Phon

A Universal Writing System

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Phon: a Universal Writing System, release 0.7 α

Introduction to the Alpha Edition

This document is the alpha edition of Phon: a Universal Writing System. The system itself is complete with the exception of some tentative work in the tone group area; the book itself is expected to undergo several revisions before general release.

The book is in the general structure it will take and the text is largely in, with the exception of the phonemic alphabet chapter. That chapter is kind of pulling in two directions at the moment. Basically, in describing Phon in phonemic terms, I can treat it in terms of the IPA or in terms of its own logic. I attempt to do both, and in the beta I will give both tasks separate justice. In the mean time, I considered the charts comparing Phon and IPA to be more immediately important, and have included them.

The bare minimum diagrams have been provided. In particular the English chapter will be bulked up considerably in this respect, and the form and morphology chapter could use more explicit stroke diagrams as well. The appendix will eventually have a table of Phon characters in terms of the logic of Phon rather than IPA; this considerable task will have to wait until I'm done traveling, in April. Phon is in this book, but expect some of it to be confusing or unclear. I welcome any questions and suggestions that any of you may have. Also any errors you see, please send by page number; I will be grateful.

The Quenya spellings in the book are inconsistent. I will eventually do a global search and replace to make all the diacritics show up, but after awhile I just stopped using them so I could write faster. Comprehension is not damaged by this minor irregularity of style.

There are little red tags scattered throughout the book. These are uncompleted tasks. There will be another alpha edition, wrapping these up, as soon as I'm able to get to it. The layout, in general, is in the right order, but no serious effort has been made to clean it up, so there are large whitespace patches before diagrams and blank pages at

the ends of some chapters.

The most glaring absence is the suprasegmentals, which are incompletely described, unfinished, and not listed in their table. I'll get there, I promise; if you have a specific interest in this topic please write me and I'll give you what I've got.

Many of my alpha readers will have some familiarity with the project; some few of you are getting cold-called because I have good reason to suspect you'll find it interesting. In all cases, I welcome and encourage feedback on the book! Anything at all which occurs to you, don't hesitate to ask. I need the active support of as many of you as possible to get a good beta edition together and prepare for general release. You will have my lavish thanks, both personally and in the front of the book.

The plan is to incorporate feedback while expanding the book in various ways. When this is done, I'll produce a beta edition: this will be available as a sliding-scale PDF file (DRM free) and as a trade paperback. The beta edition paperback will only be available until the release edition (hopefully with a credible publisher), at which time it will be retired. The alpha is being released in PDF form only, and is considered copyright restricted, hence the 'all rights reserved'; the eventual release will be under a less restrictive license.

This has been a labor of love, accomplished mostly in obscurity. This is the part of the book where acknowledgements and thanks go, but for the alpha edition, all I can say is that every one of you who has listened to me, read my drafts, or in any way supported my endeavor (and this almost certainly applies if you know me at all): all of you have my profound thanks and gratitude.

This creation is not complete, but it is ready for others to see. I hope you enjoy it.

Samuel Putman
Oakland, CA Feb 2008.

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Phon: An Introduction and User's Manual

Phon is the preferred name of a universal writing system, intended to meet the goal of being a universal auxiliary writing system, that is, one that anyone of any language group can feel comfortable learning and using to represent their own utterances. It is pronounced 'Fon', not 'φon', but is written thus in Roman letters to indicate its relationship to words derived from the Greek word φωνή, phōnē, sound or voice, as well as to differentiate it from the Fon language family. In languages which stress, it is stressed; in languages with tone, it takes the highest, level one. If the language lacks an F sound, it takes a P; if the language lacks an 'o' (as in 'rot' in North American use, or for a second choice 'o' as in 'rote'), the vowel is 'ɛ' as in 'pet', then the shwa. Instances of languages which lack a nasal ending are not known to this author: the dental nasal consonant is preferred, followed by nasalization of the vowel.

Phon is phonemic, covering in principle the same state space as the International Phonetic Alphabet (IPA). It is mnemonic, with each stroke chosen and named for ease of acquisition and recollection, and a close association between the physiology of an utterance and its representation. It is a featural writing system, where each grapheme is built up out of strokes that differ based on aspects of the pronunciation of

the phoneme represented. It may be written equally in either horizontal direction, as well as both vertical modes, and the direction of sense is inherent in the structure of each stroke; furthermore, left and right handed individuals can each write one of the modes fluently, which was an important design goal, as left-handed writers are approximately ten percent of the population. Being based only on an invented script, the Tengwar of J.R.R. Tolkien, it is without the prejudice of history and national advantage found in any script based on a natural writing system, and is in principle equally accessible to anyone who knows how to use a pen: the needed technical terms, similarly, are drawn from the language Quenya, which is not a historical language, and derive their original meaning from aspects of the natural world (or a few ubiquitous and ancient objects) which are common to our heritage as humans.

Phon is designed to be rational, universal, useful and beautiful. In meeting these design goals, insight was incorporated from the existing writing systems of the world, from other examples of constructed scripts, as well as from phonetics, ergonomics, cognitive science, calligraphy (in the Romantic and Islamic script traditions), and mathematics, particularly combinatorics and symmetry theory. The result is a writing system similar to an abiguda, incorporating several distinctive features.

Abiguda is a contemporary word for what used to be called a syllabic alphabet; Devanāgiri is the most widely used, with Tibetan, Thai and most of the Indian scripts in this family as well. Phon may be considered an abiguda, if one takes the liberty of considering the inherent vowel to be a non-utterance. Alternatively one may think of Phon as an alphabet, but one in which the vowels are written above and below the consonants, as in the Thaana script of the Maldives.

Phon is unique in several respects from any other writing system in use. First, Phon is the native script of a left-handed person, who had become frustrated with the inherent righthandedness of all existing scripts. Rather than merely design a writing system to suit the needs of left-handed persons, or simply mirror-write an existing script á la da Vinci, the decision was made to try and design a writing system which could be written equally with the left or right hand, and just as

important, would be equally comprehensible in each direction.

This proved possible, after some time spent pushing a pen across a page and applying knowledge of symmetry theory, ergonomics, and a few palette-limiting aesthetic criteria. The result is a stroke pallete of three primary strokes, four primary combinations, and twelve secondary combinations. These primitives are not arbitrary in any sense: they are the result of applying certain rules of form and symmetry to the basic strokes of an angled pen. All primitives except the dot primitive are asymmetrical across the vertical axis, both with respect to themselves and with respect to any other primitive.

Thus equipped, Phon was designed as a featural writing system covering the same state space as the International Phonetic Alphabet. That is to say, there is at least one unique symbol for each grapheme in the IPA, and every diacritic and suprasegmental has an equivalent form also. By standing on the shoulders of this particular Collossus, we may fairly say that Phon can do everything IPA can, and backwards, too.

Phon, however, is designed to be featural, so that each stroke of every grapheme provides information as to the manner of utterance of the associated phone. This is found in Hangul, but nowhere else among native scripts; in the constructed script world, the Tengwar behave similarly, but in Phon the system is quite a bit more rigorous. Utterances themselves are not in any sense fully systematic; Phon can claim only to be more featural than any writing system in existence, as perfect isomorphism is believed to be neither possible nor desirable.

The aesthetic rules for stroke generation and recombination allow for tens of thousands of distinct graphemes, far more than the hundred-odd which are needed to implement a phonemic writing system. Phon is thus being extended to cover mathematical symbolism, and other endeavors such as musical notation are contemplated. There are also a large number of characters, called protograms, which are considered ‘part of’ Phon but have no assigned meaning, and a smaller set of mesograms, which are used when writing some languages mesographically, a term which is explained in the section on strata of use: the concepts involved are similiar to those invoked by the spectrum of broad to narrow transcription. The formal nature by which Phon

characters are specified leaves great freedom in rendering, allowing for distinct families of type faces, calligraphic hands, and rendering in the 'graffiti' style of urban calligraphy. Phon is free of Eurocentric bias and other cognitive problems that arise in the use of a Latin-based phonemic alphabet, and being mnemonic and regular is easier to acquire and use.

This manual is meant to introduce the Phon project to as many people as possible, so that we can get a user and developer base established and really get this tool sharpened up and put to use. We'll begin by situating Phon in its historical context, as a writing system and as a product of linguistics as an endeavor distinct from writing per se. Chapter Two will introduce the English language writing mode; this chapter is meant to be directly accessible, so that one can get started reading and writing Phon directly. Chapter Three will define the underlying structure of Phon and explore the formal categories used in writing it, while Chapter Four will introduce Phon itself as a tool for writing, with emphasis on its role as a tool in phonetics. Eventually we will include writing modes for other major languages as well. Subsequent sections will introduce the mathematical set of Phon symbols and give a guide to their use and further development, will discuss the calligraphic and cultural applications of Phon, address the issues raised by Phon in computing, and provide guidance for the further development of the system.

A Brief History of Writing Systems

Speech cannot be called an invention. It reaches back into ancestors, not just of ourselves but of our very species, and its origins are basically mysterious despite all our etymological research. We all speak; the rare human raised without speech is deprived of culture and is more like the the other mammals than it is like us. Languages shape our social reality, and color our perceptions; how we speak is how we think, where we come from, and what we have made of ourselves.

Writing is many of these things, but firstly it is an invention, and one of recent acquisition. Many humans cannot read nor write in any script: they dress and talk alike to their peers, work and love and raise children as humans will do, but without literacy, and no one would judge them feral or less human for it, though prejudices (and practical disadvantages) abound.

Writing was in no sense invented all at once. Tens of thousands of years ago, early *Homo Sapiens* was drawing in charcoal and clay on the walls of caves, and carving symbols into soft limestone and sandstone. From what we know of Aboriginal culture in Australia, these symbol systems were probably quite complex and rich, keys into the landscape for stories that guide trails, record hunting history in the region, point to water and shelter, warn of danger from man or beast, or mark tribal territory.

We also begin to find tally sticks, and calendrical constructs such as the well-known Stonehenge. Marks to count are combined with symbols to represent the things counted: this is one of the protoliterate actions, a practical solution to a pressing need that points towards further uses.

Another activity our paleo cultures engaged in is divination. Augury is a skill completely uncomprehended by most writers, sadly; the flight of birds is a rich language and can foretell disaster or good hunting for one skilled in interpretation. I am less convinced of the benefits of extispicy, but you take the hints you can get. We don't know for sure that these were practiced, because they don't leave a record. We do know that the ancient Chinese practiced divination by scoring tortoise shells and putting them into a fire, interpreting the resulting cracks; the practice is referred to in historical texts, and archaeological digs have revealed the shards. This is believed to have been an impetus to the Chinese script, as pictures were carved into the shells to represent the subject of divination.

Irrigation created the first empires of the old world, in the Indus, the Chinese river basins, Mesopotamia and Egypt. Writing was developed in all these, although that of the Indus is disputed and remains cryptic. Sumeria was first, and is believed to have influenced

Egypt in developing their scripts, but no evidence linking Sumeria to the Chinese writing system has been discovered. The only other well-attested writing event occured among the Olmec and later Maya of the Americas, which have no current survivors; thus it is accurate to say that all current writing systems descend from either Sumeria or China.

Cuneiform was originally pictographic, carved with a round stylus on clay, and concerned in surviving samples chiefly with inventory. Over time, the shapes of the pictograms were abstracted, and the stylus was standardized as a wedge-shaped device for rapid impressions. This is the transition to logograms, unique and abstract shapes that represent words. These shapes were often hard to distinguish, and so the scribes start to notate them with other logograms that are used for their sound rather than their meaning, which is the beginning of syllabic form. The Akkadians adopted cuneiform as a syllabary for their language, prior to the decline of its use with the rise of the alphabetic scripts.

