón; *ci ? i (33) sí?ì.

Of the UA fricatives, *s is treated in one statement, since it is singly reflected in Papago; the doubly reflected *h is treated in two statements.

UA *s > /h/ in all environments: *sawa *leaf* (64) > háahag; *si- *one* (65) > hí(ma);[13] *si *guts, entrails* (66) > híhi; *si$_u$(?i ~ a) *to urinate* (67) > hí?à; *si$_s$ku *navel* (68) > hík; *simi ~ a *to go* (69) > hím; *si$_s$pa *to shave, scrape* (70) > híw-kon; *su *star* (71) > hú?u; *su$_u$tu (26) > húuč; *suwi ~ a *to consume, eat* (72) > húug ~ húg; *pisa *penis* (73) > wíhà; *pu$_n$si (5) > wúhì; *pusa *to waken* (74) > wúhan; *tu$_u$su ~ i *to grind* (75) > čúhi-wi; *k$^w$a$_u$si (51) > báhì; *ya$_n$sa *to sit* (76) > dáhà.

The first statement which follows accounts for Papago reflexes of initial *h, and the second accounts for reflexes of medial *h.

UA *h- > /?/: *hi$_s$- *to drink* (77) > ?í?ì; *hik$^w$i(si) (55) > ?íib-hi; *hu *arrow* (78) > ?ú?u; *hu$_s$pi *wife* (79) > ?úwì *woman, girl*.

UA *-h- > zero; *pahi (1) > wái-k; *tiha *hail* (80) > čía (~ čía); *muhu *to shoot* (81) > múu *to shoot with an arrow*; *yahi$_s$(pa) *to come pl.* (82) > dáiw; *?oho (61) > ?óo?o; *?oha (62) > ?óa-m (> ?úa-m).

Of the three reconstructed nasals, *m alone appears with a single reflex in Papago. Each of the two other UA nasals */n ŋ/ eventuates in a pair of Papago

[13] Hyphens are written after reconstructed forms when the daughter language forms have shared cognate material followed by non-cognate—and hence not reconstructible—material. In citing the daughter language forms of such cognates, the non-cognate material is enclosed in parentheses.



reflexes; the development is nevertheless through a single pre-Papago *n. That is to say, UA */n ŋ/ first fall together as *n in pre-Papago and this subsequently splits, appearing in modern Papago as either /n$^y$/ or /n/. Reflexes of *m are treated in a single statement, while reflexes of */n ŋ/ are treated in successive statements.

UA *m > /m/: *ma$_s$ka *to give* (83) > máak; *mala *child (with female reference)* (84) > máḍ; *mi?a *to kill sg.* (85) > mí?à (~ mú?à); *mu$_u$ki ~ u *to die sg.* (86) > múukì; *ta$_s$ma (29) > táatam; *ka$_u$ma *cheek, mouth* (87) > káam; *ku$_u$mi ~ a *to gnaw* (88) > kúum *to eat—as corn on cob*.

Separate statements are needed to account for instances of */n ŋ/ before UA high vowels and before UA low vowels.

UA */n ŋ/ > /n$^y$/ before *V$^{high}$: *ni$_s$ma *liver* (89) > n$^y$ím; *ni(?i) *to fly* (90) > n$^y$í?ì *to fly pl.*; *pini *to suck on it* (91) > wíin$^y$; *tani *to ask, beg* (92) > táan$^y$; *ti$_u$ni (19) > čín$^y$ (~čín$^y$); *sunu *corn* (93) > húun$^y$; *liŋi *tongue* (94) > n$^y$íin$^y$.

UA */n ŋ/ > /n/ before *V$^{low}$: *na$_n$ka (47) > náak; *na$_s$pi (16) > náw; *naya *to light a fire* (95) > náad; *no- *egg* (96) > nón(ha); *kuŋa *husband* (97) > kún; *?a$_u$ŋa (58) > ?á?an; *toŋo (30) > tóon; *?o$_s$ŋa (63) > ?ón.

One reconstruction is tentatively set up with initial *l; the Papago reflex of this initial is /n$^y$/: *liŋi (94) > n$^y$íin$^y$. Intervocalic *l is better attested. UA *-l- > /l/ before *-i: *puli ~ a *to tie* (97a) > wúul- ~ wúuḍ *to rope, tie*. UA *-l- > /ḍ/ before *-a: *tala (28) > táḍ; *mala (84) > máḍ; *sula *heart* (98) > húḍ *integral part of anything, as of body*.

Of the UA glides, *w is singly reflected in Papago, while */r y/ are each doubly reflected. But */y w/ are each amply attested, while the glide *r is attested by only two cognates, with alternative reconstructions for each.

UA *r > /ḍ/: *tukur(i) *owl* (105) > čúkuḍ.

UA *r > /l/: *cikuri ~ cikori *circular* (148) > síkol-k.

UA *w > /g/ in all environments: *waki *dry* (99) > gákì; *wi- *big* (100) > gí?ì; *wi$_s$ci *to fall* (101) > gíiṣ; *wi$_s$pa (17) > gíw; *wi- *fat* (102) > gíigì; *wo- *two* (103) > góo-k; *?awa *horn* (104) > ?á?ag; *tiwa (21) > číig; *suwi ~ a (72) > húug ~ húg.

UA *y > /ž/ before *V$^{high}$: *yi?i *mother* (106) > ží?ì; *yiki *to taste* (107) > žíik; *yiwa *space* (108) > žíg; *yuku *to rain* (109) > žúuk.

UA *y > /d/ before *V$^{low}$: *yaca (40) > dáaṣ; *ya$_s$ka *nose* (110) > dáak; *yoma *to copulate* (111) > dóom; *koya (45) > kókda (pre-Papago kóod); *k$^w$iya *dirt, earth* (112) > bíd; *naya (95) > náad.

The following is concerned with both positive and zero reflection of UA vowels in Papago. It is possible to state these reflexes without specifying length, stress, or other series generating component in the parent language.[14] Vowel change which is not strictly a historical matter but rather a matter of modern Papago morphophonemics is treated in **3** below.

UA vowels in initial syllables are reflected by zero only in disyllabic stems

[14] The fact that we do not specify certain series generating components in the parent language does not mean, of course, that they did not occur in that language.

which served as second members of compounds or as by-forms of stems in some stage of pre-Papago: *tiskɨ ~ a *to cut* (113) > -čk *to sever* (a stem in many languages but a suffix in modern Papago); *kʷiₛci (35) > kúubs (kúu- < *ku *fire* plus -bs < kʷiₛci *smoke*).

Otherwise, UA vowels in initial syllables remain: *ci- *spit* (114) > sís-wùa *to spit*; *siki ~ a *to cut hair, mow* (115) > híik; *ʔi *this* (116) > ʔíi- *proximal*; *tima *small* (117) > čím; *tiso *cave* (118) > číhò (~číhò ~ čího); *ʔiₛ(ca) *to plant* (119) > ʔíṣ; *ʔi- *theft* (120) > ʔíi(sid) *to steal*; *tuₛ- *to extinguish* (121) > čúu(ṣ); *su (71) > hú?u; *pa *water* (123) > wá- *referring to water*; *ʔawɨ *to tell* (124) > ʔáag; *ta- *sinew* (125) > táta(ì); *kahi ~ a *to hear* (126) > káa *to hear*, kái-dag *sounding like ...* ; *kʷaʔa *maternal grandfather and reciprocal* (127) > bá?a—maḍ *DaSo*, báab *MoFa*; *ma *hand* (128) > má(čpoḍ) *finger*, wístmáam *ten* (wíis *all*, t- *our*); *yaʔa *to yearn after* (129) > dáʔà; *poʔi ~ o *to be lying down* (130) > wóʔò; *koʔa *to eat* (131)> kóʔà (~kúʔà); *soʔi *thorn* (132) > hóʔi. Cognates given elsewhere to exemplify consonantal correspondences provide a score or more of additional instances for each UA vowel.

The inverse of the retention of vowels in initial syllables is found in final syllables of polysyllabic UA words where Papago reflection of UA vowels shows loss predominately. The first statement which follows gives conditions under which all vowels are retained; subsequent statements oppose the reflection of *i to that of the more symmetrical vowels */ɨ u o a/.

All UA vowels remain finally after */ʔ s h/: *tuʔ-i *flour* (133) > čúʔì; *ciʔi (33) > síʔì; *puₙsi (5) > wúhì; *kʷaᵤsi (51) > báhì; *yiʔɨ (106) > ǯɨʔì; *kʷiₛ(si) (52) > bíhì; *muhu (81) > múu; *yaʔa (129) > dáʔà; *toᵤsa (31) > tóhà; *tɨha (80) > čía; *moʔo *head* (134) > móʔò; *tɨso (118) > číhò; *ʔoho (61) > ʔóoʔo.

UA *i is lost finally after *c in all dialects; it is retained in all dialects after the consonants */p m w k kʷ/ at positions (1) and (4) as well as after */ʔ s h/. After consonants at positions (2) and (3), namely */t n l y/ (as well as after *ŋ whose Papago reflexes are at positions (2) and (3)), it is only possible to say that UA *i is lost in some Papago dialects and retained in others.

*i > /i/: *paₛki (2) > wáakì; *tokʷi (56) > tóobì; *muᵤki (86) > múukì; *huₛpi (79) > ʔúwì.

*i > zero (/i/ in some dialects): *mati (25) > máač (máačì); *tani (92) > táanʸ (táanʸì); *liŋi (94) > nʸíinʸ (nʸíinʸì); *puli ~ a (97) > wúul- (wúulì-).

*i > zero (in all dialects): *kʷiₛci (35) > (kúu)bs; *maₛci (36) > máas.

The more symmetrical back vowels—those in the set 2(BB°)—are retained finally after laryngeal consonants and also after *s (see above) but are lost after all other oral consonants. This situation may be generalized for Papago in as much as *s > h and *h > zero in Papago; hence only UA laryngeals and the developed laryngeal in Papago permit final vowel from the set */ɨ u o a/.[15]

[15] Even the set */ɨ u o a/ has its special dialect reflexes: in some dialects (generally western Papago), where *i remains after */t n ŋ l y/, the high back vowels */ɨ u/ are replaced by /i/ finally. Thus, in these dialects: *piᵤtɨ (3) > wíičì; *suᵤtu (26) > húučì. All dialects agree in their reflection of the low back vowels */o a/.



*V > zero: *piᵤtɨ (3) > wíič; *siᵤ(pi) > híip; *naₛpi (16) > náw; *ciₛpu (13) > síw; *tuᵤ(ku) (23) > čúk; *suᵤtu (26) > húuč; *sunu (93) > húunʸ; *toŋo (30) > tóon; *ʔato (60) > ʔát; *wiₛpa (17) > gíw; *tiwa (21) > číig; *taᵤca (27) > tás; *sita (32) > hít; *naₙka (47) > náak; *ʔoₛŋa (63) > ʔón; *kʷaᵤna *smelly* (135) > bán *coyote*.

## Hopi

Words in which *p occurred initially in UA and words in which *p occurred medially yield different sets of reflexes for this stop in Hopi. As in Papago, Hopi reflexes are also conditioned by preceding vowels.

UA *p- > /p/: *pahi (1) > pá·y- *three*; *paₛki (2) > páki *to enter*; *piᵤtɨ (3) > pítɨ *heavy*; *po (4) > pǒ-hi *road*; *puₙsi (5) > pó·si *eye*; *pi (6) > pí·-hi *breast*; *po (7) > pǒ-hö *downy feathers, body hair*; *paₛka (8) > pá·qa *reed*; *pisa (73) > pís—qöytö *glans penis*; *pa (123) > pá·-hɨ *water*.

UA *-p- > /p v/. The reflex /p/ appears after *Vᵤ (see **3**): *kuᵤpa (9) > kó·pa *top of head*; *taᵤpa (10) > tá·pa-k-na *to tap, knock, make snap*. The reflex /v/ appears after *Vₛ (see **1**): *piₛpa (12) > pí·va *tobacco*; *ciₛpu (13) > cí:vo *hot to the taste*; *siₛ-po (14) > sí·-vi *eyebrow*; *naₛpi (16) > ná·vi *prickly pear cactus*; *wiₛpa (17) > wivá:-ta *to whip*.

Only one other UA stop is doubly reflected in Hopi, namely *k. Instances of *k before the UA low vowels */o a/ are distinguished from instances of *k before high vowels */i ɨ u/.[16]

UA *k > /q/ before *Vˡᵒʷ: *koya (45) > qǒ·ya *to kill several*; *kasi (41) >

[16] However, both /k/ and /q/ occur before /a/ in modern Hopi—the former with a fronted allophone [ķ]. If, in both instances, this modern /a/ is descended from UA *a, then one might postulate, as Whorf did, that Hopi /k/ and Hopi /q/ before /a/ reflect different UA stops—Hopi /ka/ < UA *ķa, and Hopi /qa/ < UA *ka. However, Hopi would then be the only modern language in which the UA contrast *ķ:k shows up in the reflexes—other daughter languages have the same reflexes for both.

We hesitate here to reconstruct an opposition of */ķ k/ for Proto UA, because there are statable conditions, though not always testable ones, for this dual reflection before *a—from *k to Hopi /k q/. In all reconstructible stems in which Hopi /k/ appears medially before /a/, it is preceded by a UA high vowel (see the three examples below); conversely, when Hopi /q/ occurs medially before /a/, it is preceded by a UA low vowel (e.g., 47, 83, 110, 145 glossed *ear, give, nose, man*).

The reconstructible stems showing Hopi /k/ before /a/ are now given in three cognate sets. The first is *hika *wind, air, cool*: Hopi híka *to cool off*, hí:ka-ŋʷi *wind*; Comanche híka- *to cool off*; Cora ʔeéka *air, wind*; Huichol ʔe·ká· *wind, air*; Tarahumara iká *air*; Zacapoaxtla eheka-t *air, wind*. The second is *huka *leg, foot*: Hopi hóka *leg*; Mono huhka *leg*; Cora ʔiíka *leg*; Huichol ʔiká *foot*; Papago ʔúuk(ṣ) *shin, calf*. The third is *tuka *to extinguish*: Hopi tó·ka *to extinguish*; Southern Paiute tuxʷá(q) *to extinguish*.

Accordingly, we argue that UA *k descends as /k/ when preceded by a high vowel and followed by *a, but as /q/ when preceded by a low vowel and followed by *a. This argument can be extended—if restricted to examples descended from reconstructible forms—to account for the Hopi reflection of *k in all environments: UA *k > /k/ when contiguous to a high vowel; *k > /q/ when initial before a low vowel and when medial and flanked by low vowels, i.e., when not contiguous to a high vowel.

The same argument may well account for the Hopi development of /ŋʸ/ < *ŋ in *kuŋa (97) > kó·ŋʸa *husband*.

qá:si *thigh*; *ka *no, not* (136) > qa; *ka$_s$ti (42) > qáti *to sit sg.*; *ma$_s$ka (83) > má·qa *to give*; *na$_n$ka (47) > ná:qa *earring*, náqvi (with the distinction q/k neutralized before /v/ so that in transcription either could be written) *ear*.

UA *k > /k/ before *V$^{high}$: *ki$_u$(?i ~ i) (43) > kí·(ki) *to bite*; *ki (44) > kí·-hi *house*; *ku *fire, firewood* (137) > kó:—tala *light from fire*, kó-ho *firewood*; *ha(ki) *who* (138) > háki; *pu$_n$ku (46) > pó·ko *dog, pet*; *ti$_s$ki ~ a (113) > tíki *to cut*; *tu$_u$ku (23) > tokó—?ani *black ant*.

All other UA stops, namely */t c k$^w$ ?/, remain unchanged in Hopi. Their reflexes are given in successive statements below.

UA *t > /t/: *tiwa (21) > tíwa *to find*; *ta$_s$ma (29) > táma *tooth*; *tu$_u$su ~ i (75) > tó·s-i *sweet corn meal*; *tu$_s$- (121) > tó·(ka) *to extinguish*; *ta- (125) > tá-hi *sinew*; *?ati (24) > ?áti *louse*; *mati (25) > má·t- *well demeaned*; *sita (32) > síta ~ sí:ta *ochre*.

UA *c > /c/: *ci$_s$pu (13) > cí:vo; *ma$_s$ci (36) > má·ciw-ta *to be visible*; *k$^w$i$_s$ci (35) > k$^w$í·ci(ŋ$^w$i) *smoke*.

UA *k$^w$ > /k$^w$/: *k$^w$a$_u$si ~ i (50) > k$^w$así *it is cooked*; *k$^w$a$_u$si (51) > k$^w$ási *penis*; *k$^w$i$_s$(si) (52) > k$^w$ísi *to take, pick up*; *k$^w$i- (53) > k$^w$í·(vi) *cooked food*; *k$^w$i$_u$ta (54) > k$^w$íta *feces*; *hik$^w$i(si) (55) > hík$^w$si *to breathe*; *k$^w$a(?a) (48) > k$^w$i?i *to swallow* (vowels do not here follow the usual correspondences, but we are reluctant to set up a reconstructed UA by-form to regularize these vowel reflexes in Hopi); *k$^w$a- (49) > k$^w$á:-hi *eagle*.

UA *? > /?/: *?a$_u$ŋa (58) > ?á·ŋa *long hair*; *?asi *to bathe* (139) > ?á·si *to wash ones own hair*; *?ato (60) > ?á·tö *bottom*; *yi?i (106) > ?í-ŋi?i *my mother* (from pre-Hopi yí?i), yí?at *his mother*; *k$^w$a?a (127) > ?í-k$^w$a?a *my grandfather*; *su?u *grandmother* (140) > ?í-so?o *my grandmother* (cp. Papago hú?ul).

Of the UA fricatives, *s remains as Hopi /s/ in all environments, and */h/ is doubly reflected.

UA *s > /s/: *si$_u$(pi) (11) > sí:si(ŋ$^w$a) *to be cool, cold—as food*; *si- (65) > sí·(ka) *one*; *si (66) > sí·-hi *guts, entrails*; *si$_u$(?i ~ a) (67) > sísi(wki) *to urinate*; *si$_s$pa (70) > sí:va *metal*, síspa *to shave* (in this kind of reduplication the first vowel of the unreduplicated stem siva, is lost after the exfix si- and /v/ ~ /p/); *su (71) > só·-hi *star*; *suwi ~ a (72) > sówa *to eat*; *pu$_n$si (5) > pó·si; *kasi (41) > qá·si; *k$^w$a$_u$si ~ i (50) > k$^w$así; *k$^w$a$_u$si (51) > k$^w$ási; *k$^w$i$_s$(si) (52) > k$^w$ísi; *ya$_n$sa (76) > yé·se *to sit pl.* (vowels here do not follow the usual correspondence, but this may be an instance of a Hopi development analogous to Yaqui /e/ < */a/ after /y/).

The first statement below accounts for Hopi reflection of initial *h-; the second of medial *-h-.

UA *h- > /h/: *hi$_s$- (77) > hí·(ko) *to drink*; *hik$^w$i(si) (55) > hík$^w$si; *hu (78) > hó·-hi *arrow*; *hu$_s$pi (79) > siwá-hovi *unmarried person*; *ha(ki) (138) > háki.

UA *-h- > zero: *pahi (1) > pá·y-; *?oho (61) > ?ó·(qa) *bone*; *yahi$_s$(pa) (82) > yá·yva *to climb up pl.*

All UA nasals remain in Hopi—*/m n ŋ/ > /m n ŋ/, respectively; and /ŋ$^y$/ from *ŋ occurs under statable conditions (see fn. 16).



UA *m > /m/: *ma$_s$ka (83) > má·qa; *mala (84) > má·na *girl*; *mí?a (85) > mí?a *to shoot it*; *mu$_u$ki ~ u (86) > mó:ki *to die*; *ta$_s$ma (29) > táma.

UA *n > /n/: *na$_s$pi (16) > ná·vi; *na$_n$ka (47) > náqvi; *ni$_s$ma (89) > ní:ma *liver*; *no- (96) > nó-hi *egg*.

UA *ŋ > /ŋ/: *?a$_u$ŋa (58) > ?á·ŋa; *?o$_s$ŋa (63) > ?ó·ŋa *salt*; *liŋi (94) > léŋi *tongue* (this is the only instance of a reconstructible initial *l for the daughter languages which include the morpheme for tongue—Hopi, Cahuilla-Luiseño, Tübatulabal, and languages to the south of these; we assume that in this environment—after initial /l/—Hopi /i/ ~ /e/).

UA *l > /l/; see example above for the one stem reconstructed for UA with initial *l.

But Hopi has /n/ reflex for medial *l: *sula (98) > só·na *edible part of a seed*; *mala (84) > má:na *girl*; *kali *house* (141) > ?i-qáni *my place*; *tala (28) > tána *hoof*; *sala *sticky* (147) > sá·na *gum*.

The UA glide *w is triply reflected in Hopi; conditions for the reflexes can be stated partly in terms of adjacent vowels and partly in terms of position in UA words.

UA *w > /l/ initially before UA low vowels and medially when flanked by low vowels: *waki (99) > lá·ki *dry*; *wo- (103) > lö·(yöm) *two*; *wo$_s$ko (142) *pine* > löqö; *?awa (104) > ?á·la *horn*.

UA *w remains initially before UA high vowels and also remains medially before a high vowel or after a high non-nasalizing vowel. However, after at least one high nasalizing vowel (*i$_n$), UA *w > /ŋ$^w$/.

UA *w > /w/: *wi- (100) > wí·(ko) *big*; *wi$_s$pa (17) > wivá:-ta; *wi- (102) > wí-hi *fat*; *tiwa (21) > tíwa; *suwi ~ a (72) > sówa; *?awi (124) > ?á·?a·w-na *to tell, announce*.

UA *w > /ŋ$^w$/: *ti$_n$wa (20) > tíŋ$^w$a *to name*.

The UA lingual glides *r and *y are singly reflected in Hopi.

*r > /r/: *tukur(i) > tokóri *screech owl* (the only cognate for *r).

*y > /y/: *yuku (109) > yók-va *to rain*; *ya$_s$ka (110) > yáqa *nose*; *yiki (107) > yíki *to get taste from it*; *yi?i (106) > yí?at *his mother*; *koya (45) > qó·ya.

Loss of final vowels in Hopi is less a matter of regular historical development than of regular morphophonemic alternation.

Positive Hopi reflexes of UA vowels are exemplified below.

UA *i appears as Hopi /y/ after medial *h: *pahi (1) > pá·y-; *yahi$_s$(pa) (82) > yá·yva.

Otherwise, *i > /i/ in Hopi: *pi$_u$ti (143) > píti *to arrive sg.*; *k$^w$i$_s$ci (35) > k$^w$í·ci(ŋ$^w$i); *ki (44) > kí·-hi; *k$^w$i$_u$ta (54) > k$^w$íta; *si (66) > sí·-hi; *wi- (102) > wí-hi; *?i *this* (116) > ?í·?i; *pa$_s$ki (2) > páki; *kasi (41) > qá:si; *k$^w$a$_u$si (51) > k$^w$ási; *liŋi (94) > léŋi.

UA *i > /i/: *?i$_s$(ca) *to plant* (119) > ?i(y-); *?i- *theft* (120) > ?í·?i(yi) *to steal*; *sita (32) > síta; *k$^w$i$_s$(si) (52) > k$^w$ísi; *ni$_s$ma (89) > ní:ma; *pi$_u$ti (3) > píti; *na$_s$pi (16) > ná·vi; *ka$_s$ti (42) > qáti.

UA *u > /o/: *tu$_s$ki ~ a *night* (144) > tó·ki *last night*; *ku$_u$pa (9) > kó·pa;

*pu$_n$si (5) > pó·si; *pu$_n$ku (46) > pó·ko; *su (71) > só·-hi; *hu (78) > hó·-hi; *mu$_u$ki ~ u (86) > mó:ki; *yuku (109) > yók-va; *ci$_s$pu (13) > cí:vo.

*o > /ö/: *po (4) > pǒ-hi; *po (7) > pǒ-hö; *koya (45) > qǒ·ya; *no- (96) > nǒ-hi; *?o$_s$ŋa (63) > ?ǒŋa; *wo$_s$ko (142) > lǒqö; *?ato (60) > ?á·tö.

*a > /a/: *taka *man* (145) > tá·qa; *ma *hand* (128) > ma ~ má?a; *pa (123) > pá·-hi; *ta$_u$pa (10) > tá·pa-k-na; *ka (136) > qa; *k$^w$a?a (127) > ?í-k$^w$a?a; *ha(ki) (138) > háki; *mala (84) > má·na; *mi?a (85) > mí?a; *?awa (104) > ?á·la; *ti$_n$wa (20) > tíŋ$^w$a; *ya$_s$ka (110) > yáqa.

## Huichol

Of the UA stops, only *p is multiply reflected in Huichol. All other stops remain unchanged.

The three reflexes of *p are conditioned either by position in UA words or by the reflex-conditioning effect of preceding UA vowels. Instances of initial *p and of medial *p are given below.

UA *p- > /h/: *pahi (1) > hái-ka *three*; *pi$_u$ti (3) > heté- *heavy*; *po (4) > hu(yé) *road*; *pu$_n$si (5) > híši *eye*; *po (7) > hu·(šári) *body hair*; *pa$_s$ka (8) > háka *reed*; *pini (91) > hi·ni- *to suck on cane*;[17] *pa (123) > há· *water*; *puka *stomach* (149) > hu·ká (cp. Papago wóok *stomach*).

UA *-p- > /p/ after *V$_u$ and zero after *V$_s$: *ku$_u$pa (9) > ki·pá *head hair*, *ti$_u$pu *flea* (146) > tepí (cp. Papago čïipṣ *flea*); *ci$_s$pu (13) > cii- *bitter*; *na$_s$pi (16) > na·(kári) *prickly pear cactus*; *wi$_s$pa (17) > wé- *to hit, whip*; *si$_s$pa (70) > šiší·- *to shave*; *hu$_s$pi (79) > ?ii(mári) *girl* (cp. UA *mala *child*).

The reflexes of all other UA stops, */t c k k$^w$ ?/, are exemplified in successive statements below.

*t > /t/: *ti$_u$ni (19) > téni *mouth*; *ta$_s$ma (29) > ta·mé *tooth*; *toŋo (30) > tunú *knee*; *tu$_s$ki ~ a (144) > tiká·- *night*; *to$_u$sa (31) > tušá- *white*; *?ati (24) > ?até *louse*; *mati (25) > ma·ti- *to know*; *su$_u$tu (26) > šité *fingernail, claw*; *ta- (125) > ta·tá *tendons*; *tima (117) > temá(iki) *boy*, temá(ri) *boys*.

*c > /c/: *ci$_s$pu (13) > cii-; *ci(?i) (33) > cici- *to suck*; *ko$_s$c-i (34b) > ku·cí *sleep*; *?aci ~ a (39) ?a·ci- *to laugh at*; *yaca (40) > -yeca *to put*; *cikuri ~ cikori (148) > cikíri *circle*; *?i$_s$(ca) (119) > ?eca- *to plant*; *wi$_s$ci (101) > we- ~ -wece *to fall, lose*.

*k > /k/: *ki$_u$(?i ~ i) (43) > ke- *to bite*; *ki (44) > kí· *house*; *koya (45) > -kuya *to kill several*; *ku$_u$mi ~ a (88) > ki·mi- *to nibble*; *na$_n$ka (47) > naká *ear*; *waki (99) > waki- *to get dry*; *ti$_s$ki ~ a (113) > -teke *to break*; *wo$_s$ko (142) > hukú *pine*.

*k$^w$ > /k$^w$/: *k$^w$a(?a) (48) > k$^w$a- ~ k$^w$a?a *to eat*; *k$^w$a$_u$si ~ i (50) > ?i-k$^w$á·ši *ripe*; *k$^w$a$_u$si (51) > k$^w$a·ší *tail*; *k$^w$i$_s$(si) (52) > k$^w$e- *to bring sg.*; *k$^w$i$_u$ta (54) > k$^w$itá *excrement*.

*? > /?/: *?aki (57) > ?áki *arroyo*; *?a$_u$ŋa (58) > ?aná *wing, fletching of arrow*; *?asi (59) > ?a·ši- *to arrive*; *?oho (61) > ?u(mé); *mo ?o 134) > mu?ú *head*.

The UA fricative *s has a single reflex in Huichol, while *h has two reflexes. Position of *h in UA words accounts for different reflexes in Huichol.

*s > /š/: *sawa (64) > šawá *leaf*; *si- (65) > še(wí); *si$_u$(?i ~ a) (67) > ši- *to urinate*, šiši *urine*; *si$_u$(pi) (11) > šé(ri) *cold*; *sita (32) > šetá- *red*, šeta·ríka *face paint*; *pu$_n$si (5) > híši; *to$_u$sa (31) > tušá-; *tu$_u$su ~ i > ti·ši- *to grind*; *ya$_n$sa (76) > ye·ša- *to sit*.

*h > /?/ initially: *hi$_s$- (77) > ?i- *to drink*; *hu (78) > ?i(rí) *arrow*, ?i(ca) *quiver*; *hu$_s$pi (79) > ?ii(mári).

*h > zero medially: *pahi (1) > hái-ka; *?oho (61) > ?u(mé); *tiha (80) > té *hail*; *muhu (81) > mii- *to shoot with an arrow*; *yahi$_s$(pa) (82) > yei- *to go, walk*; *tahi *fire* (150) > tái (cp. Papago tái *fire*).

In Huichol, UA *m remains as /m/, but *n and *ŋ merge as /n/.

UA *m > /m/: *mu$_u$ki ~ u (86) > mi·kí *dead*; *mati (25) > ma·ti-; *ma (128) > mamá *hand*; *mo?o (134) > mu?ú; *ta$_s$ma (29) > ta·mé; *ku$_u$mi ~ a (88) > ki·mi-.

*/n ŋ/ > /n/: *na$_n$ka (47) > naká; *ni$_s$ma (89) > néma *liver*; *naya (95) > nai- *to light a fire*; *ti$_u$ni (19) > téni; *kuŋa (97) > kína *husband*; *ŋa- *root* (151) > naná (cp. Hopi ŋá- *root*); *toŋo (30) > tunú; *?a$_u$ŋa (59) > ?aná; ?o$_s$ŋa (63) > ?úna *salt*.

Reflexes of *l in Huichol are conditioned by position in UA words.

Initial *l > /n/: *liŋi > není *tongue*.

Medial *l > zero: *puli ~ a (97b) > hii- ~ -hia *to tie*; *ŋola ~ (ŋo) ŋowi ~ a *to return* (152) > -nua ~ -nu·nuwa (cp. Papago nóḍ *to turn or return in walking* < *ŋola, nóonogì *to return* < *ŋoŋowi; Hopi ŋǒla *tire, hair whorl* < *ŋowa).

One of the three UA glides is doubly reflected; the reflexes of *w are conditioned by following UA vowels. The two other UA glides, */r y/, are singly reflected.

UA *w > /h/ before UA *o and /w/ before UA */i i a/: *wo- (103) > hú·(ta) *two*; *woko (142) > hukú; *wa$_s$ki (99) > waki-; *wi$_s$ci (101) > -wece; *wi- (100) > we(ri-) *to grow*; *wi- (102) > wi·(yá) *grease*; *?awa (104) > ?awá *horn*; *ti$_n$wa (20) > -tewa *to be named*; *yiwa (108) > -yewa *to be wide*.

UA *y > /y/: *yaca (40) > -yeca *to put*; *ya$_n$sa (76) > ye·ša-; *yahi$_s$(pa) (82) > yei-; *yiwa (108) > -yewa *to be wide*; *k$^w$iya (112) > k$^w$íye *earth, ground*; *koya (45) > -kuya.

UA *r > /r/: *cikuri ~ cikori (148) > cikiri; *tukur(i) (105) > mi·kiri *owl*. This last correspondence is dubious because it assumes an *ad hoc* morpheme boundary between *tu and *kuri.

The controlled Huichol reflexes of UA vowels are exemplified below. We identify as 'controlled' those reflexes which are either single or, if multiple, appear under statable conditions.

UA *i > /i/: *?i (116) > ?i(ki) *this*; *pini- (91) > hi·ni-; *ci$_s$pu (13) > cii-; *ki (44) > kí·; *k$^w$i$_u$ta (54) > k$^w$itá; *hi$_s$- (77) > ?i-; *pahi (1) > hái-ka; pu$_n$si (5) > híši; *mati (25) > ma·ti-; *k$^w$a$_u$si (51) > k$^w$a·ší.

[17] Verbs are listed in our source in combination with affixes (prefixes or suffixes)—the stress on any verb stem varies in position according to particular affixes which combine with it in a given instance. We list verb forms here without affixes but with a hyphen preceding (in the case of prefixes) or following (in the case of suffixes) in place of the omitted affixes. Stress is omitted in citing such verbs but is retained in citing non-verbs.

UA *i > /e/: *pi$_u$ti (3) > heté-; *ti$_u$ni (19) > téni; *?i$_s$(ca) (119) > ?eca-; *ki$_u$(?i ~ i) (43) > ke-; *k$^w$i$_s$(si) (52) > k$^w$e-; *sita (32) > šetá-; *tiha (80) > té; *ni$_s$ma (89) > néma; *?ati (24) > ?até.

UA *u > /i/: *ku$_u$p(i) *to close* (153) > kipi- *to close the eyes* (cp. Papago kúup *to close*); *ku$_u$pa (9) > ki·pá; *tu$_s$ki ~ a (144) > tiká·-; *su$_u$tu (26) > šité; *mu$_u$ki ~ u (86) > mi·kí; *kuŋa (97) > kína; *ti$_u$pu (146) > tepí; *ci$_s$pu (13) > cii-.

UA *o > /u/: *to$_u$sa (31) > tušá-; *ko$_s$c-i (34) > ku·cí; *?o$_s$ŋa (63) > ?úna *salt*; *toŋo (30) > tunú; *wo$_s$ko (142) > hukú; *mo?o (134) > mu?ú.

UA *a > /e/ after *y but remains as /a/ after other UA consonants: *yaca (40) > -yeca; *ya$_n$sa (76) > ye·ša-; *yahi$_s$(pa) (82) > yei-; *k$^w$iya (112) > k$^w$íye; *pa$_s$ka (8) > háka; *pa (123) > há·; *na$_n$ka (47) > naká; *ma (128) > mamá.

In addition to the vowel reflexes exemplified above, we recognize others which we cite as found. Thus, final *a > /e/ where *a > /a/ would be expectable: *ta$_s$ma (29) > ta·mé. Final *a remains /a/ after *y where *a > /e/ would be expectable: *koya (45) > -kuya. Final *u > /e/ where *u > /i/ would be expectable: *su$_u$tu (26) > šité.

## Other Cora-Huichol: Cora

Fuller treatment is accorded to Cora reflexes which differ from Huichol reflexes than to reflexes which are the same in both languages.

Three stops, */p k k$^w$/ are multiply reflected in Cora but only the first of these is so reflected in Huichol. Unlike Huichol again, multiple reflection of Cora stops is conditioned in general by following UA vowels, and in particular by the two contrasting environments for vowels after *p (*a contrasting with other vowels) and for vowels after /k k$^w$/ (*/i ɨ/ contrasting with other vowels).

After *V$_u$, UA *p descends into Cora as either /p/ or /p$^w$/ depending on the following vowel. The reflex /p$^w$/ appears before *a, /p/ before other vowels: *ku$_u$pa (9) > kip$^w$á *head hair*; *ti$_u$pu (146) > tepí *flea*.

In other environments—initially and after V$_s$ medially—UA *p > fricative reflex /h/: *pa$_s$ka (8) > haká *reed*; *ci$_s$pu (13) > cíhi(vi) *bitter*.

UA *k always descends as a stop in Cora, either as a laminal /č/ (before */i ɨ/) or as a velar /k/ (before other vowels): *ki (44) > čí(?i) *house*; *?aki (57) > ?áči *arroyo*; *ki$_u$(?i) (43) > -čé?e *to bite*; *ku$_u$pa (9) > kip$^w$a; *pa$_s$ka (8) > haká.

The Cora reflection of UA *k$^w$ is parallel to that of *k (/č$^w$/ before *i but /k$^w$/ before *a): *k$^w$i$_u$ta (54) > č$^w$itá *excrement*; *k$^w$a$_u$si (51) > k$^w$así *tail*.

As in Huichol, UA */t c ?/ are singly reflected in Cora.

UA *t > /t/: *ti$_u$ni (19) > téni *mouth*; *?ati (24) > ?até *louse*.

UA *c > /c/: *ci$_s$pu (13) > cihi(vi); *ko$_s$ci~o (34) > kucú *he is sleeping*.

UA *? > /?/: *?a$_u$ŋa (58) > ?aná *feather*; *mo?o (134) > mu?ú *head*.

Of the UA fricatives, *s is singly reflected, *h is doubly reflected.

UA *s > /s/: *tu$_u$su~i (75) > -ti?isí *to grind*.

UA *h > /?/ initially, zero medially: *hu (78) > ?i?i(rí) *arrow*; *tiha (80) > teéte *hail*.



The UA labial nasal has two reflexes parallel to those of the UA labial stop—*m > /m$^w$/ before *a, but remains /m/ before other vowels: *ni$_s$ma (89) > neém$^w$a *liver*; *mu$_u$ki~u (86) > mi?ičí *dead*.

As in Huichol, however, the remaining UA nasals */n ŋ/ merge into /n/ in Cora: *ti$_u$ni (19) > téni; *toŋo (30) > tunú *knee*.

The UA glide *w has triple reflexes; some of these are better attested than others. As in Huichol *w > /h/ before *o: *wo$_s$ko (142) > hukú *pine*. Also as in Huichol, *w > /w/ before *a: *waki (99) > wáhči *dry*. But unlike Huichol, Cora has reflex /v/ before *i: *wi- (100) > ve(?é) *big*.

Initial UA *y remains as /y/ in Cora, but medial *y is lost: *yi$_u$?i (168) > -ye?e *to swallow water*; *k$^w$iya (112) > č$^w$éh.

Only the better controlled vowel reflexes are exemplified for Cora—these are in agreement with Huichol ones.

UA *i > /i/: *si$_u$(?i~a) (67) > si?i(súri) *urine*.

UA *i > /e/: *ti$_u$ni (19) > téni.

UA *u > /i/: *kuŋa (97) > -kiín *husband*.

UA *o > /u/: *?o$_s$ŋa (63) > ?unáh *salt*.

UA *a > /a/: *pa (123) > háh *water*.

## Tarahumara

In addition to the glottal stop *?, three UA oral stops */p t k/ are multiply reflected in Tarahumara, while the other oral stops */c k$^w$/ are singly reflected.

Reflexes of *p and of *? are conditioned according to their position in UA words. The reflexes of *t are conditioned in part by position in UA words, in part by following UA vowels, F (front *i) contrasting in its effect with 2(BB$^o$) vowels (back /ɨ a/ and /u o/).

UA *p > /b/ initially, /p/ medially: *pa$_s$ki (2) > bakí *he is entering*; *pi$_u$ti (3) > bité *it's heavy*; *po (7) > bo(?wé) *it has hair, wool*; *pu$_n$si (5) > busí *eye*; *pa$_s$ka (8) > baká *reed*; *pa (123) > ba(?wí) *water*; *po?i~o (130) > bo?i- *to be lying down*, bu?wí *he is lying down*; *ku$_u$pa (9) > kupá *head hair*; *ta$_u$pa (10) > rapa-na *he is splitting it*; *ci$_s$pu (13) > cipú *it is bitter—as coffee*; *wi$_s$pa (17) > wip(isó) *he's whipping him*; *si$_u$(pi) (11) > sip(í) *he's cooling down*; *si$_s$pa (70) > sipá *he's scraping it*; *hu$_s$pi (79) > upí *wife*; *ti$_u$pu (146) > ripu(cí) *flea*.