Chinese writing appear to have undergone a similar transition: From carving pictograms for tally and oracles, to using them to represent unique words, through the process of abstraction. Something happens, then, which puts the Chinese onto their own distinctive track. The Chinese have a limited syllable set, and each syllable has a meaning it carries in and of itself, what we call an isolating language or analytic. Ancient Chinese had this quality to a greater degree, to where each syllable can be thought of as a word, in and of itself. The Chinese reduced their pictograms to logograms through various methods: a few are in fact pictograms still, some are ideograms (the character for 'down' points down, sort of) but the vast majority consist of two or more radicals, one of which hints at the pronunciation (or used to) and others which suggest the meaning, with no real consistency. The Chinese never developed a syllabary or alphabet until modern times; the closest they got are symbols which are mostly used in transcribing foreign names.

The Egyptians were in trade with the Sumerians, and appear to have developed a logographic system out of symbols they were already painting and carving into stone and clay as part of their native craft

tradition. Again, the Egyptians developed symbols that were used for their sound, used for annotating logograms to make their meaning clearer as well as for transcribing foreign names. The Egyptians also developed their script in two forms: Heiroglyphic and Heiratic. Heiroglyphic is the familiar, picture-based system made famous from tombstone art, while Heiratic was mostly written with a reed pen on papyrus and looked more like writing as we know it. The systems were similar but by no means identical. Egypt had a strong caste system, and the scribes of Egypt were important people who guarded their literacy jealously; over time, the Egyptian systems actually became harder to use.

It is from Heiratic that all scripts in current use, which are not not based on ancient Chinese, are descended. The Egyptian empire went through multiple periods of expansion and ruled over Semitic people in the Levant during these times, with many Semitic peoples coming through conquest or migration to live and work in Egypt. It is here that the alphabet is born, based on imitation of the Egyptian writing system. It is thought to be imitation, rather than adoption, because the symbols were adopted based on how they would be pronounced in the proto-Siniatic language, not in ancient Egyptian; thus we have, for example, a symbol that ultimately becomes R that is abstracted from a head shaped symbol that was sounded t-p in Egyptian, but was used for <rsh>, the root for head in Semitic languages.

These early alphabets were influenced by the structure of Semitic languages: most of the symbols refer to consonants, with a few of them (called *matres lectionis*) used irregularly to show where vowels go on the occasions where only a vowel, and not context, can show what word is meant. Called abjads, the Hebrew and Arabic scripts are still in this family; although both later developed vowel diacritics to make vowels explicit, they are often neglected in casual use. Abjad is the word for an alphabet in Arabic, after the first four letters.

Abjads were the first alphabetic scripts, and a great power was born. Logograms are linked to words, and this is no doubt one of the sources of the Chinese civilization's great strength and endurance. Populations that came under the rule of the Chinese, in the pre-

Dynastic period, found their language and identity Sinicized because of the great advantage of adopting writing, a process that continued into modern times with the Japanese, Korean and Vietnamese people. As the Chinese language evolved, and pronunciation shifted and regionalized, the character set served for two thousand years as a point of reference; while Greek, Latin and Sanskrit passed into the domain of the learned, Chinese, no matter how it was pronounced, maintained the spoken form of the written word as acrolect, and for two thousand years was a living language for all literate people in the Chinese sphere of influence.

Alphabets, however, attempt to represent sounds, and are composed of very few symbols. This makes them easier to learn, and easier to apply to a new language. The Egyptians kept their scribe class as part of the heirarchy of their society, zealously restricting literacy, and deliberately complicating their writing system to discourage outsiders from learning it. In China, literacy was more widespread, but the difficulty of it lay beneath the existence of the scholar system of administration of the empire: those whose duties required reading and writing had to invest serious effort to learn to do so correctly, and the modern rate of literacy in places such as Taiwan must be regarded as heroic.

The Egyptians were successful enough at protecting their scripts that none was adopted to any language spoken outside of their empire, and the ability to read them was lost for many centuries. The Sumerians, less paranoid if no less cumbersome, had their system adopted by the Akkadians and ancient Persians, but this trend died with the coming of the alphabets, with all their advantages. From the development of the alphabet, writing traveled in waves throughout the city-dwelling world.

The Phonecians, sea traders in the Mediterranean, spread their alphabet widely enough that it formed the root of both the Latin and Greek, which are still in use with minor variation. It also gave birth to the Aramaic alphabet, when Aramaic became the lingua franca of Semitic peoples throughout the Middle East. Aramaic script, in addition to evolving into Modern Hebrew and Syriac (and thence

Arabic), developed into Brahmi, the ancestor of most Indian and Southeast Asian writing systems.

Something interesting happened with Brahmi, which is worth exploring a bit. Phoenician, as well as Aramaic, Hebrew and Arabic, are all abjads, which works for the languages they represent. Semitic languages rely on consonants to do most of the heavy lifting, and *matres lectionis* were used to indicate vowels where needed. When the Indo-Europeans of the Italian and Greek peninsulas encountered these systems, the needs of their language resulted in alphabets, proper, after the first two letters in the Greek alphabet. Although not always systematic, characters in alphabets are either vowels or consonants, and represent at least in principle distinct phonemes: some languages that use alphabets are quite regular in their spelling, in that a given letter or combination of letters corresponds to exactly one sound in the vast majority of cases. Others, like English, are a slough; to get through English orthography, one must sidle up to the trough. That can be tough, though.

When Aramaic writing, or one of its children, was encountered by the Indo-European speakers of India, a distinct family, the abigudas, were born. This form of writing used to be known as a syllabic, but the term is inaccurate. It is characterized by the existence of a default vowel associated with the consonant and in many cases implied by its shape. Consonants can typically be ligatured together when they don't have vowels intermediate, and vowels in turn are indicated as marks over, under and around the consonants, except at the beginning of words, where they have a special form.

This is different from the abjads because an abiguda is regular. Rather than the situation in, say, Hebrew, with three marks that usually mean a vowel and two that sometimes do, you have one consonant-like mark that denotes a vowel at the beginning of a word, and a regular system for marking up vowels around a nuclear consonant. The default vowel in Devanagiri is a simple downward stroke, and there's a mark to silence it at the end of a sentence. If two or more consonants follow directly after one another, the vowel bar is omitted, and the consonants are ligatured in various ways, some highly creative and beautiful.

Even more remarkably, we find our writing system organized in a way that follows the features of the sounds they represent. Alphabets have a conventional order which is memorized, while most of the Brahmi scripts are organized by area of articulation, with ranks containing voiced, unvoiced, aspirated and unaspirated variants. The symbols themselves follow no overarching logic, but there is some degree of similarity between characters of similar sound, sometimes. Critically, however, the order of the characters is logical, if not reflective of current thinking on the subject.

We are following a particular trail, and it leads into the mountains of Central Asia. First, the Sogdians, and later the Mongols, were to take a proto-Syriac script and do something interesting to it. The Chinese were in the habit of writing vertically, although horizontal writing was known, and in imitation of this custom the Mongolians wrote vertically as well, by turning their script 90 degrees, thus vertical, left to right, rather than the Chinese vertical, right to left. Thus we have four modes of writing which have been used by decent sized populations; poetically, we might call them the Latin, Aramaic, Chinese and Mongolian modes.

The Mongolian alphabet itself was a bit of a poor fit for the language, with phonemically relevant distinctions missing from the representation. After the Mongolian conquests, they were left with a profusion of scripts and languages under their rule. Kublai Khan had a Tibetan lama named Phags-pa come up with a script, named after him, for unifying the languages of his empire. Phags-pa came up with a vertical phonetic script useable for writing Tibetan, Mongolian, and Chinese, which is quite an accomplishment. Phags-pa script died with the Yuan dynasty, but it was influential past its time.

The Chinese script is at the heart of Chinese identity, and it appears that many ethnic groups in pre-Dynastic China adopted writing, and hence the language, becoming Han in the process. On the fringes of the Chinese sphere of influence, Chinese writing tended to be adopted by the elite in order to gain the benefits of literacy, without their cultures becoming Chinese entirely. The three nations on whom this effect was most strongly felt were Vietnam, Korea and Japan; we

will focus on Japan and Korea because of the developments in writing systems which took place there.

In both Korea and Japan, writing was Chinese writing from the beginning of literacy, and this meant at first that the literate read and wrote Chinese. Over time, certain characters came to be used as a gloss for their sound, similarly to how characters are composed of radicals in the first place; this gave a highly irregular, idiosyncratic syllabary, used initially to marginally annotate the meanings of Classical Chinese texts, a development which, if much later than that in Egypt and Sumeria, is nonetheless parallel.

In Japan, these logosyllabaries became Hiragana and Katakana, from separate traditions (women of the court and monks respectively) of shorthand. The Japanese never abandoned the logographic component of their writing system, and continue to use a rich and heterodox brew of classical Chinese characters, two syllabaries, and the Roman alphabet to represent their language; their writing system is almost a living fossil, like the coelecanth or the gingko, more like Cuneiform or Heiratic than even the Chinese writing systems (of which there are now two, as well as a dominant Roman transcription and the 'bo-po-mo-fo' system used for teaching in Taiwan). In principle, any of Hiragana, Katakana or Romaji would suffice to write the Japanese language, but there is very little interest on the part of the Japanese in doing this.

In Korea another unique writing system was developed, arguably the most interesting script in current use from the perspective of Phon. Hangul is traditionally credited as the work of one man, King Sejong; although it is clear from the record that he had advisors, it is quite possible that he developed Hangul singlehandedly, as we have the example of Phags-pa and Sequoyah (who wasn't even literate) to point to; interestingly, Phags-pa script would appear to have been an influence in the development of Hangul. The king released the system in 1446, and it was resisted by the educated elite, for classist and classicist reasons both. Hangul was used for about fifty years, abolished by a later king, and came to be used only by women and the uneducated until Korean nationalist sentiment arose in the late nineteenth century; it was not until the latter half of the 20th century that the Hanzi were

fully phased out, and relics do survive in place names and the like, at least in the South.

Hangul has syllable blocks built up out of phonemes, which in turn are built up from strokes that represent what kind of phonetic utterance the phoneme is. This makes it a featural writing system, and the only one in current use to represent a real language. This is also one of the most recent inventions to be in current use by more than one million people to represent their native tongue, as the fashion in the last few centuries has been Romanization. This is a real pity, because the Roman script is poor in symbols, with such symbols as it does have lacking family order or featural qualities. It may be hoped that this development was a feature of European imperialism generally, and that with the decline of the Eurocentric paradigm we may see other approaches to writing gain currency.

This history is in no sense systematic; it is meant only to provide some background on writing systems generally, and more information where appropriate on particular scripts that were influential in the development of Phon. Parallel to the development of writing systems is the development of linguistics, which we will explore briefly in the following section.

A Brief History of Phonetics

In order to properly situate Phon in its historical context, we need to discuss the history of phonetics, and specifically phonetic writing systems. We've seen that there are basically two living families of writing, one through the Semitic (ultimately the Sumerian) and the other through the Chinese. The Chinese, it should be noted, had a well developed science of phonetics, and cultures on the rim of Chinese influence (Korea and Japan most notably) developed scripts for recording the phonetics of their own language from a Chinese root. The sprawling family of scripts descended from the proto-Siniatic, however,

are phonetic, in concept, from the very beginning. In a happy accident of history, all of the existing members of this family descent from a script called Phoenician; though this word is unrelated to the word phonetic, it makes thinking of the phonetic scripts as the Phoenician family a mnemonic thing to do. We are mostly concerned with that family here.

Though the syllabary classes of cuneiform and hieroglyphs foreshadowed phonetics, the very invention of the alphabet may be considered the first achievement in the field, making the others possible. The idea of vowels as distinct sounds which can be represented explicitly developed slower, but in a similar organic, prehistorical way. We have no way of knowing who developed the first alphabet, or how the vowel system was refined into the explicit vowels of Greek or the modified-consonant vowels of Ethiopian and Brahmi script. We have only the archaeological record showing parts of this development over time.