UA *t > /c/ before *i in the only instance in which *t is reconstructed in this environment: *mati > mací *he knows*.

Before other vowels, UA *t > /r/ initially and /t/ medially: *ti$_s$ka (18) > riká *he is laying it down*; *ti$_n$wa (20) > riwa-rá *name, he is naming him*; *tiwa (21) > riwá *he sees it, finds it*; *ti$_u$ni (19) > riní *mouth*; *ta$_s$ma (28) > ramé *tooth*, oté-rama *molar*; *su$_u$tu (26) > sutú *fingernail*; *ku$_s$ta *neck* (154) > kutá *neck, throat*; *sita (32); sitá- *red*; *k$^w$i$_u$ta (54) > witá *excrement, he is excreting*.

UA *c > /c/: *ci$_s$pu (13) > cipú; *ci?i (33) > ci?í *he is sucking—on breast*; *ko$_s$ci~o (34) > kocí *he is sleeping*; *ma$_s$ci (36) > mací *there is light*; *?aci~a (39) > ací *he is laughing*; *?i$_s$(ca) (119) > icá *he's planting it*.

UA *k > /k/: *kasi (41) > kasí *leg*; *ki$_u$(?i~i) (43) > ikí *he's biting it*; *ku$_u$mi~a (88) > kumí *to eat whole grains, kernels*; *ku$_u$p(i) (153) > kupí

*closes the eyes*; *ko?a (131) > ko?wá *he's eating*; *tu$_u$ku (23) > ruku(áwa) *it is getting dark*; *siki~a (115) > siki(ré) *he's cutting it—with a knife*; *pu$_n$ku (46) > buku-rá *pet*; *na$_n$ka (47) > naká *ear*.

As a feature of secondary development UA *k > /g/: *mu$_u$ki~u (86) > -mugú when occurring as the second member of a compound in ri-mugú *he is dreaming* (cp. Hopi tɨ:-moki *to dream*).

UA *k$^w$ > /w/: *k$^w$a(?a) (48) > a?wá *he's swallowing it*; *k$^w$a$_u$si~i (50) > wasí *fruit*; *k$^w$a$_u$si (51) > wasí *tail*; *k$^w$ɨ$_s$(sɨ) (52) > wí *he is harvesting it*; wísa *he snatches it*; *k$^w$i$_u$ta (54) > witá; *hik$^w$i(sɨ) (55) > iwí *he breathes*; *tok$^w$i (56) > rowí *rabbit*.

UA *? > zero initially, /?/ medially: *?awa (104) > awá; *?ɨ$_s$(ca) (119) > icá; *?aci~a (39) > ací; *ci?i (33) > ci?í; *mo?o (134) > mo?ó *head*.

In the sequence B$^o$ vowel (*o) and *? and unrounded vowel (*i or *a), the cluster /?w/ results in Tarahumara: *so?i (132) > so?wí *he is getting stickers in himself*; *ko?a (131) > ko?wá. Following *i, UA *? appears as a cluster /?y/: *mi?a (85) > mi?yá *he's killing him*.

Of the two UA fricatives, *s is singly reflected. But *h has dual reflexes conditioned by position in UA stems.

UA *s > /s/: *si (66) > si(wá) *entrails*; *si$_u$(?i~a) (67) > isí *urine*; *si$_s$ku (68) > siku- *navel*; *simi~a (69) > simí *he is going*; *sunu (93) > sunú *corn*; *pusa (74) > busá *he wakes up*; *tu$_u$su~i (75) > rusú *he grinds it*; *tiso (118) > risó *cave*.

UA *h > zero initially and /h/ medially: *hik$^w$i(sɨ) (55) > iwí; *hu$_s$pi (79) > upí; *tɨha (80) > rihé *hail*; *tahi (150) > rahí-na *it burns*. Initial *h is retained if the stem in which it appears is the second member of a compound: *hi$_s$- (77) > bahí *he drinks* (ba- < *pa *water*).

Though *m remains as /m/ in Tarahumara, */n ŋ/ merge into /n/.

UA *m > /m/: *mati (25) > mací; *maci (36) > mací; *mɨ?a (85) > mi?yá; *mu$_u$ki~u (86) > mukú *he is dying*; *muhu (81) > muhu(bú) *he is shooting with a bow*; *ta$_s$ma (29) > ramé; *simi~a (69) > simí.

UA */n ŋ/ > /n/: *na$_n$ka (47) > naká; *nɨ(?i) (90) > i?ni *it is flying*; *ti$_u$ni (19) > riní; *sunu (93) > sunú; *kuŋa (97) > kuná; *ŋa- (151) > na(wá) *root*; *ŋola (152) > nor(íra) *he goes along whirling around*; *toŋo (30) > ronó; *?a$_u$ŋa (58) > aná.

Medial *l is reflected by /r/: *tala (28) > rará *foot*; *mala (84) > mará *daughter of a man*; *sula (98) > surá *heart*; *kali (141) > karí *house*; *puli~a (97b) > buré *he is tying it*. The one UA form in which initial *l is reconstructed does not have a reflex in Tarahumara.

Of the three UA glides, */w y/ are each doubly reflected in Tarahumara.

UA *w > zero initially before *o: *wo- (103) > o(kuá) *two* (but the same initial *w remains in na-wó *four* where it is now medial); *wo$_s$ko (142) > okó *pine*.

UA *w > /w/ initially before /i ɨ a/ and also > /w/ medially without restriction as to following vowel. *wɨ$_s$pa (17) > wip(isó); *wi- (102) > wi(?í) *grease*; *waki (99) > waki-céami; *wɨ$_s$cɨ (101) > wicí *he is falling*; *tɨwa (21) > riwá; *ti$_n$wa (20) > riwa(rá); *sawa (64) > sawá *leaf*; *?awa (104) > awá; *suwi~a (72) > suwí *they will die*, suwá *it is finishing*; *yɨwa (108) > iwa(rá) *he is putting a hole in it, piercing it*.



UA *y > zero initially and is reflected as a cluster /?y/ medially: *yaca (40) > acá *he is putting it*; *ya$_n$sa (76) > asá-ri *he was sitting*; *yuku (109) > ukú *it is raining*; *ya$_s$ka (110) > aká *nose, face*; *koya (45) > ko?yá *he is killing them*; *k$^w$iya (112) > wi?yé *ground*.

Reflexes of UA vowels follow:

*i > /i/: *pini (91) > bini- *to suck*; *si$_s$ku (68) > siku-; *k$^w$i$_u$ta (54) > witá; *simi~a (69) > simí; *wi- (102) > wi(?í); *pa$_s$ki (2) > bakí; *hu$_s$pi (79) > upí.

UA *ɨ > /i/ medially, /e/ finally: *pɨ$_u$tɨ (3) > bité; *tɨ$_s$ka (18) > riká; *tɨwa (21) > riwá; *tɨ$_u$ni (19) > riní; *?ati (24) > até *louse*; but also final *ɨ > i where *ɨ > e is would be expectable: *si$_u$(pɨ) (11) > sipí.

UA *u > /u/: *ku (137) > kú *firewood*; *ku$_u$pa (9) > kupá; *su$_u$tu (26) > sutú; *pu$_n$ku (46) > buku-rá; *muhu (81) > muhu(bú); *yuku (109) > ukú; *ci$_s$pu (13) > cipú; *ti$_u$pu (146) > ripu(cí).

*o > /o/: *mo?o (134) > mo?ó; *toŋo (30) > ronó; *wo$_s$ko (142) > okó; *koya (45) > ko?yá; *po (7) > bo(?wé); *tiso (118) > risó.

*a > /a/: *pa$_s$ka (8) > baká; *kasi (41) > kasí; *na$_n$ka (47) > naká; *k$^w$a$_u$si (51) > wasí; *?awa (104) > awá; *kuŋa (97) > kuná; *sula (98) > surá. But final *a > /e/ in *ta$_s$ma (29) > ramé; *k$^w$iya (112) > wi?yé; *tɨha (80) > rihé.

## Zacapoaxtla Nahuat

References made to Nahuat, below, are to be understood as applying to the Nahuat of la Sierra de Zacapoaxtla.

Dual reflexes appear in Nahuat for UA *p and *c—those for *p are determined either by the position of this stop in UA words, or by the UA vowel preceding the stop; those for *c are determined by the vowel following.

UA *p- > zero: *pa$_s$ki (2) > a·ki *to fit in*, kal—aki *to enter* (kal- < *kali *house*); *pi$_u$tɨ (3) > eti·-k *heavy*; *po (4) > oh-ti *road*; *pu$_n$si (5) > i·š- *eye, face*; *pa$_s$ka (8) > a·ka-t *reed*; *pa (123) > a·-t *water*.

UA *-p- > /p/ after *V$_u$ but zero after *V$_s$: *ta$_u$pa (10) > -tapa·-na *to split it*; *ku$_u$p(i) (153) > ihkopi *to close the eyes*; *ci$_s$pu (13) > čiči·-k *bitter*; *si$_s$pa (70) > -ši·(ma) *to flay*, -ši·(toma) *to scrape, skin*.

UA *c > /č/ before the F vowel *i, /c/ before UA vowels in the set 2(BB$^o$): *ci$_s$pu (13) > čiči·-k; *ko$_s$ci~o (34) > koči *to sleep*; *ci?i (33) > -či·či· *to suck*; *ci- (114) > -čihči *saliva, spittle*; *coma (37) > -coma *to sew*; *co(ni) (38) > co·n-ti *head hair*; *wɨ$_s$cɨ (101) > weci *to fall* (incremental /i/ in Nahuat replaced final *ɨ).

Stops other than */p c/ are uniquely reflected.

UA *t > /t/: *tɨ$_s$ka (18) > -te·ka *to lay it down*; *tɨ$_u$ni (19) > -te·n *mouth*; *ta$_s$ma (29) > -ta·n *tooth*; *tɨ$_s$ki~a (113) > -teki *to cut it*; *ta- (125) > -ta(lwa) *tendon*; *ta$_s$ka (145) > ta·ka-t~ta·ga-t *man*; *mati (25) > -mati *to know*; *su$_u$tu (26) > i-sti *his fingernail*.

UA *k > /k/: *ki$_u$(ʔi~i) > -keh(coma) *to bite*; *kahi~a (127) > kaki *to hear*; *kali (141) > kali *house*; *ka$_u$ma (87) > -kama(k) *mouth*; *na$_n$ka (47) > -naka·(s) *ear*; *ma$_s$ka (83) > -maka *to give*; *ti$_s$ki~a (113) > -teki; *wo$_s$ko (142) > oko-t *pine*.

UA *k$^w$ > /k$^w$/: *k$^w$a(ʔa) (48) > -k$^w$a· *to eat*; *k$^w$i$_s$(si) (52) > -k$^w$i *to take*; *k$^w$i$_u$ta (54) > k$^w$ita·-t *excrement*.

UA *ʔ > zero: *ʔasi~i (59) > ahsi *to arrive*; *ʔoho (61) > o·(mi-t) *bone*; *ciʔi (33) > -či·či· *to suck*; *k$^w$a(ʔa) (48) > -k$^w$a·.

Of the fricatives, *s is doubly reflected in Nahuat *h singly.

UA *s > /š/ before the F vowel *i, /s/ before UA vowels in the set 2(BB°): *si$_u$(ʔi~a) (67) > -šiši·š-a *to urinate*; *si$_s$ku (68) > -ši·k *navel*; *si$_s$pa (70) > -ši·(toma); *pu$_n$si (5) > i·š-; *si$_u$(pi) (11) > sese·-k *cold*; *su$_u$tu (26) > i-sti; *si- (65) > se· *one*; *su (71) > si·(tali·n) *star*; *sunu (93) > si·n-ti *corn cob*; si·n-mi·l *cornfield*; *pusa (74) > ihsa *to wake up*.

UA *h > zero: *ha(ki) (138) > a·k(oni) *who*, a·ki·(n) *someone*; *hi$_s$- (77) > -i· *to drink* (in a·t-i· *to drink water*); *ʔoho (61) > o·(mit); *kahi~a (126) > kaki.

Reflexes in Nahuat of UA nasals are double for *m, merging for */n ŋ/.

UA *m > /n/ when final in modern Nahuat: *ta$_s$ma (29) > -ta·n *tooth*. But *m remains /m/ when initial or intervocalic in modern Nahuat: *mati (25) > -mati; *ma$_s$ka (83) > -maka; *mu$_u$ki~u (86) > miki *to die*; *ma (128) > -ma·(y) *hand*; *coma (37) > -coma *to sew*; *ka$_u$ma (87) > -kama(k).

UA */n ŋ/ merge into /n/ in Nahuat: *na$_n$ka (47) > -naka·(s); *ti$_u$ni (19) > -te·n; *co(ni) (38) > co·n-ti; *tani (92) > -tani *to ask for*; *sunu (93) > si·n-ti; *ŋa- (151) > na·(lwa-t) *root*; *liŋi (94) > -nene-pi·l *tongue*; *toŋa-la *to shine, sun, daylight* (155) > to·nal *sun* (cp. Papago tónal-ig *light*, tónaḍ *to shine—of sun*; Hopi tóŋ-va *late morning*).

The UA lateral *l is doubly reflected, initial *l > /n/, but medial *l remains as /l/: *liŋi (94) > -nene-pi·l; *kali (141) > kali; *sala (147) > sasal-ti·k *sticky* (cp. Papago háḍ- *sticky*; Hopi sá·na *gum*).

Reflexes of UA glides */w y/ are given below—but only when these glides are in word-initial in UA, for instances showing reflexes of medial */w y/ have not been found.

UA *w > zero before *o, /w/ before other UA vowels: *wo- (103) > o·-me *two*, oh-pa *twice*; *woko (142) > oko-t *pine*; *waka (99) > wa·ki *to get dry*; *wi- (100) > we·(yi) *big*; *wi$_s$ci (101) > weci.

UA *y remains as /y/: *ya$_s$ka (110) > -yeka(col) *nose*.

Positive Nahuat reflexes of UA vowels are given first, and these are followed by instances of zero reflexes.

UA *i > /i/: *ci$_s$pu (13) > čiči·k; *k$^w$i$_u$ta (54) > k$^w$ita·-t; *hi$_s$- (77) > -i·; *si$_s$ku (68) > -ši·k; *mati- (25) > -mati.

UA *i > /e/: *pi$_u$ti (3) > eti·-k; *si$_u$(pi) (11) > sese·-k; *ti$_s$ka (18) > -te·ka; *wi- (100) > we·(yi).

UA *u > /i/: *tu$_u$su~i (75) > ti·s-keh *woman who grinds*; *pusa (74) > ihsa; *mu$_u$ki~u (86) > miki; *sunu (93) > si·n-ti; *su (71) > si·(tali·n); *su$_u$tu (26) > i-sti.



UA *o > /o/: *po (4) > oh-ti; *ko$_s$ci (34) > koči; *woko (142) > oko-t; *co(ni) (38) > co·n-ti; *ʔoho (61) > o·(mi-t); *toŋa-la (155) > to·nal.

UA *a > /e/ after *y in *ya$_s$ka (110) > -yeka(col); but *a remains as /a/ after other consonants: *pa$_s$ka (8) > a·ka-t; *ta$_u$pa (10) > -tapa·-na; *ta$_s$ma (29)> -ta·n; *na$_n$ka (47) > -naka·(s); *k$^w$a(ʔa) (48) > -k$^w$a·.

Final *V is lost in noun stems after UA continuants: *ti$_u$ni (19) > -te·n; *pu$_n$si (5) > i·š-; *ta$_s$ma (29) > -ta·n; *co(ni) (38) > co·n-ti; *sunu (93) > si·n-ti; *kali (141) > kali (the final /i/ here is not a reflex of the final *i in the reconstructed stem, but rather the final vowel of the absolute suffix -li~-ti; the underlying kal-li appears in this dialect as kali, though in some Aztec languages, e.g. Milpa Alta, the form retains both laterals as an identical consonant cluster /ll/.

It may be said generally that any UA high vowel ending a verb appears in modern Nahuat as /i/, whether by replacement or by regular descent. The replacement is evidenced only by UA verbs ending in *i, since the other two high vowels, */i u/, are both reflected regularly by Nahuat /i/: *wi$_s$ci (101) > weci; *ti$_s$ki~a (113) > -teki; *k$^w$i$_s$(si) (52) > -k$^w$i.

### Other Aztec: Pochutla

We do not attempt a detailed treatment of Pochutla, partly because available source materials are limited and partly because Pochutla reflections mainly repeat those for Nahuat, above—instead, we emphasize those reflections which distinguish Pochutla as a divergent member of the Aztec branch and give but scanty exemplification to the regular Aztec reflections of UA phonemes in Pochutla.

These regular reflections are of UA consonants:

*pi$_u$ti (3) > eti *heavy* (*p > zero initially); *ti$_s$ka (8) > teke *to lie down* (*t > /t/, *k > /k/); *co(ni) (38) > con *head hair* (*c remains /c/ before *o); *ko$_s$ci~o (34) > koči (*c > /č/ before *i); *k$^w$a(ʔa) (48) > k$^w$a *to eat* (*k$^w$ remains /k$^w$/).

*si$_u$ku (68) > šik-t *navel* (*s > /š/ before *i); *sunu (93) > son *corncob* (*s remains /s/ before *u); *ʔoho (61) > o-t *bone* (*ʔ and *h are lost).

*mu$_u$ki~u (86) > mok *to die*; *coma (37) > -come- *to sew* (*m remains /m/ initially and medially); *ti$_u$ni (19) > ten *mouth*; *toŋa-la (155) > tunel *sun* (*/n ŋ/ merge into /n/; non-initial *l remains /l/); *liŋi (94) > nene-pil *tongue* (initial *l > /n/).

*wo$_s$ko (142) > oko-t; *wa$_s$ki (99) > wak *dry* (*w > zero before *o; but remains /w/ before *a); *ya$_s$ka (110) > yeke-t *nose* (*y remains).

Reflection of UA vowels in Pochutla contributes to the status of this language as a divergent member of the Aztec branch.

Whereas, in Nahuat, UA *u > /i/, in Pochutla the vowel remains as a back rounded vowel (written /o/ in our source). UA *o also appears as one or another of the back rounded vowels in Pochutla—doubly reflected as /o u/.

UA *u > /o/: *sunu (93) > son; *tu$_u$su~i (75) > toso *to grind*; *mu$_u$ki~u (86) > mok *to die*. But in a few instances, our source shows what appears to be counter-examples to the regular *u > /o/, namely UA *yuku (109) but Pochutla yeko- *to rain*; and again, UA *pu$_n$si (5) but Pochutla iš-t *face*. We entertain the

possibility that instances of this sort represent borrowings from Aztec languages where this descent from *u to a front vowel is regular.

UA *o > /o u/: *co(ni) (38) > con; *po (4) > o(-tkan) *road*; *toŋa-la (155) > tunel. In spite of the fact that we are not as yet able to reconstruct vocalic length for UA generally, it is highly suggestive that where long /o·/ is found in other Aztec languages, short /u/ is found in Pochutla, as in the last example cited; compare Nahuatl /to·nal/.

UA *a remains as /a/ after */p $k^w$ w/, and after some *m: *$pa_s$ka (8) > ake-t *reed*; *pa (123) > a-t *water*; *waki (99) > wak; *$k^w$a(ʔa) (48) > $k^w$a; *ma (128) > -may *hand*.

But *a is reflected by /e/ after other *m and after other UA consonants: *mati (25) > meti *to know*; *$ma_s$ka (83) > meke- *to give*; *taka (145) > teke-t *man*.

UA */i i̬/ > /i e/, respectively, quite as in the other Aztec languages: *$si_s$ku (68) > šik-t; *$ti_n$ni (19) > ten.

### Other Aztec: Nahuatl

The UA stop *t is reflected in Nahuatl as /ƛ/ before *a and as /t/ before other UA vowels.

UA *t > /ƛ/: *tani (92) > -ƛani *to ask for*; *taka (145) > ƛa·ka-ƛ *man*; *$ta_u$pa (10) > -ƛapa-na *to break it, split it*; *tahi (150) > ƛi-ƛ *fire* (with loss of *a parallel to loss of *u in *$su_u$tu > -sti *fingernail*).

UA *t > /t/: *$ti_u$ni (19) > -ten *mouth*; *$ti_s$ki∼a (113) > -teki *to cut*; *toŋa-la (155) > to·nal *sun*; *mati (25) > -mati *to know*.

Nahuatl reflection of other UA consonants is the same as in Nahuat.

*$pu_n$si (5) > i·š-ƛi *face* (*p > zero); *$ta_u$pa (10) > -ƛapa-na (*p > /p/ after *$V_u$); *$ci_s$pu (13) > čiči·-k *bitter* (*c > /č/ before *i); *coma (37) > -coma *to ew* (*c remains as /c/ before *o); *kali (141) > kal-li *house* (*k remains as /k/); *$k^w$a(ʔa) (48) > -$k^w$a *to eat* (*$k^w$ remains as /$k^w$/); *ʔasi∼i (59) > asi *to arrive* (*ʔ is lost).

*$pu_n$si (5) > i·š-ƛi (*s > /š/ before *i), *si- (65) > se· *one* (*s remains /s/ before *i); *ha(ki) (138) > a·ki *who* (*h is lost).

*$mu_u$ki∼u (86) > -miki *to die*; *coma (37) > -coma (*m remains as /m/); *$ti_u$ni (19) > -ten; *toŋa-la (155) > to·nal (*/n ŋ/ merge into /n/).

*liŋi (94) > -nene-pil *tongue* (initial *l > /n/); *kali (141) > kal-li (medial *l remains as /l/).

*waki (99) > waki *to dry up* (*w > /w/); *$ya_s$ka (110) > yaka-ƛ *nose* (*y > /y/).

Of the UA vowels, *u is reflected in Nahuatl by a front vowel, as in Nahuat; but in Nahuatl there are two possible reflexes, /e i/, and the conditions which will call for one or the other of these vowels are not known.

UA *u > /i e/: *$pu_n$si (5) > i·š-ƛi; *su (71) > si·(tali·n) *star*; *$mu_u$ki∼u (86) > miki; *$tu_u$su∼i (75) > -te·si *to grind*.

Other UA vowels are reflected as in Nahuat: *$ci_s$pu (13) > čiči·-k (*i > /i/); *$ti_s$ka (18) > -te·ka *to lay it down* (*i > /e/); *po (4) > oh-ƛi *road* (*o > /o/); *$na_n$ka (47) > -naka(s) *ear* (*a > /a/).



### Tübatulabal

Half of the UA stops—*/p t k/—are multiply reflected in Tübatulabal. Of the other half, */$k^w$ ʔ/ are singly reflected, as is *c; the last with but a single cognate to attest it.

Stop reflexes of UA */p t k/ appear either as /b d g/ or /p t k/—with or without the SGC of voicing. The voiced-voiceless opposition in stops is a secondary development intricately involved in the morphophonemics of modern Tübatulabal.

Reflexes of UA */p t k/ also appear as /$^n$b $^n$d $^n$g/—with the SGC of prenasalization. On the one hand, like voicing, the SGC of prenasalization is involved in Tübatulabal morphophonemics (**3**, below), and is counted as a feature of secondary development. On the other hand, two of the unit phonemes generated, /$^n$g $^n$h/, also appear as a regular feature in the descent of one UA stop *k in a particular environment. In the enabling environment—symbolized in Chapter 3 as immediately after *$V_n$—*k > /$^n$g $^n$h/. There may well be other UA stops which have non-secondary reflexes, as yet undetected, in the prenasalized series of Tübatulabal.

Reflexes of all UA stops are treated in successive paragraphs below. Though most UA stops are reflected as such, some appear in one or another of the continuant series—as lateral, fricative, or glide.

Reflexes of UA *p are consistently stops, though they appear in different stop series *p > /p b $^n$b/: *pahi (1) > pa·y- *three*; *$pi_u$ti (3) > pili(ʔ-)∼ʔipili(ʔ) *to be heavy*; *pi (6) > pi·-l *breasts*; *po (7) > po·(n-t) *body hair, hide* (cp. po·ŋ-∼ʔo$^n$boŋ *to cut hair*); *po (4) > poh-t *road, trail*; *pa (123) > pa·-l *water*; *$pa_s$ka (8) > paha·(bi-l) *sugar cane*; *$pu_n$ku (46) > pu$^n$gu(ʔ-)∼ʔu$^n$ bu$^n$ gu(ʔ) *to domesticate him;* *$si_u$(pi) (11) > ši·b-∼ʔiši·p *to be cold*; *$mu_s$pi (15) > mupi-t *nose*; *$si_s$pa (70) > ʔišib-∼ši·p *to whittle, shave*.

Reflexes of *t appear both in the stop series and in the lateral series of Tübatulabal. Initial *t > /t d $^n$d/; medial *t > /l/: *tiwa (21) > tiw-∼ʔi·diw *to find it*; *$ti_n$wa (20) > ʔi$^n$diŋ$^w$a∼tiŋ$^w$a *to name, call him*; *$ta_u$ŋa *to kick* (156) > ʔa$^n$daŋ *to kick*; ʔa$^n$daŋa-min∼taŋa-min *to step on it*; *$tu_u$(ku) (23) > tu·gu∼ʔu·du·gu *it is dark*; *$tu_s$ki∼a (144) > tu·gi-t *night*; *tala (28) > tana(pi-t) *heel;* *$ta_s$ma (29) > taman-t *tooth*; *toŋo (30) > toŋo·-l *knee*; *ta- (125) > ta(p-t) *sinew*; *$pi_u$ti (3) > pili(ʔ-); *$su_u$tu (26) > sulu(n-t) *fingernail*; *$ka_s$ti (42) > hal(ʔ-)∼ʔa·hal(ʔ) *to sit, live*; *$pi_u$ti (143) > pil- *to arrive*; *$ku_s$ta (154) > kula·-n *his neck*.

UA *c > /c/: *co(ni) (38) > co(mo·-l) *head hair*. This is the only cognate that our lexical material affords, and includes a not understood shift in nasal, as indicated by the parentheses in the Tübatulabal citation.

Reflexes of UA *k appear both in the stop series and in the fricative series; *k > /k g $^n$g/ before UA high vowels; *k > /h $^n$h/ before UA low vowels: *$ki_u$(ʔi∼i) (43) > ki·ʔ-∼ʔi·gi *to bite*; *ku (137) > ku-t *fire*; *ha(ki) (138) > ʔagi *who*; *siki∼a (115) > ši·gi-n-∼ʔiši·gi-n *to skin it*; *kuŋa (97) > ku·ŋa-n *her husband*; *$pu_n$ku (46) > pu$^n$gu?-; *$ka_s$ti (42) > hal(ʔ-)∼ʔa·hal(ʔ); *ka (136) > ha- *not*; *kali (141) > hani·-l *house*; *kahi∼a (126) > haʔ-∼ʔa·haʔ *to hear*; *$ti_s$ki∼a (113) > tidiha∼ʔititiha *it is cut up*, titi·gi-n∼ʔititi·gi-n *to cut tobacco*;

*ma$_s$ka (83) > maha-∼ʔamha *to give it*; *taka (145) > taha($^n$biš) *old man*; *na$_n$ka (47) > na$^n$ha-l *ears*; *wo$_s$ko (142) > woho($^n$bo·-l) *bull pine*.

UA *k$^w$ > /w/: *k$^w$a$_u$si∼i (50) > wiš-∼ʔiwis *it is ripening, cooking*; *k$^w$a$_u$si (51) > wiši· *tail*; *k$^w$i$_s$(si) (52) > wi·š-∼ʔiwiš *to catch it, rope it*; *k$^w$i$_u$ta (54) > wi·la·-t *skirt feathers*.

UA *ʔ > /ʔ/: *ʔawa (104) > ʔa·wa-t *horn*; *ʔasi (139) > ʔa·š-∼ʔaʔaš *to bathe*; *ʔi(116) > ʔih *here*; *ʔi-(120) > ʔi·(y-) *to steal*; *miʔa(85) > miʔi(g-) *to kill him*; *si$_u$(ʔi∼a) (67) > šiʔ- *to urinate*; *tuʔ-i (133) > tuʔi·-l *flour*.

Both UA fricatives are multiply reflected in Tübatulabal.

UA *s > /š $^n$ʐ/—that is, /š/ initially, and also /š/ medially after non-nasalizing vowel, but /$^n$ʐ/ after nasalizing vowel *V$_n$: *saki *to parch* (157) > ʔašag-∼ša·k *to roast it* (cp. Papago háakì *to parch corn*; Huichol šakí *parched corn*; Tarahumara šakí *esquite*); *si$_s$-po (14) > šupi-l *eyebrow*; *su (71) > šu·-l *star*; *k$^w$i$_s$(si) (52) > wi·š-; *tu$_u$su∼i (75) > ʔutuš- *to grind*; *kusu *to sound—of animal* (122) > ʔukuš-∼ku·š *to crow, yell* (cp. Papago kúhù *to sound—of animal*; Tarahumara kusú); *pu$_n$si (5) > pu$^n$ʐi-l *eye*; *ya$_n$sa (76) > ya$^n$ʐ- *to sit down*.

UA initial *h remains as /h/ in at least one stem occurring as second member of a non-productive compound: *hu (78) > pa·-hu·-l *war arrow* (cp. pa·-$^n$digit *to war*). Otherwise initial *h > /ʔ/: *hi$_s$- (77) > ʔi·ʔ-∼ʔi·ʔi· *to drink*; *ha(ki) > ʔagi.

Medial UA *h > /ʔ/ in two instances, but zero in one: *muhu (81) > ʔu·muʔ-∼ʔu·mu·ʔ *to shoot it*; *kahi∼a (126) > haʔ-∼ʔa·haʔ; *pahi (1) > pa·y-.

All three UA nasals remain in Tübatulabal.

UA *m > /m/: *mu$_u$ki∼u (86) > mu·gi-n∼ʔu·mugi·-n *to hurt him*; *ma (128) > ma·-l *hand*; *miya *moon* (158) > mi·ya-l *mouth*, *mi·ya-biš-t *moon* (cp. Hopi mi·yawi *moon*); *mu$_s$pi (15) > mupi-t; *ma$_s$ka (83) > maha-; *kima *to come* (159) > kim-∼ʔi$^n$gim; *ta$_s$ma (29) > tama(n-t).

UA *n > /n/: *ni$_s$ma (89) > ni·ma-l *liver*; *na$_n$ka (47) > na$^n$ha-l; *ni$_s$pa *snow* (160) > niba (ʔ-)∼ʔiniba(ʔ) *it is snowing*.

UA *ŋ > /ŋ/: *toŋo (30) > toŋo·-l; *ʔo$_s$ŋa (63) > ʔoŋa-l *salt*; *kuŋa (97) > ku·ŋa-n *her husband*; *ta$_u$ŋa (156) > ʔa$^n$daŋ. But in *liŋi (94) > lalan-t *tongue*, with first syllable exfixed by reduplication and second syllable nasal homorganic with suffix -t in Tübatulabal; all Shoshonean languages having cognates for *tongue* show vowel correspondences peculiar to this one morpheme.

The UA lateral has two reflexes in Tübatulabal. *l > /l n/—that is, initial *l > /l/, as in the example just cited (94), while medial *l > /n/: *puli∼a (97b) > pu·n-∼ʔu$^n$bun *to tie (a knot)*; *kali (141) > hani·-l; *sala (147) > ša·n(o-t) *pitch*, ša·na·-dan *to pitch it*; *tala (28) > tana(pi-t); *wili *to stand* (161) > win∼ʔiwini *to be* (cp. Hopi wíni *to stand*; Tarahumara wirí *he is standing*).

Of the UA glides, *y is singly reflected (remaining /y/), while *w is doubly reflected in Tübatulabal.

UA *w > /w ŋ$^w$/—that is, /w/ initially and also, /w/ immediately after a non-nasalizing UA vowel, but /ŋ$^w$/ after a UA vowel symbolized as *V$_n$ (**3**, below): *wi- (102) > wi(p-t) *fat*; *wo- (103) > wo· *two*; *wa$_s$ki (99) > wa·g-∼ʔawa·k *it is dry*, wa·gi(ʔ-)∼ʔa·wa·gi(ʔ) *to be thin, poor*; *wa$_s$ʔi∼i *to roast* (162) > wa·ʔ∼ʔa·wa *to broil meat* (cp. Papago gáʔì∼gági *to roast meat*); *wo$_s$ko (142) > woho($^n$bo·-l); *wili (161) > win-; *tiwa (21) > tiw-; *ʔawa (104) > ʔa·wa-t; *ʔawi (124) > ʔa·w-∼ʔaʔaw *to gossip*; *ti$_n$wa (20) > ʔi$^n$diŋ$^w$a-∼tiŋ$^w$a.



UA *y > /y/: *ya$_n$sa (76) > ya$^n$ʐ-; *yoma (111) > yo·m- *to mate*; *yaʔa (129) > ya·ʔ-∼ʔa·ya *to yearn for his master*; *ya$_s$ka (110) > yaha·(wi-t) *point of a hill*; *miya (158) > mi·ya-l.

Instances in which UA vowels are positively reflected precede the very numerous instances in which UA vowels are lost in Tübatulabal. However, since vowels are retained in all initial syllables, and in some but not all final syllables, the sum of retained vowels greatly exceeds the sum of lost vowels.

*i > /i/: *pi (6) > pi·-l; *si$_s$pa (70) > ʔišib-∼ši·p; *k$^w$i$_u$ta (54) > wi·la·-t; *ʔi (116) > ʔih; *si(ʔi∼a) (67) > šiʔ-; *hi$_s$- (77) > ʔi·ʔ-; *mu$_s$pi (15) > mupi-t; *kali (141) > hani·-l; *k$^w$a$_u$si (51) > wiši·-; *tuʔ-i (133) > tuʔi·-l; *pu$_n$si (5) > pu$^n$ʐi-l.

UA *i > /y/ in *pahi (1) > pa·y-, and /i/ in *pi$_u$ti (143) > pil-.

UA *i > /i i/; of these two reflections, /i/ is by far the more common; *pi$_u$ti (3) > pili ʔ-; *si$_u$(pi) (11) > ši·b-; *tiwa (21) > tiw-; *ti$_s$ki∼a (113) > tidiha; *miʔa (85) > miʔ(ig-); *ni$_s$ma (89) > ni·ma-l; *wili (161) > win. The less common reflection of /i/ <*/i/ occurs under conditions which are not well controlled, as in *k$^w$i$_s$(si) (52) > wi·š-; *ti$_n$wa (20) > ʔi$^n$diŋ$^w$a-∼tiŋ$^w$a.

In one instance, it appears that *i > /u/: *si$_s$-po (14) > šupi-l. So also there is a single instance of *i > /a/: *liŋi (94) > lalan-t.

UA *u > /u/: *pu$_n$ku (46) > pu$^n$guʔ-; *mu$_s$pi (15) > mupi-t; *tu$_u$ku (23) > tu·gu; *su$_u$tu (26) > šulun-t; *ku$_s$ta (154) > kula·-n; *su (71) > šu·-l; *muhu (81) > ʔu·muʔ-.

*o > /o/: *po (4) > poh-t; *toŋo (30) > toŋo·-t; *wo$_s$ko (142) > woho-($^n$bo·-l); *wo- (103) > wo·; *ʔo$_s$ŋa (63) > ʔoŋa-l.

*a > /a/: *tala (28) > tana(pi-t); *ta$_s$ma (29) > taman-t; *na$_n$ka (47) > na$^n$ha-l; *ʔawa (104) > ʔa·wa-t; *ma (128) > ma·-l; *kuŋa (97) > ku·ŋa-n; *ni$_s$ma (89) > ni·ma-l.

Single instances of correspondences between */a/ and Tübatulabal /i i/ may be a consequence of metathesis rather than regular or undisturbed descent: *k$^w$a$_u$si∼i (50) > wiš-; k$^w$a$_u$si (51) > wiši·-. See also (143) and (14) above for other instances suggestive of metathesis.

Instances of vowel loss are shown below for every UA vowel but one; cognates for lost *o did not turn up in our sample. The sample in question is that identified in our source as verb stems.

Almost all verb final UA vowels are lost when not supported by a following suffix.

UA *i > zero: *ʔasi (139) > ʔa·š-∼ʔaʔaš; *saki (157) > ʔašag-∼ša·k; *wa$_s$ki (99) > wa·g-∼ʔawa·k.

UA *i > zero: *si$_u$(pi) (11) > ši·b-∼ʔiši·p; *ka$_s$ti (42) > hal?-∼ʔa·hal?; *k$^w$i$_s$(si) (52) > wi·š-∼ʔiwiš; *wili (162) > win (but∼ʔiwini).

UA *u > zero: *tu$_u$su∼i (75) > ʔutuš-; *kusu (122) > ʔukuš-∼ku·š; *muhu (81) > ʔu·mu?-∼ʔu·mu·ʔ.

UA *a > zero: *si$_s$pa (70) > ?išib-~ši·p; *tiwa (21) > tiw-~?i·diw; *ta$_u$ŋa (156) > ?a$^n$daŋ; *ti$_u$ka *to eat* (163) > tik~?itik.

In the last item cited, *k remains as /k/ before *a instead of showing the regular descent to /h/. There are two possibilities that would account for this anomalous reflex. The easy explanation is that Tübatulabal tik~?itik was borrowed from a sister language in which the /k/ reflex is not anomalous (but then the morpheme in question is a cognate only in the unknown language from which it was borrowed—not in Tübatulabal—and the door is opened to saying that every reflex which we do not control well is such a borrowing).

Our preferred explanation is to posit a pre-Tübatulabal period when *k > k in all environments. During this period, final UA vowels began to be dropped under certain morphophonemic conditions—i.e., in verbs not immediately followed by a suffix. Already in this period then, the form *ti$_u$ka had a reflex in which the final *a was lost. Then, at a later stage *k developed into /h/ before *a (as evidenced by *kali > hani·l and many other such cognates); but since the final *a of *ti$_u$ka was lost, the later-stage change did not occur.

## Southern Paiute

Reflexes of UA stops which appear initially in Southern Paiute are treated before those which appear medially.

UA */p t k$^w$ ?/ remain initially; */c k/ are doubly reflected initially conditioned by following UA vowel.

UA *p > /p/: *pahi (1) > pái- *three*; *pa$_s$ki (2) > paxí- *to walk*; *pi$_u$ti (3) > pixt(ía-) *heavy*; *po (4) > púu *road*; *pu$_n$si (5) > pu?úy *eye*; *pi (6) > píi-c *breast*; *pa$_s$ka (8) > paxá-mpi *cane*; *pa (123) > páa *water*.

UA *t > /t/: *ti$_s$ka (18) > tixá- *to measure, try*; *ti$_s$ni (19) > tím(pa) *mouth*; *tu$_u$ku (22) > tuxkú-av *meat*; *tu$_u$(ku) (23) > túu-k$^w$ar *black*; *tu$_u$su~i (75) > túxsu- *to grind seeds*; *ta$_u$ca (27) > táč *summer*; *tu$_s$- (121) > tú(x$^w$aq) *to put out fire*; *to$_u$sa (31) > tusá-xar *white*;

*tala (28) > tám-pi *heel*; *ta$_s$ma (29) > táŋ$^w$a-v *tooth*; *ta- (125) > ta(múa) *sinew*; *ta$_u$ŋa (156) > táŋa- *to kick*; *ti$_u$ka (164) > tiqá- *to eat*.

UA *c > /c/ before *i and /č/ before the UA 2(BB$^o$) vowels: *ci- *point* (164) > ci- *with a point* (cp. Papago sí- *with a point*); *co$_s$ni (38) > ču- *with the head*.

UA *k > /k/ before *V$^{high}$ and /q/ before *V$^{low}$: *ki$_u$(?i~i) (43) > ki?í- *to bite*; *ku$_s$ta (154) > kurá-v *neck*; *ku (137) > ku- *with fire*; *ka$_s$ti (42) > qári- *to sit*; *ka (136) > qáa-č *not*, qa *negative*; *kali (40) > qáni *house*; *ko$_u$?i~o (45b) > qu?ú- *to kill pl.* (cp. Papago kó?ò *to die pl.*).

UA *k$^w$ > /k$^w$/: *k$^w$a- (49) > k$^w$a(nánc) *eagle*; *k$^w$a$_u$si~i (50) > k$^w$así-p *cooked, ripe*; *k$^w$a$_u$si (51) > k$^w$así *tail*; *k$^w$i$_s$(si) (52) > k$^w$íi-~k$^w$i?í- *to take*;[18] *k$^w$i$_u$ta (54) > k$^w$ičá-p *excrement*; *k$^w$i$_s$ci (35) > k$^w$íi-p *smoke*.

[18] The second or parenthetic syllable of *k$^w$i$_s$(si) is not descended in some daughter languages, but is reflected in others, including Southern Paiute, where its trace is discernible in the following vowel (ii ~ i?i), while the /s/ is zeroed by the spirantizing effect of the preceding UA morph */k$^w$i$_s$/; see now Comanche.



UA *? > /?/: *?a$_u$ŋa (58) > ?aŋa-v *wing, upper arm*; *?oho (61) > ?uú-v *bone*; *?oha (62) > ?uá-qar *yellow*; *?i$_s$(ca) (119) > ?iá- *to plant*. In some modern Southern Paiute dialects, initial *? is lost.

The vowels of Southern Paiute prefixes or other morphemes have different morphophonemic effects on reflexes of UA initial */p t k k$^w$/—spirantizing, nasalizing, or unaltering (**3**, below).

After Southern Paiute spirantizing vowels, initial */p t k k$^w$/ appear as /v r x x$^w$/, respectively.

UA *p- > /v/: *pu$_n$ku (46) > -vuŋku- in sarii-vuŋku-ni *my dog*; *pahi (1) > -vái in na-vái *six*.

UA *t- > /r/: *ti$_u$ka (163) > -riqa- in piŋqá-riqa- *to keep on eating*.

UA *k- > /x/: *ka$_s$ti (42) > -xari- in áa-xari- *to sit hidden from view*.

UA *k$^w$- > /x$^w$/: *k$^w$i$_s$(si) (52) > -x$^w$ii- in kumá-x$^w$ii- *to take a husband*.

After Southern Paiute nasalizing vowels, UA initial */p t k$^w$/ appear as /mp nt ŋk$^w$/ respectively. Once the nasalizing effect is determined by a preceding vowel, the precise reflex of *k is also determined by the vowel that follows: before *V$^{high}$ and *V$^{low}$, *k is reflected as /ŋk ŋq/, respectively.

UA *p- > /mp/: *pu$_n$ku (46) > -mpuŋku- in kučú-mpuŋku-ni *my cow*.

UA *t- > /nt/: *ti$_n$ka (163) > -ntiqa- in tíi-ntiqa- *to eat well, enjoy meal*.

UA *k- > /ŋk ŋq/: *ku$_s$ta (154) > -ŋkura- in kučú-ŋkura-v *Buffalo Neck*—man's name; *kali (40) > -ŋqaani in kučú-ŋqaani *barn*.

UA *k$^w$- > /ŋk$^w$/: *k$^w$i$_s$(si) (52) > -ŋk$^w$ii- in ní-ŋk$^w$ii- *to wrestle*.

After Southern Paiute unaltering vowels, UA initial stops remain as in initial position or else appear as consonant clusters—/x/ plus stop—when the stop occurs after an obligatory prefix, as in ki-xcíp *spit* < *ci-.

The discussion which follows is concerned with instances in which medial UA stops are reflected in Southern Paiute. The stops */p t c k/ have reflexes conditioned by preceding *V$_s$ or *V$_u$; in addition, *k has special reflexes appearing after *V$_n$. Instances for medial *k$^w$ are lacking in our material. After *V$_u$, medial stops are reflected either singly or as clusters—/x/ plus stop.

UA *p > /v/ after *V$_s$: *mu$_s$pi (15) > muví-v *nose*; *ni$_s$pa (160) > nivá-v *snow*; *si$_s$-po (14) > (pixtí)siivu-v (and in another dialect, pixtísiivi) *eyebrow*; *si$_s$pa (70) > sivá- *to scrape*.

UA *p > /p/ or /xp/ after *V$_u$: *si$_u$(pi) (11) > si-pí- (and occasionally si-xpi-) *cold—of objects*.

UA *t > /r/ after *V$_s$: *ka$_s$ti (42) > qári-; *ku$_s$ta (154) > kurá-v.

UA *t > /txtč/ after *V$_u$, under conditions which are not well controlled (often with /č/ appearing after /i/): *pi$_u$ti (3) pixt(ia-) *to be heavy*; *k$^w$i$_u$ta (54) > k$^w$ičá-p *excrement*—but compare k$^w$it(ú-mpi) *buttocks*; *pi$_u$ti (143) > pičí- *to arrive sg.*; *si$_u$tu (26) > ma-síčuu-v *fingernail*.

UA *c > zero after *V$_s$: *k$^w$i$_s$ci (35) > k$^w$íi-p *smoke*; *ko$_s$ci~o (34) > (ax)-qúu- *to sleep pl.*; *ma$_s$ci (36) > mái- *to find*; *?i$_s$(ca) (119) > ?ia-; *wi$_s$ci (101) > wi(?)í- *to fall*.

UA *c > č after *V$_u$, but our sample affords only a single instance, namely,

*ta$_u$ca (27) > táč. The /č/ reflex appears before *a; the /c/ reflex would be expected before /i/, but confirming cognates have not yet come to hand.

UA *k > /x/ after *V$_s$: *pa$_s$ki (2) > paxí-; *pa$_s$ka (8) > paxa-; *si$_s$ku (68) > sixú- *navel*; *ma$_s$ka (83) > máxa- *to give*; *ya$_s$ka (110) > yaxá-r *end*; *ti$_s$ki∼a (113) > tixá(ni-) *to cut up meat*; *wo$_s$ko (142) > uxú-mpi *fir*. But *k > /x$^w$/ in *tu$_s$ki∼a (144) > tux$^w$á-nu *night*.

UA *k > /k q/ after *V$_u$—with reflex /k/ before *V$^{high}$ and /q/ before *V$^{low}$: *tu$_u$ku (22) > tuxkú-av; *mu$_u$ki∼u (86) > ča-ŋ$^w$íki- *to die off pl.*; *ti$_u$ka (163) > tiqá- *to eat.*

UA *k > /ŋk ŋq/ after *V$_n$—with /ŋk/ before *V$^{high}$ and /ŋq/ before *V$^{low}$: *pu$_n$ku (46) > púŋku-v *pet, domesticated animal*; *na$_n$ka (47) > náŋqa-v *ear*.

The UA glottal stop is doubly reflected medially: *ʔ > /ʔ/ and zero. It is possible to equate the zero reflection of *ʔ with the zero reflection of */s c n ŋ/, since all zero out after *V$_s$. Despite the fact that the spirantizing effect does not include loss of a following consonant in modern morphophonemics, *V$_s$ is set up as one of two determining environments to account for the reflection of *ʔ.

UA *ʔ > zero: *wa$_s$ʔi∼i (162) > waí- *to roast.*

UA *ʔ > /ʔ/: *ki$_u$(ʔi∼i) (43) > kiʔí-; *si$_u$(ʔi∼a) (67) > siʔí- *to urinate.*

Of the UA fricatives, *h has one reflex, *s more than one; reflexes of the latter are conditioned by preceding vowels.

UA *s > /s/ initially and after *V$_u$: *si$_s$ku (68) > sixú-; *suwi∼a (72) > suwá- *to consume*; *to$_u$sa (31) > tusá-xar; *tu$_u$su∼i (75) > túsu-; *k$^w$a$_u$si∼i (50) > k$^w$así-p; *k$^w$a$_u$si (51) > k$^w$asi.

UA *s > /ʔ/ after *V$_n$ in *pu$_n$si (5) > puʔí∼puʔúy.

UA *s > /ʔ/∼zero in *k$^w$i$_s$(si) (52) > k$^w$iʔí-∼k$^w$ií-.

UA *h > zero: *hi$_s$- (77) > i(ví-) *to drink;* *hu (78) > úu *arrow;* *ʔoho (61) > ʔuú-v; *ʔoha (62) > ʔuá-qar.

All UA nasals have more than one reflex, depending on whether the preceding vowel is *V$_s$ or *V$_u$, or whether the nasal is in initial position.

UA *m > /m/ initially and after *V$_u$: mu$_s$pi (15) > muví-v; *ma$_s$ci (36) > mái-; *ma$_s$ka (83) > máxa-; *ma (128) > ma- *with the hand*; *miya (158) > miá-c *moon*; *ku$_u$mi∼a (88) > kumí *corn* (archaic); *ka$_u$ma (87) > qama- *to taste*; *to$_u$mo *winter* (165) > tómo (cp. Tarahumara romó *winter*; Hopi tömö$^ʔ$ö *it is winter*).

UA *m > /ŋ$^w$/ after *V$_s$: *ta$_s$ma (29) > taŋ$^w$á-v *tooth*; *ni$_s$ma (89) > niŋ$^w$ú-mpi *liver* (but nuŋú-v in some dialects). After the spirantizing pre-Paiute morpheme ča-, the reflex of initial *m appears as medial /ŋ$^w$/ in Southern Paiute: *mu$_u$ki∼u (86) > ča-ŋ$^w$íki- *to die off.*

UA *n > /n/ both initially and after *V$_u$ but shows secondary assimilation to a following consonant: *na$_n$ka (47) > náŋqa-v; *ni$_s$ma (89) > niŋ$^w$ú-mpi∼nuŋú-v; *na$_u$ʔá (95b) > naʔá- *to burn* (cp. Tarahumara naʔá *they make fire*); *no- (96) > nú(axa) *pregnant*; *ni$_s$pa (160) > nivá-v; *to$_u$no *hill* (167) > tunú-(ki-či) *knoll, swell in ground* (cp. Papago tóon-k *hill*); *k$^w$a$_u$na (135) > k$^w$aná- *to smell, give off odor*; *ti$_u$ni (19) > tiní(a-) *to tell*, and with homorganic assimilation to following /p/ in tím(pa).



UA *n > zero after *V$_s$: *so$_s$no *lung* (166) > suú-vi (cp. Tarahumara sono-rá *lung*; Papago hón *body*).

UA *ŋ > /ŋ/ after *V$_u$: *ʔa$_u$ŋa (58) > ʔaŋá-v; *ta$_u$ŋa (156) > táŋa-.

UA *ŋ > zero after *V$_s$: *o$_s$ŋa (63) > ʔúa-v *salt.*

The UA lateral is well attested medially; reflexes of medial *l appear even in Southern Paiute which lacks reflexes of initial *l. (The latter, when it does appear in other languages, is supported by only one cognate (94), glossed *tongue.*)

UA *l > /n/: *kali (141) > qáni; *sala (147) > saná-pi *gum*; *wili (161) > winí- *to stand*; apparently *l > /m/, as in *tala (28) > tám-pi, but this is better explained as descent of *n remaining /n/ in Southern Paiute, with homorganic assimilation to labial nasal before labial stop.

Dual reflexes are attested for both UA glides, */w y/.

UA *w > zero initially and medially; so also, *w > /w/ initially and medially; paucity of cognates makes it difficult to state the determining environments with confidence. Initial instances are *wo$_s$ko (142) > uxú-mpi *pine*, with loss of *w; but *wa$_s$ʔi∼i (162) > waí-, as well as *wi$_s$ci (101) > wi(ʔ)í, with *w retained. Medial instances are *ʔawa (104) > ʔaa-p *horn* as well as *yiwa (108) > yií *doorway*, with loss of *w; but *suwi∼a (72) > suwá- with *w retained.

UA *y > /y/ in all instances of initial occurrence; *y > zero in the one instance of medial occurrence: *ya$_s$ka (110) > yaxá-r; *yi$_u$ʔi *to swallow* (168) > yiʔí-ki- (cp. Cora and Huichol -ye$^ʔ$e *to swallow*); but *miya (158) > miá-c.

Reflexes of vowels in initial syllables are straightforward and well attested; however, reflexes of vowels in final syllables are complicated by morphophonemic involvements as those discussed in Chapter 3. In this section, final vowels are exemplified when their descent is parallel to that of vowels in initial syllables.

UA */i i a/ remain in Southern Paiute, while */u o/ merge into /u/. Stated in terms of the Proto UA vowel type, F + 2 (BB°)—that is, i

| | |
|---|---|
| i | u |
| a | o |

—vowels in the subset FB remain, while those in subset B° merge.

UA *i > /i/: *pi (6) > pii-c; *ci- (164) > ci-; *k$^w$i$_u$ta (54) > k$^w$ičá-p; *si$_s$pa (70) > sivá-; *pahi (1) > pái-; *pa$_s$ki (2) > paxí-; *kali (40) > qáni; *k$^w$a$_u$si (51) > k$^w$así.

UA *i > /i/: *ti$_u$ka (164) > tiqá-; *ki$_u$(ʔi∼i) (43) > kiʔí-; *ʔi$_s$(ca) (119) > ʔiá-; *si$_u$(pi) (11) > si-pí-; *pi$_u$ti (143) > píči-; *ka$_s$ti (42) > qári-; *k$^w$a$_u$si∼i (50) > k$^w$así-p.

UA *u > /u/: *pu$_n$si (5) > puʔúy; *tu$_s$ku (22) > tukú-av; *tu$_u$su∼i (75) > túsu-; *ku$_s$ta (154) > kurá-v; *mu$_s$pi (15) > muví-v; *pu$_n$ku (46) > púŋku-v; *si$_s$ku (68) > sixú-; *hu (78) > úu.

In one instance *u > /i/: *mu$_u$ki∼u (86) > ča-ŋ$^w$iki-.

*o > /u/: *po (4) > púu; *to$_u$sa (31) > tusá-xar; *ko$_u$ʔi∼o (45b) > quʔú-; *ʔoha (62) > ʔuá-qar; *ʔo$_s$ŋa (63) > ʔúa-v; *ʔoho (61) > ʔuú-v; *wo$_s$ko (142) > uxú-mpi.

*a > /a/: *pa$_s$ka (8) > paxá-mpi; *pa (123) > páa; *ta$_u$ca (27) > táč;

*ta$_s$ma (29) > táŋ$^w$a-v; *?a$_u$ŋa (58) > ?aŋá-v; *ni$_s$pa (160) > nivá-v; *si$_s$pa (70) > sivá-.

## Comanche

All UA stops remain initially in Comanche.

UA *p > /p/: *pahi (1) > páhI ~ pahi- *three*; *po (4) > pú(?E) *road*; *pu$_n$si (5) > púi *eye*; *pi (6) > pí(cipi) *milk*; *pa (123) > páa *water*.

UA *t > /t/: ti$_s$ka (18) > tíki- *to put something away, sg.*; *tu$_u$ku (22) > túhkU ~ tuhku *human flesh*; *ta$_s$ma (29) > táamA ~ táma *tooth*; *to$_u$sa (31) > tósa-*white*; *tu$_s$ki ~ a (144) > túka(ni) *night*.

UA *c > /c/: *ci- (164) > ci- *with a point*; *co(ni) (38) > co- *with the head*.

UA *k > /k/: *ka$_s$ti (42) > kári- *to sit down, sg.*; *ko$_u$?i ~ o (45b) > kóoi-, kó?i- *to die, pl.*; *ku (137) > ku- *referring to fire*; *ki$_u$ma (159) > kíma- *to come*.

UA *k$^w$ > /k$^w$/: *k$^w$a$_u$si (51) > k$^w$ásI ~ k$^w$ási *tail*; *k$^w$a$_u$si ~ i (50) > k$^w$ási- *to cook*; *k$^w$i$_s$(si) (52) > k$^w$ihi- *to catch, capture*; *k$^w$i$_u$ta (54) > k$^w$íta- *excrement*.

UA *? > /?/: *?oha (62) > ?óha- *yellow*; *?o$_s$ŋa (63) > ?ónaa-vI *salt*; *?awa (104) > ?áa- *horn*.

After prefixes, the Comanche reflexes of UA initial stops undergo a secondary development reminiscent of Southern Paiute (e.g. initial */p t > /v r/, respectively, after some prefixes but remain as stops after other prefixes). Another kind of development results in the elaboration by cluster of stop to h + stop, of nasal to h + nasal consonant, and of fricative /s/ to/hs/—all after certain prefixes.

After *V$_s$, medial *p > /v/ in Comanche; there is an analogical basis for postulating that after *V$_u$, medial *p > /p/ in Comanche, but cognates are lacking to attest this. Compare UA medial *t > /r̥/ after *V$_s$, while remaining /t/ after *V$_u$.

UA *p > /v/: *mu$_s$pi (15) > múuvI *nose*; *si$_s$pa (70) > síve- *to shave, scrape off*.

UA *t > /r/: *ka$_s$ti (42) > kári-.

UA *t > /t/: *k$^w$i$_u$ta (54) > k$^w$íta-; *si$_u$tu (26) > má-siitO *fingernail*; *pi$_u$ti (43) > píti- *to arrive*.

UA *c > zero after *V$_s$; and by analogy we postulate *c > /c/ after *V$_u$, without support of cognates.

UA *c > zero: *k$^w$i$_s$ci (35) > k$^w$ii- *smoke*.

UA *k remains as /k/ after both *V$_s$ and *V$_n$, but after *V$_u$, the reflex of *k is a consonant cluster, /hk/.

UA *k > /k/: *si$_s$ku (68) > síikU *navel*; *ma$_s$ka (83) > máka- *to give to eat*; *wo$_s$ko (142) > wókoo-vI *pine*; *ka$_s$ku (170) > káku(?) *grandmother* (cp. Papago káak; Southern Paiute kaxú-); *tu$_s$ki ~ a (144) > túka(ni); *na$_n$ka (47) > náka- *to hear*, nákI *ear*; *pu$_n$ku (46) > púukU *horse*.

UA *k > /hk/: *tu$_u$ku (22) > túhkU ~ tuhku; *ti$_u$ka (163) > tihka- *to eat*.

By analogy, we postulate parallel descent from medial *k$^w$, but Comanche cognates are lacking.

According to our manuscript source, UA *? remains medially; according to our published source, this glottal stop is no longer phonemically distinctive: *ko$_u$?i ~ o (45b) > kó?i-, kóoi-; *yi$_u$?i (168) > yí?(wi-), yí(wi-) *to swallow*. It is quite possible that the different transcriptions are not in conflict; dilaect or idiolect differences may be distinguished by the presence or absence of the glottal stop.



One of the UA fricatives, *s is triply reflected in Comanche; the other, *h, singly.

UA *s > /s/ initially and after *V$_u$: *si$_s$ku (68) > síikU; *si$_s$pa (70) > síve-; *tu$_u$su ~ i (75) > túsuh- *to thresh*; *to$_u$sa (31) > tósa-; *k$^w$a$_u$si (51) > k$^w$ásI.

UA *s > /h/ after *V$_s$: *k$^w$i$_s$(si) (52) > k$^w$íhi-.

UA *s > zero after *V$_n$: *pu$_n$si (5) > púi-.

UA *h > /h/: *ha(ki) (139) > hák(ari) *who*; *hi$_s$- (77) > hí(vi) *to drink*; *hu (78) > húu-hpI *tree, stick*; *?oha (62) > ?óha-; *pahi (1) > páhI.

The UA bilabial nasal *m remains as /m/, while */n ŋ/merge as /n/.

UA *m > /m/: *mu$_s$pi (15) > múuvI; *ma$_s$ka (83) > máka-; *ma (128) > ma- *referring to the hand*; *miya (158) > mía *moon*; *ta$_s$ma (29) > táamA ~ táma; *ki$_u$ma (159) > kíma-; *to$_u$mo (165) > tómO- ~ tómo- *winter*.

*n > /n/: *na$_n$ka (47) > náka-; *no- (96) > nó(yO) *egg*; *nimi (171) > ními- *to move about, walk* (cp. Nahuat nemi- *to walk, live, exist*); *k$^w$a$_u$na (135) > k$^w$ánaa- *to smell, give off odor*.

*ŋ > /n/ (or hn): *?o$_s$ŋa (63) > ?ónaa-vI; *?a$_u$ŋa (58) > ?áhna *upper arm, armpit*.

The UA lateral is reflected as /n/ which, like Comanche /n/ from *ŋ, also appears as a second member of a consonant cluster, after /h/.

UA *l > /n/ (or /hn/): *sala (147) > sána-hpI *sticky substance, gum*; *wili (161) > wíni- *to stand, sg.*; *kali (141) > káhni *house*.

Both of the UA glides */w y/ remain as such in initial position; but they are lost medially.

UA *w > /w/: *wo$_s$ko (142) > wókoo-vI; *wili (161) > wíni-.

UA *w > zero: *?awa (104) > ?áa-.

UA *y > /y/: *yi$_u$?i (168) > yí?(wi-).

UA *y > zero: *miya (158) > mía.

In the usual reflection, UA vowels remain without change in Comanche.

*i > /i/: *pi (6) > pí(cipɬ); *ki$_u$ma (159) > kíma-; *k$^w$i$_u$ta (54) > k$^w$íta-; *si$_s$pa (70) > síve-; *k$^w$i$_s$ci (35) > k$^w$íi-; *si$_s$ku (68) > síikU; *pahi (1) > pahI ~ pahi-.

*ɨ > /i/: *k$^w$ɨ$_s$(si) (52) > k$^w$íhi-; *miya (158) > mía; *nimi (171) > ními-; *ka$_s$ti (42) > kári-; *k$^w$a$_u$si ~ i (50) > k$^w$ási-; *pi$_u$ti (43) > píti-.

*u > /u/: *pu$_n$si (5) > púi; *tu$_u$ku (22) > túhkU ~ túhku; *tu$_s$ki ~ a (144) > túka(ni); *ku (137) > ku-; *mu$_s$pi (15) > múuvI; *pu$_n$ku (46) > púukU; *tu$_u$su~i (75) > túsuh-; *si$_s$ku (68) > síikU.

*o > /o/: *to$_u$sa (31) > tósa-; *ko$_u$?i~o (45b) > kóoi-, kó?i-; *?oha (62) > ?óha-; *to$_u$mo (165) > tómO- ~ tómo-; *no- (96) > nó(yO).

*a > /a/: *pa (123) > páa; *ta$_s$ma (29) > táamA ~ táma; *?awa (104) > ?áa-; *ma$_s$ka (83) > máka-; *na$_n$ka (47) > náka-; *sala (147) > sána-hpI.

In addition to the instances exemplified above, we find some others—in final

position—in which the usual reflection is not followed: *a > /e/: *si$_s$pa (70) > síve-; *u > /o/: *si$_u$tu (26) > má-siitO; *o > /u/: *po (4) > pú(ʔE).

## Mono

Data on Mono available to us affords a relatively small body of cognate material. However, since the Mono data are highly reliable, we attempt to present all the Mono forms which have well attested cognates in other UA languages.

UA *p > /p/, so far (but more cognate data would probably provide instances of Mono /hp/ < *p): *pahi (1) > pahi *three*; *po (4) > po(yo) *road*; *po (7) > poo *to cut hair*; *mu$_s$pi (15) > mupi *nose*; *pa (123) > pa(ya) *water*; *ni$_s$pa (160) > nipa *snow*.

UA *t has dual reflexes medially, but remains as /t/ initially: *ta$_s$ma (29) > tawa *tooth*; *ta$_u$ca (27) > taca *summer*.

*t > /ht/ after *V$_s$: *ka$_s$ti (42) > qahti *to sit*; *ku$_s$ta (154) > kuhtu *neck*.

*t > /t/ after *V$_u$: *k$^w$i$_u$ta (54) > k$^w$ita *to defecate*, *si$_u$tu (26) > mah-situ *fingernail*.

In modern Mono, medial /ht/ ~ /t/ in some of the stems cited, so that /qahti/, for example, also appears as /qati/.

UA *c > /c/: *co(ni) (38) > coh- *head* (a prefix); *ci- (164) > cih- *with a point* (a prefix); *ta$_u$ca (27) > taca.

Initial UA *k > /k q/, the former before high vowels, the latter before low vowels: *ku (137) > kuh- *fire, heat* (according to the morphemic cut of our source—prefix before stem); *ki$_u$ma (159) > kihma *to come*; *ki$_u$(ʔi) (43) > kih- *biting* (a prefix); *ko$_u$ʔi ~ o (46b) > qoi *to kill more than one*; *ka$_s$ti (42) > qahti; *ka$_u$ma (87) > qahma *to taste*.

Medial *k > /hk hq/, the former between high vowels, the latter between low vowels: *pu$_n$ku (46) > puhku *dog, pet*; *na$_n$ka (47) > nahqa *ear*, *wo$_s$ko (142) > wohqo *ponderosa pine*; *ma$_s$ka (83) > mahqa *to give food or drink* (~ -ʔmaqa). The former has also been found flanked by high vowel, low vowel: *ti$_u$ka (163) > tihka *to eat*.

UA initial *k$^w$ > /k$^w$ q$^w$/, the former before high vowels, the latter before low vowels: *k$^w$i$_u$ta (54) > k$^w$ita; *k$^w$a$_u$si (51) > q$^w$aci *tail*, *k$^w$a$_u$si ~ i (50) > q$^w$ahsi *to be ripe*.

It is postulated by analogy, without supporting cognates that /hk$^w$/ and /hq$^w$/ are descended from medial *k$^w$.

UA initial *ʔ remains; medial *ʔ is lost: *ʔoho (61) > ʔoho *bone*; *ʔoha (62) > ʔoha *yellow*; *ʔawa (104) > ʔawa *horn*; *si(ʔi ~ a) (67) > sii *to urinate*; *ko$_u$ʔi ~ o (46b) > qoi.

Initial UA *s > s when initial in Mono, but /hs/ after prefixes (e.g. ʔihsono *my lungs*), while medial *s > /hs c/: *so$_s$no (166) > sono *lung*; *si (66) > si(hi) *guts*; *k$^w$a$_u$si ~ i (50) > q$^w$ahsi; *pu$_n$si (5) > puhsi *eye*; but *k$^w$a$_u$si (51) > q$^w$aci. (Conditions for the dual reflection of medial *s are not yet known.)

UA *h > /h/: *hi$_s$- (77) > hi(pi) *to drink*; *pahi (1) > pahi; *ʔoho (61) > ʔoho; *ʔoha (62) > ʔoha.

The UA nasals */m n/ remain initially in Mono: *ma (128) > ma(ya) *hand*; *mu$_s$pi (15) > mupi; *no- (96) > no(yo) *egg*; *na$_n$ka (47) > nahqa.



Initial /m/ is replaced in alternation by /w/ or /hm/ after a prefix: ʔiwupi *my nose*, ʔihmupi *your nose*.

Medial UA *m is doubly reflected in Mono—by /w/ after *V$_s$, and by /hm/ after *V$_u$: *ta$_s$ma (29) > tawa; *ka$_u$ma (87) > qahma.

Medial *n remains /n/ in *so$_s$no (166) > sono, but is lost in *ti$_u$ni (19) > ti(hpih) *mouth*.

UA *ŋ > /hm/: *ʔo$_s$ŋa (63) > ʔohma *salt*.

The UA lateral *l > /n/: *wili (161) > winih *to stand*.

UA *w > /w/: *wo$_s$ko (142) > wohqo; *ʔawa (104) > ʔawa.

UA *y > /y ʔ/: *yi$_u$ʔi (168) > yi(hk$^w$i) *to swallow*; *miya (158) > ta-miʔa *moon*.

Most UA vowels remain without change in Mono.

*i > /i/: *k$^w$i$_u$ta (54) > k$^w$ita; *ci- (164) > cih-; *si$_u$(ʔi ~ a) (67) > sii; *hi$_s$- (77) > hi(pi); *pahi (1) > pahi.

*i > /i/: *ni$_s$pa (160) > nipa; *ti$_u$ka (163) > tihka; *ka$_s$ti (42) > qahti; *k$^w$a$_u$si ~ i (50) > q$^w$ahsi.

*u > /u/: *mu$_s$pi (15) > mupi; *ku (137) > kuh-; *pu$_n$ku (46) > puhku; *pu$_n$si (5) > puhsi. In the following example, if it is really descended from UA, *u > /o/: *tuki ~ a (144) > toqa *night*.

*o > /o/: *po (4) > po(yo): *co(ni) (38) > coh-; *ko$_u$ʔi ~ o (46b) > qoi; *wo$_s$ko (142) > wohqo; *ʔoho (61) > ʔoho; *so$_s$no (166) > sono.

*a > /a/: *pa (123) > pa(ya); *ta$_s$ma (29) > tawa; *na$_n$ka (47) > nahqa; *ʔoha (62) > ʔoha; *ʔawa (104) > ʔawa; *ki$_u$ma (159) > kihma. One example has been found in which final *a > /u/: *ku$_s$ta (154) > kuhtu.

## Luiseño

The UA stops */p t k ʔ/—those without off-glide—are multiply reflected in Luiseño. Stops with off-glide—*/c k$^w$/—are singly reflected.

UA *p > /p/ initially, but /v/ medially after all *V$_s$ and after one *V$_u$; *p > /p/ after two *V$_u$: *pahi (1) > pa·hi *three*; *po (4) > pe-t *road*; *pa (123) > pa·-la *water*; *pu$_n$si (5) > pu·š-la *eye*; *pi$_s$pa (12) > pi·va-t *tobacco*; *mu$_s$pi (15) > muvi-l *nose*; *na$_s$pi (16) > na·vo-t *prickly-pear cactus*; *si$_u$(pi) (11) > šovó·(ya) *to be cold*; *ku$_u$p(i) (153) > kup *to sleep*; *ti$_u$pa (169) > to·pa-l *mortar* (cp. Papago čippa *mortar*; čiip-id-akuḍ *mano*).

UA *t > /t/ initially, /l/ medially: *ta$_s$ma (29) > tamá- *tooth*; *ta- (125) > -ta(ʔ) *sinew*; *tu$_s$ki ~ a (144) > tuq-vo ~ tuk-va *night*; *tiwa (21) > to·w *to see*; *su$_u$tu (26) > šul(á-t) *claw, nail*; *ka$_s$ti (42) > qalo- ~ qal *to be*.

UA *c > /č/: *ci$_s$pu (13) > čivu-t ~ či·v *to be bitter*.

UA *k > /k q/ initially—/k/ before *V$^{high}$, /q/ before *V$^{low}$: *ki (44) > kí·-ča *house*; *ki$_u$(ʔi) (43) > ko?y(qa) *to bite*; *kuŋa (97) > -kuŋ *husband*; *ka (136) > qa(y) *no, not*; *kasi (41) > -qa·ši *thigh*; *ko$_u$ʔi ~ o (45b) > qe? ~ qeʔé *to kill a few*.

UA *k > /q/ medially following nasalizing *a$_n$ in *na$_n$ka (47) > -naq *ear*; after other *a, *k > /x/: *ha(ki) (138) > hax *who*; *taka (146) > ata·x-am *people*; *waki (99) > wax(aq) *to become dry*; *ma$_s$ka (83) > (na)mxa *to give*.

UA *k > /k q/ medially in *tu$_s$ki ~ a (144) > tuq-vo ~ tuk-va.

UA *kʷ > /kʷ/: *kʷa(ʔa) (48) > kʷaʔ *eat*; *kʷa$_u$si ~ i (50) > kʷašó(ʔax) *ripe, cooked.*

*ʔ > zero initially, /ʔ/ medially: *ʔo$_s$ŋa (63) > eŋ-la *salt*; *ʔasi (139) > aš ~ a·š *to bathe*; *na$_u$ʔa (95b) > naʔ *to burn*; *si$_u$(ʔi ~ a) > ši·ʔi-š *urine*; *yɨʔi (106) > -yoʔo(p) *mother.*

Both the UA fricatives */s h/ are singly reflected in Luiseño.

UA *s > /š/: *sula (98) > šun-la *heart*; *su (71) > šu·-la *star*; *pu$_n$si (5) > pu·š-la; *kasi (41) > -qa·ši.

UA *h > /h/: *ha(ki) (138) > hax; *hu (78) > hu·-la *arrow*; *pahi (1) > pa·hi.

All UA nasals remain unchanged in Luiseño:

UA *m > /m/: *mu$_s$pi (15) > muvi-l; *ma (128) > ma-t *hand*; *ta$_s$ma (29) > tamá-.

UA *n > /n/: *na$_s$pɨ (16) > na·vo-t; *na$_n$ka (47) > -naq.

UA *ŋ > /ŋ/: *kuŋa (97) > -kuŋ; *ʔo$_s$ŋa (63) > eŋ-la.

The UA lateral *l is attested for Luiseño in medial position only.

UA *l > /n/: *sula (98) > šun-la; *sala (147) > ša·na-t *tar.*

The UA glides */w y/ remain in Luiseño.

UA *w > /w/: *wa$_s$ʔ ɨ ~ i (163) > wa·ʔiš *meat*, waʔya ~ wa·ʔaw *to roast meat*; *wo- (103) > we·(x) ~ we(ʔ) *two*; *wi- (102) > -wi·(ʔ) *fat*; *tɨwa (21) > to·w.

UA *y > /y/: *yɨʔɨ (106) > -yoʔo(p); *mɨya (158) > mo·y-la *moon.*

Vowels in initial syllables of UA words are positively reflected; in final syllables, some are positively reflected and some are lost.

Positive reflexes are exemplified first below, then zero reflexes follow.

The three vowels */i u a/ remain; *o is reflected by a front unrounded vowel /e/, *ɨ by a back rounded vowel /o/.

*i > /i/: *pi$_s$pa (12) > pi·va-t; *ci$_s$pu (13) > či·v; *ki (44) > kí·-ča; *si$_u$-(ʔi ~ a) > ši·ʔi-š; *kasi (41) > -qa·ši.

*u > /u/: *pu$_n$si (5) > pu·š-la; *mu$_s$pi (15) > muvi-l; *kuŋa (97) > -kuŋ; *su (71) > šu·-la.

*a > /a/: *pahi (1) > pa·hi; *pa (123) > pa·-la; *ta$_s$ma (29) > tamá-; *pi$_s$pa (12) > pi·va-t.

*o > /e/: *po (4) > pe-t; *ko$_u$ʔo (45b) > qeʔe; *ʔo$_s$ŋa (63) > eŋ-la; *wo-(103) > we·(x).

*ɨ > /o/: *tɨwa (21) > to·w; *kɨ$_u$(ʔi) (43) > koʔy(qa); *yɨʔɨ (106) > -yoʔo(p); *mɨya (159) > mo·y-la; *na$_s$pɨ (16) > na·vo-t; *si$_u$(pɨ) (11) > šovó·(ya); *kʷa$_u$si ~ i (50) > kʷašó(ʔax).

*i > zero: *pu$_n$si (5) > pu·š-la; *waki (99) > wax(aq); *ʔasi (189) > aš; *ha(ki) (138) > hax.

*u > zero: *su$_u$tu (26) > šul(á-t); *ci$_s$pu (13) > či·v.

*a > zero: *tɨwa (21) > to·w; *kuŋa (97) > -kuŋ; *na$_n$ka (47) > -naq; *sula (98) > šun-la; *mɨya (158) > mo·y-la.

*o > zero: *ko$_u$ʔo (45b) > qeʔ (but ~ qeʔé).

*ɨ > zero: *ka$_s$tɨ (42) > qal (but ~ qalo-).



## Yaqui-Mayo

All UA stops are singly reflected in Yaqui-Mayo except *p which is doubly reflected under conditions which are not yet apparent.

Under certain morphophonemic conditions involving stress and length alternation, medial consonants are doubled (geminated).

UA *p > /p/ in *pu$_n$si (5) > puúsi *eye*, and in *pi (6) > píppi-m *breasts.*

UA *p > /v/ (or geminated /vv/) in all other known cognates: *pahi (1) > váhi *three*; *pa (123) > va(ʔá-m) *water*; *pa$_s$ki (2) > vakí(m-) *to enter*; *pi$_u$ti (3) > vétte *heavy*; *pi$_s$pa (12) > viíva *tobacco*; *po (4) > voó(ʔo) *road*; *pusa (74) > vúsa *to wake*; *si$_u$(pɨ) (11) > sévve ~ seéve *cold*; *poʔi ~ o (130) > vóʔo- *to be lying down.*

UA *t > /t/ (or geminated /tt/): *tɨ$_u$ni (19) > teéni *mouth*; *tɨ$_s$ka (18) > teéka *to spread it out*; *tu$_s$ki ~ a (144) > tuka-; *ta$_s$ma (29) > támm(i-m) *teeth*; *toŋo (30) > tónno *knee*; *to$_u$sa (31) > tosá-i *white*; *su$_u$tu (26) > súttu *fingernail.*

UA *c > /č/ (or geminated /čč/): *co(ni) (38) > čoóni-m *hair*; *kʷi$_s$ci (35) > pʷičí(a) ~ pʷiččí(a) *smoke*; *ko$_s$ci ~ o (34) > kóče *to sleep*; *ʔaci ~ a (39) > ʔáče *to laugh.*

UA *k > /k/ (or geminated /kk/): *ka$_s$tɨ (42) > káte-k *to be there, sit, live*; *kɨ$_u$(ʔi ~ ɨ) (43) > keʔé *to bite*; *kuŋa (97) > kuúna *husband*; *ku$_s$ta (154) > kutá(naa) *neck*; *kahi ~ a (126) > hí-kahi *to hear something*; *ka (136) > kaá *not*; *tɨ$_s$ka (18) > teéka; *na$_n$ka (48) > nákka *ear*; *ma$_s$ka (83) > mak- *to give*; *mu$_u$ki ~ u (86) > muúke *to die, sg.*, *yuku (109) > yúku *to rain.*

UA *kʷ > /pʷ/: *kʷa(ʔa) (48) > -pʷa *to eat*; *kʷa$_u$si (51) > pʷássi(a) *tail*; *kʷɨ$_s$(sɨ)(52) > pʷis- *to take, catch*; *kʷi$_u$ta (54) > pʷítta *excrement*; *kʷi$_s$ci (35) > pʷičí(a).

UA *ʔ > /ʔ/: *ʔaci ~ a (39) > ʔáče; *ʔi (116) > ʔií *this*; *ʔawa (104) > ʔáaʔa *horn.*

Both UA fricatives remain in Yaqui-Mayo.