The next major achievement takes place during what I consider one of the great flowerings of human history, Northern India during the Magadha and Maurya empires. The sages of this era are with us still: Mahavira, founder of the Jain religion, Siddhartha Gautama the Buddha, and Patanjali and the other major figures in Yoga, were all of this age. Equal in stature to these rishis is the great linguist and grammarian, Pānini.

Pānini adopted a rule-based approach to grammar, one based on morphology and phonetics. His achievement, a grammar of the Sanskrit language, was so thorough and far-reaching that it became not merely descriptive, but prescriptive. Before Pānini, Sanskrit was a 'high' dialect of the common tongue (Prakrt), preserved by the priestly Brahmin caste, which linguists refer to as Vedic Sanskrit. After Pānini we have the era of Classical Sanskrit, where for more than a thousand years the proper dialect of the language was defined by the Ashtadhyayi, his description of the morphology of Sanskrit.

The beginning of the Ashtadhyayi is called the Shiva Sutras, and conveys, in a compact form, the phonetics of the Sanskrit language. The significant achievement here is that Pānini divides the sounds of

his language into vowels and consonants, and within these makes families based on shared properties of sound. All nasals, for example, are grouped together, and all stops, in aspirated and unaspirated form, are grouped together. Thus, due to Pānini, Indian writing systems have always been organized this way, while the descendents of Greek and Aramaic in the West remain in an arbitrary order to this day. Altough Pānini may not have even been literate, and if he was he used Brahmi, I have chosen to include a table from the Devanagiri script, familiar to anyone who has studied it **<add>**. It shows the rank and file order of the main group of consonants, and careful observation will show some irregular resemblances between symbols on a featural basis. It was this version of the basic organization introduced by Pānini which was most influential in modern phonetic development.

Pānini's achievement, basic to high Sanskrit culture, remained unknown, and unsurpassed, in the West until the late 18th century. The discovery of the Sanskrit corpus at this time, and the translation of Pānini into European languages, marks the beginning of modern linguistics, due to the resemblance between Sanskrt, Persian, Greek and Latin which was thereby recognized, as well as the incorporation of the Indian tradition of phonetics and morphology into the Western study of grammar.

It is an interesting facet of the phonetic science that every hale human being has the apparatus to study it. Each of us has a mouth, lips, a tongue, a vocal tract and the means to construct statements in at least one language. As a result of this, basic facts about phonetics (such as the distinction between vowels and consonants) were widely known from prehistory, and various distinctions were invented multiple times as thinkers independently came to the same, basically correct, conclusions about how sounds are produced.

The spread of Latin writing across the whole of Western Europe came at some cost. Italian, which descends closest from Latin, remains closely linked phonetically with its written form, and Spanish does well in this also. As we move north, we find decent adaptations for the Germanic languages, and while French has somewhat drifted, it too began with a decent fit.

English, on the other hand...

The creole nature of English, crafted from the interactions between ruling Normans and their Anglo-Saxon subjects, has made spelling a hopeless mess from the beginning. This evident fact may be why English speakers and teachers have been a rich source of writing reforms since the seventeenth century. Early efforts such as Francis Lodwick's Universal Alphabet bear a charming resemblance to Phon, actually. There were a number of Enlightenment Era reform proposals of this sort, which we will pass lightly over; in the United States, Benjamin Franklin's reform alphabet is perhaps the best known, and is a conservative, Roman-based alphabet with some influence on the modern IPA.

By the mid-nineteenth century, several factors converged to produce a flurry of work in the field. One of these was the movement to teach the deaf to speak, through instruction in the articulation and placement of sounds, another was the aforementioned spelling reform movement. A third was the use of phonetics in teaching foreign languages, and a fourth was the rise in popularity of shorthand methods of writing.

Where education of the deaf is concerned, the remarkable Bell family are the standouts. The patriarch of the clan, one Alexander Bell, was an actor and orator who wrote several books on 'elocution'. His son, Alexander Melville Bell, is the Bell of interest; grandson Alexander Graham Bell invented the telephone, but not Visible Speech.

Alexander Melville Bell joined the family trade, becoming a lecturer on elocution at the University of Edinburgh. He married a deaf woman, which may have influenced his life work, the teaching of spoken language and lip-reading to deaf-mute individuals. Towards this end, he developed a writing system called Visible Speech, first publishing around 1867. Visible Speech was an attempt to make icons representing the shape of sound articulations directly, thus not merely featural but iconic as well. This system played a role in the development of the IPA (as well as the Canadian Syllabics used to write some First Nation languages), and certain structures turn up later in Tolkien's work, so it merits a closer look.

Visible Speech divides consonants into four places of articulation: lip, point, top and back, referring to the part of the tongue used to articulate each. In modern thinking we are more interested in which region of the vocal tract works with the tongue or on its own to constrict the air flow, and would call these categories labial, dental, palatal and velar. Due at least partly to the need to cast type for each unique shape, an expensive and labor-intensive process, Melville Bell chose to rotate his symbols in each of four directions, one direction each for the four major places. This has many consequences, once of which is that the consonants are all the same length and width, making them hard to distinguish, like reading something written in Roman capitals.

Manner of articulation is shown by changing the basic shape in various ways: closed for a stop, closed with a wiggly line for nasal, a bar separating the stroke for voicing, etc. The vowels are essentially sticks, with small modifications (hooks and cross bars) to indicate degree of stricture and placement in the mouth. There is a lot more to it, but much of the phonetics is idiosyncratic or obsolete; in any case, enough has been said here to further the story.

Isaac Pitman is at least as well known in shorthand circles as Melville Bell is in the Deaf education community. Moreover, his system is still in widespread use, unlike Visible Speech, and is the most widely-used system in the UK and Commonwealth communities to this day. His shorthand was the first phonetic shorthand, and predated Visible Speech by some thirty years, being introduced in 1837. He invented the word "Phonotypy" to describe writing systems where the shape of the character is related to the aspects of its pronunciation, what we would now call "featural", and his Phonotypic Shorthand was a great success, employing a great economy of line and exploiting the ability of the pens in use to draw a thick or a thin line quite easily.

From that basis, he turned his attention to spelling reform, devising many alphabets in the ensuing decades. The earliest of them resemble the shorthand quite closely, but in later systems he concluded (as Benjamin Frankin did a century before) that a modified Roman character set was required for widespread adoption. His later efforts

can be read, without overt strain, by native speakers of English, and represent phonetics precisely. While his reforms never caught on for general reading (they never seem to, with the notable exception of Webster and his flipped 're's and dropped 'u's) they were influential on the IPA, and in this sequence of alphabets, a detailed pictured of the development of phonetic thinking in the mid-19th century can be seen.

Henry Sweet was a noted philologist specializing initially in ancient Germanic languages such as Icelandic and Anglo-Saxon, and a student of Bell's writing system. He became an advocate of scientific, phonetic alphabets for teaching English abroad, initially working with a modified form of Visible Speech he called Organic Speech, and later became an advocate of spelling reforms in the vein of Pitman's later efforts. His modification of Visible Speech did make it easier to use, and he retained an interest in its use throughout his career. But the expense of maintaining entire typesets, and the ease of acquisition of the Roman based systems, kept it only modestly successful, used in early publications by what became the IPA.

Sweet was an influential member of the International Phonetic Association, which was founded as 'Dhi Fonètik Tîcerz' Asóciécon' in 1886, in Paris. Originally concerned mainly with the teaching of English as a foreign language using phonetic alphabets, the Association came increasingly to be concerned with one goal: the standardization and promulgation of a single, phonetic alphabet, derive from the Roman character set and useful in the phonetic realization of all languages. This development is chiefly due to Otto Jesperson, who also devised the notion of an International Phonetic Association proper. It took only a few years for phonetic concerns to become the chief focus of the journal, which was published for many decades entirely in phonetic script. In early years, various phonetic scripts were introduced and compared, and Sweet maintained a sort of Organic Speech for the use of the publication, but over time the Journal, and the IPA, settled on the alphabet now considered the standard in linguistic and phonetic science.

The International Phonetic Alphabet is considered in detail

elsewhere. Here it is enough to note that it was a great success, developed through the process of academic consensus in a paragon of the 19th century style. It was possible to type it with a little creative overstrike and modification, and every printer of academic subjects had a sort of the type on hand. Such later offerings as Shavian sank without a visible trace; Phoneticians and academic linguists used the IPA, and everyone else stuck with their native orthographies, and that was that.

It is fitting, then, that the next development was a hobby, albeit the now-famous hobby of a distinguished linguist and author. J.R.R. Tolkien is best known as the author of The Hobbit and The Lord of the Rings, but in his professional life he was a professor at Oxford, initially in Anglo-Saxon. His profession was linguistics, in other words, and his passion was inventing languages and writing systems; he has claimed more than once in his writings that the entire world of Middle Earth and the stories written there are to provide background and history for the languages, writings and lore that were his abiding interest.

Tolkien developed two Elven languages, Quenya and Sindarin, which reflected (among other things) his great love of Finnish and Welsh, respectively. He designed several ways for each to be written: a mode using Roman letters, which is the one he actually used most, a runic form called Cirth (not further discussed here), and two script hands, Sarati and Tengwar. Of the two, Sarati is older, both in the legendarium and in historical chronology, and Sarati has intriguing traces of the form found in Tengwar and later Phon. In particular, Tolkien's elves were ambidextrous, and Sarati could be written in three (arguably four or five) directions. Certainly, a vertical and two horizontal modes were present.

It is Tengwar which is associated in the public imagination with the Elvish language. The inscription on the Ring is written in the Tengwar, and in the film adaptation most of the additional Elvish is in Tengwar also. Tengwar is also the only script Phon may fairly be said to be descended from, though its debt to the IPA is also certain. So it's worth exploring in a bit of detail.

The Tengwar reflect Tolkien's personal aesthetic as to what writing should look like, just as Quenya and Sindarin reflect his sense

of what language should sound like. They draw visual inspiration from the Uncial hand, particularly the Insular development seen in the Book of Kells, just as Quenya and Sindarin drew much of their sound quality and morphology from Finnish and Welsh. In formal structure, however, we see a continuity with the old iconic school of phonotypy.

As a professor of Anglo-Saxon, Tolkien must as a matter of course have been familiar with the works of Henry Sweet, who was also a noted Anglo-Saxon scholar, and must therefore have had familiarity with Visible Speech. It is perhaps not surprising, therefore, that we can see parallels between Visible Speech and Tolkien's writing systems. The four columns of the main consonant grid, called the témar, correspond closely to the four places of articulation in Visible Speech, and the tyeller, the manner of articulation, have a similar arrangment. The Tengwar are conceived of as meta-letters that are assigned values depending on language, but in practice the assignments are familiar to a student of Visible Speech. The strokes are doubled to form voiced consonants, which is a similar visual effect to the dividing bar used in Visible Speech to represent the same distinction.

Tengwar follows Visible Speech in distinguishing vowels visually from consonants, but does so through tehtar, which are essentially diacritics. These are placed above or below the consonants, as one pleases, with different ways standard for different languages. The consonants that don't fit the classification scheme come in non-standard shapes, that continue to be formally related to the Insular hand. The Tengwar lay close to the heart of Tolkien's mythology: the inventor, Fëanor, later went on to forge the Silmarils, which are the central pivot of the entire legendarium. It was designed only to please his particular sense of the beautiful, and succeeds, I daresay, in the esteem of most.

Luigi Seraphini takes his own sense of the beautiful and arguably goes even further with it. An Italian graphic artist, Seraphini is best known for the *Codex Seraphinianus*, a monumental work in the form of an encyclopedia. It is richly illustrated, and entirely laid out in longhand, featuring a writing system which has never been deciphered and which may not prove decipherable. The numbering system, it

should be noted, has been worked out with some satisfaction, and one cannot read (if that's the word) the *Codex* without getting the sense that there's at least some meaningful text in there. It could be entirely decoration, but if so, it does an incredible job of imitating a language, with recurring words and the like. The *Codex* was completed in 1978, and I encountered it as a young college student in the late 90s and fell in love. The sense of the mysterious that browsing the *Codex* invokes in me to this day was a major influence in directing my attention towards writing as an aesthetic and esoteric pursuit.