UA *s > /s/: *sawa (64) > sáwwa *leaf*; *si- (65) > seé(nu) *one*; *si$_u$(ʔi ~ a) > síʔi- *to urinate*; *simi ~ a (69) > siim- *to go, sg.*; *to$_u$sa (31) > tosá-i.

UA *h > /h/: *yahi$_s$(pa) (82) > yahi- *to arrive, pl.*; *pahi (1) > váhi; *tahi (150) > táhi *fire*; *tɨha (80) > téha-m *hail*; *ha(ki) (138) > há(vve) *who*; *hi$_s$- (77) > hi(ʔi-) ~ he(ʔé) *to drink*; *hu$_s$pi (79) > huví.

The nasal *m remains in Yaqui-Mayo; */n ŋ/ merge into /n/.

UA *m > /m/ (or geminated /mm/): *ma (128) > mámma *hand*; *ma$_s$ka (83) > mak-; *mala (84) > mára *daughter*; *miʔa (85) > méʔa *to kill*; *ku$_u$mi ~ a (88) > kuúme *to munch.*

UA */n ŋ/ > /n/ (or geminated /nn/): *na$_n$ka (48) > nákka; *ni(ʔi) (90) > neʔé *to fly*; *tɨ$_u$ni (19) > teéni; *ŋa- (151) > naá(wa) *root*; *kuŋa (97) > kuúna; *toŋo (30) > tónno.

The UA lateral is doubly reflected in Yaqui-Mayo: *l > /n/ initially, /r/ medially: *liŋi (94) > nínni *tongue*; *mala (84) > mára; *kali (141)< kári *house.*

Of the UA glides, the laminal *y is singly reflected, but the bilabial *w, like bilabial *p, is doubly reflected under conditions which are not yet apparent.

UA *y > /y/: *yaca (40) > yéča *to put*; *ya$_s$ka (110) > yékka *nose*; *k$^w$iya (112) > p$^w$íya *earth*.

UA *w > /w/ initially, but zero or /ww/ medially: *wi$_s$ci (101) > wéče *to fall*; *wo- (103) > woó(yi) *two*; *?awa (104) > ?áa?a; *ti$_n$wa (20) > téa *name*; *sawa (64) > sáwwa.

Reflexes of UA vowels are more regular and more reliable when descended from vowels in the first syllable of UA words than from vowels in final syllables. The latter are cited here when regular:

UA *i > /i/: *pi$_s$pa (12) > viíva; *k$^w$i$_u$ta (54) > p$^w$ítta; *?i (116) > ?íi; *hi$_s$- (77) > hi(?i-) (but ~ he?é); *pu$_n$si (5) > puúsi; *pahi (1) > váhi; *tahi (150) > táhi; *ti$_u$ni (19) > teéni; *co(ni) (38) > čoóni-m; hu$_s$pi (78) > huví.

UA *i > /e/ in some final syllables; further cognate data might well show that this reflection is regular enough, but conditioned by the preceding consonant: *ko$_s$ci ~ o (34) > kóče; *?aci ~ a (39) > ?áče; *mu$_u$ki (86) > muúke; *ku$_u$mi ~ a (88) > kuúme.

UA *i > /e i/, of the reflecting vowels, /i/ is found in two cognates, /e/ in all others: *ti$_u$ni (19) > teéni; *pi$_u$ti (3) > vétte; *si$_u$(pi) (11) > sévve ~ seéve; *si- (65) > seé(nu); *tiha (80) > téha-m; *mi?a (85) > mé?a; *wi$_s$ci (101) > wéče; *liŋi (94) > nínni; *k$^w$i$_s$(si) > p$^w$is-.

UA *u > /u/: *pu$_n$si (5) > puúsi; *pusa (74) > vúsa; *su$_u$tu (26) > súttu; *yuku (109) > yúku.

UA *o > /o/: *po (4) > voó(?o); *to$_u$sa (31) > tosá-; *toŋo (30) > tónno; *co(ni) (38) > čoóni-m; *wo- (103) > woó(yi).

UA *a > /e/ after initial *y; otherwise *a > /a/: *ya$_n$sa (76) > yes- *to sit*; *yaca (40) > yéča; *ya$_s$ka (110) > yékka; *pa (123) > va(?á-m); *pa$_s$ki (2) > vakí(m-); *ka (136) > kaá; *mala (84) > mára; *na$_n$ka (48) > nákka; *kuŋa (97) > kuúna; *ti$_s$ka (18) > teéka.

**2.3.** Of the 171 cognates used in this study to exemplify phonological developments from the reconstructed Proto UA language to the daughter languages, 156 occur in Papago. Of these, 94 are shared by Hopi, 92 are shared by Tarahumara, 82 are shared by Huichol, 71 by Southern Paiute, 68 by Tübatulabal, 64 by Yaqui-Mayo, 56 by Zacapoaxtla, and 48 by Luiseño.

Of the 171 cognates, 103 occur in Hopi. Of these 103, 59 are shared by Tübatulabal, 59 are shared by Tarahumara, 57 by Southern Paiute, 54 by Huichol, 45 by Yaqui-Mayo, 42 by Luiseño, and 41 by Zacapoaxtla.

Of the 171 cognates, 84 occur in Huichol. Of these 84, 61 are shared by Tarahumara, 45 are shared by Yaqui-Mayo, 42 by Tübatulabal, 40 by Southern Paiute, 36 by Zacapoaxtla, and 32 by Luiseño.

Of the 171 cognates, 97 occur in Tarahumara. Of these 97, 50 are shared by Yaqui-Mayo, 46 are shared by Southern Paiute, 45 by Tübatulabal, 38 by Zacapoaxtla, and 27 by Luiseño.

Of the 171 cognates, 60 occur in Zacapoaxtla. Of these 60, 37 are shared by Southern Paiute, 34 by Yaqui-Mayo, 33 by Tübatulabal, and 24 by Luiseño.



Of the 171 cognates, 84 occur in Southern Paiute. Of these 84, 51 are shared by Tübatulabal, 36 by Yaqui-Mayo, and 30 by Luiseño.

Of the 171 cognates, 79 occur in Tübatulabal. Of these 79, 39 are shared by Yaqui-Mayo and 36 by Luiseño.

Of the 171 cognates 67 occur in Yaqui-Mayo and 51 occur in Luiseño. 28 of these are shared by these two languages.

The preceding information may be stated in tabular arrangement as follows:

| Shared Cognates | Hopi | Huichol | Tarahumara | Zacapoaxtla | Southern Paiute | Tübatulabal | Luiseño | Yaqui-Mayo |
|---|---|---|---|---|---|---|---|---|
| Papago | 94 | 82 | 92 | 56 | 71 | 68 | 48 | 64 |
| Hopi | | 54 | 59 | 41 | 57 | 59 | 42 | 45 |
| Huichol | | | 61 | 36 | 40 | 42 | 32 | 45 |
| Tarahumara | | | | 38 | 46 | 45 | 27 | 50 |
| Zacapoaxtla | | | | | 37 | 33 | 24 | 34 |
| Southern Paiute | | | | | | 51 | 30 | 36 |
| Tübatulabal | | | | | | | 36 | 39 |
| Luiseño | | | | | | | | 28 |

It is our intention to provide an annotated bibliography whose scope will extend from descriptive work on Uto-Aztecan languages to papers devoted to comparative linguistics in UA. When annotating, however, we do not confine our comment to phonology but give equal attention to the rest of grammar; and we hope to have something systematic to say about cultural domains covered in dictionaries on Uto-Aztecan languages. An annotated bibliography of this extended scope would seem more useful if appended to a subsequent part of this monograph—a part concerned with morphology and syntax.

For the narrow scope of Part I, we content ourselves with giving an abbreviated bibliography of sources actually used so far, arranged in the order in which languages are presented in Chapter 2. In our use of these sources we have—without separate specific mention—made isomorphic substitutions in orthography, in order to obtain uniformity for our study as a whole; but whenever we deviated from the phonemic distinctions given in our source, we stipulated (mostly in Chapter 1) that the phonemicization was ours rather than that given in the source.

### Papago

Kenneth Hale's unpublished manuscripts, including Ph.D. dissertation, field notes, and morpheme file (ca. 1500 items). This source was used exclusively whenever Papago was cited: both in discussions of its reflection of the phonemes

of the parent language and in making the cognate counts. In the case of the cognate count, certain obviously non-aboriginal domains (e.g. Catholic Church, Cattle Raising, Introduced Technology) were excluded from consideration since vocabularies in other UA languages, with other cultural experiences, would require special study, beyond our present scope, to control comparability.

### Hopi

C. F. and F. M. Voegelin's Hopi Domains, IUPAL 14, a memoir of IJAL volume 23 (1957). As for Papago, only a single source was used for Hopi in the phonological part of this monograph. There are approximately 1500 morphemes in Hopi Domains and virtually every one has been considered to see if it had a cognate elsewhere in Uto-Aztecan. In making cognate counts between Hopi and other UA languages, certain domains were excluded, especially those dealing with Pueblo culture—a culture not generally shared by speakers of other UA languages. Among the less shared domains are Dress, Adornment, Religion, parts of domains closely associated with Topography, Animals and Plants peculiar to the mesas, and certain economic activities closely associated with Pueblo culture. Hopi particles were excluded from consideration in making cognate counts, as were particles in other languages. Also in making counts, compounds were excluded if one or another or both of their members had already been entered in the cognate count (thus pá·hi is said to be cognate with Southern Paiute páa *water*; after counting this once, all compounds with pá·- in them were skipped). This procedure, also, applies not only to Hopi, but also to other languages involved in our cognate counting.

### Huichol

J. B. McIntosh's and J. Grimes's Vocabulario Huichol-Castellano, 1954. This vocabulary contains some 1500 entries; the number of morphemes would, however, be somewhat less than this, since morphemes are repeated in different entries. This is the only source that we used for Huichol; it was better than our Cora source since it gave us clearer indication of morpheme boundaries.

### Cora

A. and M. A. McMahon's Vocabulario Cora, 1959; and also K. T. Preuss, Worterbuch Deutsch Cora, IJAL 8.81–102 (1934).

We used the first source in citing actual forms, but had used the second source earlier to establish sound correspondences. The first source was used exclusively in making cognate counts; it contains some 2000 entries. Since it is difficult to find morpheme boundaries in many of the forms (especially in verbs), many of the possible forms had to be excluded from comparisons.

### Tarahumara

K. Simon Hilton's Vocabulario Tarahumara (1959); and also David Brambila's Gramatica Raramuri, Editorial Buena Presa (1953). Our citations are from the first source except where a particular form could be found only in Brambila.



Before the publication of the first source, Brambila was used to set up tentative sound correspondences. Hilton's vocabulary alone was used in making cognate counts; it contains some 1600 entries.

### Zacapoaxtla Nahuat

H. and M. R. Key's Vocabulario Mexicano de la Sierra de Zacapoaxtla, Puebla (1953) was used both in establishing sound correspondences and in making cognate counts. It contains some 3627 entries, but the number of different morphemes is much less, since many verbs are listed at least twice (e.g. once with one prefix, as ki- *3 sg. goal*, and again with another prefix, as mo- *reflexive*).

### Pochutla

Franz Boas' El Dialecto de Pochutla, Oaxaca, IJAL 1.9–44 (1917) was used to set up tentative sound correspondences that distinguish Pochutla as divergent Aztec. The data were too limited to give full treatment, but what data there were seemed reliable enough to permit a partial treatment.

### Nahuatl

Kenneth Croft's Matlapa Nahuatl II and III, IJAL 19.274–280 (1953) and 20.37–43 (1954); and also R. S. Pittman's A Grammar of Tetelcingo (Morelos) Nahuatl, Language Dissertation 50, Supplement to Language volume 30 (1954); and also B. L. Whorf's The Milpa Alta Dialect of Aztec, Linguistic Structures of Native America, VFPA 6.367–497 (1946). All three of these sources were used to find examples for Nahuatl reflection of UA phonemes.

### Tübatulabal

C. F. Voegelin's Tübatulabal Grammar, UCPAAE 34 (1935), and Tübatulabal Texts, UCPAAE 34 (1935), and Working Dictionary of Tübatulabal, IJAL 24.221–228 (1958). A few of our Tübatulabal citations are from the Grammar, but most are from the Dictionary. The Dictionary alone was used in making cognate counts—it contains nearly 1000 entries. Vocabulary items in domains which are peculiar to California, as acorn harvesting and preparation, were excluded from comparisons.

### Southern Paiute

Edward Sapir's Southern Paiute, PAAAS 65.1–296 and 537–730 (1930–31), and F. M. Voegelin's unpublished manuscripts (texts and field notes), and Vivian Jake's transcriptions of her native language. All three sources were used in establishing sound correspondences. In making cognate counts between Southern Paiute and Comanche and Papago and Hopi, Sapir's dictionary (1300 main entries) was used. For counts between Southern Paiute and Mono and Nahuatl, our more recent sources were used.

### Comanche

Joseph B. Casagrande's unpublished manuscripts, as well as his Comanche Linguistic Acculturation I, II, III: IJAL 20.140–51, 217–37; 21.8–25 (1955, 1956);

and also Elliott D. Canonge's Comanche Texts, University of Oklahoma (1958). In establishing sound correspondences, both sources were used. Our citations are mostly from Canonge; when needed forms could not be found there, they were often found in Casagrande's unpublished manuscripts. One cognate count was made between Southern Paiute and Comanche. The source for this was the dictionary appended to Canonge's texts (some 1100 entries). This dictionary is necessarily restricted, since it includes only forms excerpted from the texts. Many morphemes are repeated often, either as alternants or with different affixes.

### Mono

Sidney M. Lamb's unpublished manuscript, Grammar of Mono; and also Sheldon Klein's Comparative Mono-Kawaiisu, IJAL 25.233–38 (1959). The first source was used in establishing sound correspondences; the second source provided a few additional examples. We used only the first source in making the cognate count between Mono and Southern Paiute.

### Bannock

Sven Liljeblad's unpublished manuscripts, as well as his Bannock Phonemes, IJAL 16.126–31 (1950).

### Luiseño

A. L. Kroeber's and George William Grace's The Sparkman Grammar of Luiseño, UCPL 16 (1960). This was the only source that we had for Luiseño; we used it both for the cognate counts and for sound correspondences.

### Cahuilla

Hansjakob Seiler's unpublished manuscripts, as well as his Zur Aufstellung der Wortklassen des Cahuilla, Münchener Studien zur Sprachwissenschaft, 12.61–79 (1958), as well as his Die Phonetischen Grundlagen der Vokalphoneme des Cahuilla, Zeitschrift für Phonetik, 10.204–23 (1957) yielded enough cognate material to show how Cahuilla reflects certain UA phonemes.

### Yaqui-Mayo

Gerd Fraenkel's unpublished field notes, as well as his Yaqui Phonemics AL 1.5.7–18 (1959) yielded enough cognate data to show Yaqui-Mayo reflection of UA phonemes.

## CHAPTER 3

## INTERPHONEMIC SPECIFICATIONS



**3.0.** What is covered by the more common term 'morphophonemics' is partly included in our cover-term 'interphonemic specifications'. Since there are two or three technically competing scopes to which 'morphophonemics' applies, it is tempting to restrict oneself to one or another of them as that of the single scope, or that of the double scope; in the latter automatic morphophonemics is treated with phonology while non-automatic morphophonemics is treated with morphology. Our cover-term 'interphonemic specifications' permits us to present somewhat less or somewhat more than is implied in any one of the competing usages of 'morphophonemics'—less, for example, when our UA sources are insufficient for a really adequate morphophonemic statement; and more, for example, when we include phonemic data which extend beyond the range of our typological treatment in Chapter 1: e.g. when we include canonical forms and consonant cluster problems in interphonemic specifications.

Our sources are least adequate for fully outlining morpheme alternates determined by phonemic environments, more or less exclusively. Nevertheless we give such information when it is available to us, as in the second statement or restatement of Tübatulabal phonology (listed in our sources in **2.3**).

The reason why we cannot be exhaustive in this respect is that our UA sources characteristically follow the single scope order of treatment: sounds (phonetics, and later phonemics) before morphology, but including in the latter morpheme alternates, whether automatic or not; if not—if apparently not automatic—alternates applicable to particular morphemes are listed, as in the first statement of Tübatulabal phonology (cited in our sources, **2.3**). The difficulty here is not so much that our UA sources fail to keep apart the two kinds of morpheme alternates, as that the distinction itself is largely a matter of definition or strategy in structuralizing. Those who describe UA languages do not often draw a sharp line between automatic and non-automatic morphophonemics, since many morpheme alternants are automatically determined (by phonological environment), but not wholly so (e.g. restricted to the verb class of stems, and yet statable in terms of phonological environment within that restriction). Hence in one description, morpheme alternants may be listed as applicable to subclasses of the verb class (i.e. as non-automatic); in another description of the same language, the morpheme alternants may be stated in terms of phonological environment (i.e. as an approximation to automatic morphophonemics within some particular morphological restriction).

The relevance of typology to structure is most apparent when alternative possibilities of structuralization present themselves. We do not quarrel with different strategies which permit structuralists to arrive at non-identical statements for the same language. But we do attempt to typologize two competing statements in such a way that one typological statement will satisfy either structural statement—e.g. a statement that says morphophonemics is not at all automatic, and one that says it is so, but not wholly so.

We have not yet done this for interphonemic specifications, but we have achieved some degree of unification of alternative phonemicizations by typologizing stop + SGC (e.g. prenasalization) as equivalent to consonant cluster (nasal + stop). In consequence—for UA languages, at least—it is possible to match most continuants against the linear distinctions made by stops, and obtain the same score for two or more alternative phonemicizations. The score in such matching is not affected by phonemicizing preference for multiple series of stops (generated by SGC) or for one series of stops (capable of appearing in consonant cluster, as after /h/ or /n/).

Since this is Part I (phonology) of a monograph which will be followed by subsequent part or parts (morpho-syntax), we give now interphonemic specifications which can be stated with minimum reference to morphology. But still, we cannot help anticipating Part II by mentioning in passing that there are alternants of vowel increments associated with preceding verb stem or with following transformative or *status quo* suffix. We do this however, without giving the devisive morphological criteria for such stems or affixes, since such criteria are to be treated in parts concerned with comparative morphology and syntax.

In order to obtain comparability, we begin with interphonemic specifications in Proto UA as a point of departure.

### Specification One

**3.1.** Vowels are progressively determining in one of three ways.

*$V_s$ is written when a vowel preceding a stop may suspend the stopness of the stop, and when preceding a nasal may suspend the nasal articulation, thereby possibly switching the consonant from one series to another without changing the linear distinction point of articulation (e.g. tight contact nasal *m is replaced in one daughter language by loose contact glide /w/ after *$V_s$). In Sapir's terminology, $V_s$ 'spirantizes'; but we use a more general term, since 'suspending' extends all the way from a replacement within the stop series (plosive stop by affricate stop) to a replacement of a consonant by zero (see below). In short, the symbol *$V_s$ marks not one effect but multiple effects.

*$V_n$ also has progressive phonological effects on a following consonant—but different effects than *$V_s$ has. We write *$V_n$ when a vowel precedes a consonant which is reflected either by change of the consonant, or by addition of a nasal in consonant cluster with the unchanged consonant.

*$V_u$ also has—in a differential sense—a progressive effect. We write *$V_u$ when there is ample evidence to show that a vowel has an 'unaltering' effect on a following consonant and, hence, a different effect than a vowel designated either



*$V_s$ or *$V_n$. It may well be asked: why add the subscript? What does *$V_u$ indicate that might not just as well be shown by *V? It indicates that there is sufficient evidence to show that an unaltering *$V_u$—rather than an altering *$V_s$ or *$V_n$—precedes a consonant; and it permits us to use the general symbol *V—or a particular vowel without subscript indication of progressive effect—when the phonological effect is environmentally precluded or is not relevant to the discussion, or when we are perforce non-committal for lack of data.

It is possible that in Proto UA times a differential effect of *$V_s$, *$V_n$ and *$V_u$ obtained across morpheme boundaries (or in some other way) as part of the morphophonemics in the parent language. But we cannot postulate such effects within a Proto UA morpheme and at the same time employ the usual reconstructive techniques for setting up Proto UA consonants. So far as the use of symbols is concerned, *$V_s$, *$V_n$, *$V_u$ are part of the reconstruction, and hence derived from comparisons (cognates) among the daughter languages.

And in addition, consonants in at least one of the daughter languages continue, more or less, to be affected by vowels which are progressively determining. Stated more generally, each of the daughter languages exhibits what may be called its own 'productive morphophonemics' which may include some progressive effect of vowels on consonants, but of course much else besides. Rather than give a morphophonemic inventory for each given language—as the phonemic inventories were given in **1.1**, above—we confine ourselves, in this and the following INTERPHONEMIC SPECIFICATIONS, to giving a general indication of the synchronically on-going productive morphophonemics that is relevant to the diachronic phonology under discussion.

The latter is our first concern—to show how *$V_s$, *$V_n$ and *$V_u$ in Proto UA effect following consonants in the daughter languages. This is done by retrieving and summarizing from the preceding section (**2.2**) the differential effects of the vowels in question; parenthetic numbers refer to cognates cited in **2.2**. Having done this, we add analogous instances of productive morphophonemics in the daughter languages.

*$V_s$ has the effect of zeroing UA *p in all the traditional Aztec languages. The following example is taken from Zacapoaxtla: *ci$_s$pu (13) > čiči·-k *bitter*. Two environments in which *p occurs other than *p after *$V_s$ are: *p after *$V_u$, where *p remains /p/ in Aztec languages (e.g. 10); and *p in UA initial position, where *p is lost in Aztec languages (e.g. 2).

UA *k after *$V_n$ appears in Aztec languages as /k/ (e.g. 47); cognates are lacking to test the effect in Aztec of *$V_n$ before *w or *s.

Cora-Huichol, Yaqui-Mayo, Tarahumara, Papago—and Mono—partially parallel the Aztec languages in showing the effect of *$V_u$ and *$V_n$ on following consonants: namely, no differential effect. Hence *$V_u$ and *$V_n$ are merged in respect to the languages listed here. But of course differential effects are shown by languages not included in this list (see below) and so justify the reconstruction of *$V_u$ and *$V_n$.

Most of the languages just listed show different changes for a given consonant

in three environments—*$V_s$ before consonant, *$V_u$ before consonant, no vowel before consonant—as will appear in the following summary. But Yaqui-Mayo (e.g. 11, 12, 48) and Tarahumara (e.g. 9, 13, 46) agree with each other in the effect of *$V_s$, *$V_n$ and *$V_u$ on following consonants: namely, no differential effect.

UA *p after *$V_s$ appears in Huichol as zero: *ci$_s$pu (13) > cii- *bitter*; but after *$V_u$, *p remains /p/ (e.g. 9); and after no vowel, i.e. initially, *p > /h/: pa$_s$ka (8) > háka *reed*.

Cora agrees with Huichol in two environments—*p after *$V_u$ and after no vowel (e.g. 8). Instead of zero, UA *p after *$V_s$ appears in Cora as /h/: *ci$_s$pu (13) > cíhi(vi) *bitter*. After *$V_u$, UA *p appears as /p$^w$/ before /a/—a regressive effect of Cora /a/ not found in Huichol (e.g. 9); but as in Huichol, *p appears as /p/ before other Cora vowels (e.g. 146).

UA *p after *$V_s$ and after no vowel (i.e. initially) appears in Papago as /w/: *pi$_s$pa (12) > wíw *tobacco*; but after *$V_u$, *p remains /p/ (e.g. 9).

UA *t remains /t/ in Mono after *$V_u$ (e.g. 54) and after no vowel (initially, e.g. 29). (So also *m after no vowel remains /m/ but not *m after *$V_u$.) According to our source, *t after *$V_s$ appears in Mono as /ht/: *ka$_s$ti (42) > qahti *to sit*; but, curiously enough, *m after *$V_u$ (rather than after *$V_s$) also appears preaspirated in Mono, /hm/: *ka$_u$ma (87) > qahma *to taste*. We conjecture that some Mono dialects favor inclusion, others exclusion of preaspiration in instances like this; though evidence for this is not cited by our source, parallels are plentiful in some other Shoshonean languages, as Hopi. If further evidence were to attest our conjecture, the correction would not extend to the statement that *$V_u$ and *$V_s$ merge in their effects on following consonants, since *m after *$V_s$ appears in Mono as /w/: *ta$_s$ma (29) > tawa *tooth*.

The parallelism exemplified above between the traditional Aztec languages and the traditional Sonoran languages—and Mono—amounts to merging—for lack of differential effect—of *$V_u$ and *$V_n$, at the very least; and at the most, to an extended merging which includes *$V_s$ with *$V_u$ and *$V_n$. This parallelism scarcely extends beyond the languages in the traditional Aztec and Sonoran branches. Languages in the traditional Shoshonean branch, Mono excepted, have their own parallelism, to wit: they distinguish among the progressive effects of all three Proto UA vowels marked by *$V_s$, *$V_n$ and *$V_u$, as already identified. And additionally they distinguish *$V^{high}$—i.e. the vowel set */i i u/—from *$V^{low}$—i.e. the vowel set */a o/—in terms of the effect of one set of vowels or the other on a preceding consonant; the latter is mentioned in passing here, but summarized in another interphonemic specification (**3.2**, below).

The distinctions mentioned do not all occur in all the Shoshonean languages. Thus, in terms of their effects, *$V_s$ and *$V_u$ are merged in Tübatulabal—their differential effect is in respect to *$V_n$ before consonants. UA *k after *$V_n$ appears as /$^n$h/ before /a/, and as /$^n$g/ before other Tübatulabal vowels: *na$_n$ka (47) > na$^n$ha-l *ear*, *pu$_n$ku (46) > pu$^n$gu(?)- *to domesticate him*. After *V other than *$V_n$, *k > /k/ or /g/ before *$V^{high}$; but before *$V^{low}$, *k > /h/ (e.g. 42, 43). So also, *s after *$V_n$ appears in Tübatulabal as /$^n$ẓ/ (*pu$_n$si (5) > pu$^n$ẓi-l *eye*), while after other *V and initially *s > /š/ (e.g. 52, 157). So also, *w > /ŋ$^w$/ after *$V_n$: *ti$_n$wa (20) > ?i$^n$diŋ$^w$a *to name* (initially reduplicated), while after other *V and initially, *w remains /w/ (e.g. 21).



Unlike the regressive effect of the high set and low set of vowels on Tübatulabal consonants, there is a flanking effect of *$V^{high}$ and *$V^{low}$ on Hopi consonants. UA *w remains /w/ when flanked by *$V^{high}$ and *$V^{low}$ (e.g. 21), but appears as /l/ when flanked by *$V^{low}$ vowels: *?awa (104) > ?á·la *horn*. As in Tübatulabal, *w > /ŋ$^w$/ after *$V_n$: *ti$_n$wa (20) > tíŋ$^w$a *to name*. In Hopi (but not in Tübatulabal), *$V_u$ and *$V_s$ have differential effects on following consonants. Thus, *p remains /p/ after *$V_u$ and after no vowel (initially, e.g. 9, 12); but after *$V_s$, *p appears as /v/ in Hopi: *pi$_s$pa (12) > pí·va *tobacco*.

So also in Luiseño, *$V_u$, *$V_s$ and *$V_n$ have differential effects on following consonants: *p remains /p/ after most *$V_u$ and after no vowel (always initially, e.g. 1, 153), but appears as /v/ after *$V_s$ in Luiseño (e.g. 12); and, reminiscent of Hopi morphophonemics (see below), also appears as /v/ in one instance after *$V_u$: *si$_u$(pi) (11) > šovó·(ya) *to be cold*. When *$V_n$ is *a$_n$ the following *k appears as /q/ in Luiseño: *na$_n$ka (47) > -naq *ear*; but after *V other than *$V_n$, *k appears as /x/: *taka (146) > ata·x-am *people* (initially reduplicated). This is sufficiently attested when *V is *a; when *V is a vowel other than *a, *k > /q/ ~ /k/ (e.g. 144), but the paucity of Luiseño examples leaves us in doubt here. The regressive effect of *$V^{high}$ versus *$V^{low}$ is not too suggestive here, since it has been noted only for initial *k which appears in Luiseño as /k/ before *$V^{high}$ but as /q/ before *$V^{low}$: *ki (44) > kí·-ča *house*, *ka (136) > qa(y) *no, not*.

Southern Paiute and Comanche have several parallel progressive changes in consonants after *$V_s$. Thus, after *$V_s$, *p > /v/ in both languages: *mu$_s$pi (15) > muví-v, múuvI, respectively, *nose*; *t > /r/ in both languages: *ka$_s$ti (42) > qári-, kári, respectively, *sit*; *c > zero in both languages: *k$^w$i$_s$ci (35) > k$^w$íí-p, k$^w$ii-, respectively, *smoke*.

In addition we have further evidence that for Southern Paiute after *$V_s$, *k > /x/: *pa$_s$ki (2) > paxí- *to walk*; *k$^w$ > /x$^w$/: *k$^w$i$_s$(si) > x$^w$ii, as in kumáx$^w$ii- *to take a husband*; *? > zero: *wa$_s$?i ~ i (162) > wai- *to roast*; *s > zero or /?/: *k$^w$i$_s$(si) (52) > k$^w$i?i- ~ k$^w$íí- *take*; *m > /ŋ$^w$/: *ta$_s$ma (29) > taŋ$^w$á-v *tooth*; *n > zero: *so$_s$no (166) > suú-vi *lung*; *ŋ > zero: *?o$_s$ŋa (63) > ?úa-v *salt*.

For Comanche, *s > /h/: *k$^w$i$_s$(si) (52) > k$^w$íhi- *to take, get*.

For Southern Paiute, we have cognates to show that after *$V_u$ and after no vowel (initially) stops remain as such or appear as such in consonant clusters after /x/: *p > /p/ or /xp/ (e.g. 1, 11); *t > /t/ or /xt/ or /č/ (before some vowels other than /i/, e.g. 3, 18, 143); *c > /č/ before all vowels other than /i/, but remains /c/ before *i (e.g. 27, 38, 164); *k > /q/ before *$V^{low}$ but remains /k/ before /*$V^{high}$ (e.g. 22, 163, 42, 43).

And other consonants in Proto UA remain in Southern Paiute: *? > /?/ (e.g. 43, 61); *s > /s/ (e.g. 31, 68); *m > /m/ (e.g. 15, 88); *n > /n/ (47, 167); *ŋ > /ŋ/ (e.g. 58—but with restriction to medial position in most languages, including Southern Paiute).

For Comanche *$V_s$ and *$V_n$ are merged as opposed to *$V_u$ before *k which remains /k/ after *$V_s$ and *$V_n$—and after no vowel—(e.g. 64, 66, 42), but appears as /hk/ after *$V_u$: *ti$_u$ka (e.g. 163) > tɨhka- *to eat.*

Other consonants in Proto UA remain in Comanche after *$V_u$ and after no vowel (initially) (cognates were not available for *p and *c after *$V_u$, but their reflexes after *$V_u$ are assumed by analogy to be the same as their initial reflexes); *p > /p/ (e.g. 1); *t > /t/ (e.g. 18, 54); *c > /c/ (e.g. 164); *s > /s/ (e.g. 68, 51).

After *$V_n$, Proto UA *s > /ʔ/ in Southern Paiute but is replaced by zero in Comanche: *pu$_n$si (5) > puʔí ~ puʔúy and púi-, respectively, *eye.* In addition, we have evidence for Southern Paiute that *k > /ŋk/ before *$V^{high}$: *pu$_n$ku (46) > púŋku-v *pet, domesticated animal*; and that *k > /ŋq/ before *$V^{low}$: *na$_n$ka (47) > náŋqa-v *ear.*

More traces of the diachronic phonology summarized under interphonemic specification one, above, are found to be still active in languages of the traditional Shoshonean branch than in languages of the Sonoran branch, with the possible exception of Papago. So few traces are found in Sonoran languages, in general—and none of the Aztec languages show productive effects—that these two traditional branches may be categorized for the most part as made up of 'little effect languages' in respect to their continuing morphophonemics.

The traces of still active morphophonemics of the type in question are found chiefly associated with reduplication; also frequently found are morpheme alternants of free form and compound member of the same morpheme; less frequently found are morpheme alternants of initial form and post-prefix form of the same morpheme.

In discussing initial reduplication, we label the reduplicated part the EXFIX, and the remaining part of the reduplicated stem, after the exfix, the THEMATIC PARTIAL. The latter may be identical with the unreduplicated stem; or the thematic partial may be reduced or otherwise changed in respect to the shape of the unreduplicated stem. Reduplication types in any given language, as well as among the UA languages, differ bidimensionally—by selection of the exfix; and by the morphophonemic effect of the exfix on the thematic partial as a whole. In this section, we now focus our attention on the second dimension, and within it, on the effect the exfix has on the first consonant in the thematic partial. Such effects are observable by comparing the thematic partial initial consonant with the initial consonant of the unreduplicated stem.

The first vowel of the unreduplicated stem is exfixed in Tübatulabal initial reduplication. The three differential effects of this exfix vowel are marked by the following morphophonemic formulae:

$V_n$ when the thematic partial stop after the exfix is combined with SGC of prenasalization and voicing;

$V_v$ when the thematic partial stop after the exfix is combined with SGC of voicing, but not of prenasalization;

$V_u$ when the thematic partial stop after the exfix is unaltered and so remains the same as the initial stop of the unreduplicated stem.



Thus, the exfix vowel is $V_n$ in ʔi$^n$gina·n (from unreduplicated stem kina·n *to bring it for him*); and in ʔa$^n$ẓami·n (from unreduplicated stem cami·n *to burn it*). The exfix vowel $V_n$ is always selected from unreduplicated stems with initial syllable having the following canonical shape: PLAIN STOP - VOWEL - NASAL CONSONANT; but $V_n$ is not the only possible selection. The exfix vowel $V_u$ may be selected from unreduplicated stems with initial syllable having this canonical shape, or with initial syllable having other canonical shapes. Thus, the exfix vowel is $V_u$ in ʔakami·ẓan (from unreduplicated stem kami·ẓan *to catch it for him*). But it is also $V_u$ in ʔiči·čwana·bi (from unreduplicated stem či·čwana·bi *to accompany him*); and in ʔicinini·ʔ (from unreduplicated stem cinini·ʔ *to shake it*). The examples above show that the exfix vowel $V_u$ is short always before thematic partial stop, but may be selected from unreduplicated stems having either a long or a short vowel in initial syllable. The following examples show that the exfix vowel $V_v$ is long rather than short before thematic partial stop; but $V_v$, like $V_u$, is selected from unreduplicated stems having either a long or a short vowel in initial syllable. Thus, $V_v$ in ʔa·dawi·gina·nala (from unreduplicated stem ta·wigi·nana·la *to go along causing him to see*); and in ʔi·bili·la (from unreduplicated stem pili·la *to arrive*). Neither $V_n$ nor $V_u$ are selected as exfix vowel from unreduplicated stems beginning with continuant rather than with stop; conversely stated, only $V_u$ is selected from continuant initial unreduplicated stems since, in reduplication, the initial continuant of the thematic partial after the exfix remains unchanged. But while $V_u$ is always short before thematic partial stop, $V_u$ may be either short or long before thematic partial continuant. Thus, $V_u$ is short in ʔiyilahola (from yilaho·la *to go along happily*), and in ʔiniba? (from niba? *to snow*); but long—though selected from short vowel in the first syllable of the unreduplicated stem—in ʔi·šiwgan- (from šiwgan *to comb his hair for him*); and also long—but selected from long vowel in the first syllable of the unreduplicated stem—in ʔu·lu·min (from lu·mi·n *to takeit off*), and in ʔi·mi·hli·n (from mi·hli·n *to hurt him*).

Alternations of vowel length are less frequently found in Luiseño than in Tübatulabal reduplication; and while the latter exfixes the first vowel of the stem, Luiseño exfixes the entire stem. It is still possible, however, to utilize the label 'exfix vowel' for Luiseño, if the last vowel of the exfixed stem—the vowel preceding the initial consonant in the thematic partial—is identified as the exfix vowel; this Luiseño exfix vowel is not always the same as the final vowel of the unreduplicated stem. The two differential effects of the exfix vowel in Luiseño are marked by two morphophonemic formulae:

$V_s$ when the stopness of the initial stop in the unreduplicated stem is suspended (replaced by fricative or lateral at the same linear distinction point) in the thematic partial after the exfix vowel;

$V_u$ when the thematic partial stop after the exfix vowel is unaltered, and so remains the same as the initial stop of the unreduplicated stem.

Our examples show that the first vowel of the unreduplicated stem may be lost in the thematic partial after the exfix vowel $V_u$, but retained after the exfix vowel $V_s$. Thus, /p/ is replaced by /v/ after $V_s$ in peči-veči *to drip hard* (from

unreduplicated peči *to drip*); and in pono-vóni *to tie them up* beside ponó·-voni *to tie them on* (from unreduplicated po·ni *to tie*); and in pi·ðiviði *to break a long thing to pieces* (from unreduplicated pi·ði *to break a long thing*); and in pe·ve *licked off corn gruel* (from unreduplicated pe(?) *to lick off corn gruel*). But /p/ remains /p/ after $V_u$ in paká-pka(š) (from unreduplicated paká(yi)). Though /t/ is replaced by /ð/ after $V_s$ in tiki-ðiki (from unreduplicated tiki *to light a fire*), and /t/ remains /t/ after $V_u$ in tupú-tpu(š) *thick* (from unreduplicated tupi(ki)), /t/ is also replaced by /l/ after $V_s$ in to·lo *borrowed* (from unreduplicated stem to·(?) *borrow*). The latter may reflect an older strata of reduplication (as opposed to the widespread stop replaced by fricative in later Luiseño), since UA medial *t descends regularly as /l/ in Luiseño (and also in Tübatulabal). Though /č/ is replaced by /ð/ after $V_s$ and remains /č/ after $V_u$, the latter is retained in thematic partial with increase in length of the following vowel rather than with decrease in length (with the decrease resulting in vowel loss in the preceding examples): čevi-ðévi *break to pieces, pull apart* (from unreduplicated čevi); čara-ča·ra(xat) *much torn* (from unreduplicated stem čari). Examples may also be cited in which /k$^w$/ is replaced by /x$^w$/, and /q/ by /x/—both after $V_s$: k$^w$a·x$^w$a *ate* (from unreduplicated k$^w$a(?) *eat*); qexe *killed a few* (from unreduplicated qe(?) *to kill a few*).

In Hopi there are two differential effects of the exfix vowel, marked by morphophonemic formulae:
$V_s$ when the exfix vowel suspends the stopness of the unreduplicated initial stop, replaced by fricative in the thematic partial after the exfix;
$V_u$ when the exfix vowel has an unaltering effect on the initial consonant in the thematic partial.
But Hopi reduplication morphophonemics is complicated by such free morpheme alternants as pó:voko beside pópko *dogs*; here one exfix vowel, $V_s$, is selected for the first alternant, but $V_u$ is selected for the second alternant, since the unreduplicated stem is pó·ko *dog, pet*; and the loss of vowel in the thematic partial after $V_u$ parallels Luiseño morphophonemics.

In Southern Paiute and other Shoshonean languages—especially those of the Plateau sub-branch—reduplication morphophonemics is similar (in respect to the effect of vowels on following consonant) to the effect of prefix vowel and first member of compound vowel on the following stem initial consonant (see below).

In Papago, reduplication morphophonemics show an influence of exfix vowel on the initial consonant of the thematic partial (with loss of first stem vowel parallel to Luiseño and Hopi)—but an influence that is the inverse of the Shoshonean parallel. In the latter, UA *p descends as a stop in stem initial, and is replaced by a continuant under the influence of the exfix vowel; but UA *p appears in Papago as /w/ in stem initial, and is restored, so to speak, to the stop from which it descended under the influence of the exfix vowel. Thus, the reduplicated form of Papago wóo(g) *road* is wópo(g) *roads* (with thematic initial consonant /p/ after exfix wó-); the reduplicated form of wúhì *eye* is wúupuì *eyes* (with first syllable of the unreduplicated stem lengthened in exfix wúu-, and with thematic partial replacing initial /w/ by /p/ and also showing loss of /h/);



the reduplicated form of wíin$^y$ *to suck on it* is wíipin *to suck on it momentaneously* (with thematic partial replacing /w/ by /p/, long vowel by short vowel, and final /n$^y$/ by /n/). The following examples show, in addition to restoration of stop, loss of unreduplicated stem vowel in thematic partial: wíipč from unreduplicated wíič *heavy*), wáapkì (from unreduplicated wáakì *to enter*).

Other languages in the traditional Sonoran branch are categorized as 'little effect languages' in respect to the progressive effect of exfix vowel on initial consonant of the thematic partial. Tarahumara pairs such as upí *wife*, hubi *wives* may possibly be analyzed in terms of initial reduplication; but even slight traces of progressive vowel influence seem to be lacking in Cora-Huichol, Yaqui-Mayo, and the traditional Aztec languages.

Three progressive effects of Southern Paiute prefix vowel, or first member of compound vowel, on stem initial vowel are marked by the following morphophonemic formulae:
$V_s$ when the stem initial stop is spirantized;
$V_n$ when the stem initial stop is preceded by homorganic nasal;
$V_u$ when the stem initial consonant is unaltered.
Thus, stem initial /p/ is replaced by /v/ after $V_s$: púŋku *pet*, sarii-vuŋku-ni *my dog* (*dog-pet-my*); /t/ by /r/ after $V_s$: tiqa- *to eat*, piŋqá-riqa- *to keep on eating*; /k/ by /x/ after $V_s$: qari- *to sit*, áa-xari- *to sit hidden from view*; /k$^w$/ by /x$^w$/ after $V_s$: k$^w$ii- *to take*, kumá-x$^w$ii- *to take a husband*. Differentially, stem initial /p/ is replaced by /mp/ after $V_n$: púŋku *pet*, kučú-mpuŋku-ni *my cow* (*buffalo-pet-my*); /t/ by /nt/ after $V_n$: tiqa- *to eat*, tii-ntiqa- *to eat well* (*intensively*), *enjoy meal*; /k/ by /ŋk/ after $V_n$: kura- *neck*, kučú-ŋkura-v *Buffalo Neck* (man's name); /q/ by /ŋq/ after $V_n$: qáani *house*, kučú-ŋqaani *barn* (*buffalo house*). And again, differentially, not only stops but continuants remain after $V_u$.

Without citing examples, we may say that, similarly for Comanche, after prefixes with $V_s$, /p/ is replaced by /v/, /t/ by /r/; and that after prefixes with V other than $V_s$, /p/ and /t/ remain or appear in cluster after /h/. After some prefixes other stops, both nasals, and /s/ remain, and after other prefixes they appear in cluster after /h/.

In modern Mono morphophonemics initial /m/ is replaced by /w/ after $V_s$: mupi *nose*, ?iwupi *my nose*.

### Specification Two

**3.2.** Vowels that are regressively determining in diachronic phonology and in still active morphophonemics are treated below in paired sets: *V(non-i) *vs* *i, *$V^{high}$ *vs* *$V^{low}$, *V(non-a) *vs* *a, *V(non-o) *vs* *o.

#### *V(non-i) *vs* *i

*V(non-i)—that is, any one vowel in the set */i u a o/—is said to be opposed to *i when a preceding Proto UA consonant is dually reflected in a daughter language, with the reflexes depending on which of the two vowel possibilities follows the consonant. Thus, *koci (34) appears in Zacapoaxtla as koči *to sleep* (*c before *i appears as /č/, but *c before *V(non-i) remains /c/: e.g. 37). And

*si$_s$ku (68) appears in Zacapoaxtla as -ši·k *navel* (*s before *i appears as /š/, but *s before *V(non-i) remains /s/: e.g. 65). The differential effect of *V(non-i) *vs* *i on the preceding consonant is restricted in the traditional Aztec languages to reflexes of */c s/, as exemplified here for Zacapoaxtla.

The differential effect of *V(non-i) *vs* *i—and a slight variant of this opposition—is found in some Sonoran languages (Papago, Tarahumara and Cora). Other Sonoran languages (Huichol, Yaqui-Mayo) are characterized as 'no effect' languages in respect to *V(non-i) *vs* *i. Not only do sub-branches in the traditional Sonoran branch differ in that some do and some do not show differential effects in consonants before these vowels, but even within a given sub-branch, as Cora-Huichol, one language may show the differential effect (Cora), the other may not (Huichol).

Thus, *ci?i (33) appears in Papago as sí?ì *to suck out*, while *coma (37) appears as ṣóom to *sew* (*c appears either as /s/ or as /ṣ/ depending on whether the following vowel is *i or *V(non-i; the non-i is *o in the example cited). The phonemic inventory of Papago includes /č/ (descended from *t) and /ž/, but not /c/; the Tarahumara inventory includes /c/ but not /č/. In Tarahumara, máci *he knows* is descended from *mati (*t before *i appears as /c/). Before *V(non-i) *t remains in Tarahumara as /t/ medially (e.g. 26), but appears as /r/ initially: *ti$_s$ka (18) > riká *he is laying it down* (in the Proto UA form, the determining *V(non-i) vowel is *ɨ which descends in Tarahumara as /i/). A slight variant of the *V(non-i) *vs* *i opposition is reflected in Cora, namely, *V(non-i, ɨ)—that is, any one vowel of the set */u a o/—is opposed (in its effect on the preceding consonant) to any one vowel of the set */i ɨ/. Thus, *?aki (57) appears in Cora as ?áči *arroyo*, *k$^w$ita (54) as č$^w$itá *excrement* (*k and *k$^w$ before *i or *ɨ descend as /č c$^w$/, respectively; but before *V(non-i, ɨ) they remain /k k$^w$/: e.g. 8, 9, 51).

The 'no effect' Sonoran languages, as already mentioned, are Huichol and Yaqui-Mayo; in neither of these languages are the linear distinction points (2) and (3) opposed in the production of affricates or sibilants (that is, there is one affricate without phonemic distinction between /c č/; and one sibilant, without phonemic distinction between /s š/). The 'no effect' Shoshonean languages are Hopi, Luiseño, Mono, Comanche, Bannock, and Tübatulabal; except for the last two, the linear distinction points (2) and (3) are not phonemically opposed in the production of affricates; in the case of Tübatulabal, we can account for the development of /c/ but not of /č/. The only Shoshonean languages in which linear distinction points (2) and (3) are opposed in the production of affricates are Tübatulabal, Bannock and Southern Paiute.

And the latter is unique (among traditional Shoshonean languages) in showing the effect of *V(non-i) *vs* *i on preceding consonant. Thus, *c before *i remains /c/ (e.g. 164); but *co$_s$ni (38) appears in Southern Paiute as *ču- *with the head* (*c before *V(non-i) appears as /č/).

To summarize: the 'no effect' languages include all the Shoshonean languages, except Southern Paiute, and two of the Sonoran languages (Huichol and Yaqui-Mayo); the effect of *V(non-i) *vs* *i on preceding consonant obtains for all Aztec languages, for three of the five Sonoran languages in our sample (Papago, Tarahumara, Cora), and for a single Shoshonean language (Southern Paiute).



Still active morphophonemics involving regressive effect of /i/ (in contrast to other vowels) is in general restricted to UA languages which show the effect of *V(non-i) *vs* *i in diachronic phonology. The correlation is exemplified by Southern Paiute whose morphophonemics include such instances as táŋ$^w$?aci *man*, táŋ$^w$?ačaŋ *man-he* (/c/ before /i/ but /č/ before other vowels); this suggests complementarity of affricate allophones, since medial and initial /c/ occur only in the one environment exemplified—before /i/—while medial and initial /č/ occur in other environments—before /a/ in the example; but the phonemic contrast /c č/ is attested in word final position, and—not counting loan words—the contrast is phonemically attested only in word final position. Sporadic or nonce examples may appear in some of the 'no effect' languages, as Hopi qáti *to sit, dwell*, qaci *life* (/t/ before /i/ replaced by /c/ before /i/).

### *V$^{high}$ *vs* *V$^{low}$

The distinction between *V$^{high}$ (the vowel set */i ɨ u/) and *V$^{low}$ (the vowel set */a o/) has already been mentioned in an unusual bilateral context: when one vowel from each set proceeds and follows a Proto UA consonant (**3.1**, above); however, the usual unilateral effect, a regressive one, is reflected in most of the traditional Shoshonean languages and in Papago.

In Tübatulabal, *ku (137) appears as ku-t *fire*, *kali (141) as hani·l *house* (*k before *V$^{high}$ remains /k/, but *k before *V$^{low}$ appears as /h/ or—if *V$^{low}$ is also *V$_n$—as /$^n$h/: e.g. 47). So similarly in Hopi, Luiseño, Mono, and Southern Paiute: *k before *V$^{high}$ remains as /k/ (e.g. 43 for all four languages); but *k before *V$^{low}$ appears as /q/. Thus, *ka$_s$tɨ (42) *to sit* appears in Hopi as qáti, in Mono as qahti, in Southern Paiute as qári-. In Luiseño, however, the preceding vowel (**3.1**, above) progressively effects medial *k; regressive effects of the following vowel are found only when initial *k is involved. Thus, *ka (136) appears in Luiseño as qa(y) *no, not* (initial *k before *V$^{low}$ is reflected as /q/, but before *V$^{high}$ as /k/: 43, 44). Mono and Hopi also have their own peculiarities. Thus, *k$^w$i$_u$ta (54) and *k$^w$a$_u$si (51) appear in Mono as k$^w$ita *excrement* and q$^w$aci *tail* (*k$^w$ before *V$^{high}$ remains /k$^w$/ while *k$^w$ before *V$^{low}$ appears as /q$^w$/). The opposition *V$^{high}$ *vs* *V$^{low}$ not only affects stops, as above, but also preceding continuant. Thus, *waki (99) and *?awa (104) appear in Hopi as lá·ki *dry* and ?á·la *horn* (both *w's appear as /l/: initial *w before *V$^{low}$ and medial *w flanked by *V$^{low}$, but either initial or medial *w before *V$^{high}$ remains as /w/: e.g. 21, 100).

The only UA language outside of the traditional Shoshonean branch that fully reflects the effect of the *V$^{high}$, *V$^{low}$ opposition is Papago; the effect is not only on preceding stop but also, as in Hopi, on preceding continuant. Thus, *ti$_s$ka *to put* (18) appears in Papago as čɨ̀k *to put down sheet like object* (*t before *V$^{low}$ remains /t/ (e.g. 27), but before *V$^{high}$ appears as /č/). So similarly, *ni$_s$ma (89) and *liŋi appear in Papago as n$^y$im *liver* and n$^y$ɨ́in$^y$ *tongue* (*n and

*ŋ before *V$^{high}$ appear as /n$^{y}$/); compare the reflexes of *na$_{n}$ka (47) and *kuŋa (97) which appear in Papago as náak *ear* and kún *husband* (*n before *V$^{low}$ remains as /n/, and *ŋ before *V$^{low}$ appears as /n/). The following examples show reflexes from Proto UA glide (*y) to stops (/ǰ d/): *yi?i and *ya$_{s}$ka appear in Papago as ǰí?ì *mother* and dáak *nose* (*y before *V$^{high}$ descends as /ǰ/, and before *V$^{low}$ as /d/).

UA languages in our sample other than those exemplified above are categorized as 'no effect' languages in respect to *V$^{high}$ *vs* *V$^{low}$. All the Aztec languages and all the Sonoran languages, save Papago, are so categorized; but the only 'no effect' Shoshonean languages appear to be the more northerly members of the Plateau sub-branch—e.g. Comanche, Shoshone and Bannock.

Regressive effects of high vowel *vs* low vowel in on-going morphophonemics are rarely found among Shoshonean languages, but are numerous in Papago.

Only sporadic examples can be cited for Shoshonean languages, as Mono yaqa *to cry*, yaki *to cry out*, and Hopi háki *who*, haqámi *to where* (in both languages /q/ before low /a/, /k/ before high /i/).

In Papago a following high vowel determines the replacement of /t/ by /s/, of /ṣ/ by /s/, of /n/ by /n$^{y}$/, of /ḍ/ by /l/, and of /d/ by /ǰ/. In each of these pairs, the first member of the pair appears either before low vowel or finally: híot *to bloom*, híos-ig *flower*; kóoṣ *to sleep*, kóos-id *to cause to sleep*; číkpan-akuḍ *tool* (with /n/ also finally, číkan *to work*), číkpan$^{y}$-id *to work for him*; wúuḍ-a *act of roping* (with ḍ also finally, wúuḍ *to tie, to rope*), wúul-id *to tie it up, to bundle it (e.g. wheat)*; náad-a *fire*, náad-akuḍ *stove* (with /d/ also finally, náad *to light a fire*), náaǰ-id *to light it for him*.

### *V(non-a) *vs* *a

The opposition of *V(non-a): any one vowel in the set */i ɨ u o/, and *a has a differential effect in one language in the Aztec branch (Nahuatl) and in one in the Cora-Huichol sub-branch (Cora). The remaining Aztec languages (those of the Nahuat group—Zacapoaxtla and Mecayapan in our sample—and Pochutla), and the remaining Sonoran languages, and all the traditional Shoshonean languages may be categorized as 'no effect' languages in respect to *V(non-a) vs *a. The opposition of these vowels is reconstructed from the reflexes of two languages, Cora and Nahuatl. These reflexes, however, give scant support to Whorf's prediction that evidence will be found to merge the Cora-Huichol sub-branch and the traditional Aztec languages into one Aztecoid branch of Uto-Aztecan.

*taka (145) appears in Nahuatl as ƛa·ka-ƛ *man* (*t before *V(non-a) remains /t/—e.g. 19—but appears as /ƛ/ before *a).

*ni$_{s}$ma (89) and *ku$_{u}$pa (9) appear in Cora as neém$^{w}$a *liver* and kip$^{w}$á *head hair* (*m and *p before *V(non-a) remain /m p/—e.g. 86, 146—but appear as /m$^{w}$ p$^{w}$/ before *a).

Morphophonemic traces of this opposition—of still active consonant replacements before V(non-a) *vs* /a/—may possibly turn up in the daughter languages, though none have been found so far.



### *V(non-o) *vs* *o

The opposition of *V(non-o): any one vowel in the set */i ɨ u a/, and *o affects the reflection of only one UA consonant, namely *w. Exemplification is given for at least one language from each of the three traditional branches of Uto-Aztecan. *wo$_{s}$ko *pine* appears in Cora and Huichol as hukú, in Tarahumara as okó, in Zacapoaxtla as okó-t, and in Southern Paiute as uxú-mpi (*w before *V(non-o) remains /w/ in all languages—e.g. 101; but before *o, *w becomes /h/ in Cora and Huichol, and is lost in Tarahumara, Zacapoaxtla, and Southern Paiute).

### Specification Three

**3.3.** Some vowels are progressively determining (**3.1**, above), some regressively so (**3.2**, above); but some differential consonant effects are also determined by phonemic distribution—especially by positional contrasts of consonants in the parent language; and similar positional contrasts are relevant to the morphophonemics of most daughter languages.

## NO VOWEL *VS* V$_{U}$ (OR ANY VOWEL) BEFORE CONSONANT

The opposition treated below is somewhat more restricted than a simple contrast of the reflexes of initial *vs* medial consonant. If a preceding vowel is *V$_{s}$ or *V$_{n}$ it may determine the reflex of the following consonant differently than if the vowel were *V$_{u}$—unaltering in its effect (**3.1**). In diachronic phonology the effect of position of Proto UA consonant on reflexes in the daughter languages can be stated as a simple opposition of initial *vs* medial for some languages, but as a more complex opposition for other languages. The opposition is between no vowel before a consonant—i.e. initial consonant—and *V$_{u}$ vowel (rather than any vowel) before medial consonant where the daughter language shows differential effect of *V$_{u}$ and *V$_{s}$, *V$_{n}$; but the opposition is between no vowel (initially) and any vowel before medial consonant in daughter languages which do not show these differential effects.

The Aztec examples show that */p l/ remain medially (e.g. 10, 141) but not initially. Thus, *pa$_{s}$ki (2) appears in Zacapoaxtla as a·ki *to fit in*, and *liŋi (94) appears as -nene-pi·l *tongue*.

The Tarahumara examples show that */p t ? h w/ remain medially but not initially (e.g. 10, 26, 134, 80, 20, respectively); *w does not remain initially before *o, but does before other vowels; and though medial *y does not remain as such medially, initial *y and medial *y are still differently descended in Tarahumara. When the Proto UA consonants listed occur in initial position, half of them—*/? h y/—are descended as zero in Tarahumara: *?awa (104) appears as awá *horn*, *hik$^{w}$i(si) (55) appears as iwí *he breathes*, and *yaca (40) appears as acá *he is putting it*; but when in medial position, as in *koya (45), *y appears as a consonant cluster with glottal stop—/?y/—rather than simply remaining (as in the case of the other consonants—other than *?—descended medially): ko?yá *he is killing them*. Compare now the descent of initial */p t w/: *pa$_{s}$ki (2) appears

in Tarahumara as bakí *he is entering* (initial *p > /b/), *ti$_s$ka (18) appears as riká *he is laying it down* (initial *t before *V(non-i) > /r/).

Examples in Huichol, and also for the most part in Cora, show that */p h l/ (and in addition a reconstruction of *y supported by Cora) are differently descended according to position in Proto UA. The reflexes of medial (rather than initial) */h l y/ (and *p after *V$_s$) are zero; in only one instance does a medial consonant from this list remain (*p after *V$_u$, e.g. 9)—hence, on the whole, the inverse of the Tarahumara reflex pattern as delineated above. In the general pattern initial consonants appear to be zeroed in Tarahumara (but to remain in Huichol), and medial ones appear to be zeroed in Huichol (but to remain in Tarahumara). The reflexes of initial */p h l y/ are /h ʔ n y/, respectively; *pa (123) appears in Huichol as há· *water* (but medial *p after *V$_s$ is zeroed: *ci$_s$pu (13) > cii- *bitter*); *hi (77) appears as ʔi- *to drink* (but medial *h is zeroed: *tahi (150) > tai *fire*); *liŋi (94) appears as není *tongue* (but medial *l is zeroed: *puli ~ a (97b) > hii- ~ -hia *to tie*), The Cora reflexes of medial *y are zeroed, while initial *y remains /y/ (e.g. 168); *k$^w$iya (112) appears in Cora as č$^w$éh *dirt, earth*.

The Papago examples show that */p h l/ mostly remain as such or are zeroed medially, but not initially; when in initial position, the reflexes of */p h l/ are /w ʔ n$^y$/, respectively. Thus, *piti (3) appears in Papago as wíič *heavy*; but medial *p either remains (after *V$_u$, e.g. 9) or else appears as /w/ (after *V$_s$, e.g. 12); *hi$_s$- (77) appears as ʔíʔì *to drink*, but medial *h is zeroed: *pahi > wái-k *three*; *liŋi (94) appears as n$^y$íin$^y$ *tongue*, but medial *l either remains (before *i) or else appears as /d̲/ (before *a): *puli ~ *pula (97a) > wúul- ~ wúud̲- *to rope, tie*.

Examples in Yaqui-Mayo show that position determines the differential reflexes of */l w/. Initial *l descends as /n/, medial *l as /r/: *liŋi (94) > nínni *tongue*, *kali (141) > kári *house*. Initial *w remains as such (e.g. 101), while medial *w is either zeroed or geminated. Thus, *ʔawa (104) appears in Yaqui-Mayo as ʔáaʔa (reduplicated with dropping of *w) *horn*, *sawa (64) as sáwwa *leaf*.

In Tübatulabal, reflexes of */t l/ are positionally determined. Initially, */t l/ remain, respectively, stop (in the same or different stop series) and /l/; but medially, they appear as continuants, /l n/ respectively. Initial *t remains as /t/ when it is also initial in Tübatulabal, but after the exfix of reduplication appears as /t/ or /d/ or as /$^n$d/: *tiwa (21) > tiw (unreduplicated), ʔi·diw (reduplicated) *to find it*; compare the reflex of medial *t in *ka$_s$ti (42) in Tübatulabal hali- *to sit, live* (the reconstruction *V$_s$ is not supported by Tübatulabal where its effect is not distinguished from *V$_u$).

Examples in Luiseño show that position—as well as adjacent vowels—determines the differential reflexes of */t k ʔ/. Thus, *t remains as /t/ initially (e.g. 21), but appears medially as /l/ in the descent from *ka$_s$ti (42) to Luiseño qalo ~ qal *to be*. And initial *k before *V$^{high}$ (e.g. 44) and before *V$^{low}$ (e.g. 41) appears as /k q/, respectively, while medial *k after *a (e.g. 138) and after *V$_n$ (when *V$_n$ is *a$_n$—e.g. 47) appears as /x q/, respectively. Though *ʔ remains /ʔ/ medially (e.g. 106), it zeroes initially: *ʔasi (139) > aš ~ a·š *to bathe*.



Hopi examples show that position determines the differential reflexes of */h l/. Initial *h remains /h/ (e.g. 77), but medial *h is zeroed in the descent from *pahi (1) to Hopi pá·y *three*. So also initial *l remains /l/ (e.g. 94), but medial *l, as in *sala (147) appears as /n/: sá·na *gum*.

In Southern Paiute the differential effect of position is exemplified by the descent from *y which remains /y/ initially (e.g. 110) but is zeroed medially, as from *miya (158) to miá-c *moon*.

Most Mono consonants exemplified for differential effects that are determined by position show that initial UA consonants remain, while a medial UA consonant may be replaced; most remain but then appear in Mono as second members of consonant clusters after /h/. Thus, medial *k in *pu$_n$ku (46), flanked by *V$^{high}$, appears in Mono as puhku *dog, pet*; but initial *k remains as /k/ or appears as /q/ depending on whether *k is followed by *V$^{high}$ (e.g. 137) or *V$^{low}$ (e.g. 24). In a parallel way, medial *k in *na$_n$ka (47), flanked by *V$^{low}$, appears in Mono as nahqa *ear*. So also initial *s remains /s/ (e.g. 166), but medial *s in *pu$_n$si (5) appears as /hs/ (puhsi *eye*) and in *k$^w$a$_u$si (51) as /c/ (q$^w$aci *tail*). So also, initial *m remains /m/ (e.g. 128), but medial *m in *ka$_u$ma (87) appears as /hm/: qahma *to taste*. Initial *ʔ remains /ʔ/ (e.g. 61), while medial *ʔ is zeroed: *si(ʔi) > sii *to urinate*.

Occasional parallels to the diachronic phonology summarized above are found to be still active in the morphophonemics of those daughter languages that show consonant replacement which depends on position of the consonant: initial *vs* medial.

Thus, initial plain stops in Tübatulabal may be replaced by stops combined with SGC of voicing and prenasalization after an exfix vowel in reduplication.

In Mono initial /s/ and initial /x/ are replaced by /hs/ and /hx/, respectively, after prefixes; similarly, initial /m/ is replaced by /hm/ after prefixes with vowel other than V$_s$: sono *lung*, ʔihsono *my lungs*; xaahnuʔu *cup*, ʔihxaahnuʔu *my cup*; mupi *nose*, ʔihmupi *your nose*.

In Hopi, initial /p/ is replaced by /v/ after prefix or after a preceding member of a compound. Thus, pó·ko *dog, pet* is -voko after prefix (ʔivóko *my dog, my car*), and is -vo·ko when second member of a compound (ʔik$^w$á·y-vo·ko *my pet eagle*); compare ʔikík-vosi *my toes*, lomá-vosiʔyta *he's got good eyes* (pó·si *eye, seed*); tamá·-vǒckoho *jaw* (pöckoho *throwing stick*); qalá-voyo *sharp knife* (póyo *knife*); compare nikír-vö *poor road* with pö(hi) *road*.

There are no initial vowels in Proto UA, nor in most of the daughter languages. Hopi, Tübatulabal, Mono, Shoshone, Comanche, Papago, Yaqui-Mayo, Cora and Huichol words are all consonant initial. However, at least one language in each of the three traditional branches of Uto-Aztecan has developed some vowel initial words: Southern Paiute, Tarahumara, and all the Aztec languages.

There are restrictions on which consonants are permitted in word initial in

most but not all Uto-Aztecan languages—not in Mono, Cora, Huichol and some languages in the traditional Aztec branch; in these every consonant, without exception, appears initially. The following suggests the range of restriction in the other languages—consonants which appear medially but not initially:
/v ŋʷ ŋʸ/ in Hopi (but initial /v/ is used in baby talk spoken by children and by adults in conversation with little children);
/v r ŋ ŋʷ x xʷ/ in Southern Paiute;
/v r/ in Comanche;
/r/ in Yaqui-Mayo;
/ʔ/ in Tarahumara and some Aztec languages, but glottal stop as first member of a cluster, /ʔm ʔn ʔw ʔy/, does appear in Tarahumara word initial. Other consonantal restrictions, as already mentioned for Tübatulabal, are involved in morphophonemic alternations, as of medial voiced or prenasalized stop with initial voiceless stop; only the latter are permitted in word initial.

## NO VOWEL *VS* ANY VOWEL AFTER CONSONANT

Consonant finals do not occur in Proto UA; but the UA consonant before the last vowel may be differentially effected by retention or loss of the final vowel in a daughter language.

Thus, *m remains before vowels (e.g. 25, 37), but appears as /n/ when final in Zacapoaxtla: *taₛma (29) > -ta·n *tooth*.

Similarly, on-going morphophonemics in particular daughter languages show a variety of consonant replacements depending on the position of the consonant: prevocalic *vs* final.

Thus, Tübatulabal stops combined with SGC (voicing and prenasalization) before a vowel may be replaced by plain stops finally; and some continuants appear finally or before another consonant as first member of a consonant cluster before glottal stop: hali- beside reduplicated ʔa·halʔ *to sit, live*; hali- is replaced by halʔ- before consonant in identical compound—i.e. stem reduplication: halʔhali-t *the hole*.

In Luiseño, similarly, /č/ before a vowel is replaced by /š/ finally: yuŋá·vič-om beside yuŋá·viš *turkey buzzard*; and so also, but with additional consonant cluster developing in the prevocalic form, qeŋč-um beside qe·ŋiš *ground squirrel*.

As already mentioned, there are no final consonants in Proto UA, only final vowels. About half of the daughter languages preserve the parent pattern. Daughter languages still favoring vowel finals include some but not all Plateau Shoshonean languages (Mono, Comanche, Shoshone); and all Sonoran languages end words in vowels, with the notable exceptions of Papago and Yaqui-Mayo. Some of these, as Comanche and Cora, permit a laryngeal consonant final, /h/ or /ʔ/ or both, but no other final consonant.

Papago and Yaqui-Mayo in the traditional Sonoran branch, all the languages in the traditional Aztec branch, and most Shoshonean languages have developed consonant finals. A wide variety of consonants appear in word final in Hopi, Tübatulabal, Luiseño and Cahuilla. In Southern Paiute relatively few consonants are permitted in word final. Papago not only permits single consonants in word final but has also developed a proliferation of consonant clusters that may appear in word final; other languages permit occasional final consonant clusters.



### Specification Four

**3.4.** Papago preserves Proto UA morpheme alternates cited in **2.2** with final vowel *i ~ *a, *i ~ *i̱, *i ~ *u, or *i ~ *o. What has been cited as *kʷasi ~ i (or equally well, *kʷasi ~ i̱), for example, might instead be written in full for each of the morpheme alternants, as a pair of morphs: *kʷasi ~ *kʷasi̱. This particular pair, as reflected in Papago, appears with the final vowel -/i/ (báhì *to be ripe, cooked*) as well as with the final vowel -/i̱/ (when reduplicated: bábhi̱ *to become ripe, usitatively*). Another pair of morphs, *muᵤki ~ *muᵤku appears in Papago as múukì *to die*, as well as (reduplicated) múmku *to be sick*. Examples of this sort are not uncommon in Papago but seem rare or sporadic in other languages—e.g. Hopi nákʷsi *singular actor departs* beside reduplicated nánkʷsi *plural actor departs*; other languages generally preserve either the *i final morph or the *V(non-i) morph where both are reconstructed for Proto UA—but not both. Where Papago alone (see above) shows descent from both *kʷasi and *kʷasi̱ *to be ripe, cooked*, only the former is reflected in Hopi, Huichol, and Tarahumara (kʷási, -kʷa·ši, and wasí, respectively); and only the latter in Southern Paiute, Comanche, Mono, Luiseño, and Tübatulabal (kʷasi̱, kʷási̱, qʷahsi̱, kʷašó-, and wiši-, respectively).

The differential effect of the final vowels of the morph pair *ʔaci ~ ʔaca (39) on the preceding consonant in Papago (*c becomes /s/ before *i, but /ṣ/ before *a) is apparent in ʔás- ~ ʔáṣ,—morpheme alternants of one Papago stem, *to laugh at*. So also the pair *puli ~ *pula (97b), appears as alternants of one Papago stem, wúul- ~ wúuḍ *to tie, rope*.

Still active morphophonemic analogues of these Proto UA morpheme alternants—morph pairs in the daughter languages, one with final /i/ the other with V(non-i)—are numerous and complex. They involve, for example, suffix dependent vowels ('vowel increments'—either /i/ or V(non-i), with selection of the vowel determined by the following suffix); they also involve a more or less productive suffix (operator-like suffix) which transforms verbs (ending in non-i) into nouns (ending in /i/). Both are most productive in Tübatulabal; and perhaps least productive in Hopi, where only sporadic examples occur of transformation from verb to noun: tíŋʷa *to name him*, tíŋʷi *name*; kɨ́·ya *he brings water*, kɨ́·yi *potable water*; qáti *he sits, dwells*, qáci *life*.

Hopi and Tübatulabal represent two extremes. Many parallel examples in the middle range of productiveness can be cited from other languages. For example, *siʔa appears in Papago as híʔà *to urinate*, which may be transformed into noun by replacement of final -à by -ì: híʔì *urine*.

That such transformations are not always simple V(non-i) ~ i replacements is shown by the contrast of *tuʔa *to grind*, *tuʔi *flour* (133) and *tusu ~ tusi (75) for another kind of *grinding*. The latter pair descends in most languages as verbs which end in -/u/, as Tübatulabal ʔutušu-, and Southern Paiute tusú *to grind*

*seeds*. But this same pair descends in Hopi as a noun: tó·si *ground up stuff*. The first UA pair cited—*tu?a *to grind*, *tu?i *flour*—descends in Tübatulabal, but only as a noun: tu?i·-l *flour*.

The verb final vowel in some UA verbs can be inferred from the shape of the consonant preceding the final vowel in such Aztec languages as Zacapoaxtla: koči *to sleep* < UA *koci (the verb final must have been *i, since UA *c before *i is reflected in Aztec languages as /č/); compare weči *to fall* < UA *wici (the verb final in Proto UA must have been *V(non-i), since UA *c remains /c/ in Aztec in this environment in Aztec languages).

Traces of V(non-i) alternating with -/i/ can probably be found in all the daughter languages: see above, and compare the paired Huichol stems for *to break*, and *to poke a hole in, to puncture*: sana ~ sani- and ce·ke ~ ce·ki-, respectivizing suffix. Compare also Yaqui-Mayo yúku *to rain* and yúke *rain* (noun morph ending in (-u) but verb morph in /-e/ < *i), with nominalizing *i replacing verb final vowel, as is usual in Uto-Aztecan morphophonemics. But verb final vowel remains when a nominalizing suffix is added in Tarahumara: ukú *to rain*, ukuí *rain*.

One kind of morphophonemic specialization is exemplified by Tübatulabal with its alternating 'vowel increments' occurring not only after stems, but after suffixes as well (the alternation depending on the following morpheme)—not to mention associated alternation of stress and length. Another kind is exemplified by Papago. Here the stem final consonant is distinguished morphophonemically as $C_1$ or $C_2$ (both reduced from final syllable of UA stems, all of which end in -CV). When a suffix is added to Papago stem final in $C_1$, the 'vowel increment' following is /i/; when added to Papago stem final in $C_2$, the 'vowel increment' is /a/; but when added to Papago stem final in vowel, the vowel is unaltered. Examples of final $C_1$ are húuč *fingernail*, húučiẓ *his fingernail*; síis *elder brother*, síisiẓ *his elder brother*. An example of final $C_2$ is táḍ *foot*, táḍaẓ *his foot*. An example of vowel final is mó?ò (< UA *mo?o) *head*, mó?oẓ *his head*.

**3.5.** For specification ONE, TWO, THREE and FOUR, above, it was possible to obtain comparability among the daughter languages by using interphonemic specifications in Proto UA as a point of departure. There remain now a few additional interphonemic specifications which cannot be brought up to the reconstructed parent language with the assurance possible for the first four, already treated. In general, these additional interphonemic specifications are merely introduced or identified in this section. (They are reserved for more comprehensive treatment in part II of this monograph—or in independently published structural statements—since they are closely concerned with morpheme classes and sub-classes.)

Proto UA is reconstructed without vowel clusters and without consonant clusters.

The first additional interphonemic specification has to do with clusters of unlike vowels and consonant clusters, and more generally with loss of vowel (V) or consonant (C) whether or not such loss yields diphthongal vowel cluster (VV) or consonant cluster (CC). When, as in the synchronic discussion of SPECIFICATION ONE (**3.1**), the thematic partial after exfix is reduced by loss of vowel, the unreduplicated stem may be CVC (as náak *ear* or dáak *nose* in Papago), while the thematic partial of the reduplicated form may be CC, even though the intervening vowel in the CVC stem is long (as in Papago náank *ears*, dáadk *noses*, where the thematic partials after exfix are -nk and -dk, respectively). Less commonly in Uto-Aztecan (with examples from Papago again), the thematic partial after exfix is reduced by loss of consonant, as wúupuì *eyes*, where the thematic partial after exfix (-puì) matches the unreduplicated stem (wúhì *eye*) isomorphically except for the loss of intervocalic /h/; when the unreduplicated stem báhì *tail* is compared with the reduplicated form báabhaì *tails*, it is notable that there is no loss of C or of V in the thematic partial after exfix (-bhaì)—instead, both a consonant cluster (-bh-) and a vowel cluster (-aì) appear in the thematic partial as a consequence of metathesis (báhì ~ -bhaì). The diphthongal vowel cluster in the thematic partial (-puì), for *eyes*, above, appears as a consequence of consonant loss. (VV or diphthongal vowel cluster is here taken to mean the juxtaposition of two unlike vowels, and is not to be confused with the juxtaposition of two identical vowels; the latter is merely an alternative phonemicization of vocalic length.) Metathesis is quite common in particular Tübatulabal sequences, as mu·hy- reduplicated as ?umu·yh *to make a fiesta*. Vowel clusters with /i/ or /u/ as second members can be avoided in Tübatulabal—and in some other languages, as Hopi—by phonemicizing with semivowel /y/ or /w/ instead of /i/ or /u/; the consequences are a VC (semivowel) sequence instead of a VV or diphthongal vowel sequence. But in still other languages, as Southern Paiute, vowel clusters are unavoidable, since second members of such clusters are not only /i/ and /u/ but also other vowels, as /ɨ/. We may now list languages which do not show vowel clusters: Luiseño, Hopi, Tübatulabal, and Nahuatl as phonemicized by Whorf, and Mono as phonemicized by us. Vowel clusters cannot be phonemicized away in Papago, Cora-Huichol, Southern Paiute, and possibly not in Comanche.

Another additional interphonemic specification is concerned with stress, which is not yet included in our reconstruction of Proto Uto-Aztecan. Three kinds of stress are specified (**1.1**) in the phonemic inventories of the daughter languages (*q.v.*): (1) word stress, (2) predictable stress, and (3) alternating stress.

(1) Word stress has been fully phonemicized for Papago. For all words containing vowels—vowelless particles are not considered here—one or more of three SGC's of stress are combined with vowel (V): maximum V́, minimum V̀, and ordinary V (unmarked by stress diacritic). Monosyllabic words are combined with ordinary stress (pi *negative*, particle), or with minimum stress (kì *apparently*, also a particle), or with major stress (táḍ *foot*, hím *to go*, čúk *black*). Bisyllabic words include the stress patterns V́ + V̀ and V́ + V (wúhì *eye*, gágḍa *to sell*, respectively). Trisyllabic words include the stress patterns V́ + V̀ + V and V́ + V + V̀ (dágìto *to release*, gígokì *plural actor stands*, respectively). Other

languages with word stress may be—though our sources are sometimes ambiguous—Cora, Tarahumara (possibly alternating stress), Luiseño and Cahuilla, and Comanche (possibly alternating stress).

(2) Predictable stress—stress which is not phonemic since it is non-contrastive—has been phonemicized for the traditional Aztec languages and for Mono (with elaborate rules distinguishing degrees of stress in specified environments). The rule for predictable stress in Nahuat-Nahuatl can be stated in one word—prefinal; so also, that for Pochutla—final.

(3) Preliminary publications and manuscripts on Hopi and Tübatulabal and Southern Paiute give rules for alternating stress that account for all utterances; our preliminary source for Yaqui-Mayo accounts for about 90 percent of the words cited. But the matrix for alternating stress where developed in Uto-Aztecan is probably not the 'word'—rather the span between pause junctures, as the CONTOUR of Hopi and Southern Paiute. Within this span or contour, it is necessary to write stress once only; other stresses are predictable by counting mora values (length units) of vowels from this single phonemic indication, with overriding restrictions from the juncture phonemes. If this probability is confirmed, then the rules for alternation of stress cannot be stated until the effects of junctures are analyzed—an analysis which has begun in only a few Uto-Aztecan languages. This problem may also be related to the occurrence of changes of stress in languages typologized as having word stress—for example, Papago kómì *small of back* (V́ V̀), kómiʔ *his small of back* (V́ V).

Another additional interphonemic specification has to do with tone and junctures. The latter is a matter of intonation, in this context; but tone, *qua* tonemics, has been asserted in our sources for Bannock and Huichol.

Another additional interphonemic specification is concerned with de-devoicing whether as a phonemic contrast (possibly for Comanche vowels) or as a subphonemic alternation, as in most other Uto-Aztecan languages (for vowels or consonants, or both).

Another additional interphonemic specification is concerned with alternation of vowel length—quite aside from, but associated with, the central alternation, that of stress (see above). Hopi distinguishes three moras of length in some dialects; Pochutla does not distinguish short vowels from long vowels; other Uto-Aztecan languages do so. Alternation of length appears clearly in reduplication in Hopi, Tübatulabal and Papago. Examples from the last language are (1) shortening of exfix vowel and thematic partial vowel in wópog *roads* from unreduplicated wóog *road*; (2) lengthening of exfix vowel in tád *foot*, táatad *feet*; (3) lengthening of the exfix vowel with shortening to zero of the first vowel of the thematic partial in čúkud *owl*, čúučkud *owls*.