One week in October of 2006, I developed the core elements of the Phon writing system. I'll explore this process in detail in the chapter on the forms and morphology of Phon. Our next task, however, is to explore Phon in the context of English, the language in which this book is written. We have overviewed the nature of Phon, and established the historical context of the script; now let's take some time to understand something about phonetics, phonemics, and how to write and read English using Phon.

Phon in (and for) Plain English

Phon can be approached from several different angles, more or less useful for different backgrounds. For people accustomed to computer programming or mathematics, the formal underpinnings of the writing system itself are probably of greatest interest, and Chapter III would be the best place to start. For those with a grounding in linguistics, particularly the International Phonetic Alphabet, Chapter IV introduces Phon as a phonemic script, contrasts it with the IPA, and provides a detailed overview of how the various formal elements of the writing system work together to represent utterances.

This chapter is a guide to using Phon to read and write English. To do this right, we'll need to introduce some phonetic concepts and some of the terminology of Phon, but this chapter assumes no prior knowledge of the subject.

We are used to thinking of speech, just like writing, as being composed of discrete 'chunks' which we combine together to make meaningful sentences. Interestingly, most of the terms used for the chunks of writing and the chunks of speech are the same: although we don't speak of 'paragraphs' of speech very often, we refer to sentences, phrases, words and syllables interchangably between utterances and written statements.

This works out well enough in practice, although we know that a written sentence is not the same as a spoken one. It's lossy, for one

thing. Consider how little meaning is contained in the written sentence "I can't believe it!". We have no idea if the speaker is being serious or sarcastic, which would be opposite meanings. The distinction is carried in the intonation of the sentence, which is not written out in English, though the exclamation point serves as a guide to intonation just as the question mark does.

Words are even more interesting, because we discover when we listen carefully to speech that words are not a part of the audio signal. Sentences and phrases are set aside by rhythm, breath, and tone: a sentence in English will begin faster and higher in pitch, and breaths are taken only between phrases, with larger, deeper breaths at the end of sentences. Syllables are easily recognized by the absence (really a muting in many cases) of sound between them. Words, however, are cognitive: someone listening to English who didn't speak it could mark out the syllables but wouldn't know where a word began or ended. "someone listening to English" has eight syllables, and someone naive of English could tell you that, but couldn't tell you that it has four words. The fact is that stress, which is a property of syllables, has a semi-regular pattern within words in English which makes them easier to pick out, but a language like Japanese lacks this feature, relying on shifts in consonant (e.g. from a phrase-initial k to a g in the middle of a word) to distinguish words.

At the lowest level, we have different words for speech and writing. In English writing, the atomic unit is the letter; in English speech, as in speech generally, the atomic unit is called the phoneme. The term alphabet, in the broadest sense, is used for writing systems where the fundamental unit (called a grapheme) represents phonemes. If the graphemes represent syllables, we have a syllabary; if they represent words, a logographic system.

There are good reasons to not just call phonemes a 'letter', as we call text and speech words with the same 'word' word. A sentence like "anyone who knows it knows it" has six words and eight syllables, in spoken or written form. This same sentence has twenty-three letters and seventeen phonemes. There is, for practical purposes, a single written word for each spoken word in English. This is an idealized

claim, of course, but not far off. It is emphatically not the case for phonemes. 'f';, for example, is represented by 'f" in 'fall', 'ph' in 'Phon', 'gh' in 'enough', while 't' is found in 'θ' 'think', 't' 'tall', 'ð' 'that', 'ʃ' 'motion', and silent "match".

Some alphabets have a very regular correspondence between letters and the phonemes they represent, with Italian often cited as an example. English is not at all a regular language, with many spellings reflecting old pronunciations which have shifted, sometimes multiple times, since spelling was refined into a standard form in the 17th and 18th centuries.

Phon was designed to provide a symbol for every phoneme, in any language, and it can used to write English easily. In fact, if one can imagine for a moment a native English speaker who not only couldn't read but didn't know the letters by shape or name, it is easy to see that this person would find Phon much easier to use. Picture trying to explain the use of the consonant 'c', which has the same consonant sound in its name as the consonant 's' and which is mainly used either as an 's' sound or as a 'k' sound, or why 'g' and 'j' have the same consonant sound in their names when 'g' is used for (among other things) 'g' and 'dʒ'.

Phon is phonemic, which means that the phonemes of in this case English are each represented with a single symbol. It is also featural, and this means that the shapes of the symbols corresponds to parts of pronunciation. One part of a consonant shows where in the mouth it is articulated (made by the tongue), and another part shows how: for example, whether the airstream is completely blocked by the tongue (a plosive or stop), whether the airstream is directed into the sinuses (a nasal), a narrowing producing a turbulent hissing noise (fricatives) or a narrowing producing a consonant sound but without turbulence (approximants). English examples of these phonemic categories are 't', 'n', 's' and 'j': the last is pronounced 'y' in 'yellow', the first three as found in their names "tee en ess".

Phon aims to be perfectly phonemic: that is, to provide a unique symbol for every meaningfully distinct difference between utterances in every language. It does not aim to be perfectly featural, but it is highly

so, and it can justly claim to be the most reguarly featural writing system in existence. This makes Phon letters (graphemes, really) easier to learn, because the shape tells you something about how to say them.

Consonants are easier for an actual reader of English to learn than vowels are, because the consonants of our written language are (comparatively) regular in use. A consonant in Phon consists of two types of strokes: a single vertical stroke called a sirpë, and one or more rounded strokes attached to it, called lassë. The words mean 'stem' and 'leaf', and are meant to make you think of the shapes, as well as help you remember the order of drawing them: first the stem, then the leaves. 'stem' has a specific linguistic meaning that's different, and for that and other good reasons we'll use our particular terms here, which are taken from J.R.R. Tolkien's Elven language Quenya. Tolkien's writing is ancestral to the Phon system, and this is done in homage to that, as well as to emphasize the transnational character of the writing system, which is not based on any historically used scripts, but only on the hobby of a distinguished linguist.

Phon is carefully designed so that left handed people and right handed people can write it, in the same way but with opposite results on the page. Right handed people write in the usual mode for Roman characters, from left to right, while left handed people do the opposite. This means that, instead of talking about left and right, we usually talk about 'senseward' and 'anti-senseward'. The diagrams in this book are, unless noted, in Rightic Phon, but were produced by writing Leftic Phon and flipping it on the computer, on the assumption that lefties are used to reversing things and righties are comparatively helpless in this regard. This means that 'senseward' in the diagrams is towards the right margin.

The sirpë are organized so that ascenders 'point' to the front of the mouth and descenders point down the throat. This means that a sirpë that is ascended refers to a bilabial, a sound made with both lips. If we take the first lassë, which looks like a bow, and draw it senseward on a bilabial sirpë, we have the first consonant in Phon, a bilabial plosive, unvoiced: '  ', pronounced əpə and equivalent to the IPA character 'p'. This represents the 'p' in 'pin'. If we draw two lassë

of this type we get a voiced bilabial plosive, '  ', pronounced əbə, and representing the 'b' in 'bin'. These two words form what's called a minimal pair: they differ only on the basis of a single phoneme. Minimal pairs are important in sorting out what the phonemes are for a given language, because there are a variety of phones (actual sounds uttered by a speaker) which are all considered the 'same' sound by particular listeners. English speakers, for example, cannot typically tell the 'p' in 'pen' from the 'p' in 'spin', but the difference (the first is aspirated in the second is not) is contrastive in Hindi; there are words that differ only by whether or not the 'p' is aspirated. Similarly, the distinction between 'l' and 'ɹ' (the sounds of 'lift' and 'rift') is not made by Koreans, who would not detect lift and rift as different words.

The next sirpë is called the dental: it is assigned, usually, to sounds which take place against the teeth or just above them.  , an unvoiced dental plosive, represents the sound 't' in 'tin', while  is the sound 'd' in 'din'. The palatal stem, which neither ascends nor descends, comes next; there are no palatal plosives in English, and only one actual palatal. After this is velar, and we have  for 'cut' and  for 'gut', which are 'k' and 'g' in IPA terms; the place where these sounds are made is called the velar region.

Other languages, such as Arabic, have stops even lower in the throat, such as the uvular stop heard in the word Qur'an, a 'q' in IPA and a  in Phon. For English, we're done with the stops. The next group of sounds are the nasals, where the airflow through the mouth is stopped but it is continued in the nose; while this is happening, the vocal cords are vibrating, making nasals voiced. Because nasals are all voiced, we do not need to double strokes to represent them, and nasals in Phon are symbolized by a spiral shaped lassë, called a hwinya, in the same direction as the stop lassë. The first nasal, which is bilabial, is , the sound 'm' in 'bam'; next we have the dental nasal  for 'n' in 'ban', both straightforward enough. Although we're used to representing it 'ng', the sound 'ŋ' in 'bang' is a distinct phoneme, articulated where a 'g' is but voiced like an 'n'; we represent this as  . There is a palatal nasal,  , which is used in Spanish loanwords such as 'piñon' and has the IPA form 'ɲ'; some accents (Cajuns for example) will render 'onion'

with this consonant.

English has no true trills, taps or flaps. These sounds are 'r' like, and are made by the tongue tapping once or several times against the top of the mouth: for example, the alveolar trill 'r', found in the Spanish word 'perro' meaning 'dog'. The r sound in English is produced in the same spot, but in a different fashion, and is called an approximant. In Phon, however, it comes before most other approximants in order; for the reason see the discussion of sort order in Chapter III. So the next character used for writing English is the rhotic approximant ﬧ, written 'ɹ' in IPAese and pronounced like the 'r' in 'rat'.

Fricatives are next. These are sounds in which the airstream is narrowed enough to make it turbulent and noisy, but not stopped entirely. Fricatives, like nasals, are described as sonorants, which means they can be sounded for as long as one likes, such as the extended ʃ written as 'Shhhh!' which English speakers use to obtain silence in a crowd. This is because the fricatives do not disrupt the airstream through the mouth entirely. Because the airstream is making a noise at the point of articulation, fricatives can be both voiced and unvoiced.

There are a lot of different fricatives, more than any other type of consonant. There is a bilabial fricative, for instance, but it is not found in English and would sound cartoonish if used. The closest we have, and much more common in languages generally, is a labiodental fricative. This is formed by the bottom lip nearly touching the top teeth, and we have a variant of the bilabial sirpë to show this articulation. The unvoiced labiodental fricative is ﬩, pronounced 'f' in 'fat', and the voiced is שׁ, 'v' in 'vat'.

The dental sirpë refers to a region of the mouth where no less than six distinct phonemes of the fricative type are found, and all of them mean something in English. There are a few reasons for this: one is that the 'dental' sirpë also refers to the alveolar region, found above the teeth along a ridge on the palate , another is that the tongue, by changing shape, can change the turbulent qualities of the airstream quite a bit. Our ears are so sensitive to this quality that we have a special word, sibilance, to describe it. A third reason is that English has more dental-type fricatives than many other languages.

Rather than tag the dental sirpë to mark variants (we're saving that option for later) we are going to use different lassë to tell these strokes apart. Of the three unvoiced options, the one that seems most directly contrastive with our dental stop 't' is the dental fricative 'θ', pronounced 'th' in 'thigh', so we write it ﬦ. The voiced version, שׁ or 'ð', is pronounced 'th' in 'thy'.

The next fricative we'll encounter is ﬨ, pronounced 's' in 'sip', and its voiced counterpart שׂ, 'z' in 'zip'. Also, we have שּׁ, IPA 'ʃ', the 'sh' in 'ship', and שּׂ for 'ʒ', the 's' in 'pleasure' ('ʒɪp', sadly, is just not an English word). These are presented in phonetic order; because Phon characters are sorted according to the strokes they're made of, rather than the sounds those strokes represent, words starting with these sounds would be found after all other fricatives.