# CHAPTER 4

# QUANTIFICATION



**4.1.** One dimension of quantification has been lightly sampled and expressed in terms of rank-order of frequencies (**1.1**). This is of course not the only quantitative expression possible for occurrences of phonemes, nor the most ambitious or extensive one possible to make. We would quantify experimentally, but count the effort an experimental failure if it did not illuminate structure or history; in other words, ours was an attempt to count as little as possible in order to resolve our doubts as to whether quantification of the rank-order kind would correlate with or approximate the descriptive facts given in phonemic change and in phonemic typology. The approximations obtained concerning vowels are more interpretable than those concerning consonants, though additionally generated unit phonemes—via SGC combinable with consonants—turned out to be worth counting too. With more extensive and more controlled counting, we may some day have something to say bearing on Martinet's theoretically developed notion of functional load; for the present, our simple rank-orders may be looked upon as a trial and error beginning—for typological and comparative UA—in the direction of statistical phonemics.

Vowels are arranged according to their phonemic oppositions so as to obtain what has been identified (**1,** above) as two wholly symmetrical, two or three moderately symmetrical, and two asymmetrical vowel types. The vowels are found to be quite differently arranged when they are ordered in terms of their frequencies, from the most recurring to the least recurring in a one hundred word sample.

A question then arises: is there any correlation between the quantification arrangement—the different kinds of rank-orders—and the typological arrangement? As will be shown, the correlation is very high between rank-order and the dual level 2(FB) type; a positive correlation is found between rank-order and the dual level 2(FCB) type, as well as between rank-order and the triple level 2(FB) over N type. This leads to the expectation that if sufficient exemplars were available for the asymmetrical types and the pair of inverse vowel types, positive correlations with rank-orders might also become apparent.

Type 2 (FB) may be diagrammed as a two dimensional box:

| | |
|---|---|
| i | o |
| e | a |

The rank-order of the vowels diagrammed is /i a o e/ in all Nahuat and Nahuatl languages in the traditional Aztec branch (Milpa Alta Nahuatl, Mecayapan, Zacapoaxtla, and even in Pipil, except for one slight difference: the order of the final pair inverted to /e o/). This rank-order is remarkable because, in all languages outside the Aztec branch, /a/ is found in first rank rather than /i/. Accordingly, if

any UA language affiliated with a branch other than Aztec is an exemplar of the 2(FB) vowel type, we would expect its rank-order to show /a/ as most frequent—more frequent than /i/. And so it is in the coexisting short vowel system of Cahuilla, with dual level 2(FB) type, and /a i e o/ rank-order.

Type 2(FCB) may likewise be diagrammed as a two dimensional box: | i i u / e a o |

All languages in the traditional Shoshonean branch agree not only in ranking /a/ as most frequent (see above) but also—and more important as a diagnostic criterion—by ranking /e/ as the least frequent (or in Tübatulabal, just before the least frequent). In addition to agreeing on the ranks of most frequent and least frequent vowels, Shoshonean languages of the 2(FCB) type approximate agreement in the middle ranges of rank-orders: after /a/, two high vowels: /i ɨ/ (Comanche), /i ɨ/ (Shoshone), /i u/ (Tübatulabal), but /i o/ (Mono); and after these two vowels, /o u/ in Comanche and Shoshone, and /i e/ and /i u/, respectively, in Tübatulabal and Mono.

The triple level type 2(FB) over N may be diagrammed as a two dimensional box over the N or neutral vowel at a lower tongue-height: | i u / e o | The rank-

a

orders of traditional Sonoran languages—of Tarahumara, Varohio, and Yaqui-Mayo—are identical: /a i e o u/, with /e/ in middle rather than low rank-order. Luiseño deviates from this chiefly in placing /e/ in lowest rank-order, as is expectable in the behavior of a good Shoshonean language. Pochutla deviates not only from the vowel type otherwise characteristic of the Aztec branch—2(FB)—but also deviates from the Sonoran pattern, as well as from the Shoshonean instance of rank-orders within the 2(FB) over N type—chiefly by placing /e/ first in frequency. And there is good evidence in phonemic change from Proto UA times to show why this high rank-order for /e/ is inevitable in Pochutla (**2**, above).

There are too few languages exemplifying any one of the remaining vowel types—all more or less asymmetrical—to adduce interesting correlations with rank-orders. But some interpretation is attached to the rank-order of the last or least frequent vowel in any given type (and among types).

Type F + 2(BB°) is diagrammed as a two dimensional box, with the F or front vowel to the left of the box but at the same height as the higher of the dual level vowels: i | i u / a o | The rank-order of Papago and Tepecano vowels is identical, /a i o ɨ u/, and the Pima Bajo order agrees in ranking /u/ least frequent. Bannock is one of the two or three Shoshonean languages having the same vowel type—but with a different rank-order: /a i u ɨ o/. This Bannock order differs slightly from the other Shoshonean exemplars; there is inversion of adjacent vowel order in the middle range: /i ɨ/ or /ɨ i/ before /u/ in Northern Paiute and Ute, respectively. Accordingly, the only general difference in rank-order between the Piman-Tepehuan languages and the Shoshonean languages



is that /u/ ranks lowest in the former but more or less in the middle range in the latter. Or conversely stated, /o/ is in the middle of the Piman-Tepehuan rank-order range, but least frequent in Shoshonean languages having the same vowel type.

Type 2(FB) + B° is diagrammed as a two dimensional box, with the B° or rounded back vowel to the right of the box but at the same height as the higher of the dual level vowels: | i ɨ / e a | u. Huichol exemplifies this vowel type with rank-order /a i e ɨ u/. It is a literal fact that /u/ ranks lowest in this Sonoran representation of 2(FB) + B°; so also /u/ ranks lowest in the Piman-Tepehuan subbranch of Sonoran—in languages representing the F + 2(BB°) vowel type which is the inverse of the type found for Huichol. But this is only an orthographic coincidence, since the Piman-Tepehuan contrast of /o/ versus /u/ is lacking in Huichol. It is also lacking in Cora whose vowels are also typologized as 2(FB) + B°, but with slightly different rank-order: /a i u e i/.

The most asymmetrical vowel types are diagrammed as pairs of successive one dimensional boxes. Though vowels in the first box are understood to be produced at a higher tongue-height than vowels in the second box of each pair, there is nevertheless a lack of symmetrical tongue-height contrasts at the same linear distinction points. In short, the paired boxes are asymmetrically related. Type (FBB°) over N is diagrammed | i ɨ u | | a |, with rank-order /a i ɨ u/ (Southern Paiute). Type (F BB°) over (FF° B) is diagrammed | i ɨ o | | e ö a |, with rank-order /a i ɨ o ö e/ (Hopi).

The transparent correlation between vowel type and rank-order of vowels—as detailed above—has no apparent parallels in obvious correlation between linear types for stops (or their matchings with different continuant series), and the rank-orders of stops (or the various continuant series: N F G L R). One parallel does exist, but it lies in very general patterning and is applicable to both vowels and consonants. In the general case, additional unit phonemes generated by SGC appear in lower rank-orders than unit phonemes uncombined with SGC. Or put conversely and more specifically, short vowels are encountered more frequently than long vowels just as plain stops appear in higher rank-orders than voice or prenasalized stops (stop + SGC of VOICING or of PRENASALIZATION). It would be possible to supplement the rank-orders detailed above (which are for short vowels throughout) with information on the rank-orders for long vowels (which are always different than those for short vowels). But we content ourselves by saying that long vowels—in whatever order—appear in lower rank-order than short vowels, just as additionally generated stops appear in lower rank-orders than do plain stops.

By 'the general case', we refer to those instances among stops where there is an unambiguous distinction between plain stops and the additional unit phonemes generated by SGC. This distinction is open to possible ambiguity in two languages—Papago and Cora.

Which of two stop series is the plain one and which is stop + SGC is indeterminate in Papago even when frequencies are counted, for in rank-order the stops of one series do not rank higher than those of the other; the order alternates between lenis stops and fortis stops.

If Cora plain stops /p č k/ are said to be combined with SGC of LABIALIZATION, three additional unit phonemes are generated /$p^w$ $č^w$ $k^w$/; but can we not just as well say (instead of bothering with SGC) that /$p^w$ $č^w$ $k^w$/ are three additional linear distinctions in a string of nine such distinctions? In favor of setting up six linear distinctions for one stop series (plain stops) and three matching linear distinctions for a second stop series (labialized stops) is the fact that—as in the general case of linear types with SGC—all the additionally generated stops appear in lower rank-order than the plain stops. This leads to the suggestion that frequency counting can influence the structuralization of a phonemic system.

**4.2.** One dimension of quantification, treated above, is concerned with correlations between the structure or typology of phonemic systems and the rank-orders of their unit phonemes (**4.1** above). Another dimension or parameter is lexicostatistics adapted to Uto-Aztecan languages. The two hardly bear any resemblance to each other. Rank-order is concerned with the phonemic inventories of one language at a time; lexicostatistics with cognates—therefore involving a minimum of two languages at a time. The rank-order parameter quantifies as little as possible; it begins with UA languages, and does not generalize beyond them. Our lexicostatistic adaptation to UA is derived from glottochronology which postulates that the same rate of change obtains for all the world's languages.

According to the language universal postulate in glottochronology, all languages will lose about twenty per cent of a particular lexical sample every millennium; or stated conversely, a contemporary language ($L_2$) will preserve in recognizable shape about eighty per cent of a particular lexical sample that an earlier stage of the same language ($L_1$) had a thousand years before. If the lexical sample includes a particular selection of 100 items in $L_1$, then a thousand years later this language, now called $L_2$, will include $100 - 20 = 80$ of the same items. For purposes of the postulate, it does not matter how the non-retained items in $L_2$ may have disappeared from sight and sound.

The best support for this postulate is found when an historically earlier stage of a language—a dead language but one preserved in writing ($L_1$)—upon being compared with its own lineal descendent ($L_2$) a millennium later, turns out to be twenty per cent richer than its descendent which, therefore, is only eighty per cent as rich as its forebear—not in respect to the possession of total dictionary resources, which may be the same in magnitude, but in respect to a particular lexical sample. If the retention rate is found to be the same in all instances that can be controlled by direct comparison of $L_2$ with $L_1$—if some living $L_2$'s (all those with $L_1$ forebears preserved in writing) have the same retention rate—



then we would be willing to postulate that other living $L_2$'s (without written $L_1$, as in UA) have a closely similar retention rate. But what are we to postulate if there exist well controlled counter-examples to the language universal postulate of glottochronology?

And there are such counter-examples. The most devastating of all are those brought forth by Knut Bergsland and Hans Vogt—e.g. between one written forebear, Old Norse ($L_1$) and its own lineal descendent, Modern Icelandic ($L_2$). According to glottochronology, time elapsed between these instances of $L_1$ and $L_2$ is at most a century or two, or (by a variant way of counting) zero—that is, no time elapsed at all, since it turns out that Modern Icelandic has retained all the items in the particular lexical sample that are preserved in writing in Old Norse—a thousand years ago, according to historiographic ways of measuring time. There are, then, variables in phenomena; and the glottochronology postulate is not valid as a language universal.

Non-agreement in the results of glottochronology applied independently to UA languages raises a different problem: not of variables in phenomena, as above, but of variables in measurement. Two of our sources obtain two different results in their application of the same constant of retention-rate to much the same lexical sample—the old and the revised Swadesh list. The results are stated in terms of time of separation for each pair of languages; the time in Chart I, below, is to the nearest half millennium.

This first chart (with corrections, especially for the Luiseño-Tübatulabal separation, from personal correspondence with Swadesh) follows a geographic orientation from top (north) to bottom (south), and with three classes of time indicated by connecting lines between languages. Broken lines (dashes) connect languages separated 3 to 4 millennia ago; single solid lines are drawn between languages separated 2 to 3 millennia ago; double solid lines are between languages whose separation is computed as less than two millennia, but not less than eight hundred years (the latter is numbered 1, as the nearest to one millennium). The numbers in parenthesis are supplied, when available, to show the deviant or agreeing computation (also to the nearest half-millennium) apparent in the second chart (after Hale).

Separation dates from our two sources differ as follows: Papago from Tepecano 800 (I) or 427 (II) years ago; Cora from Pochutla 3600 (I) or 3885 (II) years; Yaqui-Mayo from Pochutla 2700 (I) or 2877 (II) years ago; Tepecano from Mecayapan 3600 (I) or 3481 (II) years ago; Tepecano from Yaqui-Mayo 2900 (I) or 2878 (II) years ago; Tarahumara from Yaqui-Mayo 2400 (I) or 3031 (II) years ago; Hopi from Yaqui-Mayo 3100 (I) or 3389 (II) years ago; Hopi from Papago 3200 (I) or 3779 (II) years ago; Hopi from Tübatulabal 3200 (I) or 2878 (II) years ago; Tübatulabal from Southern Paiute 2900 (I) or 2649 (II) years ago—differences ranging from 22 to 631 years.

Our second source lists all forms out of its particular lexical sample which share a single gloss, irrespective of whether the forms are counted as cognate (or possibly so) or non-cognate. This is done to make data available for further

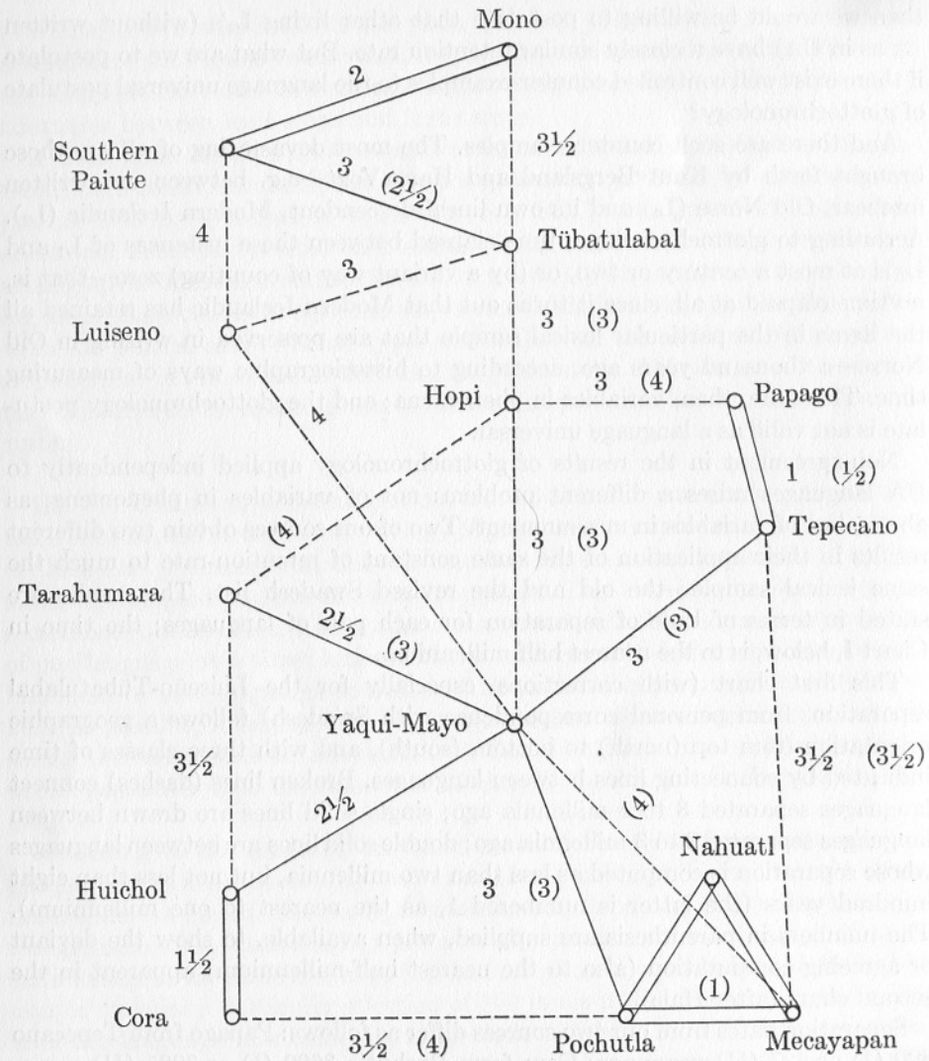



Chart I (after Swadesh)

computation—in anticipation that variant results, such as those listed here, would be encountered. Obviously, without making some such lists available, further computation is inhibited.

But the differences encountered are not easily resolved even when forms are listed, since the computed score for language separation dates depends on what is to be counted as relevant. For example, in a pair of languages sharing a gloss from the test list, one language may have two forms (with overlapping referent for the one gloss), the other a single form for the gloss in question. Does one score this positively? or do so only if the corresponding form is the more frequent in the language with two forms? or toss a coin to decide how to score in such cases? or weight the score (e.g., one-half for such cases)? It seems perfectly obvious that variant computation is reducible to near uniformity simply by computing in the same way.[19]



More difficult to carry out is the one indispensible distinction of the comparative method—the distinction between forms that are similar but non-cognate, and forms which are dissimilar yet cognate. If there were a Papago form sówa meaning *to eat*, it would not be given a positive score when compared to Hopi sówa *to eat*, since the sound correspondences between these two languages would require the Papago cognate to be húg, as indeed it is.

Though the decision to count only cognates, however dissimilar, seems obvious enough, it still imposes a contradiction to the widespread impression that glottochronology can give good first approximations of the relative closeness of sister languages before reconstructive work is done by the comparative method. The difficulty, of course, is that in the absence of sound correspondences, nothing remains but phonetic similarity—a far cry from an objective criterion: what seems more or less similar to the first observer may seem less rather than more similar to the second observer. Before any uniform lexicostatistic computations

[19] The critical writings about glottochronology are unbelievably serious in laboring points like these which seem so superficial and so patently apparent to us that we are puzzled as to what covertly stimulates the deep concern of the critics. Variables in measurement can be reduced and averaged (rather than entirely avoided) when the same general way of measuring is followed. If there is, additionally, a variable in what is measured—if languages change at different rates but within a certain range—then two sets of variables need to be computed, and averages or means need to be expressed, (a) for the measurement variables, and (b) for the range within which languages change, or—more generally—for variables in the phenomena.

The counter examples mentioned above will surely discourage any further analogizing between carbon 14 in physics and glottochronology in linguistics. Radioactive loss for a particular carbon, numbered 14, was discovered to be constant by physicists—the constant rate was not said to be upheld predominantly in the best laboratories, with some exceptions granted without objection; it was taken to mean that there are no variables in the phenomena having to do with the half life of $C^{14}$. However, in the early days of the application of carbon 14 dating to archaeology, there was considerable fluctuation in time estimates—and some fluctuations were not unlike the one or two centuries (or less) which reflect variant ways of counting dates of separation between Old Norse and Modern Icelandic, above. But in carbon 14 dating, the variables in estimation were assumed to be in the measurements made, not in the constant measured (i.e., the margin in $C^{14}$ estimates is a measurement variable rather than an index of variability in the half life of this particular carbon). In glottochronology, on the other hand, two kinds of variables are encountered: variables in measurement (as for $C^{14}$); and also—since carefully controlled counter examples to the eighty percent retention rate have been adduced—variables in the phenomena (from about eighty percent in what has been called above 'the best support for glottochronology' to one hundred percent retention in the case of Old Norse and Modern Icelandic). The old glottochronology will simply have to be revised to accommodate the fact that it faces variables in the phenomena as well as variables in measurement. The revision promises to be—for the first time—mathematically interesting, since (as Hogbin holds) one needs a different statistics for measuring fields in which the variables are in the phenomena. It may be that the mean is meaningful only when the variables are in the measurement; Fischer thinks not, at least not in mathematics relevant to genetics.

can be expected, it is necessary to establish sound correspondences between pairs of languages, and thereby obtain an objective criterion for cognates.

Since we cannot document the following generalization, it is stated as an opinion: that the not inconsiderable volume of work devoted to glottochronology is no more often stimulated by its language universal postulate (now devastated), than by an expectation that it makes possible comparative results via a short-cut which avoids the reconstructive fuss and bother of a comparative method by simply counting similarities among forms sharing the same gloss in a very brief but very particular lexical sample.

The popularity of glottochronology is based on efficiency (short-cut) and absolute positiveness (within a range of computational diversity, as between 22 and 631 years in the UA case just cited) and the utilization of similarity retentions beside cognate retentions; it is also based on an evolutionary-like postulate of change, expressed as a percentage of retained cognates through successive millennia.

There is an important difference between this last and most characteristic expression of glottochronology and the Hoenigswald view—*Language Change and Linguistic Reconstruction* (Chicago, 1960)—that a morpheme is retained so long as its lexical position is filled in the diachronic development (or lineal descent) of a language, even though the lexical position is filled by a form no longer cognate with its own earlier stage or with its sister languages. In this third view (on what is relevant in comparing languages) it might be said for a given language family, as UA, that some high percentage of a particular lexical sample in a language is retained but—unlike glottochronology—not without regard to how the remaining low percentage disappears from sight and sound. This low percentage does not disappear entirely in Hoenigswald's concept of morphemic permanence behind morph replacement. If many later morphs replace earlier morphs, much of glottochronology's disappearing 20 % over a millennium would not disappear at all; every or almost every morphemic slot might be filled, as it was a thousand years ago, or else shifted in the sense of having a given morph associated with one morpheme in $L_1$ but with another morpheme in $L_2$ (the lineal descendent of $L_1$).

There are three kinds of lexical retentions that may be seen, then, depending on how deeply one looks:
(1) similarity retentions are observable before sound-correspondences have been established;
(2) cognate retentions are observable after sound-correspondences have been established;
(3) morphemic retentions are observable even though the forms compared are neither similar nor cognate.

In our adaptation of lexicostatistics to the grouping of UA languages, additional computations are made in order to obtain a quantification of a restricted lexical sample to be compared in **4.3** with approximations of exhaustive lexical selection from pairs of dictionaries.



The results already charted (I, above) are most unpromising for purposes of grouping UA languages. The three or four unusually recent separations revealed in the chart have been traditionally associated as a branch (Aztec), as subbranches (Cora-Huichol and Mono-Southern Paiute), or even—according to Whorf—as a single language (Papago-Tepecano). For the most part, however, languages are computed to have been separated 3 or 4 millennia ago—almost any two Shoshonean languages or two Sonoran languages seem to be no closer to each other than to languages in the other traditional branch.

Chart II, which now follows, is no more revealing than Chart I, but is nevertheless cited for two reasons. First, to show that the years of separation given in our second source, with its commitment to the language universal postulate of glottochronology, can be restated as an inverse index of cognate similarity between pairs of languages (the higher the numbers in Chart II, the lower the number of cognates between a pair of languages). Second, to present in tabular arrangement the numbers which, when averaged, turn out to be useful for grouping languages.

For illustrating the first step in averaging, we take the Hopi vertical column and add successively the inverse indices of cognate density between Hopi and seven other traditional Shoshonean languages in the sample: Northern Paiute (2954), Southern Paiute (2740), Ute (2879), Shoshone (2725), Comanche (2504), Tübatulabal (2878) and Cahuilla (2878), thereby obtaining the sum of 19558 which, when divided by seven, yields 2794 as the average inverse index of cognate density for Hopi and the other Shoshonean languages.

Next we take the Hopi horizontal row and add successively the indices given between Hopi and three Aztec languages in our sample: Zacapoaxtla (3885), Mecayapan (4107), and Pochutla (3779), thereby obtaining a sum of 11771

| | Za | Me | Po | Co | Ta | Ma | Tp | Pi | Pa | Ho | Ca | Tu | Cm | Sh | U | Sp |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Np | 4213 | 4595 | 3992 | 3217 | 4099 | 3298 | 3702 | 3779 | 3206 | 2954 | 3206 | 3039 | 1046 | 1427 | 1328 | 1748 |
| Sp | 4106 | 4733 | 3992 | 3298 | 4107 | 3298 | 3504 | 3779 | 3298 | 2740 | 2802 | 2649 | 1092 | 1198 | 618 | |
| U | 4267 | 4214 | 3992 | 3038 | 3992 | 3038 | 4588 | 3481 | 3389 | 2879 | 3389 | 2649 | 954 | 1481 | | |
| Sh | 5023 | 5152 | 4595 | 3481 | 4733 | 3617 | 4108 | 4107 | 4107 | 2725 | 3046 | 2229 | 424 | | | |
| Cm | 4733 | 4733 | 4099 | 3389 | 4259 | 3481 | 3519 | 3481 | 3298 | 2504 | 2641 | 2298 | | | | |
| Tu | 4221 | 3809 | 3809 | 3046 | 3504 | 3206 | 3809 | 3617 | 3481 | 2878 | 2229 | | | | | |
| Ca | 3617 | 4466 | 3992 | 3671 | 3481 | 3672 | 3481 | 3298 | 3122 | 2878 | | | | | | |
| Ho | 3885 | 4107 | 3779 | 3779 | 3992 | 3389 | 4214 | 3617 | 3779 | | | | | | | |
| Pa | 3916 | 3809 | 3916 | 3389 | 3298 | 3046 | 427 | 198 | | | | | | | | |
| Pi | 4099 | 3702 | 4351 | 3581 | 3206 | 2878 | 695 | | | | | | | | | |
| Tp | 3481 | 3481 | 3617 | 3389 | 2878 | 2878 | | | | | | | | | | |
| Ma | 3617 | 3908 | 2877 | 2878 | 3031 | | | | | | | | | | | |
| Ta | 4466 | 4595 | 3779 | 3779 | | | | | | | | | | | | |
| Co | 4344 | 3885 | 3885 | | | | | | | | | | | | | |
| Po | 1252 | 1214 | | | | | | | | | | | | | | |
| Me | 1145 | | | | | | | | | | | | | | | |

Chart II (after Hale, with abbreviations for Northern Paiute, Np; Southern Paiute, Sp; Shoshone, Sh; Comanche, Cm; Tübatulabal, Tu; Cahuilla, Ca; Hopi, Ho; Papago, Pa; Pima, Pi; Tepecano, Tp; Yaqui-Mayo, Ma; Tarahumara, Ta; Cora, Co; Pochutla, Po; Mecayapan, Me; Zacapoaxtla, Za)

which, divided by 3, gives 3924 as the inverse index of cognate density for Hopi and the traditional Aztec branch.

Finally we continue along the Hopi row, from left to right, and add successively the indices given between Hopi and the six Sonoran languages in the sample: Cora (3779), Tarahumara (3992), Yaqui-Mayo (3389), Tepecano (4214), Pima (3617), and Papago (3779), thereby obtaining the sum of 22770 which, divided by 6, gives 3795 as the average inverse index of cognate density for Hopi and the traditional Sonoran branch.

This first step gives indices which are interpretable roughly for Hopi and the three traditional branches in UA: Hopi shows greater average cognate density with the Shoshonean branch (lower inverse index 2794) than with the Aztec branch or Sonoran branch languages (higher inverse indices, 3924 and 3795, respectively).

**4.3.** Our preliminary consideration (**4.2**) was based on cognate density in a restricted lexical sample but was expressed (in both our sources) in terms of absolute dates giving time elapsed between separation of certain pairs of UA languages. The question now raised is whether the same quantitative dimension or parameter cannot be reconverted to the fundamental data which animate it—different cognate densities which distinguish one pair of languages from another pair of languages in the same family. It is not until the cognate density estimate is based on a relatively randomized or unrestricted lexical sample that a third quantitative dimension or parameter is obtained (see below).

The essential characteristic—or indeed the very basis—of the quantification involved in our preliminary consideration (**4.2**) lies in what has been identified so far as 'a particular lexical sample'. This particular sample has an interesting history. Its author, Morris Swadesh, must have sensed—while working with Salish languages in the Franz Boas Collection of American Indian Languages—that the relatively short word list samples (averaging a few hundred words) used by his Americanist predecessors—Powell, Henshaw, Boas, Haeberlin, Reichard, Kroeber, and others—were so strongly influenced by the domain concept that once the word for a low number occurred, the N+1 count would go up to a score or a hundred; once a body part was cited free association would lead to a dozen or more; once a kinship term was given, the more common kinship terms were sure to follow (but not exhaustively so: not enough kinship terms were cited to satisfy the social anthropologist because the total lexical list was in principle restricted in any one domain so as to assure coverage of several domains).[20] Some few of the domain-dominated words in the restricted list might be inhospitable to borrowings (e.g., the body-part *eye*); but most words, though they shared glosses among the sister languages, had shapes which

[20] Swadesh's predecessors would characteristically elicit and cite only the most frequent or common meaning—*mother's sister*, for example, without listing the possible extended referents of the term for other generations than the immediately ascending one; hence the restricted domain-dominated lexical lists of the last generation are quite different from modern cultural domain dictionaries.



were not promising for working out sound correspondences—whether because they were hospitable to borrowing, or for some other reason. What Swadesh did then was to select from the domain-dominated lexical samples referent ranges (without reference to cultural domains) which would serve to elicit words which might be inhospitable to borrowing and resistant to semantic shift, and by virtue of this be more promising for comparative work than the domain-dominated referent ranges. This Swadesh list became known by two attractive but misleading labels ('basic vocabulary' and 'culture-free vocabulary'), and was reduced in size under the influence of collaborators. A considerable amount of linguistic sophistication has been expended on the production of this new lexical type, or inhospitable lexical sample or, more briefly, Swadesh list. It has been widely tested—perhaps in every part of the world.

It is the Swadesh list that was used by our two sources in **4.2** who, further, converted the cognate densities shared by pairs of languages ($c$) into time elapsed ($t$) (since the separation of a given pair of languages) by postulating 86 % as a universal rate of retention ($r$) in the formula: $t = \log c \div \log r^2$. Since a lesser cognate density is one basis for a greater time of separation, dates for the latter ($t$) are isomorphic with cognate density, but inversely so; hence instead of $t$ in the formula, we might substitute inverse index of cognate densities, or more briefly inverse density ($id$), for the left side of the equation, $id = \log c \div \log r^2$.

Of course, indices of cognate density of the same value could also be obtained—and more directly—by taking percentages of shared cognates of language pairs, and giving a higher index number of cognate density (5 or more) to language pairs which share most cognates, and successively lower index numbers, down to 1 for language pairs which share the least cognates. This we now do in Chart III; this diagram also reflects continued averaging of indices of cognate density, with the consequence that the average of all averages for each traditional branch and sub-branch are roughly interpretable (see below). In this adaptation of lexicostatistics to UA languages (revised from IJAL 24.101–7 and 25.114–21), the diagram which follows is quite divorced from time (therefore, 4 does not mean that number of millennia, nor does 1 mean one thousand years of separation).

This diagram represents the different cognate densities among daughter languages listed at the base of the triangle. Lines run upward from the daughter languages. Most of these converge to form inner triangles whose apexes appear at the left side of the main triangle or arrive at this side by a connecting line. Only one inner triangle has its apex appearing at the right side of the main triangle.

The diagram can also be viewed from top to bottom. From the apex of the main triangle or, more precisely, from both the right side and the left side of this triangle lines run to the daughter languages. But in addition, horizontal lines—each with a number indexing relative cognate density—intersect the main triangle as well as the included inner triangles.

The first horizontal line, with index number 1, marks the lowest cognate density in the diagram. This line intersects the apex of the main triangle from

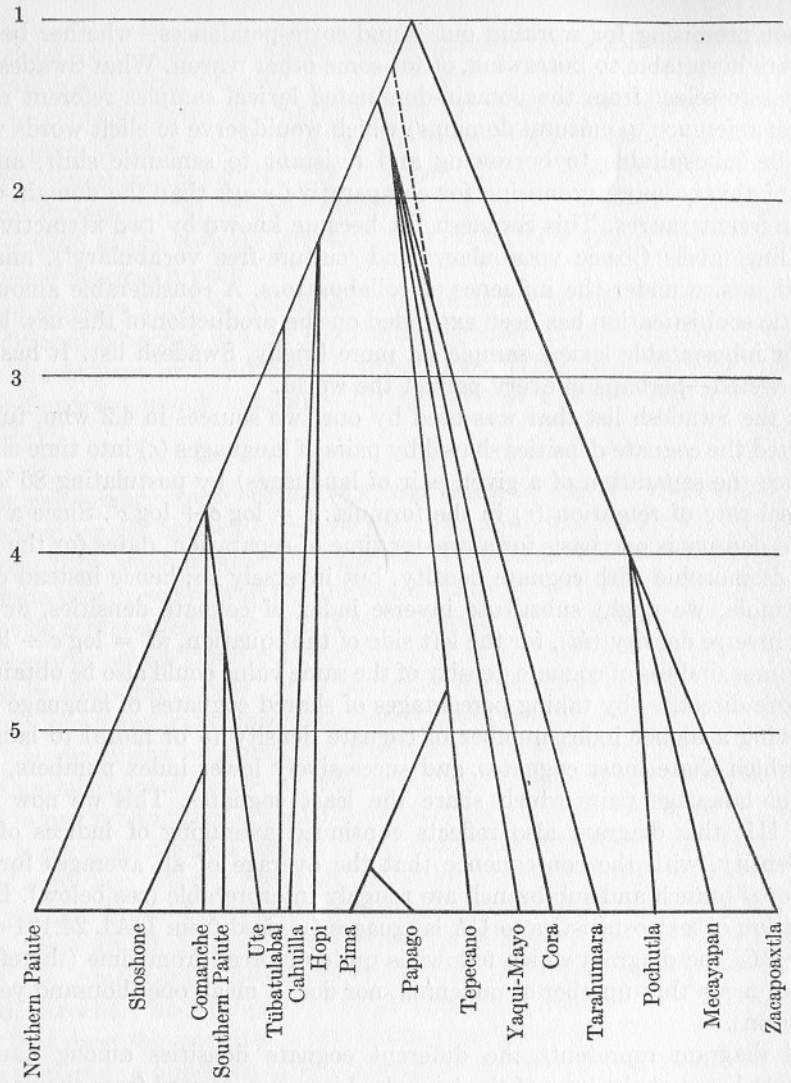



Chart III

which lines run down, on the right side, to the Aztec languages, and on the left side to the remaining UA languages. This is meant to indicate that the fewest cognates are found between the daughter languages in the traditional Aztec branch and the daughter languages in all other branches of UA.

The next horizontal line has the index number 2. It intersects the apex of one included triangle whose lines run down to the daughter languages in the traditional Sonoran branch; and a line connects the apex of this included triangle with the left side of the main triangle, midway between the horizontal lines indexed 1 and 2. This is to indicate that about 1.5 cognate density exists between



Sonoran languages and the remaining daughter languages to which the remaining part of the line of the main triangle then leads—i.e., to all languages in the traditional Shoshonean branch. In addition, a dotted line leads from the Tarahumara line on the included triangle up to the 1.1 cognate density point, or thereabouts, on the left side of the main triangle (just below the apex); this is intended to point out a peculiarity in the proportion of cognates existing between Tarahumara and the traditional Shoshonean languages—fewer than cognates between other Sonoran languages and Shoshonean languages. But, curiously enough, the cognate density among Sonoran languages themselves, including Tarahumara, is about the same; Tarahumara is peculiar in respect to Shoshonean languages, not in respect to other Sonoran languages.

Just below line 2—between the intersecting lines indexed 2 and 3—three lines meet, including the line which forms the left side of the main triangle. This is to indicate that about 2.2 cognate density exists between Hopi and Cahuilla and all the rest of the Shoshonean languages.

And immediately below—but also between horizontal lines 2 and 3—the left side of the main triangle meets with a line leading to Tübatulabal; this is to show that about 2.5 cognate density exists between Tübatulabal and the remaining Shoshonean languages which will be seen to be members of the Plateau sub-branch.

The next horizontal line has the index value 4. It intersects—on the right side of the main triangle—the apex of lines leading to the three Aztec languages which, according to this parameter, would then have approximately the same cognate density. On the left side of the main triangle, an apex of three lines is encountered just above the index 4 line; these lead to daughter languages of the Plateau sub-branch of Shoshonean. According to this, the cognate density among languages of the Aztec branch is more or less the same as that among languages in the Plateau sub-branch of Shoshonean.

The last horizontal line has the index value 5, intersecting most inner triangles, including the triangle representing the Sonoran branch and also the triangle representing the Plateau sub-branch of Shoshonean. Two lines meet a bit above the 5 mark which lead to the Sonoran daughter languages Tepecano and Pima-Papago, which have a cognate density indexed as about 4.9 (but the Pima-Papago pair have a higher cognate density index, perhaps 5.7). In the triangle representing the Plateau sub-branch, two lines meet above the 5 mark, two below. The lines meeting above it lead to two daughter languages (Southern Paiute and Ute), having a cognate density of about 4.5. The lines meeting below it lead to two other daughter languages (Shoshone and Comanche), having a much greater cognate density, say 5.2.

So much for our second dimension or parameter, whether stated in terms of cognate density, as above, or in terms of time elapsed by assuming that a constant rate of change is operative (**4.2**), but quantitatively comparable only over a diffusionally inhospitable lexical selection—the Swadesh list—rather than over a randomized or exhaustive comparison of the lexical resources in pairs of dictionaries.

An attempt is made in the remaining part of this section to show that the cognate densities obtained from the Swadesh list are comparable to cognate densities obtained from unrestricted lexical lists. Our third dimension or parameter amounts to cognate densities obtained from the lexical resources of pairs of dictionaries, insofar as these are available for UA languages. We give the percentages of cognates obtained from less than an exhaustive but more than a restricted lexical sample—in brief, relatively randomized selections from the lexical resources of the following pairs of languages.

Between Southern Paiute
and Mono, 54 percent;
and Comanche, 57 percent;
and Papago, 23 percent;
and Zacapoaztla, 21 percent.

The cognate density between Southern Paiute and other languages in the Plateau sub-branch lies in the fifty percent decade, while the cognate density between Southern Paiute and a representative of either the Sonoran branch (Papago) or the Aztec branch (Zacapoaxtla) lies in the twenty percent decade. This is based on the relatively unrestricted dictionary sample; when based on the Swadesh list, cognate density between Southern Paiute (as well as other Shoshonean-Sonoran languages) and the Aztec branch is indexed 1—somewhat lower than cognate density between Shoshonean and Sonoran languages, indexed 1.5 in the diagram above.

Between Hopi
and Southern Paiute, 41 percent;
and Luiseño, 42 percent;
and Zacapoaxtla, 23 percent;
and Tarahumara, 33 percent.

From the relatively unrestricted dictionary sample, it appears that the cognate density between Hopi and a representative of either the Plateau sub-branch (Southern Paiute) or the Southern California sub-branch (Luiseño) of Shoshonean lies in the forty percent decade, while the cognate density between Hopi and the representative of the Aztec branch (Zacapoaxtla) lies in the twenty percent decade. This agrees with the index number of about 2.2 in the diagram above for cognate density of Hopi and Cahuilla (also a representative of the Southern California sub-branch) in respect to other traditional Shoshonean languages, all of which share fewer cognates with the Aztec branch. Also, according to the diagram above, Shoshonean languages generally, including Hopi, share more cognates with the Sonoran than with the Aztec languages; the relatively unrestricted dictionary sample seems to confirm this, since the cognate density lies in the thirty percent decade for Hopi and Tarahumara; but see below for the wholly unexpected percentages of shared cognates between the traditional Sonoran languages, on the one hand, and Hopi and Luiseño, on the other.