The remaining fricatives are the rarely used אַ, for a voiceless velar fricative, a turbulent version of 'k'. This is spelled 'x' in IPA, and is found in the Scottish word 'loch' as the 'ch' sound, and in the occasional loanword from other languages; many English speakers would pronounce 'loch' with a 'k'. Much more commonly found is the glottal fricative אָ, pronounced 'h' in 'hip'. Neither of these is found voiced in English; although the 'h' is sometimes actually voiced as 'ɦ' or אּ this is not contrastive, that is, English speakers hear the same phoneme and the 'h' is voiced or not depending on the neighboring phonemes.

The approximants come next, sounds where the airstream is narrowed enough to produce a consonant-like sound, rather than a vowel, but not so much that it becomes turbulent. The 'r' sound in English is an approximant, but the symbol has already been given. We also find the only palatal which is frequent in English, the character בּ , spelled 'j' in IPA and providing the 'y' sound in 'yes'.

English also has a lateral approximant in the dental region. As mentioned before, many languages such as Korean and Japanese do not contrast between the two so-called liquids 'r' and 'l'. In those languages, both phonemes and anything in between are allophones, sounds which carry the same meaning within the language. There are rules that govern which is used when, but these rules are not ones that

a native speaker would need to know; indeed, one would only know such rules if taught them, wheras one learns a native language without instruction. Similarly, the rule as to when to aspirate a 'p' in English is not one most people who speak English can explain, and I'd guess the vast majority don't even know they're doing it.

We represent the dental lateral approximant , the 'l' sound in 'left'. The sirpë show that it is dental, while the hook (which is a type of stroke called a tuima) shows that the sound is lateralized, that is, released from the side of the tongue. Approximants don't have a definite side of the sirpë the way stops and fricatives do, and this particular lassë is found on the stop side; one good reason is that there is a lateral fricative also, and fricatives are all to be found on the fricative side of the sirpë, for consistency.

We are left with a couple offbeat consonants, which are banished to the 'other symbols' part of the IPA table for being so irregular. The common one is , which IPA renders 'w' for 'weather'; this is a voiced labial-velar approximant, made by narrowing both the lips and the velar region. In some types of English, we have a second sound , rendered 'ʍ' for 'wh' in 'whether'. If you pronounce both 'w', that's fairly common these days; make the distinction in writing or not, as you please, but it does provide contrast between common words so it's useful to include whether you say it or not.

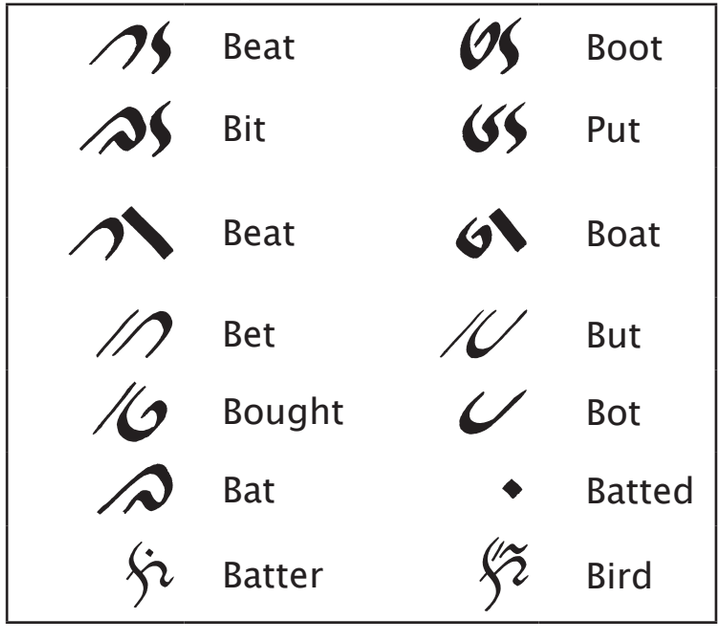
Those are the simple consonants used in English. There are a couple more sounds that we tend to think of as simple consonants, namely the 'ch' in 'chin' and the g in 'gin' (or 'j' in 'june'). These sounds are affricates: they begin as stops, but release into a fricative at the same position. The phoneme represented as 'ch' is written 'tʃ' by the IPA, with a tie bar added sometimes for clarity, but these are considered one phoneme in English rather than two. Consider: if one were to exchange 'chin' for 'shin', one would not hear it as though a phoneme had been deleted; and yet we would hear the names 'flynn' and 'lynn' as differing only by the absence of 'f' in the latter. The sound 'ts' as in 'its' is also an affricate, but is treated as two phonemes in English, because we treat 'it' and 'its' as differing by the addition and deletion of an 's'.

Thus there are several ways of writing affricates in English. The

long form, which is proper but seldom to be encountered, is for 'tʃ' and for 'dʒ'. These are just the individual phonemes with a stroke, called a falma, connecting them. The short forms are and respectively; the place of articulation of the fricative, as well as the voicedness, are understood. If one wished, the short form of 'ts' can be written , to show that it is an affricate, and also to make the word 'its' or "it's" a single consonant long.

To emphasize the phonemic nature of these affricates, they are commonly written with entirely different characters. Phon offers an extension set of characters which do not have globally defined meanings: these can be associated. In English, 'tʃ' is ordinarily rendered , with 'dʒ' being rendered . You will note that these both take palatal stems; there are historic reasons for that, as well as the good reason that there is only one genuine palatal in English, so using these mesograms offers visual contrast. The lassë used in each are found only in mesograms, making them easy to spot as such.

Figure 2.1 English Vowels



English Vowels in Phon

The vowels of English are not as straightforward as our consonants are. This is partly because our spelling has only minimal bearing on which vowels are actually used. The vowel structure of English also changes considerably depending on which variety of English is being spoken: for the purposes of this document 'General American' as spoken by actors and news anchors is the standard.

Also, we are taught that there are 'short' and 'long' vowels, which is true in some languages (Hindi and Finnish for examples) but not so in English. There is a relationship between stress and what are called 'long' vowels, but length is not a factor. While we have five letters to represent vowels, there are between ten and twelve (varying with regional accent) vowels in English, and they don't correspond neatly to the vowel markers.

What is a vowel? In school, we learn 'a, e, i, o, u, and sometimes y and w', but these are of course letters, not phonemes, and 'ough' is also sometimes a vowel (with a silent 'ugh', which is not an uncommon reaction to English spelling). We are interested in what a vowel is as an utterance, because when we understand how vowels are sounded we can then understand how they are written in Phon, and more importantly, why.

Earlier, we've talked about different kinds of consonants: stops, where the airflow is entirely interrupted, fricatives, where the airflow is narrowed enough to cause turbulence, and approximants, where the narrowing is not enough to cause turbulence. Each of these corresponds to a more open air passage than the one before it: when we open the air passage further, we produce a vowel. All vowels are voiced, by definition, and all vowels are also sonorants: the vocal cords vibrate and the sound can be maintained for as long as there's breath in the lungs.

The approximants lie on the border between consonants and vowels, and it is not always possible to distinguish between them. For

example, we have the approximant 'ɹ', found in a word like 'red'. But what of the 'r' sound in the word 'flower'? This is assuming that one speaks a sort of English in which there is an 'r' sound at the end of that word: much of the Anglophone world does not, including most of Britain and all of Australia and New Zealand. For other places, notably North America, Scotland, and India, there is a so-called r-colored vowel, represented in IPA as 'ɚ' and in Phon as ʎɾ. This is considered a vowel, but 'rhotacized', that is, the tongue is bunched in the way used to pronounce the approximant 'ɹ' but the air passage is not narrowed as much as for the actual approximant.

Another example of this border can be seen by pronouncing the word 'yellow' while stretching the first sound out, then pronouncing the word 'evil'. The former uses the approximant 'j' for the first sound, while the latter begins with the vowel 'i', however the sounds are either nearly the same or identical. The initial sound in 'yellow' becomes an approximant because the next sound is the vowel 'ɛ', and it becomes a vowel in 'evil' because the next sound is the fricative 'v'. Saying the words 'only yellow' at speed will make this clear, as well as illustrating how it is that the letter 'y' came to be used for both purposes in English orthography.

In Phon, the consonants are written where an English speaker expects to see letters, that is, along the main line and extended above and below it. Vowels, on the other hand, are written above and below the main line, either over/under a consonant or on a sirpë of lassë size, that is, a palatal sirpe. A vowel above a consonant is pronounced before the consonant, while a vowel below a consonant is pronounced after it. This sort of arrangement will be familiar to students of Hebrew, Arabic, Farsi, Urdu, and to a lesser degree of Hindi, Thai, or languages which use related scripts. A student of Tengwar, of course, will be right at home.

The vowel 'i' is as narrow in the mouth as you can get and still have a vowel, as saying the word 'easy' will illustrate: the tongue narrows from 'i' to 'z' and back to 'i', with no phoneme in between. The vowel is also as far forward in the mouth as it can be. Therefore we write this vowel as  , where the bow-like stroke shows forwardness

and the upright stroke indicates a closed vowel, one that is as narrow as it can be without becoming a consonant of some sort.

In English, there is no contrast between rounded and unrounded vowels, that is, there are no vowels which differ only by how rounded the lips are. Some English vowels are rounded, some, like , are not. An example of a rounded vowel is , which is 'u' to the IPA and pronounced like the 'oo' in 'boot'. The swirly looking shape symbolizes a back rounded vowel; if it was back unrounded, it would be like an upside down version of the bow stroke in .

Most of the vowels can be remembered by putting them between 'b' and 't', as 'beat' and 'boot' show. This pair have two similar vowels that are slightly more open: , written 'ɪ' and said 'bit', and , written 'ʊ' which must be remembered with 'put'. More open than these are , written 'e' and pronounced 'bait', and , written 'o' and pronounced 'boat': note that the latter is a common use for 'o' in English, but that 'e' is seldom used that way (or should i say 'we' which is certainly not pronounced 'wi'; IPA can get confusing when applied to a language that uses Roman characters already).

Next we come to the mid-opens, , spelled 'ɛ' and pronounced 'bet', and , spelled 'ʌ' and pronounced 'but'.

Some accents of American English distinguish between , spelled 'ɔ' and pronounced 'bought', and , spelled 'ɑ' and pronounced 'bot'; if you don't distinguish these sounds, just use . There's also a slightly less open, forward vowel, , spelled 'æ' and pronounced 'bat'.

These are the main vowels of General American English; there are also the three dipthongs: , spelled 'aɪ' and pronounced 'eye', ,spelled 'aʊ' and pronounced like the exclamation 'ow!', and , spelled 'oɪ' and pronounced like the interjection 'oi!': or, if you prefer, there's 'bite', 'bout' and 'boy'.

English accents are split between what are called rhotic and non-rhotic accents. The English, Australians and New Zealanders, would not pronounce the 'r' at the end of 'New Zealanders', whereas Americans, Scots and Indians would. Most of these 'r' sounds rendered in IPA by following the vowel with 'ɹ', which is what we might expect;

in Phon, we would draw the vowel above the approximant 'ɹ'. Two, however, are considered rhotasized vowels. That is to say that the word 'bird' is typically rendered 'bɝd'; the middle character is a distinct vowel with an 'r' quality, not a change from a vowel to a different tongue position as the orthographic spelling suggests. The other vowel is used to render 'butter' as 'bʌtɚ', and is a reduced vowel. These are rendered in Phon as and , where the little tail on the shows that it modifies the vowel above.

The shwa 'ə', a simple dot by itself: , is used to render the reduced vowel found in e.g. the end of the word 'roses'. In mesographic use, the shwa can also be used for the reduced vowels at the end of 'button' and 'bottle'. It should be noted though, that these words involve an unusual airstream mechanism, where instead of a vowel the stop ends when the air either goes into the nasal cavity ('button') or is expressed laterally ('bottle'). If these special airstream release characters are drawn instead of the vowel, they must be placed under the stop consonant, not above the lateral or nasal. The lateral release character is and the nasal release character is .

Writing consonants is perfectly straightforward: they are written one at a time, in the senseward direction (left to right for right handed writers), and they come in only one form. Vowels, in Phon, are written as diacritic marks, above and below consonants; in Phon, these marks are called cermë, which means grain or harvest. When a vowel is found alone, it is put onto an unextended sirpë, what we call a bare palatal sirpë: dipthongs, as shown above, are written above and below this character.

The vowels as written here are p-type, that is they are shown as they would be drawn above and below a plosive consonant, or any consonant with the lassë in the senseward direction. If you try and write, say, the vowel on an f-type consonant, you will run into a problem: the thick stroke indicating mid-closed will get in the way of the bottom extension of the sirpë, assuming the consonant has one. For that reason, and others discussed in the formal chapter, the vowels are written differently for f-type and p-type consonants, as well as to make it easier to read Phon in both directions. The rule is that the

closed mark and the mid-closed mark are both drawn away from the sirpë, with the other part of the vowel next to it; while the mid-open mark is always drawn next to the sirpë. Vowels by themselves are always rendered in the p-type, above a bare palatal sirpë.

Phon aims to achieve several goals: one is to provide a tool for phonetic and phonemic notation, and another is to provide a practical script that can be used by speakers of the world's languages in order to write them. These are complementary goals: certainly if one can render an acceptable amount of phonemic distinction, one can use it to write languages. Spoken utterances have more information in them than is typically written down. Some languages, such as English and Spanish, have stress: in Spanish this is indicated only when it varies from the rule, while in English it is never indicated at all.

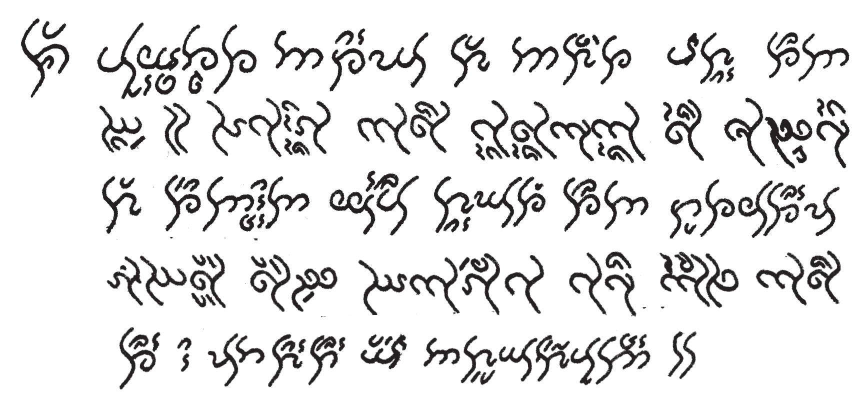
In Phon, we distinguish between arcograpic and mesographic use of the writing system. Arcographic use encompasses both broad and narrow transcription in the phonetic sense: it is concerned with accuracy, use of a single invariant and international standard, and completeness of rendering. There is a continuum between arcographic and mesographic use, and between meso- and basigraphic use, which is using Phon in a way that isn't recognized as valid by the Foundation, or which is simply incorrect in some way.

The idea is that Phon will be modified in small, systematic ways, to make it easier to write and read various real languages. These modifications will be part of the official reference standard of the Phon language. An example we've already encountered is the affricates: they can be written as two consonants with a falma connecting (the most arcographic choice), in the short form (still arcographic), or as the two mesograms and . . These characters show that 'tʃ' and 'dʒ' are single phonemes, while adding visual contrast to the script particularly by inhabiting the sparsely-populated palatal region instead of the densely packed dental.

There are several cases where English is contracted by implying the vowel with a shwa, such as for 'the', for 'of' and for the ending '-ing'. It should be noted that, while the proper pronunciation of 'the' and 'of' is close to that implied by the spelling, would sound

more like the end of the word 'hung', but as -ing is so common in English and 'əŋ' is practically unknown ('hung' is properly rendered 'hʌŋ'), the switch saves effort in writing and is essentially a contraction. The mesograph for 'and', , is a contraction of the 'n' and 'd' of the long-form. There is also a symbol that represents the words 'of the', which is a contraction of those mesograms and rendered ; this is perhaps somewhat fanciful. but follows clearly from the existing mesograms (which are useful) and is included as an homage to Tolkien among other reasons.

That's how it's done; the key is to practice, particularly the vowels. A sample text in English is given in the appendices, for reading practice. We hope to publish a journal and blog in Phon, as soon as we can get any sort of font together. This chapter explores the how of writing English using Phon, but not why one might want to do so, or how Phon came into existence. Our next task is to explore, in considerable detail, how Phon got to be the way it is and what this reveals about the underlying structure of the writing system; in other words, the form and morphology of Phon.



The Form and Morphology of Phon

Letters are strangely invisible. We see them every day, thousands of them, of course, but the act of seeing the letters of a word invokes the word, the sentence, the meaning. We gaze at letters but we see language, just as we gaze at brushstrokes but see a painting.

But how unlike those brushstrokes are the glyphs of writing! A painting, from the old representative school, uses the physics of the eye to trick the brain into seeing an image. A writing system is a complex, abstract map between sounds and shapes. At the extreme end, every classical Chinese character can be pronounced dozens of different ways, not only within the languages called Chinese but in Japanese, Korean and Vietnamese as well. English is in a middle ground, with some rules and some regularity to the exceptions, with Italian a fairly regular match. But in each case, there is nothing but a learned response which lets us correspond between sounds and written symbols. Without the key, we are helpless.

And yet the process, once mastered, fades from consciousness. A word is seen, apprehended, 'heard', meaning is conveyed, and we give it as little thought as we give to what lies outside the frame of a photograph. This gives the letters the feeling of something natural, like the elements or the colors; something we were given, not something

we created. The great antiquity of the Latin alphabet contributes to this feeling; the invention was lost in time, and custom has given our symbols a weight, a gravity, that is so pervasive as to be hard to see. It is as though one pointed out that we wear clothing, or use utensils to eat food.

Phon is as it is out of a fascination with the form of writing. It has a deep formal structure whose shape arises from a process of elaborating and refining shapes, the shapes a pen makes on paper. . Each stroke in Phon takes a particular shape, and that shape has a definite relation both to the other shapes of Phon and to the meaning conveyed by the stroke. This happened because Phon was designed in a particular way, which allowed a simple, supple pattern to elaborate into something which can encompass the entire phonemic state space.

Phon can best be understood by understanding how it came to be. Phon began as a simple project: I wanted to be able to write beautifully, with a fountain pen, without smearing ink on the page, and without having to orient the page sideways or upside down. Through successive evolution it became something at once simple and intricate, beautiful and powerful. I don't believe Phon can really be grasped without understanding this process.

Phon is a work of synthesis, which builds on the work of many. In form, of course, the greatest debt is to J.R.R. Tolkien, whose work pioneers many of the concepts and forms found in Phon. The process, however, owes the most to Christopher Alexander, a Berkeley professor of architecture. He has devoted his life to understanding something simple and profound: how life is formed and nurtured in space and time. He is best known for two books, A Pattern Language and The Timeless Way of Building, which between them describe a sweeping vision of how to organize human spaces to serve the greater wholeness of humanity, society and nature. Thirty years later (in 2003) he published a magnum opus, The Nature of Order, which generalizes these insights into a full understanding of how patterns are elaborated by transformation into all living systems, be they sand dunes, coral reefs, or mammals.

Alexander's work is resistant to summary in a similar way to

Phon, and for the same reason. But its heart is the idea that there are 15 principal transformations which are found at all levels of organization in nature, and that these and only these create good structure, living structure. By identifying these transformations, and finding examples of them in good structure (both natural in the limited sense and in the artifacts of humanity), Alexander provides a system for building anything at all, and having it come out beautiful, healthy, and vibrant. Though I hadn't read The Nature of Order when I designed Phon, the principles are found in nascent form throughout the earlier works, and I will refer to them here.

Phon, as stated, began as a simple calligraphy project: i was tired of smearing ink, and generally felt constrained by Latin-based calligraphy. I had already tried writing English backwards, using Hebrew or Arabic script to write English, and writing Tengwar backwards in one of the 'modes' for English writing I found on the Internet. None of them were what I was looking for: it became clear that I was inventing something new.

<addquote>The first, fundamental insight was in Appendix E of the Lord of the Rings, where Tolkien explained the logic behind Tengwar. Tengwar has a main body of regular characters, all consonants, where the vertical stroke (called Telco) indicates the method of articulation and the horizontal strokes (the Lúva) indicates the place of articulation, and are doubled to indicated a voiced consonant.

I remember feeling the hair on the back of my neck bristle as I thought about this. It echoed a similar electric feeling from years ago, when I briefly studied Sanskrit, and first saw the neat ranks which organize the Devanagiri script. Except in this ranking you could see the shape of the rank when you took the grid away! In Sanskrit, and the IPA, there is an ordering on the basis of features of sound, but in Tengwar, you could see that organization in each of the rank and file characters. This was exciting.

Note that this germ, this kernel, is still at the heart of Phon. The first insight was the correct one to generate the whole structure, which is transformed from there. I next asked myself why Tengwar was not itself what I was looking for. I came up with a few things. First, I didn't

like the irregular consonants; although I thought they were beautiful, they didn't fit the crystalline sense of beauty I was developing. They didn't resonate with the core insight about symbolizing articulation and place. Every consonant has an articulation and a place, so why symbolize them in some and not in others? Devanagiri, which is highly readable, has an invariant stroke, the top bar, for each consonant, and a common vowel stroke for most instances also.

Next, I realized that I needed to switch the basic axis of the system. Tolkien puts method of articulation along a vertical axis and place along the horizontal one; he then complicates matters by putting voicing, clearly a matter of articulation, along the horizontal axis also. So I switched them: the vertical stroke would symbolize place, and the horizontal strokes method, of articulation. This also accords with certain feelings about the voice, where the 'h' sound is below the 'k' sound which is below the 'p' sound in physical space. Also, the articulation of a sound involves a puff of breath along the horizontal axis. I resolved to maintain the doubling for voicing, because it was simple and beautiful.

These two decisions alone radically simplify the pattern while making it much, much sharper. In the first iteration we have no shape at all, just the idea: 'Something like Tengwar where the strokes indicate the sounds, with place along one axis and type along another'. Now we have 'a writing system where a vertical stroke defines the place, and horizontal strokes the manner, of articulation of a consonant, where a symbol is doubled for voicing.'. This is a definite shape, and again, this shape is found intact in Phon as it exists, just as the very first specification is accurate.

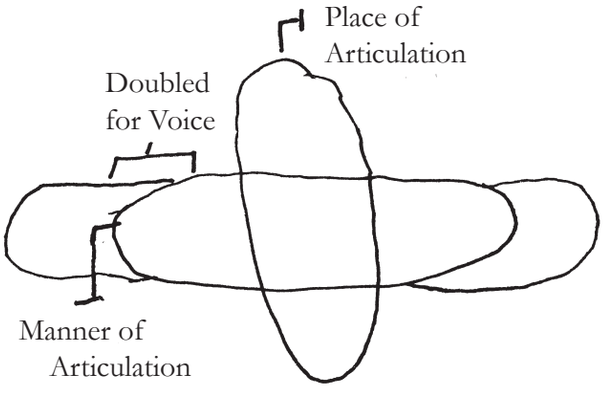


Figure 3.1 First shape of the Phon pattern

We aren't quite done with gleaning wisdom from Tolkien, however. His vowels, the Tehtar, are found above and below the horizontal (lúva) stroke, and I liked that. Among other things, vowels don't clearly fit the place/manner scheme, which is accurate only for consonants. I took a cue from Tolkien, as well as from Devanagiri, Hebrew and Arabic, and put the vowels above and below the consonants. The new pattern is "consonants as described earlier, with vowels above and below". The shape of these vowels is completely undetermined at this time, and ended up resembling Tengwar not at all, other than placement.