Between Papago
and Tarahumara, 34 percent;



and Cora, 35 percent;
and Southern Paiute, 23 percent;
and Zacapoaxtla, 29 percent;
and Luiseño, 33 percent;
and Hopi, 33 percent.

These cognate densities, computed from relatively unrestricted dictionary samples, are mostly expectable, since they are in general agreement with the indices of cognate densities in the diagram based on the Swadesh list; but the last two are surprising, since they are not represented in the diagram derived from the Swadesh list. While the cognate densities among the Sonoran languages (Papago, Tarahumara, Cora) fall in the thirty percent decade, cognates shared by Papago and representatives of the two other traditional UA branches—Southern Paiute and Zacapoaxtla—fall in the twenty percent decade. So far, so good. But cognate densities between Papago and representatives of two sub-branches of Shoshonean—Hopi and Luiseño—fall in the thirty percent decade also; that is to say, there appear to be no more shared cognates among traditional Sonoran languages than between Papago and Hopi in this tabulation, or between Tarahumara and Hopi in the preceding tabulation.

Interpretation at this point is much dependent on what the percentage of shared cognates between Sonoran and the remaining Shoshonean sub-branch (Tübatulabal) will show. So far, our representative of the northernmost sub-branch of Shoshonean (Plateau) shares significantly fewer cognates with Sonoran (Papago) than Sonoran languages share with each other. Two of the three other sub-branches of Shoshonean (Southern California and Hopi are spoken in geographic areas closest to the Sonoran areas, thereby facilitating diffusion. (Sound correspondences among the languages in question should provide a clue to borrowing; such clues have not been detected.) However, the Tübatulabal area is bordered by languages of the Plateau sub-branch, and is non-contiguous to the Sonoran languages. Despite this, the cognate density of Papago and Tübatulabal is 33 percent—essentially the same as the cognate density between Papago and Hopi, Papago and Luiseño, and Papago and other Sonoran languages.

# CHAPTER 5

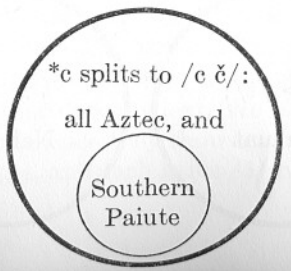
## TOWARD RECONSTRUCTING MAJOR BRANCHES

In the paired sections (on DEVELOPMENTS as well as on SAMENESSES), letters for phonemes preceded by asterisks indicate Proto Uto-Aztecan reconstructions. (Reconstructions for each of the Proto branches are discussed after the paired sections.)

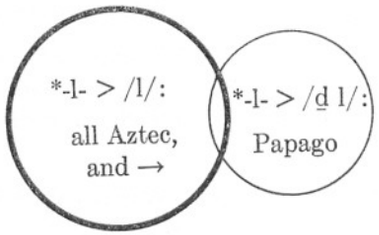
## PHONOLOGICAL DEVELOPMENTS IN AZTEC


This development—in the distributionally restricted environment, as stated—is universal for Aztec; it is also exclusive to Aztec, since it is found in neither of the other major branches.

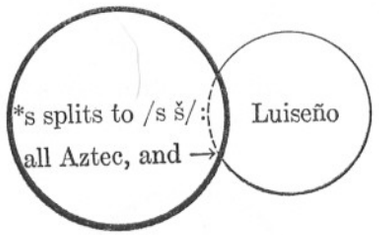

This development of UA laryngeals holds for all environments in which UA laryngeals occur; it is not to be confused with the so called saltillo which appears in some Aztec languages (see **1.1**). The two negative statements which follow may be correlated: (1) the saltillo in Aztec languages is never directly descended from either laryngeal in UA; (2) it differs in interphonemic specification from /ʔ h/ in other daughter languages in other UA branches. The latter—laryngeals descended from UA */ʔ h/—appear initially and intervocalically in non-Aztec languages; the saltillo occurs finally and as first member of consonant clusters in some Aztec languages.



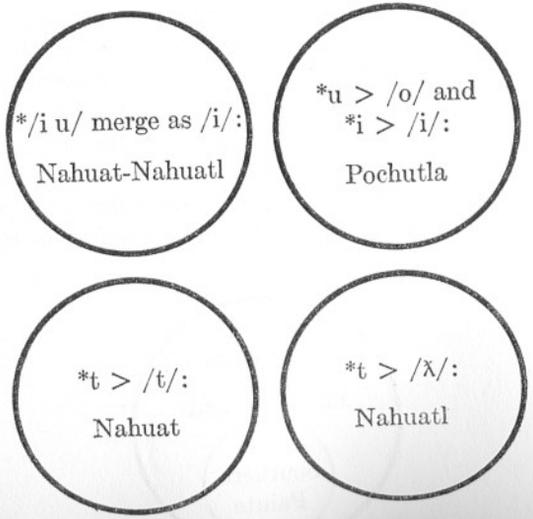
This development is universal for Aztec; it is not exclusive to this branch since a parallel development appears in a Shoshonean language.




This development is found universally in Aztec, and almost exclusively so; the Papago /l/ is peculiar to Arizona Pima-Papago, since in other dialects and languages of the Piman-Tepehuan sub-branch of Sonoran, the descent of *l is to /r/.




This development is really both universal for Aztec and exclusive to Aztec, since the Luiseño instance represents a secondary development—hence a parallel structural sameness which, in effect, is a convergence with, rather than a parallel development with Aztec. The Luiseño development is not a direct split from UA *s; indeed, the usual descent is from *s to /š/ in Luiseño.

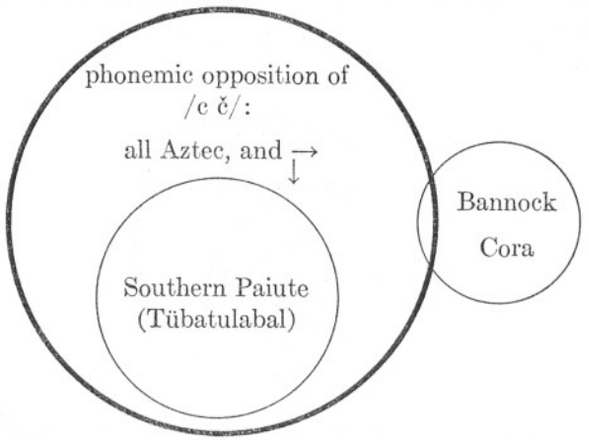




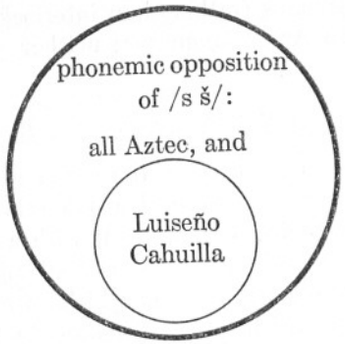

The two pairs of contiguous (rather than interlocking) circles show parallel developments peculiar to Aztec languages; neither pair of developments are found in non-Aztec languages.

## STRUCTURAL SAMENESSES IN AZTEC

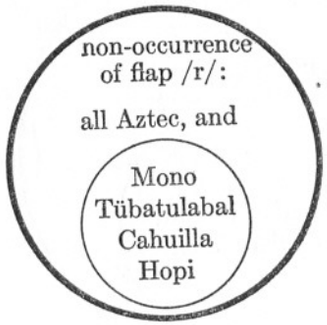
The fact that, for each major branch, the DEVELOPMENTS section (as above) is paired with the SAMENESSES section (as here) does not mean that we intend to match each specific phonological development with a parallel structural sameness, though such paired matchings are occasionally given for special reasons. Thus, compare the development above in which *c splits into /c č/, and the structural sameness below which draws attention to the phonemic opposition of /c č/; both are universal for Aztec and indeed report the same bit of information on Aztec phonology from two different points of view—so far as Aztec phonology is concerned; however, since the phonologies of non-Aztec languages are also relevant to this report, it is important to note that from one point of view the feature in question is rarely found in a parallel way outside the Aztec branch, while from the other point of view (structural sameness) this feature is widely spread beyond the Aztec branch.



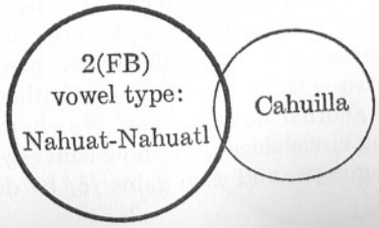

This structural sameness is universal for Aztec, though not exclusive to this branch. Though the /c č/ opposition is here taken as a single sameness, from the point of view of phonemic structure, we know that it is a consequence of at least two separate developments. First, as already noted in the paired section, above, splitting from UA *c accounts for the opposition in Aztec languages, and in Southern Paiute; we now add Tübatulabal parenthetically in the inner circle to indicate that we lack information on whether the source for /c č/ is from *c by split or by another development. We chart Bannock and Cora together in an interlocking circle since they show convergent development: UA *c remains /c/ in both languages, and each gains /č/ by descent from another UA phoneme.




This structural sameness is universal for but not exclusive to Aztec. As already noted in the preceding section, splitting from UA *s accounts for the /s š/ opposition in Aztec languages, under statable environmental conditions (see above). Though the Luiseño /s š/ opposition, and probably the Cahuilla opposition, also descended from UA *s, the conditions under which the split occurred are not yet statable; there is evidence to suggest that the convergence of this opposition in the Southern California Shoshonean languages is the consequence of a secondary development which did not affect a parallel affricate linear distinction.




This structural statement is universal for Aztec; it is not exclusive to Aztec, since it is shared by at least one language in every sub-branch of Shoshonean. If we were to assume that the Luiseño /r/ is restricted to Spanish loans, then Luiseño should be added to the languages charted in the inner circle.






Though this structural sameness is neither universal for Aztec nor exclusive to Aztec, it approximates being both—less one language on each count. All Aztec languages, except Pochutla, are exemplars of the wholly symmetrical 2(FB) vowel type. No vowel system outside the Aztec branch is a complete exemplar of this type; though the 2(FB) vowel type occurs in Cahuilla, it occurs as one of two co-existing vowel types (for short vowels) beside another vowel type, 2(FB) over N (for long vowels). However, we chart Cahuilla in a minor circle interlocking the Nahuat-Nahuatl circle, above, because two different developments lead to the 2(FB) convergence. This vowel type is developed in Nahuat-Nahuatl as a consequence of merging UA */i u/ as /i/; it is developed in Cahuilla as a consequence of merging */o u/ as /u/.

## TOWARD A RECONSTRUCTION OF PROTO AZTEC PHONOLOGY

In a relative density range for cognates among all UA branches and languages, the least cognate density noted is given the weight of 1, the lowest number in the scale which ranges up to 5 or a fraction more than 5 for the greatest cognate density noted (see **4.3**, above). According to this scale, languages in the Aztec branch reach a higher rank order in cognate density—namely 4—than do languages in either of the other two UA branches. But when cognates shared by Aztec languages and other UA languages are ranked only the minimum weight of 1 is reached.

Proto Aztec Phonemic Inventory

| | | | | | |
|---|---|---|---|---|---|
| p | t | c | č | k | $k^w$ |
| | | s | š | | |
| m | n | | | | |
| | -l- | | | | |
| w | | y | | | |
| i | u | | | | |
| e | o | | | | |
| | a | (plus or minus saltillo) | | | |

The reconstruction of both consonants and vowels in Proto Aztec differs from their reconstruction in Proto Uto-Aztecan in structural detail as well as in vowel type and in linear distinctions for consonants. (See **1.2** for the inventory of Proto Uto-Aztecan phonemes.)

The development which led to the phonemic opposition of /c č/ and /s š/ was completed after Proto Uto-Aztecan times but before Proto Aztec times—a period of development that may be called pre-Aztec. This opposition between linear distinction points (2+) and (3) in consonants (see **1.1**, above) is a consequence of the merger of UA */i i/ as *i in pre-Aztec verb final vowels; before the merger, *[c č] and *[s š] were allophones of a single affricate and a single sibilant, respectively, since the allophones appeared in complementary distribution:

*[č š] before *i, and *[c s] before *i or, more generally, before *V(non-i). After the vowels were merged as *i in pre-Aztec, the allophonic or phonetic differences in these consonants were transformed into phonemic contrasts, since /c č/ and /s š/ thereafter would occur in overlapping distribution—that is, in the same environment: before /i/.

The merger of UA */n ŋ/ as *n was also completed in pre-Aztec times.

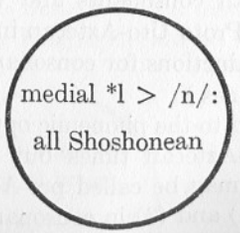
The lateral is distributionally restricted to medial position, and hence is written (in the chart above) between hyphens, as reconstructed -l-.

The development which led to the loss of the laryngeals was already completed in pre-Aztec times, before the introduction of the so-called 'saltillo' (see **1.1**). The latter is classified in the chart above as a vocalic rather than as a consonantic feature; in distribution, the saltillo is post-vocalic.

Vowels appearing in Aztec languages are ultimately descended from the UA vowel inventory (**1.2**, above)—the earliest stage; the next stage in the descent is the 2(FB) over N type, as represented in the chart above for Proto Aztec—an intermediate stage made necessary by the vowel system of pre-Aztec; this intermediate stage continues as the modern five vowel system of Pochutla. The third stage was completed after pre-Aztec times just after the separation of Pochutla from Nahuat-Nahuatl—a period of development that may be called pre-Nahuat-Nahuatl. Then, finally, */i u/ of the pre-Aztec stage merged as *i in the pre-Nahuat-Nahuatl stage, with a consequent transformation of vowel type from 2(FB) over N to the wholly symmetrical 2(FB) type, $\begin{matrix} i & o \\ e & a \end{matrix}$, which continues in the several Nahuat languages today as well as in Nahuatl which is spoken in several dialects.

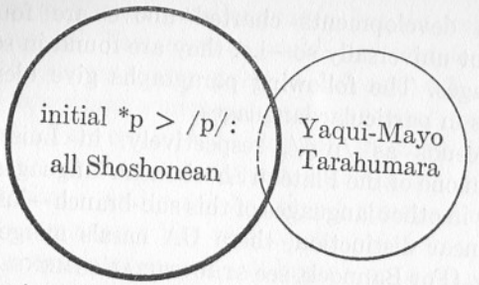
## PHONOLOGICAL DEVELOPMENTS IN SHOSHONEAN

Of the nine developments which are listed below, one is found exclusively and universally in Shoshonean; a couple of others are either universal or near universal for Shoshonean, and almost but not entirely exclusive to this major branch; the remaining half dozen developments are exclusive to Shoshonean—i.e. not found in either of the other two branches.

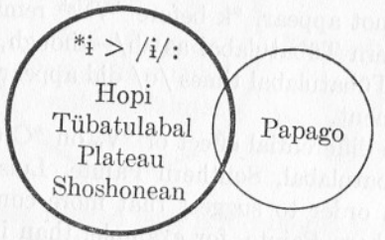



In this development, medial UA *l descends as /n/ in all Shoshonean languages; medial *l does not appear as /n/ in any Sonoran language nor in any Aztec language.

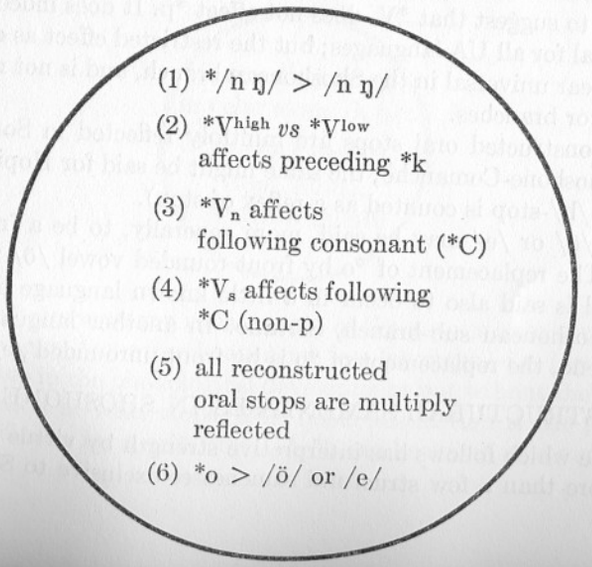





This development is universal for Shoshonean. We chart Yaqui-Mayo and Tarahumara in a minor circle which weakly interlocks (hence dotted interlocking lines) with the circle enclosing the Shoshonean development, since (1) UA *p- usully descends in Yaqui-Mayo as /v/, rarely as /p/; and (2), though UA *p- remains as a labial stop in Tarahumara, it appears combined with SGC of voicing as /b/.




This development is near-universal for Shoshonean: it appears in all sub-branches but one (Southern California Shoshonean). Of sub-branches made up of more than one language, it appears in all Plateau Shoshonean languages, but in neither Luiseño nor Cahuilla. However, it is not exclusive to the Shoshonean branch since a parallel development occurs in Papago.



The half dozen developments charted above are found exclusively in Shoshonean, but not universally so—i.e. they are found in some rather than all Shoshonean languages. The following paragraphs give identifying details for these developments in particular languages.

(1). */n ŋ/ descends as /n ŋ/, respectively, in Luiseño-Cahuilla, Hopi, Tübatulabal, and in one of the Plateau Shoshonean languages (Southern Paiute), but not apparently in other languages of this sub-branch—instead of maintaining the apical-velar linear distinction, these UA nasals merge in Shoshone-Comanche and Mono. (For Bannock, see STRUCTURAL SAMENESSES, below.)

(2). The regressive differential effect of $*V^{high}$ *vs* $*V^{low}$ on *k is reflected in all Shoshonean languages except Shoshone-Comanche and Bannock. In all but one of the languages in which this regressive effect is apparent, initial *k before $*V^{high}$ remains /k/, but before $*V^{low}$ appears as /q/ (Luiseño and Cahuilla and Hopi; and of the languages in the Plateau Shoshonean sub-branch, Southern Paiute and Mono). And even in the single affected language—Tübatulabal—in which this precise split does not appear, *k before $*V^{high}$ remains /k/ but *k before $*V^{low}$ descends in modern Tübatulabal as /h/—though, of course, there is the possibility that in pre-Tübatulabal times /q/ did appear and was later replaced by /h/ in this environment.

(3). The progressive differential effect of $*V_n$ on *C (UA consonant) is variously reflected in Tübatulabal, Southern Paiute, Luiseño, Shoshone, Hopi—languages listed in an order to suggest that more consonants are affected in Tübatulabal and Southern Paiute, for example, than in Hopi, the last on the list.

(4). The progressive differential effect of $*V_s$ on *C (non-p) is reflected only in some Shoshonean languages, as Southern Paiute, Bannock, Comanche, and possibly Shoshone; and there are difficulties in showing the reflexes in Mono and Luiseño. The effect of $*V_s$ is here restricted to UA consonants other than *p; this is not to suggest that $*V_s$ does not effect *p. It does indeed effect *p, as a near universal for all UA languages; but the restricted effect as charted above, appears as a near universal in the Shoshonean branch, and is not reflected in the two other major branches.

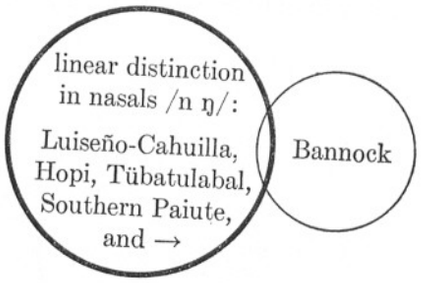
(5). All reconstructed oral stops are multiply reflected in Southern Paiute, Mono, and Shoshone-Comanche; the same might be said for Hopi (if the phonemic sequence /h/-stop is counted as a reflex of stop).

(6). *o > /ö/ or /e/ may be said, more generally, to be a fronting of Uto-Aztecan *o. The replacement of *o by front rounded vowel /ö/ is well attested for Hopi, and is said also to occur in a little known language of the Southern California Shoshonean sub-branch, Serrano. In another language of this sub-branch, Luiseño, the replacement of *o is by front unrounded /e/.

## STRUCTURAL SAMENESSES IN SHOSHONEAN

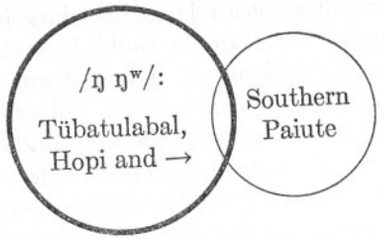
The sample which follows has interpretive strength by virtue of showing that there are more than a few structural samenesses exclusive to Shoshonean—i.e. found in two or more Shoshonean languages but in neither of the other branches of Uto-Aztecan. This sample could be extended—e.g. by the inclusion of rank-order computations given in **1.2** and **4.1.** In the sample, as given, none of the structural samenesses are universal for Shoshonean even though, as mentioned, all are exclusive to Shoshonean. Excluded from this sample are narrow scope samenesses—e.g. the non-occurrence of both liquids, /l r/, in Mono, Bannock, Shoshone, and possibly other languages in the Plateau Shoshonean sub-branch; samenesses like this are excluded from our sample when they are known to be restricted to one sub-branch or one language. Conversely stated, structural samenesses are included in our sample only when they are shared by two or more Shoshonean sub-branches.



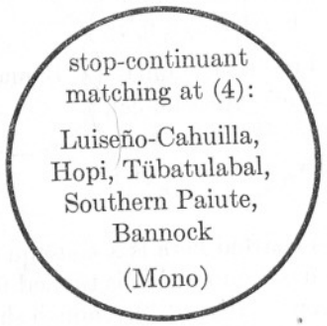



The structural sameness charted here is a consequence of two developments. The reconstruction of the nasal opposition is carried up from Proto Shoshonean (see below) to Proto Uto-Aztecan (see **1.2**). Though sharing the structural sameness in question, Bannock does not support this reconstruction, since Bannock /ŋ/—contrasting with /n/, to be sure—is obtained from some unknown source (but other than from *ŋ).

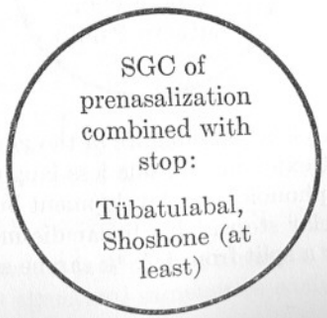

This structural sameness is a consequence of the PHONOLOGICAL DEVELOPMENT numbered (2), above, but extends over one less language—i.e. less Tübatulabal which participates in the phonological development but wthout the consequence of linear distinction in velar stops. This linear distinction is not reconstructed because the conditions for a split from UA *k can be stated as a regressive effect of $*V^{high}$ *vs* $*V^{low}$.




In this structural sameness, which contrasts unrounded and rounded velar nasals, the rounded velar is a consequence of two phonological developments. In both Hopi and Tübatulabal, /ŋʷ/ descends not from all UA *w, but from *w which occurs after *$V_n$. But in Southern Paiute, /ŋʷ/ descends from *m which occurs after *$V_s$.

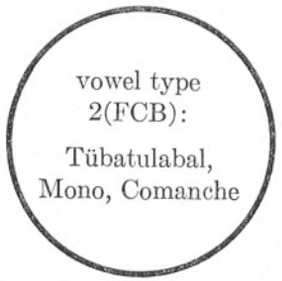



Strictly speaking, it is a typological sameness that is charted here: all Shoshonean languages, except Shoshone-Comanche, match stops with continuants at the linear distinction point numbered (4) in the languages listed (and at (4̣) in Mono, listed parenthetically); the velar stop is always /k/ or /q/ but the matching continuant is either velar fricative /x/, or velar nasal /ŋ/, or both. Thus, stop matches fricative at (4̣), /q x/, in Mono; stop matches nasal at (4), /k ŋ/, in Bannock, Hopi and Tübatulabal; stop matches both fricative and nasal at (4), /k x ŋ/, in Southern Paiute and Luiseño-Cahuilla.






Here again, but in a different sense, it is possible to speak of a typological sameness. Though phonemicizations may be non-unique (structurally), it is possible to typologize some Shoshonean languages in the same way—namely, when stops are preceded by homorganic nasal—irrespective of whether such nasal-stop phonetic sequences are phonemicized as clusters of two consonants (see **1.1** for examples), or as unit phonemes of one consonant; the latter phonemicization is followed for Tübatulabal and Shoshone.




This is one of the two wholly symmetrical vowel types in Uto-Aztecan, and is found exclusively in Shoshonean languages; the other—2(FB)—is found exclusively in Aztec languages; none of the Sonoran languages exhibit a wholly symmetrical vowel type.

## TOWARD A RECONSTRUCTION OF PROTO SHOSHONEAN PHONOLOGY

In the density range scale from least (1) to most (5 plus), a rank-order of somewhat more than 2 is shown for the cognates among all Shoshonean languages (see **4.3**, above). When the Shoshonean lexical sample is counted for shared cognates with other branches within Uto-Aztecan, a lower cognate density rank is obtained—namely 1.5 between Shoshonean and Sonoran, and 1 between Shoshonean and Aztec. When the Shoshonean lexical sample is counted for shared cognates with sub-branches within the Shoshonean branch, higher density ranks than 2 are obtained (see again **4.3**).

Proto Shoshonean Phonemic Inventory

| | | | | | |
|---|---|---|---|---|---|
| p | t | c | k | $k^w$ | ʔ |
| | | s | | | h |
| m | n | | ŋ | | |
| | l- | | | | |
| w | | y | | | |
| i | ɨ | u | | | |
| | a | o | | | |

And morphophonemic formulae: *$V_u$ *$V_s$ *$V_n$.

Since the languages in the Shoshonean branch give, by and large, more sup-

port to the reconstruction of Proto Uto-Aztecan than the languages of the other branches, it is not surprising that the reconstruction of Proto Shoshonean turns out to be closely similar to the reconstruction of Proto UA. Still, there are differences.

If the Shoshonean lexical sample included reflexes of Proto UA medial *l alone, and not of initial *l, then it would not be necessary to include this lateral in the phonemic inventory of Proto Shoshonean, since Proto UA medial *l and medial *n merge in Proto Shoshonean as *n. However, we do include initial *l- in the phonemic inventory of Proto Shoshonean in order to account for the initial consonant of the stem glossed *tongue* (94) in Tübatulabal and Hopi.

In the phonemic inventory of Proto UA, /r/ is included, but not in that of Proto Aztec nor that of Proto Shoshonean. The absence of glide *r in the Proto Aztec inventory does not call for comment, since none of the Aztec daughter languages include /r/. However, among the Shoshonean daughter languages, flap /r/ is included in the inventories of Southern Paiute and Comanche; but this flap /r/ is descended from Proto Shoshonean *t after *$V_s$. And in addition, glide /r/ is included in the phonemic inventory of Hopi; but this glide /r/ is not descended from Proto Shoshonean *t—it is descended from Proto UA *r which, according to the usual reconstructive techniques, is sufficiently supported, since at least three languages show the descent from Proto UA *r—besides Hopi, Papago and Huichol. But within the Shoshonean branch alone, it is difficult to find support for reconstructing Hopi glide /r/ as *r in Proto Shoshonean, since cognates in which Hopi /r/ occurs are either entirely lacking in other Shoshonean languages, or else are dubiously cognate—e.g. *bean*, in Hopi móri (with glide /r/), and in Southern Paiute múri (with flap /r/), the latter a form not known to be shared by any other languages than Southern Paiute in the Plateau sub-branch, and hence probably borrowed by Southern Paiute from Hopi; this possibility is supported by extra-linguistic cultural considerations.

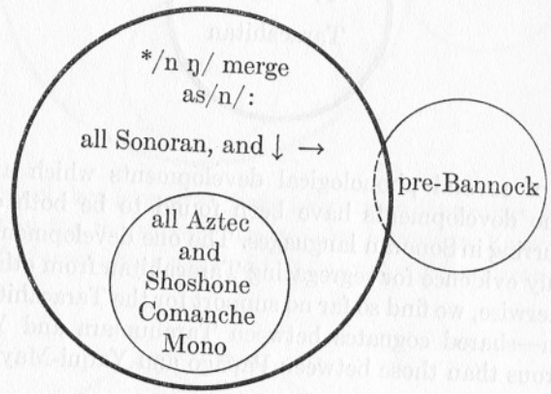
Literally speaking, the vowel sets *$V_s$, *$V_n$, and *$V_u$ are reconstructed neither for Proto Aztec (see above) nor for Proto Sonoran (see below), but only for Proto Shoshonean (and hence, by definition, for Proto UA). Without the evidence from Proto Shoshonean languages—i.e. operating only with evidence from Aztec and Sonoran languages—one additional consonant reconstruction, as *$p_1$ beside *$p_2$ (see Sonoran, below) would account for the correspondences which involve a labial stop in Proto UA. However, in parallel Shoshonean correspondences, not only is UA *p involved, but other consonants as well. The reconstruction of *$V_s$, *$V_n$, *$V_u$ are applicable to the Aztec and Sonoran languages, but are primarily supported by Shoshonean languages. That is, when reconstructed for Proto Shoshonean (and hence, Proto UA), the reconstructions of these vowel sets neatly account for parallel developments from UA *p into Aztec and Sonoran languages.

## PHONOLOGICAL DEVELOPMENTS IN SONORAN

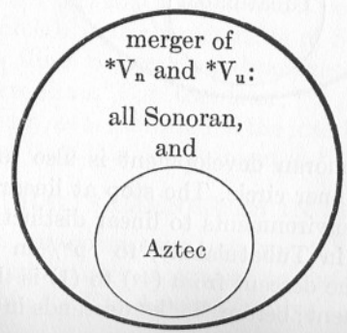
The sample which follows may be divided into four classes of phonological developments, according to their distribution within the Sonoran branch and



within the Uto-Aztecan family. The first class of developments is found in all Sonoran languages but also in both of the other UA branches. The second class of developments is likewise found in all Sonoran languages and, with certainty, in one other major branch. The third class of developments is exclusive to Sonoran, but occurs in only one Sonoran sub-branch. The fourth class—developments which may at most be said to be characteristic of Sonoran—are found neither universally nor exclusively in this branch.

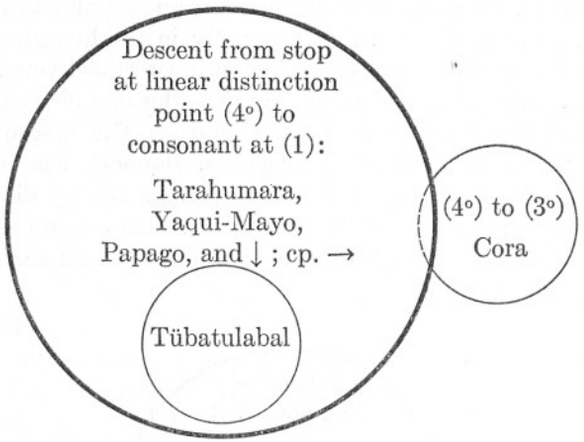



This merger is found universally in Sonoran; and so also in Aztec, listed in the inner circle. It occurs also, but not universally, in Shoshonean—in the Plateau Shoshonean languages which are listed in the inner circle. One additional language from this same Shoshonean sub-branch—the one charted above in the interlocking circle—is designated as pre-Bannock. The link overlapping the main circle is dotted to indicate that modern Bannock has redeveloped the linear distinction /n ŋ/; however, that the merger to /n/ did occur in pre-Bannock times is supported by the fact that modern Bannock /ŋ/ did not descend from *ŋ in the way usual for other Shoshonean languages which maintain the /n ŋ/ linear distinction.



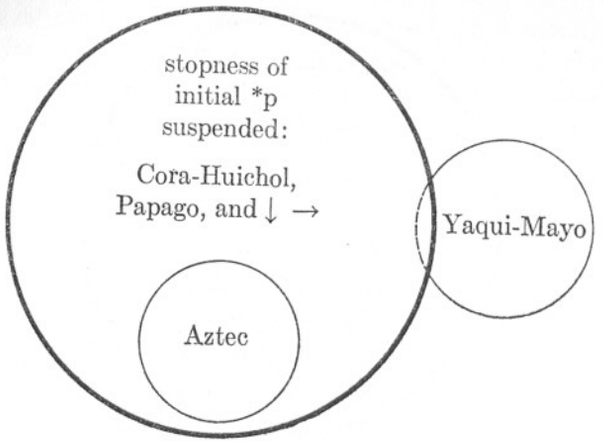
It is possible, but not certain, that this widespread merger differentiating *$V_s$ from merged *$V_n$ and *$V_u$, is reflected in Mono. An analogous merger in Comanche differentiates *$V_u$ from merged *$V_s$ and *$V_n$.


This is one of several phonological developments which are exclusive to Sonoran; but no developments have been found to be both exclusively and universally occurring in Sonoran languages. The one development charted above provides the only evidence for segregating Taracahitan from other sub-branches of Sonoran; otherwise, we find so far no support for the Taracahitan classification within Sonoran—shared cognates between Tarahumara and Yaqui-Mayo are no more numerous than those between Papago and Yaqui-Mayo, for example.

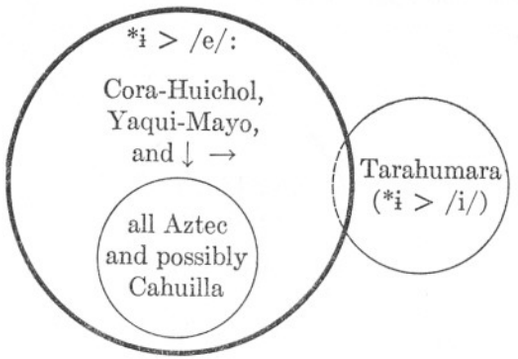



This characteristic Sonoran development is also found in the Shoshonean language shown in the inner circle. The stop at linear distinction point (4°) is *$k^w$; it descends in all environments to linear distinction point (1)—to /w/ in Tarahumara (and also in Tübatulabal); to /$p^w$/ in Yaqui-Mayo; to /b/ in Papago. Analogous to the descent from (4°) to (1) is that from (4°) to (3°), but in a particular environment; before *i, *$k^w$ descends in Cora as /$č^w$/.





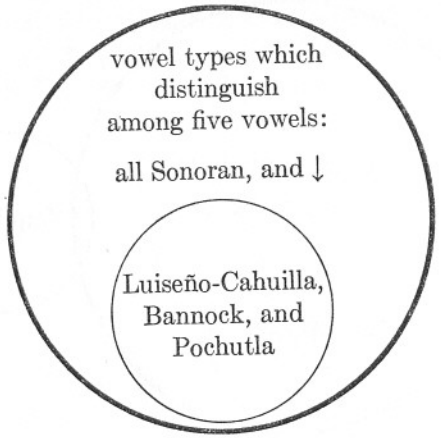

This phonological development, shared by Aztec languages and the Sonoran languages listed in the main circle above, also occurs in Yaqui-Mayo; though the stopness of *p is usually suspended (*p > /v/), *p sometimes remains /p/ in Yaqui-Mayo.



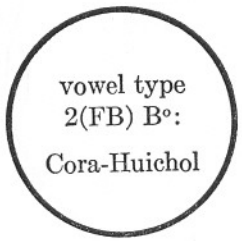

Like the first phonological development noted above, this development is found not only in Sonoran but also in Aztec and possibly in Shoshonean (as indicated in the inner circle). It is characteristic of Sonoran in the sense that it occurs in two of the three Sonoran sub-branches—not in Papago, but in Cora-Huichol and Taracahitan. For the later, *i > /e/ in Yaqui-Mayo; but *i > /i/ in Tarahumara, as is indicated in the interlocking circle with dotted overlap line (less frequent than this development is *i > /e/ in Tarahumara).

## STRUCTURAL SAMENESSES IN SONORAN

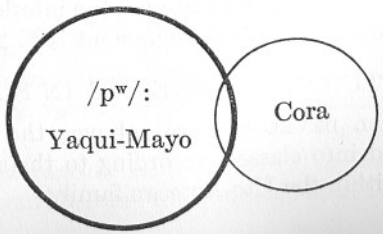
As for PHONOLOGICAL DEVELOPMENTS, above, the following STRUCTURAL SAMENESSES are divided into classes, according to their distribution within the Sonoran branch, and within the Uto-Aztecan family.




This is a typological rather than a structural sameness, and a generalized typological sameness at that. It is cited because it appears to be the olny instanec of a structural sameness in phonology for all Sonoran languages; it is not exclusive to Sonoran since it also appears in the two other branches: Aztec (Pochutla) and Shoshonean.

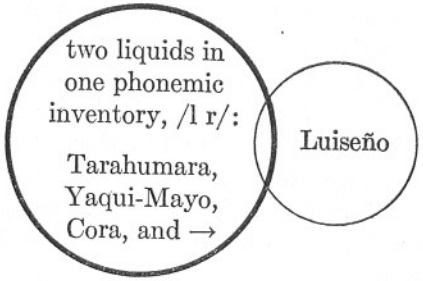



This structural sameness is found exclusively in Sonoran, but occurs in only one Sonoran sub-branch (see further reference to Cora-Huichol under non-occurrence of /k$^{w}$/, below).

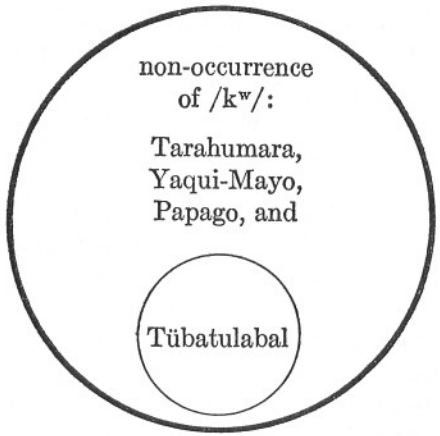





This structural sameness is also found exclusively in Sonoran, but occur in-two sub-branches rather than one. The second instance is charted in an inters locking circle because it is developed from a different source than the first.




This characteristic structural sameness is not universal for Sonoran; nor is it exclusive to Sonoran since it occurs also in the Shoshonean Luiseño (assuming a Luiseño /r/ before contact with Spanish). Luiseño is placed in an interlocking circle—rather than in an inner circle—because Luiseño occurrences of /l/ are descended from UA *t; the same cannot be said for the Sonoran languages. Beside the occurrences of /l/ < *t, Luiseño /l/ appears in reduplicated forms as a secondary development (in thematic partial immediately after the reduplicated exfix).




This is another characteristic structural sameness in Sonoran: the lack of /k$^{w}$/ can be accounted for as a phonological development in which stop at linear distinction point (4°) in the parent language is replaced by consonant at linear distinction point (1)—in Sonoran and in one Shoshonean language

(Tübatulabal). It is not universal for Sonoran since /k$^w$/ does occur in Cora-Huichol, and thereby supports the distinction of this sub-branch from other sub-branches in Sonoran.

## TOWARD A RECONSTRUCTION OF PROTO SONORAN PHONOLOGY

In the density range scale from least (1) to most (5 plus), a rank of somewhat less than 2 is shown for the cognates among all Sonoran languages (see **4.3**, above). When the Sonoran lexical sample is counted for shared cognates with other branches of UA, a lower density range is obtained—1.5 between Sonoran and Shoshonean and 1 between Sonoran and Aztec. It is interesting that there are more shared cognates, apparently, between Sonoran and Shoshonean than between Sonoran and Aztec; and it is also unexpected, since there are more shared phonological developments between Sonoran and Aztec than between Sonoran and Shoshonean.