One more thing struck me about the Tengwar; there was something about their shape that was subtly off to me, not good in some way I couldn't quite place. I thought about it for awhile, and eventually I realized I didn't like the characters where the lúva is closed off by a bottom stroke. I resolved that my new script would have no space-enclosing strokes, such as the letter o or the offending Tengwar. This adds "no enclosed space" to the earlier pattern, without disturbing what comes before.

I'd like to focus a little on what prompted this decision. It is on the face of it aesthetic, and we tend to think of aesthetic choices as basically arbitrary. It is tempting to think that I didn't have to make this choice at this point, or that I could have made another choice and

still produced something 'like' Phon. This would be a mistake; this decision was made from a deep sense that the unenclosed characters had a Quality, a living nature, that the enclosed characters couldn't touch.

Figure 3.2 Which is a better picture of the self?

Alexander gives an exercise which is useful here. Look at these two shapes, a circle, and something like a circle that is nonetheless open, and ask: which of these is a better model of my own self? I am convinced that the open circle is the answer, and that this answer is not arbitrary. In a moon celebration circle I used to participate in, we would say "the circle is open and not unbroken", and this same wisdom is expressed in choosing not to enclose space in Phon. Lastly consider this enso, a Zen painting of a circle, how simple and right it is.

Figure 3.3 Enso

At this point I was done with Tengwar, but note: just these few extracted kernels give a definite family resemblance to the two systems. This is the power of doing structure-preserving transformations on a pattern. Note that 'looks like Tengwar' as a guiding principle was stripped from the pattern between the first and second iteration, but the result still contains the realization of that desire. If I had merely set out to make something that looks like Tengwar, drawing characters one at a time in an effort to make something at once different and the same, the result would be a derivative mess. But by isolating a few patterns from the Tengwar, and adding them to the earliest iterations of the Phon pattern, the resemblance is obvious to the untrained eye.

I just said I was done with Tengwar, but this is not quite true. I was down to a small number of symbols, 12 as it happens: those which had a telco and a lúva, with no closing stroke. In a real sense, these twelve (with different meanings) are still found in Phon. It was at this point that I had an insight which sent me deeper into the structure of the evolving system. I realized that all strokes on the left of the telco opened down, and all those on the right opened up. This made it clear that one of the reasons I didn't like the closing strokes is that they obscure this asymmetry! Why did this matter?

Eventually (and this is still within the first week of working on the system) I got it. We have two eyes, arranged on the horizontal axis, and optimized for objects with a vertical axis of symmetry. We also have two hands and the natural way to write with each of them is away from the writing, so that the hand doesn't drag across the ink and so that what was just written is visible. By eliminating any symmetry across the vertical axis, Phon could be written in either direction, with identical motions; furthermore the shape of the characters would show which direction the sentence should be read. For the first time, I was designing something useful to all of the population instead of roughly ten percent.

More than that, though: I had applied enough constraints to generate a basic palette of strokes. When the project began, the letters could be literally any shape; now, we have a pretty definite shape. 'A Phon consonant is made of strokes along the vertical axis, corresponding to

place, and the horizontal axis corresponding to manner of articulation, with a doubled stroke for voicing. A vowel is a mark above or below a consonant. None of these strokes may enclose space, and they must all be asymmetrical across the vertical axis.' is the pattern used to generate everything that follows.

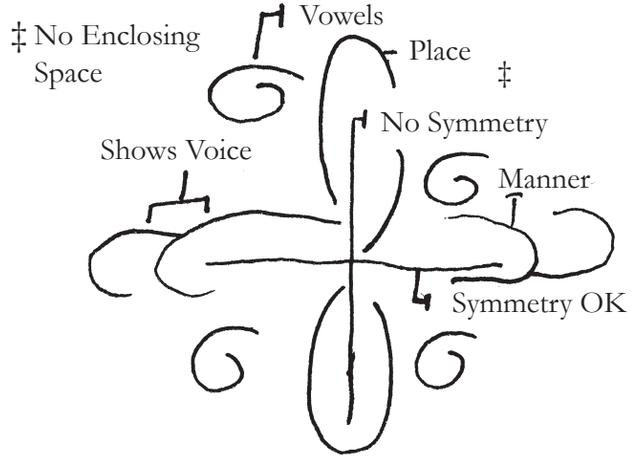


Figure 3.4 The Phon pattern after more iterations

At this stage I had enough to design several characters and I did so; I also hacked together a vowel system which didn't satisfy me, but which did let me move forward. In studying what it would take to write English in a rational way with the new system, I became reacquainted with the IPA and resolved that the system (I was calling it Scriptic at the time) would implement the IPA scheme of distinctions. After all, this was the consensus verdict of the field of linguistics, and had been hammered on for more than a hundred years. In assigning symbols, I drew the telco/vertical symbol like in the version of Tengwar that appears modeled on Italic rather than Uncial, which is more like an 's' than like an 'l', and pulled the lúva shape off that. I developed spirals and wiggles as variant lúva without any particular plan in mind, they just looked right. The vowels weren't working though...

Figure 3.5 Strokes must begin and end on a thin line

At some point I realized I had another palette-limiting rule on my hands, which is that all strokes must begin and end on a thin line. I was using an angled pen, which made lovely thick strokes, and I liked these strokes to taper off at both ends. It passes the 'mirror of the self' test, as these examples **<ref>** show. There is, at a basic level, a sense that these sorts of sinuous shapes taper: it is the shape of a vibrating string, of the body of a worm or snake. As I refined it, the strokes became bolder, more at right angles to each other and more definitely at 45 degrees to the page orientation.

I was on the verge of further insight here, and trying to rework the vowels, I hit on it. I wanted the vowels to be in a particular order, and to represent the numerals as a result. I realized this was a poor approach to the vowels, but that the basic strokes could be ordered, and that in so doing the numerals could be generated. This was the deepest, fundamental, formal work; this done, the system emerged, combinatoric, powerful, and ready to go.

We begin (and this is important) with the simplest symbol you can make, a simple dot on the page, moved only enough to form a diamond shape. This is symmetrical, in principle, in all directions, and is the only exception to our rule of asymmetry across the vertical axis. This dot is made with either hand, by a relaxed human, sitting or standing in front of a surface, with an angled pen, that is, one where the tip is wider in one direction than another, rather than a stylus (round) or a brush. This is called elen, the Quenya word for star. It is our first primitive.

Figure 3.6

The next stroke is a thin one, made with the thin edge of the pen. This can be done either upwards or downwards, in principle. We decree upward as basic, because of the stroke that follows: a thick one, made with the thick edge of the pen. It is more natural to pull a pen along the thick edge, less natural to push it. So to give these two strokes maximum contrast, the thin one is considered an upstroke and the thick one a downstroke. Because either stroke can in fact be written as an upstroke or a downstroke, we name them amban (up) and pendë (down), words from Quenya which mean similar things. Both are at $\pi/4$ radians (45 degrees) to the page, with the pen, therefore, held at $\pi/4$ radians also.

Pendë, we notice, breaks the rule about symbols beginning and ending with a thin stroke. It is the only symbol which will do so. It is felt that a simple straight line has an honesty about it which needs no taper, but this simple beauty is easily marred, and I was later to discover restrictions in the use of pendë that are needed to keep the overall structure intact. Also, one might see amban and pendë as reflections of each other across the vertical axis, but one is thick and the other thin. Because we don't always use angled pens, however, this fact is kept in mind as the system is evolved.

The next most simple shape is the type called lúva in Tengwar. If you bend a thin stroke into a thick one, and then curve around to end it thin, you get a shape like a rainbow. If you do the thin stroke as a downstroke, you get something like a pit. These are considered simpler than the telco types, because the turn is the same in each case: similarity is considered simpler, and prior, to difference. helyanwë means rainbow in Quenya, and latta means pit; these are the names of our fourth and fifth primitives.

They are defined, in formal terms, as two left turns (helyanwë)

of the pen and two right turns, and thus symbolized LL and RR. This is descriptive, not proscriptive: it defines the symbols in the specific case of a left-handed generator of symbols, rather than trying to set rules for stroke formation in Phon itself. The formal system is defined in relative terms from the Leftic mode simply because I am left handed, and find it easier to think this way without headaches and their attendant errors. At some point a more neutral, mathematical description will be needed. In the meantime, please realize that, as the diagrams shown are rightic, they actual penstrokes go in the other direction from that indicated by the words 'right' and 'left'.

Figure 3.7

Our sixth is like a flat telco, because we start with our thin upstroke, bring it down as a thick stroke, and bring it back up thin rather than curling it back on itself. If we start with a downstroke we get the familiar vertical telco. We call these falma, for wave, and nárë, flame. These four symbols are the primary combinations, formed of three segments with two turns, falma is LR and nárë is RL. The remaining basic palette are combinations of these, consisting of five segments with four turns.

Figure 3.8

If you combine two lúva type strokes, you get a spiral sort of shape. There are four possible spirals which embody the combinations

of two poles: opening up or down, and spiralling inward clockwise or counterclockwise, as shown. This is more distinction than the eye can easily distinguish, so we eliminate two, collapsing two kinds of symmetry into one. Now we have one symbol which opens up, one which opens down, with two ways of spiralling into the center. We call the first one, which starts like a helyanwë and opens down, a hwinya, meaning 'swirling'; the second which opens up is a hyalma, or 'shell'. Hwinya is named because in the leftic mode it takes the shape of a tropical storm, which are (prior to 2005) found exclusively in the northern hemisphere. Shells and swirls go in either direction, but we had to call them something; this is how the distinction was made.

Note that by collapsing two kinds of symmetry into one, we have made this much, much easier to distinguish. The canonical forms cannot be superimposed, while our special sensitivity to up and down gains us the kind of rapid recognition our visual system needs for symbol acquisition. Note, however, that a hwinya rotated is still a hwinya. It is the direction of the spiral, not the way it opens, that defines which symbol we have. Hwinya is defined as LLLL and Hyalma as RRRR.

Figure 3.9

These two non-superimposable symbols are only one of the ways of combining the lúva type primitives. If you first draw a helyanwë and then follow with a latta, you have another shape, which we call lócë, from the Quenya for dragon. If you start with a latta and follow with helyanwë, you get sírë, river. These figures cannot be superimposed, but there are two obvious ways to write each: with the two curves on top of one another, or side by side. We make the dragon rear, and the river meander, and this gives us two more primitives. A flat lócë is still a lócë,

and a tall sírë is still a sírë. The symbols were chosen mostly because the tall sírë was felt to look awkward, thus eliminating its partner, the flat lócë. In formal terms, these are LLRR and RRLL. Note we are following a formal order here: sameness is ranked prior to difference. This is one reason I haven't used a simple binary representation, so as not to think of the order as being the numeral value of the symbols.

This becomes especially important as we try to sort out the symbols which come next. When combining lúva and telco, there are sixteen distinct symbols one can generate, two to the fourth power. The powers are: upstroke/downstroke, large telco / large lúva, and the four combinations of helyanwë or latta with falma or nárë. We want a way of stripping this down to four canonical symbols, and we also want to be able to categorize the remaining twelve as instances of exactly one of the four. Note the way that symmetry breaking has come to be a basic part of the Phon pattern generator, emerging organically from the very first decision to symbolize different basic concepts across different axes.

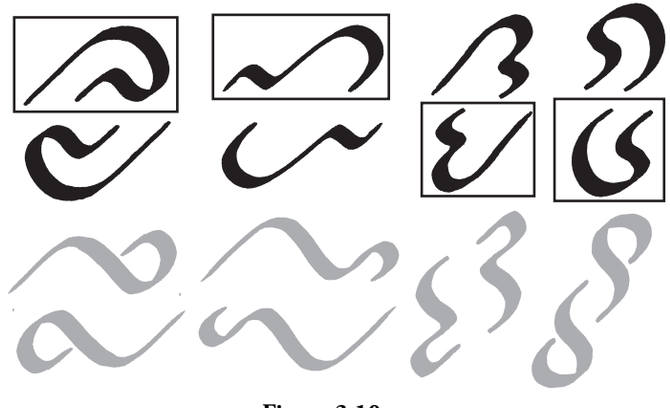


Figure 3.10

We begin by eliminating an entire dimension: the canonical symbols are those in which the telco is smaller than the lúva, because these were felt to be the more powerful symbols, with good shape and the most positive space. We are left with eight symbols, and four can be

superimposed on each other: clearly we must eliminate one from each of these four pairs. It is tempting to break the pattern all the way down. We have two axes remaining: which symbol is paired with which, and which direction the symbols open. Why not choose so that two open up, two open down, and one each of the four pairs is represented?