Proto Sonoran Phonemic Inventory

| | | | | | | |
|---|---|---|---|---|---|---|
| p$_1$ | p$_2$ | t | c | k | k$^w$ | ? |
| | | | s | | | h |
| m | | n | | | | |
| | | -l- | | | | |
| | | r | | | | |
| w | | | | y | | |
| i | ɨ | u | | | | |
| | a | o | | | | |

When the phonemic inventory of Proto Sonoran is compared with that of Proto Shoshonean on the one hand, and with Proto UA on the other, it appears to be closely similar to both. But the differences are not unimportant.

Unlike Proto Shoshonean and like Proto Uto-Aztecan, *r is reconstructed in Proto Sonoran because /r/ occurs in more than one daughter language but, more importantly, */l r/ are differently reflected in Huichol; they are merged in Papago.

Though *l is reconstructed for both Proto Sonoran and Proto Shoshonean, the latter is a distributionally restricted reconstruction (hence written *l-); the *l reconstructed for Proto Sonoran is also restricted in its distribution, but medially so (hence written *-l-), like Proto Aztec rather than Proto Shoshonean.

Unlike Proto Shoshonean but like Proto Aztec (*q.v.*) is the merger of Proto UA */n ŋ/ as *n in Proto Sonoran.

Two labial stop phonemes */p$_1$ p$_2$/ are reconstructible for Proto Sonoran, but not for Proto Aztec. The single *p of Proto UA is lost in some Proto Aztec environments where its former presence is reconstructible only on the basis of information obtained from other branches. But */p$_1$ p$_2$/ have to be distinguished in the reconstruction of Proto Sonoran because they yield different reflexes in some of the daughter languages.

These same reflexes are more neatly accounted for by the progressive effects



of the vowel sets *V$_s$, *V$_n$, *V$_u$ on a single *p than by the reconstruction of */p$_1$ p$_2$/. However, there is insufficient evidence among Sonoran languages to reconstruct *V$_s$, *V$_n$, *V$_u$. But once these vowel sets are reconstructed on the basis of evidence obtained from Shoshonean languages, their differential effects on *p are felt in most Sonoran languages as *V$_s$ *vs* merged *V$_n$ and *V$_u$. Hence, the reconstruction of */p$_1$ p$_2$/ in Proto Sonoran can be replaced by the reconstruction of a single *p in Proto UA which will account for all the Sonoran reflexes—but only when supplemented by the progressive effect specification of vowel sets preceding *p.

Literally speaking, our reconstruction of the vowels in Proto Sonoran and Proto Shoshonean are identical with the earlier vowel system reconstructed for Proto UA, namely: i $\begin{matrix} \text{i} & \text{u} \\ \text{a} & \text{o} \end{matrix}$. Support for this vowel system given by the Shoshonean languages is unambiguous. It is unambiguously supported by one Sonoran language, Papago; the remaining Sonoran languages also lend support to this vowel system but, equally well, could lend support to a reconstruction of the five vowel system set up for the Proto Aztec phonemic inventory (*q.v.*).

The effect of vowels on Papago consonants in diachronic phonology can be stated more efficiently when Proto Sonoran vowels are reconstructed as in the first system cited; this permits one to oppose the effect of high */i ɨ u/ *vs* low */a o/, and also to oppose front */i/ *vs* back * $\begin{matrix} \text{i} & \text{u} \\ \text{a} & \text{o} \end{matrix}$.

Conversely, the effect of vowels on Cora consonants in diachronic phonology could be more efficiently stated if the Proto Aztec five vowel system were reconstructed for Proto Sonoran. This would permit us to oppose three different effects, depending on whether the vowel following a consonant is front * $\begin{matrix} \text{i} \\ \text{e} \end{matrix}$, back * $\begin{matrix} \text{u} \\ \text{o} \end{matrix}$ or neutral *a.

This dilemma as to which vowel type to reconstruct for Proto Sonoran—dual level F + 2(BB°), which facilitates the explication of vowel effects on Papago consonants; or triple level 2(FB) over N, which makes for easier exposition of vowel effects on Cora consonants—will perhaps be resolved once SGC combinable with vowels are reconstructed for the proto branches and for Proto UA. Then, perhaps, it will be possible to say that two coexisting vowel systems may be reconstructed for Proto Sonoran: dual level F + 2(BB°) combinable with one SGC, and triple level 2(FB) over N combinable with another SGC.

# APPENDIX

(1) *pahi *three*: Papago wái-k; Hopi pá·y-; Huichol hái-ka; Tübatulabal pa·y-; Southern Paiute pai-; Comanche páhI ~ páhi-; Mono pahi; Luiseño pa·hi; Yaqui váhi.

(2) *pa$_{a}$ki *to enter*: Papago wáakì; Hopi páki; Tarahumara bakí; Zacapoaxtla a·ki, kal--aki; Southern Paiute paxi- *to walk*; Yaqui vakí(m-).

(3) *pi$_{u}$ti *heavy*: Papago wíič; Hopi píti; Huichol heté-; Tarahumara bité; Zacapoaxtla eti·-k; Pochutla eti; Tübatulabal pili(ʔ-) ~ ʔipili(ʔ); Southern Paiute pixt(ía-); Yaqui vétte.

(4) *po *road, path*: Papago wóo-g; Hopi pǒ-hi; Huichol hu(yé); Zacapoaxtla oh-ti; Pochutla o(-tkan); Nahuatl oh-ƛi; Tübatulabal poh-t; Southern Paiute púu; Comanche pú(ʔE); Mono po(yo); Luiseño pe-t; Yaqui voó(ʔo).

(5) *pu$_{n}$si *eye*: Papago wúhì; Hopi pó·si; Huichol híši; Tarahumara busí; Zacapoaxtla i·š-; Pochutla iš-t; Nahuatl i·š-ƛi; Tübatulabal pu$^{n}$ži-l; Southern Paiute puʔúy; Comanche púi; Mono puhsi; Luiseño pu·š-la; Yaqui puúsi.

(6) *pi *breast*: Papago wípi; Hopi pí·-hi; Tübatulabal pi·-l; Southern Paiute píi-c; Comanche pí(cipɬ) *milk*; Yaqui píppi-m.

(7) *po *body hair, fur*: Papago wópo; Hopi pǒ-hö; Huichol hu·(šári); Tarahumara bo(ʔwé); Tübatulabal po·(n-t); Mono poo *to cut hair*.

(8) *pa$_{s}$ka *reed*: Papago wáapk; Hopi pá·qa; Huichol háka; Cora haká; Tarahumara baká; Zacapoaxtla a·ka-t; Pochutla ake-t; Tübatulabal paha·(bi-l); Southern Paiute paxá-mp.

(9) *ku$_{u}$pa *head hair*: Papago kúup; Hopi kó·pa; Huichol ki·pá; Cora kip$^{w}$á; Tarahumara kupá.

(10) *ta$_{u}$pa *to split*: Papago táapa-n; Hopi tá·pa-k-na *to tap, knock, make snap*; Tarahumara rapá-na; Zacapoaxtla -tapa·-na; Nahuatl -ƛapa-na.

(11) *si$_{u}$(pi) *cold*: Papago híip; Hopi sí:si(ŋ$^{w}$a); Huichol šé(ri); Tarahumara sipí; Zacapoaxtla sese·-k; Tübatulabal ši·b- ~ ʔiši·p; Southern Paiute si-pí-; Luiseño šovó·(ya); Yaqui sévve ~ seéve.

(12) *pi$_{s}$pa *tobacco*: Papago wíw; Hopi pí·va; Luiseño pi·va-t; Yaqui viíva.

(13) *ci$_{s}$pu *bitter*: Papago síw; Hopi cí:vo; Huichol cii-; Cora cihí(vi); Tarahumara cipú; Zacapoaxtla čiči·-k; Nahuatl čiči·-k; Luiseño čivu-t, či·v.

(14) *si$_{s}$-po *eyebrow*: Papago híhì--wo; Hopi sí·-vi; Tübatulabal šupi-l; Southern Paiute -siivu-v.

(15) *mu$_{s}$pi *nose, point*: Papago múuwi-ž; Tübatulabal mupi-t; Southern Paiute muví-v; Comanche múuvI; Mono mupi; Luiseño muvi-l.

(16) *na$_{s}$pi *prickly pear cactus*: Papago náw; Hopi ná·vi; Huichol na·(kári); Luiseño na·vo-t.

(17) *wi$_{s}$pa *to whip*: Papago gíw; Hopi wivá:-ta; Huichol we-; Tarahumara wip(isó); Tübatulabal wiba-.

(18) *ti$_{s}$ka *to put, lay flat object down*: Papago číik; Tarahumara riká; Zaca-

poaxtla -te·ka; Pochutla teke; Nahuatl -te·ka; Southern Paiute tixá- *to measure, try*; Comanche tíki-; Mono tiki; Yaqui teéka.

(19) *ti$_u$ni *mouth*: Papago čín$^y$ ~ čín$^y$; Huichol téni; Cora téni; Tarahumara riní; Zacapoaxtla -te·n; Pochutla ten; Nahuatl -ten; Southern Paiute tim(pa); Mono ti(hpi); Yaqui teéni.

(20) *ti$_n$wa *to name*: Papago číig-ig, číičig; Hopi tíŋ$^w$a; Huichol -tewa; Tarahumara riwa-rá; Tübatulabal ʔi$^n$diŋ$^w$a- ~ tiŋ$^w$a; Yaqui téa.

(21) *tiwa *to find*: Papago číig; Hopi tíwa; Tarahumara riwá; Tübatulabal tiw- ~ ʔi·diw; Luiseño to·w.

(22) *tu$_u$ku *meat*: Papago čúuku-g; Southern Paiute tuxkú-av; Comanche túhkU ~ túhku.

(23) *tu$_u$(ku) *black*: Papago čúk; Hopi tokó--ʔani *black ant*; Tarahumara ruku(áwa); Tübatulabal tu·gu ~ ʔu·du·gu; Southern Paiute tuu-k$^w$ar.

(24) *ʔati *louse*: Papago ʔáaʔač; Hopi ʔáti; Huichol ʔaté; Cora ʔaté.

(25) *mati *to know*: Papago máač; Hopi má·t- *well demeaned*; Huichol ma·ti-; Tarahumara mací; Zacapoaxtla -mati.

(26) *su$_u$tu ~ si$_u$tu *fingernail, claw*: Papago húuč; Huichol šité; Tarahumara sutú; Zacapoaxtla -sti; Tübatulabal sulu(n-t); Southern Paiute ma-síčuu-v; Comanche má-siitO; Mono ma-hsitu; Luiseño šul(á-t); Yaqui súttu.

(27) *ta$_u$ca *sun, summer*: Papago táṣ; Southern Paiute táč; Mono taca.

(28) *tala *foot*: Papago táḍ; Hopi tána; Tarahumara rará; Tübatulabal tana(pi-t) *heel*; Southern Paiute tám-pi *heel*.

(29) *ta$_s$ma *tooth*: Papago táatam; Hopi táma; Huichol ta·mé; Tarahumara ramé; Zacapoaxtla -ta·n; Tübatulabal taman-t; Southern Paiute táŋ$^w$a-v; Comanche táamA ~ táma; Mono tawa; Luiseño tamá-; Yaqui támm(i-m).

(30) *toŋo *knee*: Papago tóon; Huichol tunú; Cora tunú; Tarahumara ronó *foot*; Tübatulabal toŋo·-l; Yaqui tónno.

(31) *to$_u$sa *white*: Papago tóhà ~ túhà; Huichol tušá-; Tarahumara rosákami; Southern Paiute tusá-xar; Comanche tósa-; Yaqui tosá-i.

(32) *sita *ochre, red*: Papago hít; Hopi sí:ta ~ síta; Huichol šetá-; Tarahumara sitá-.

(33) *ci(ʔi) *to suck out*: Papago síʔì; Huichol cici-; Tarahumara ciʔí; Zacapoaxtla -či·či·.

(34) *ko$_s$ci~o *to sleep*: Papago kóoṣ; Huichol -kucí ~ -ku·cú; Cora kucú; Tarahumara kocí; Zacapoaxtla koči; Pochutla koči; Southern Paiute (ax)qúu-; Yaqui kóče.

(34b) *ko$_s$c-i *sleep, slumber*: Papago kóos; Huichol ku·cí.

(35) *k$^w$i$_s$ci *smoke*: Papago kúu-bs; Hopi k$^w$í·ci(ŋ$^w$i); Southern Paiute k$^w$ií-p; Comanche k$^w$íi-; Yaqui p$^w$ičí(a).

(36) *ma$_s$ci *to appear, come to light*: Papago máas; Hopi má·ciw-ta; Tarahumara mací *there is light*; Southern Paiute mái- *to find*.

(37) *coma *to sew*: Papago ṣóom; Zacapoaxtla -coma; Pochutla -come-; Nahuatl -coma.

(38) *co(ni) *head hair*: Papago ṣón$^y$- *head of instrument used for chopping*; Zacapoaxtla co·n-ti; Pochutla con; Tübatulabal co(mo·-l); Southern Paiute ču-; Comanche co-; Mono coh-; Yaqui čoóni-m.



(39) *ʔaci~a *to laugh at*: Papago ʔáṣ ~ ʔás-; Huichol ʔa·ci-; Tarahumara ací; Yaqui ʔáče.

(40) *yaca *to set it down*: Papago dáaṣ; Huichol -yeca; Tarahumara acá; Yaqui yéča.

(41) *kasi *leg, thigh*: Papago káhì(o); Hopi qá:si; Tarahumara kasí; Luiseño -qa·ši.

(42) *ka$_s$ti *to sit*: Papago káač *to be in position, inanimate*; Hopi qáti; Tübatulabal hal(ʔ-) ~ ʔa·hal(ʔ); Southern Paiute qari-; Comanche kári-; Mono qahti; Luiseño qalo- ~ qal; Yaqui káte-k.

(43) *ki$_u$(ʔi~i) *to bite*: Papago kíʔì *to bite*; Hopi kí·(ka); Huichol ke-; Cora -čeʔe; Tarahumara iki; Zacapoaxtla -keh(coma); Tübatulabal ki·ʔ- ~ ʔi·gi; Southern Paiute kiʔí-; Mono kih-; Luiseño koʔy(qa); Yaqui keʔé.

(44) *ki *house*: Papago kíi; Hopi kí·-hi; Huichol kí·; Cora čí(ʔi); Luiseño kí·-ča.

(45) *koya *to kill, pl.*: Papago kóod; Hopi qǒ·ya; Huichol -kuya; Tarahumara koʔyá.

(45b) *ko$_u$ʔi~o *to kill, die, pl.*: Papago kóʔì ~ kóʔò; Southern Paiute quʔú-; Comanche kóoi-, kóʔi-; Mono qoi; Luiseño qeʔ ~ qeʔé.

(46) *pu$_n$ku *dog, pet*: Papago wá-wuk *raccoon*; Hopi pó·ko; Tarahumara buku-rá; Tübatulabal pu$^n$gu(ʔ-) ~ ʔu$^n$bu$^n$gu(ʔ); Southern Paiute puŋku-v; Comanche púukU; Mono puhku.

(47) *na$_n$ka *ear*: Papago náak; Hopi náq-vi, ná:qa; Huichol naká; Tarahumara naká; Zacapoaxtla -naka·(s); Nahuatl -naka(s); Tübatulabal na$^n$ha-l; Southern Paiute naŋqa-v; Comanche náka-, nákI; Mono nahqa; Luiseño -naq; Yaqui nákka.

(48) *k$^w$a(ʔa) *to eat, swallow*: Papago báʔà; Hopi k$^w$íʔi; Huichol k$^w$aʔa; Tarahumara aʔwá; Zacapoaxtla -k$^w$a·; Pochutla k$^w$a; Nahuatl -k$^w$a; Luiseño k$^w$aʔ; Yaqui -p$^w$a.

(49) *k$^w$a- *eagle*: Papago bá(ʔag); Hopi k$^w$á:-hi; Southern Paiute k$^w$a(nánc).

(50) *k$^w$a$_u$si~i *cooked, ripe*: Papago báhì; Hopi k$^w$así; Huichol ʔi-k$^w$á·ši; Tarahumara wasí *fruit*; Tübatulabal wiš- ~ ʔiwiš; Southern Paiute k$^w$así-p; Comanche k$^w$ási-; Mono q$^w$ahsi; Luiseño k$^w$ašó(ʔax).

(51) *k$^w$a$_u$si *tail*: Papago báhì; Hopi k$^w$ási *penis*; Huichol k$^w$a·ší; Cora k$^w$así; Tarahumara wasí; Tübatulabal wiši·; Southern Paiute k$^w$así; Comanche k$^w$ásI ~ k$^w$ási; Mono q$^w$aci; Yaqui p$^w$ássi(a).

(52) *k$^w$i$_s$(si) *to take, get*: Papago bíhì; Hopi k$^w$ísi; Huichol k$^w$e-; Tarahumara wí; Zacapoaxtla -k$^w$i; Tübatulabal wi·š- ~ ʔiwiš; Southern Paiute k$^w$ií- ~ k$^w$iʔí-; Comanche k$^w$íhi-; Yaqui p$^w$is-.

(53) *k$^w$i- *food*: Papago bí-i, bía; Hopi k$^w$í·(vi).

(54) *k$^w$i$_u$ta *excrement*: Papago bíit; Hopi k$^w$íta; Huichol k$^w$itá; Cora č$^w$itá; Tarahumara witá; Zacapoaxtla k$^w$ita·-t; Tübatulabal wi·la·-t *skirt feathers*; Southern Paiute k$^w$ičá-p; Comanche k$^w$íta-; Mono k$^w$ita; Yaqui p$^w$ítta.

(55) *hikʷi(si) *to breathe*: Papago ʔíibhi; Hopi híkʷsi; Tarahumara iwí.

(56) *tokʷi *rabbit*: Papago tóobì; Tarahumara rowí.

(57) *ʔaki *arroyo*: Papago ʔákì; Huichol ʔáki; Cora ʔáči.

(58) *ʔaᵤŋa *wing, feather, arm*: Papago ʔáʔan; Hopi ʔá·ŋa *long hair*; Huichol ʔaná; Cora ʔaná; Tarahumara aná; Southern Paiute ʔaŋa-v *wing, upper arm*; Comanche ʔáhna.

(59) *ʔasi~i *to arrive*: Papago ʔáhì; Huichol ʔa·ši-; Zacapoaxtla ahsi.

(60) *ʔato *anus, bottom*: Papago ʔát; Hopi ʔá·tö.

(61) *ʔoho *bone*: Papago ʔóoʔo; Hopi ʔő·(qa); Huichol ʔu(mé); Zacapoaxtla o·(mit); Pochutla o-t; Southern Paiute ʔuú-v; Mono ʔoho.

(62) *ʔoha *yellow*: Papago ʔóa-m, ʔúa-m; Southern Paiute ʔuá-qar; Comanche ʔóha-; Mono ʔoha.

(63) *ʔoₛŋa *salt*: Papago ʔón; Hopi ʔőŋa; Huichol ʔúna; Tübatulabal ʔoŋa-l; Southern Paiute ʔua-v; Comanche ʔónaa-vI; Mono ʔohma; Luiseño eŋ-la.

(64) *sawa *leaf*: Papago háahag; Huichol šawá; Tarahumara sawá; Yaqui sáwwa.

(65) *si- *one*: Papago hí(ma); Hopi sí·(ka); Zacapoaxtla se·; Yaqui seé(nu).

(66) *si *guts, entrails*: Papago híhi; Hopi sí·-hi; Tarahumara si(wa); Mono si(hi).

(67) *siᵤ(ʔi~a) *to urinate*: Papago híʔà; Hopi sísi(wki); Huichol ši-, šíši; Tarahumara isí; Zacapoaxtla šiši·š-a; Tübatulabal šiʔ-; Southern Paiute siʔí-; Mono sii; Luiseño ši·ʔi-š; Yaqui síʔi-.

(68) *siₛku *navel*: Papago hík; Tarahumara siku-, sukí; Zacapoaxtla -ši·k; Pochutla šik-t; Southern Paiute sixú-; Comanche síiku.

(69) *simi~a *to go*: Papago hím; Tarahumara simí; Yaqui siim-.

(70) *siₛpa *to shave, scrape*: Papago híw-kon; Hopi síspa, sí:va; Tarahumara sipá; Zacapoaxtla -ši·-; Tübatulabal ʔišib- ~ ši·p; Southern Paiute sivá-; Comanche síve-.

(71) *su *star*: Papago húʔu; Hopi só·-hi; Zacapoaxtla si·(taɬi·n); Nahuatl si·(taɬi·n); Tübatulabal šu·-l; Luiseño šu·-la.

(72) *suwi~a *to consume, eat up, to finish*: Papago húg ~ húug; Hopi sówa; Tarahumara suwí, suwá; Southern Paiute suwá-.

(73) *pisa *penis*: Papago wíhà; Hopi pís—qöytö.

(74) *pusa *to waken*: Papago wúha(n); Tarahumara busá; Zacapoaxtla ihsa; Yaqui vúsa.

(75) *tuᵤsu~i *to grind*: Papago čúhi-wi; Hopi tó·s-i; Huichol tɪ·ši-; Cora -tɨʔisi; Tarahumara rusú; Zacapoaxtla ti·s-; Nahuatl -te·si; Tübatulabal ʔutuš-; Southern Paiute tuxsu-; Comanche túsuh-.

(76) *yaₙsa *to sit*: Papago dáhà; Hopi yé·se; Huichol ye·ša-; Tarahumara asá-ri; Tübatulabal yaⁿz̨-; Yaqui yes-.

(77) *hiₛ- *to drink*: Papago ʔíʔì; Hopi hí·(ko); Huichol ʔi-; Tarahumara ba-hí; Zacapoaxtla -i·; Tübatulabal ʔi·ʔ- ~ ʔi·ʔi·; Southern Paiute i(ví-); Comanche hí(vi); Mono hi(pi); Yaqui hi(ʔi-) ~ he(ʔé).

(78) *hu *arrow*: Papago ʔúʔu; Hopi hó·-hi; Huichol ʔi(ɾɨ́); Cora ʔiʔi(ɾɨ́); Tübatulabal pa·-hu·-l; Southern Paiute úu; Comanche húu-hpI *tree, stick*; Luiseño hu·-la.



(79) *huₛpi *wife, woman*: Papago ʔúwì; Hopi siwá-hovi; Huichol ʔii(mári); Tarahumara upí; Yaqui húvi.

(80) *tiha *hail*: Papago čía, čía; Huichol té; Cora teéte; Tarahumara rihé; Yaqui téha-m.

(81) *muhu *to shoot—as with arrow*: Papago múu; Huichol mii-; Tarahumara muhu(bú); Tübatulabal ʔu·muʔ- ~ ʔu·mu·ʔ.

(82) *yahiₛ(pa) *to come, pl.*: Papago dáiw; Hopi yá·yva *to climb up, pl.*; Huichol yei- *to go, walk*; Yaqui yahi-.

(83) *maₛka *to give*: Papago máak; Hopi má·qa; Zacapoaxtla -maka; Pochutla meke-; Tübatulabal maha- ~ ʔamha; Southern Paiute maxa-; Comanche maka-; Mono mahqa; Luiseño (na)mxa; Yaqui mak-.

(84) *mala *child—with female reference, i.e., child of woman, man's daughter, girl*: Papago máḏ; Hopi má:na; Tarahumara mará; Yaqui mára.

(85) *miʔa *to kill, sg.*: Papago míʔà, múʔà; Hopi míʔa; Tarahumara miʔyá; Tübatulabal miʔi(g-); Yaqui méʔa.

(86) *muᵤki~u *to die, sg.*: Papago múukì ~ múuk; Hopi mó:ki; Huichol mɨ·kí; Cora miʔičí; Tarahumara mukú; Zacapoaxtla miki; Pochutla mok; Nahuatl -miki; Tübatulabal mu·gi-n ~ ʔu·mugi·-n *to hurt him*; Southern Paiute ča-ŋʷɨ́ki-; Yaqui muúke.

(87) *kaᵤma *mouth, cheek; to taste*: Papago káam *cheek*; Zacapoaxtla -kama(k) *mouth*; Southern Paiute qamá- *to taste*; Mono qahma.

(88) *kuᵤmi~a *to eat—as corn, to nibble*: Papago kúum; Huichol ki·mi-; Tarahumara kumí; Southern Paiute kumí *corn*; Yaqui kuúme.

(89) *niₛma *liver*: Papago nʸɨ́m; Hopi ní:ma; Huichol néma; Cora neémʷa; Tübatulabal ni·ma-l; Southern Paiute niŋʷú-mpi ~ nuŋú-v.

(90) *niʔi *to fly*: Papago nʸɨ́ʔì; Tarahumara iʔní; Yaqui neʔé.

(91) *pini *to suck on it*: Papago wiinʸ; Huichol hi·ni-.

(92) *tani *to ask, beg*: Papago taanʸ; Zacapoaxtla -tani; Nahuatl -ɬani.

(93) *sunu *corn, corn cob*: Papago húunʸ; Tarahumara sunú; Zacapoaxtla si·n-ti; Pochutla son.

(94) *liŋi *tongue*: Papago nʸɨ́inʸ; Hopi léŋi; Huichol není; Zacapoaxtla nene-pi·l; Pochutla nene-pil; Nahuatl -nene-pil; Tübatulabal lalan-t; Yaqui nínni.

(95) *naya *to light a fire*: Papago náad; Huichol nai-.

(95b) *naᵤʔa *to burn*: Tarahumara naʔá *to make a fire*; Southern Paiute naʔá-; Luiseño naʔ.

(96) *no- *egg*: Papago nón(ha); Hopi nő-hi; Southern Paiute nu(axa); Comanche nó(yO); Mono no(yo).

(97) *kuŋa *husband*: Papago kún; Hopi kó·ŋʸa; Huichol kɨ́na; Cora -kɨ́n; Tarahumara kuná; Tübatulabal ku·ŋa-n; Luiseño -kuŋ; Yaqui kuúna.

(97b) *puli~a *to tie*: Papago wúuḏ ~ wúul-; Huichol hii- ~ -hia; Tarahumara buré; Tübatulabal pu·n- ~ ʔuⁿbun.

(98) *sula *heart*: Papago húḏ *integral part of anything, as of body*; Hopi só·na *edible part of a seed*; Tarahumara surá; Luiseño šun-la.

(99) *waki *dry*: Papago gákì; Hopi lá·ki; Huichol waki-; Cora wáhči; Tarahumara waki-céami; Zacapoaxtla wa·ki; Pochutla wak; Nahuatl waki; Tübatulabal wa·g- ~ ʔawa·k, wa·gi(ʔ-) ~ ʔa·wa·gi(ʔ); Luiseño wax(aq).

(100) *wi- *big*: Papago gɨ́(ʔì); Hopi wɨ́·(ko); Huichol we(ri-) *to grow*; Cora ve(ʔé); Zacapoaxtla we·(yi).

(101) *wi$_s$ci *to fall*: Papago gɨ́iṣ; Huichol -wece; Tarahumara wicí; Zacapoaxtla weci; Southern Paiute wi(ʔ)ɨ́; Yaqui wéče.

(102) *wi- *fat*: Papago gɨ́igì; Hopi wí-hi; Huichol wi·(yá); Tarahumara wi(ʔí); Tübatulabal wi(p-t); Luiseño -wi·(ʔ).

(103) *wo- *two:* Papago góo-k; Hopi lo̊·(yöm); Huichol hu·(tá); Tarahumara o(kuá), na-wó; Zacapoaxtla o·-me; Tübatulabal wo·; Luiseño we·(x) ~ we(ʔ); Yaqui woó(yi).

(104) *ʔawa *horn*: Papago ʔáʔag; Hopi ʔá·la; Huichol ʔawá; Tarahumara awá; Tübatulabal ʔa·wa-t; Southern Paiute ʔáa-p; Comanche ʔáa-; Mono ʔawa; Yaqui ʔaáʔa.

(105) *tukur(i) *owl*: Papago čúkuḍ; Hopi tokóri; Huichol (mi·)kiri.

(106) *yiʔi *mother*: Papago ɣ̌íʔì; Hopi yíʔ at; Luiseño -yoʔo(p).

(107) *yiki *to taste*: Papago ɣ̌ɨ́ik; Hopi yɨ́ki.

(108) *yiwa *space, opening*: Papago ɣ̌íg; Huichol -yewa; Tarahumara iwa-rá; Southern Paiute yii.

(109) *yuku *to rain*: Papago ɣ̌úuk; Hopi yók-va; Tarahumara ukú; Yaqui yúku.

(110) *ya$_s$ka *nose, end*: Papago dáak; Hopi yáqa; Tarahumara aká; Zacapoaxtla yeka(col); Pochutla yeke-t; Tübatulabal yaha·(wi-t); Southern Paiute yaxá-r; Yaqui yékka.

(111) *yoma *to copulate*: Papago dóom; Tübatulabal yo·m-.

(112) *k$^w$iya *dirt, earth*: Papago bíd; Huichol k$^w$íye; Cora č$^w$éh; Tarahumara wiʔyé; Yaqui p$^w$íya.

(113) *ti$_s$ki~a *to cut*: Papago -čk, -čik; Hopi tɨ́ki; Huichol -teke *to break*; Zacapoaxtla -teki; Nahuatl -teki; Tübatulabal tidiha ~ ʔitidiha; Southern Paiute tixá(ni-).

(114) *ci- *spit*: Papago sís-wùa; Zacapoaxtla -čihči; Southern Paiute ki-xcí-p.

(115) *siki~a *to cut hair, mow*: Papago híik; Tarahumara siki(ré); Tübatulabal ši·gi-n- ~ ʔiši·gi-n.

(116) *ʔi *this*: Papago ʔíi- *proximal*; Hopi ʔí·ʔi; Huichol ʔí(ki); Tübatulabal ʔih; Yaqui ʔií.

(117) *tima *small*: Papago čím; Huichol temá(iki) *boy*, temá(ri). *boys*.

(118) *tiso *cave*: Papago číhò; Tarahumara risó.

(119) *ʔi$_s$(ca) *to plant*: Papago ʔíṣ; Hopi ʔí(y-); Huichol ʔeca-; Tarahumara icá; Southern Paiute ʔiá-.

(120) *ʔi- *theft*: Papago ʔɨ́i(sid); Hopi ʔɨ́·ʔi(yi); Tübatulabal ʔi·(y-).

(121) *tu$_s$- *to extinguish*: Papago čúu(ṣ); Hopi tó·(ka); Southern Paiute tú(x$^w$aq).

(122) *kusu *to sound—of animal*: Papago kúhù; Tarahumara kusú; Tübatulabal ʔukuš- ~ ku·š.



(123) *pa *water*: Papago wá-; Hopi pá·-hi; Huichol há·; Cora háh; Tarahumara ba(ʔwí); Zacapoaxtla a·-t; Pochutla a-t; Tübatulabal pa·-l; Southern Paiute páa; Comanche páa; Mono pa(ya); Luiseño pa·-la; Yaqui va(ʔá-m).

(124) *ʔawi~a *to tell*: Papago ʔáag; Hopi ʔá·ʔa·w-na; Tübatulabal ʔa·w- ~ ʔaʔaw.

(125) *ta- *sinew*: Papago táta(ì); Hopi tá-hi; Huichol ta·tá; Zacapoaxtla -ta(lwa); Tübatulabal ta(p-t); Southern Paiute ta(múa); Luiseño -ta(ʔ).

(126) *kahi~a *to hear*: Papago káa, kái-dag; Zacapoaxtla kaki; Tübatulabal haʔ- ~ ʔa·haʔ; Yaqui hí-kahi.

(127) *k$^w$aʔa *mother's father, daughter's son*: Papago báab, báʔa--maḍ; Hopi ʔí-k$^w$aʔa.

(128) *ma *hand*: Papago má(čpoḍ), wístmáam; Hopi ma~máʔa; Huichol mamá; Zacapoaxtla -ma·(y); Pochutla -ma(y); Tübatulabal ma·-l; Southern Paiute ma-; Comanche ma-; Mono ma(ya); Luiseño ma-t; Yaqui mámma.

(129) *yaʔa *to yearn after, cherish*: Papago dáʔà; Tübatulabal ya·ʔ- ~ ʔa·ya.

(130) *poʔi~o *to be lying down*: Papago wóʔò, wóʔì-wùa; Tarahumara boʔi-, buʔwí; Yaqui vóʔo-.

(131) *koʔa *to eat*: Papago kóʔà, kúʔà; Tarahumara koʔwá.

(132) *soʔi *thorn*: Papago hóʔi; Tarahumara soʔwí.

(133) *tuʔ-i *flour*: Papago čúʔì; Tübatulabal tuʔi·-l.

(134) *moʔo *head*: Papago móʔò; Huichol muʔú; Cora muʔú; Tarahumara moʔó.

(135) *k$^w$a$_u$na *smelly*: Papago bán *coyote*; Southern Paiute k$^w$aná-; Comanche k$^w$ánaa-.

(136) *ka *no, not*: Hopi qa; Tübatulabal ha-; Southern Paiute qa, qáa-č; Luiseño qa(y); Yaqui kaá.

(137) *ku *fire, firewood*: Papago kúu-; Hopi kó:-, kó-ho; Tarahumara kú; Tübatulabal ku-t; Southern Paiute ku-; Comanche ku-; Mono kuh-.

(138) *ha(ki) *who*: Hopi háki; Zacapoaxtla a·k(oni), a·ki·(n); Nahuatl a·ki; Tübatulabal ʔagi; Comanche hák(ari); Luiseño hax; Yaqui há(vve).

(139) *ʔasi *to bathe*: Hopi ʔá·si; Tübatulabal ʔa·š- ~ ʔaʔaš; Luiseño aš ~ a·š.

(140) *suʔu *mother's mother, grandmother*: Papago húʔu(l); Hopi ʔí-soʔo.

(141) *kali *house*: Hopi ʔi-qáni; Tarahumara karí; Zacapoaxtla kali; Nahuatl kal-li; Tübatulabal hani·-l; Southern Paiute qáni; Comanche káhni; Yaqui kári.

(142) *wo$_s$ko *pine*: Hopi lo̊qö; Huichol hukú; Cora hukú; Tarahumara okó; Zacapoaxtla oko-t; Pochutla oko-t; Tübatulabal woho($^n$bo·-l); Southern Paiute uxú-mp; Comanche wókoo-vI; Mono wohqo.

(143) *pi$_u$ti *to arrive*: Hopi píti; Tübatulabal pil-; Southern Paiute pící-; Comanche píti-.

(144) *tu$_s$ki~a *night*: Papago čúčka-gid; Hopi tó·ki; Huichol tikáˑ-; Tübatulabal tu·gi-t; Southern Paiute tux$^w$á-n; Comanche túka(ni); Mono toqa; Luiseño tuq-vo, tuk-va; Yaqui tuka-.

(145) *taka *man*: Hopi tá·qa; Zacapoaxtla ta·ka-t ~ ta·ga-t; Pochutla teke-t; Nahuatl ƛa·ka-ƛ; Luiseño ata·x-am.

(146) *ti$_u$pu *flea*: Papago čɨ́ip(ṣ); Huichol tepɨ́; Cora tepɨ́; Tarahumara ripu(cí).

(147) *sala *sticky, gum*: Papago háḍ-; Hopi sá·na; Zacapoaxtla sasal-ti·k; Tübatulabal ša·n(o-t), ša·na·-dan; Southern Paiute saná-pi; Comanche sána-hpI; Luiseño ša·na-t.

(148) *cikuri ~ cikori *circular*: Papago síkol-k; Huichol cikɨ́ri.

(149) *poka *stomach*: Papago wóok; Huichol hu·ká.

(150) *tahi *fire*: Papago tái; Huichol tái; Tarahumara rahí-na *it burns*; Nahuatl ƛi-ƛ; Yaqui táhi.

(151) *ŋa- *root*: Hopi ŋá-; Huichol naná; Tarahumara na(wá); Zacapoaxtla na·(lwa-t); Yaqui naá(wa).

(152) *ŋola ~ (ŋo)ŋowa~i *to return, bend, coil*: Papago nóḍ, nóonogì; Hopi ŋṓla; Huichol -nua ~ -nu·nuwa; Tarahumara nor(íra).

(153) *ku$_u$p(i) *to close—especially in reference to the eyes, and hence, to sleep*: Papago kúup; Huichol kɨpi-; Tarahumara kupí; Luiseño kup.

(154) *ku$_s$ta *neck*: Tarahumara kutá; Tübatulabal kula·-n; Southern Paiute kurá-v; Mono kuhtu; Yaqui kutá(naa).

(155) *toŋa-la *to shine, sun*: Papago tónal-ig, tónaḍ; Hopi tṓŋ-va; Zacapoaxtla to·nal; Pochutla tunel; Nahuatl to·nal.

(156) *ta$_u$ŋa *to kick*: Tübatulabal ʔa$^n$daŋ; Southern Paiute taŋa-.

(157) *saki *to parch, as corn; parched corn*: Papago háakì; Huichol šakí; Tarahumara sakí; Tübatulabal ʔašag- ~ ša·k.

(158) *miya *moon*: Hopi mɨ́·ya-wi; Tübatulabal mi·ya-l; Southern Paiute miá-c; Comanche mía; Mono ta-miʔa; Luiseño mo·y-la.

(159) *ki$_u$ma *to come*: Tübatulabal kim- ~ ʔi$^n$gim; Comanche kíma-; Mono kihma.

(160) *ni$_s$pa *snow*: Hopi níva; Tübatulabal niba(ʔ-) ~ ʔiniba(ʔ); Southern Paiute nivá-v; Mono nipa.

(161) *wili *to stand*: Hopi wíni; Tarahumara wirí; Tübatulabal win ~ ʔiwini; Southern Paiute winɨ́-; Comanche wíni-; Mono winih.

(162) *wa$_s$ʔi~i *to roast*: Papago gáʔì, gági; Tübatulabal wa·ʔ ~ ʔa·wa; Southern Paiute waɨ́-; Luiseño wa·ʔi-š, waʔya ~ wa·ʔaw.

(163) *ti$_u$ka *to eat*: Tübatulabal tik ~ ʔitik; Southern Paiute tiqá-; Comanche tɨ́hka-; Mono tihka.

(164) *ci- *point*: Papago sɨ́i-; Southern Paiute ci-; Comanche ci-; Mono cih-.

(165) *to$_u$mo *winter*: Hopi tṓmöʔö; Tarahumara romó; Southern Paiute tómo; Comanche tómO- ~ tómo-.

(166) *so$_s$no *lung*: Papago hón *body*; Tarahumara sono-rá: Southern Paiute suú-vi; Mono sono.

(167) *to$_u$no *hill, rise in ground*: Papago toon-k; Southern Paiute tunú(ki-či).

(168) *yi$_u$ʔi *to swallow*: Huichol, Cora -yeʔe; Southern Paiute yiʔɨ́-ki-; Comanche yɨ́ʔ(wi-), yɨ́(wi-); Mono yi(hk$^w$i).

(169) *ti$_u$pa *mortar*: Papago čɨ́ppa, čɨ́ip-id-akuḍ; Luiseño to·pa-l.

(170) *ka$_s$ku *father's mother, grandmother*: Papago káak; Southern Paiute kaxú-; Comanche káku(ʔ).

(171) *nimi- *to walk around, live*: Zacapoaxtla nemi-; Comanche nɨ́mi-.

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