This was a subtle decision and was put off for quite some time. As I continued to work on the writing system, certain versions of these symbols seemed inherently useful and beautiful, and this was an influence on the final decision. In the end, the symmetry is partially collapsed: falma is paired with helyanwë, and nárë is paired with latta. This reinforces the difference, strengthening the pairs: making the similarity more similar and the difference more different. Because the lúva are larger than the telco, the symbols with helyanwë open downwards, and those with latta open up. The order is helyanwë before latta, and within pairs, the one where the lúva is drawn first comes prior. This gives us these formal orders: LLLR, LRLL, RRRL and RLRR, for each of our symbols. We name them lampa, meaning tongue, ulumpë, meaning camel, salpë, meaning sack, and ampa, meaning hook.

Figure 3.11

I know there exists some small number of you who are frowning at these formal paths, scenting a bit of a whiff... of the arbitrary, perhaps? Not at all, my mathematically inclined fellows. The symmetry was mapped, and broken, exactly as described above, for the given reasons. It was the right way to do it; the formal pattern is what it is because of these decisions. The pattern exhibits levels of scale, three levels with four binary degrees of difference. It is the breakdown of these four symbols that makes this so.

Thus also, there are four more symbols, representing combination of the telco type primitives. Two falma gives us allin,

the lake, LRLR. Twiddle the less significant quad, and you get LRRL, which we dub cúna, or bend. The inverse, RLLR, we dub táta, hat, and the last, two nárë, we dub tulwë, pole. Note that allin and tulwë are not superimposable, but that táta and cúna are. We allow this because they open strongly up and down, like lúva with lips, and aren't likely to be confused for one another whichever direction they are drawn.

Figure 3.12

I want to take a moment to point out that each of these symbols has two canonical renders, one leftic and one rightic. Rather than speak of left and right, we tend to refer to senseward and anti-senseward. It is basic to Phon that each stroke (excepting elen) shows the sense of render. The overall effect strongly reinforces a sense of the correct direction to read the script; it might be said to have momentum in the direction of sense.

I emerged from this process with nineteen shapes, the primitive strokes of the Phon system. Had I sat down to invent an arbitrary number of fundamental shapes, I would likely have produced a mess; by allowing the symbols to emerge from the structure-preserving transformation of the original pattern, something powerful was generated.

Lets return to that original pattern for a moment: Phon is descended from Tengwar because it shares with it both the idea of representing place and manner of articulation of a consonant on the vertical and horizontal axes, as well as some agreement about the shapes to be used. to represent this. In addition to Tengwar, both Devanāgiri and Hebrew have a thematic stroke (the Yod or the 'a') which is echoed in each character, and this is the source of much of their power and beauty.

In Tengwar, the main body of characters consist of a vertical part, called telco and a horizontal part called lúva. As I developed the primitive palette in Phon, I started to call the helyanwë and latta type strokes 'lúva type' and the falma and nárë 'telco type'. In Tengwar, the type of articulation is symbolized by the vertical stroke (telco) and the place by the type of lúva; we have found it convenient to reverse these assignments, while keeping the concept of voicing as a double stroke.

As far as how a consonant is articulated, one of those ways is to not make a sound at all, and for that reason and others the invariant symbol should indicate where the consonant is sounded. Phon is typically written horizontally, and so we want a symbol that stacks, so our invariant doesn't waste space on the page. Nárë stacks, as does tulwë, but tulwë takes longer to write and is logically further out, right at the end of the series. Nárë it is: a single nárë, by itself, of 'full' size, is one way to say no sound at all, and is used as a comma. As a conceit, one may say that a solitary full-sized nárë, or two nárës together, shows the tip of the tongue coming to rest in the alveolar-dental region, without any sort of articulation happening at that point: a full stop or major foot group.

Real scripts have ascenders and descenders, and so it would seem we can get away with four nárë forms: ascended, descended, both and neither. That isn't enough articulation points but it'll do for now: call them bilabial, velar, dental and palatal. This type of nárë is called the sirpë, stem. Let's draw a dental sirpë, and contemplate what we might attach to it. Elen doesn't attach, so how about amban? It looks well enough to attach one to the thick part of the nárë, but there's no obvious point of attachment on the thin sections, and a pendë, although it can be brought to the thin part, looks ugly, being easy to push entirely through and spoil the stroke. Here we have two new aesthetic rules: an amban may join a pendë but not the other way around, and no strokes are allowed to cross. These act together as a complement to the rule that uninked space is not to be enclosed, by specifying how positive, inked space can interact while keeping the integrity of the individual strokes

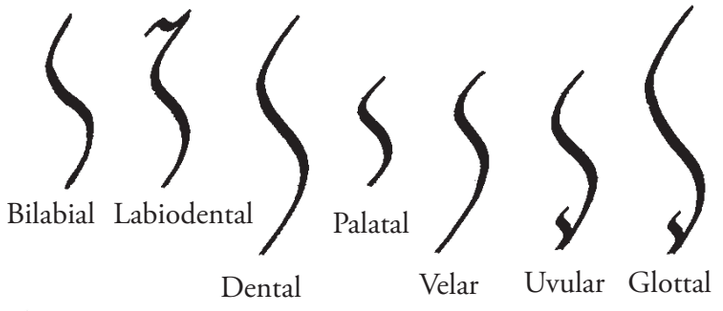


Figure 3.13 Types of sirpe

So we can attach an amban, but there's not much else we can do there. When we attach a lúva type figure, however, the pot starts to bubble. A helyanwë can attach to the senseward side of the sirpë, and a latta to the anti-senseward side, quite naturally. It seems natural that senseward should come prior to anti-senseward, and helyanwe, happily, comes before latta in logical order. We therefore assign stops to the senseward, helyanwe stroke, because stops are the shortest and most consonant like consonants, and are traditionally first in series for this reason. We decide that the helyanwë form is plosive, because 'p' sounds like the sound of rain falling from the sky, and the latta form is fricative, because 'f' and 's' sound like smoke rising. This type of stroke, a stroke as large as a palatal sirpë and attached in this fashion, is called a lassë, leaf.

Figure 3.14 Lasse

The lasse are limited to strokes containing a luva type stroke. Also, some strokes simply do not attach in a way that lets them open correctly (down on the senseward side, up on the antisenseward side). Figure **<ref>** shows the single stroke lasse which are possible; up to two strokes are used in the script, with up to three contemplated for some extensions. Because of our pattern of using a doubled symbol for voiced/unvoiced pairs, and the other sources of variation, only the first six are used to define the central consonants of the Phon system.

There are a large number of lasse possible, far more than will ever be needed. Each lasse may be combined with itself, or with any other lasse of its general type. They may combine with themselves one way and with other symbols in two ways, giving a grand total of 12(single) + 12 (double) + 12(5*2)(mixed) = 144 unique lasse. The eye would quickly tire of such monotonous variation; we use many methods to indicate difference in characters. But all 144 are considered protograms, as discussed later. There is even more variation than this possible, as the symbols used for clicks and whistles are considered single lasse, though they could just as easily be seen as lasse modified with an exceptionally large tuima.

The question of how to represent variation returns us to the sirpe. Four different symbols for placement in the mouth isn't near enough, with eleven recognized places of articulation according to the IPA. The level-headed move would seem to be to mark the risers or descenders in some way, and this is what we end up doing. If we attach a small falma or a nárë to the tip of our sirpe, we get a graceful, wishbone like shape that creates positive space without damaging the integrity of either stroke. After a few prototypes, I decided that these symbols were equivalent, so, say, a rising (bilabial) sirpe with the top tagged with a falma means the same thing (in this case labiodental) as one tagged with a nárë in the same place, but on the other side. We can tag three of these stems, giving us seven distinct sirpe. Seven is still not as many as we use, but other modifiers are available. We could get nine, by generating three variants of the dental, but this lacks a certain grace; the character starts to look encumbered with both flags, and we don't need an 'in front of bilabial' the way we need a 'below uvular'

symbol, so we leave it as is. The exact choice to use nárë or falma in a given instance is aesthetic, but the canonical form puts the tag on the opposite side from the lasse, so that a stop consonant takes a falma and a fricative takes a nare.

The consonants are starting to flesh out at this point. Repeating our single lassë gives us the voiced form, as per Tolkien, in the usual case. We use a hwinya in the plosive position for nasals, and a lócë in the plosive for trills, taps and flaps, and the rhotic approximant. Fricatives being abundant, we reuse these primitives on the fricative side for basic frications, then start putting them to use for approximants. Clicks are a plosive helyanwë with a latta attached, and whistles, of course, are the reversed. These symbols were developed early in the system, before the primitives were thoroughly worked out, but it is felt that their unusual shape emphasizes the unusual nature of these non-pulmonic consonants. The combinatoric possibilities here generate a large phase space, larger than needed, leaving room for expansion and abbreviations and the like.

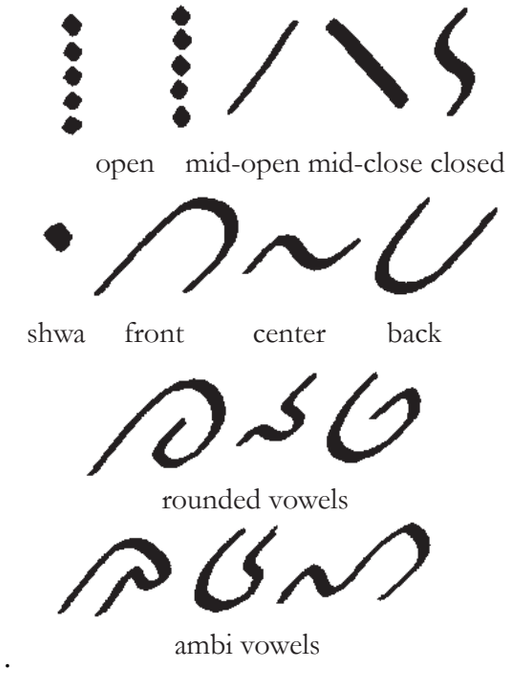


Figure 3.15 Cerme

Vowels, you will remember, were determined early on to be symbols above and below what came to be known as the lasse of a consonant, so early, in fact, that the concept had no name yet. The upper vowel position is called yávë, the lower one sulca, meaning fruit and edible root respectively; the vowels marks generally are cermë, grains or harvest. The vowel marks are smaller than lasse, unattached to any other strokes or to each other. Each vowel combines two cermë: one of them, composed of a null stroke, an amban, a pendë or an nárë, symbolizes the degree of openness of the lips, and the other is one of ten of the remaining primitives and symbolizes placement within the mouth and roundedness of the lips. A vowel on its own, or two in a row, can be placed on a palatal sirpë without a lassë, another echo of Tengwar which emerges from similar rules of formation, rather than

imitation in the usual sense.

The system had the rough form it was going to take, already, at this point. This was good, great actually, but we were starting to generate really quite a lot of formal structure, and it needed some organizing metaphor, a mnemonic of shape. Happily, I struck on a mnemonic scheme to organize the strokes in space and order. This was generated from thinking of the vertical stroke as a 'stem' and the horizontal stroke as a 'leaf', just simple visual resemblance, and then expanding to think of the whole process of plant growth as the visual metaphor for a Phon character. In this I must say I was influenced by the line from the Gnostic Mass: "therefore by seed, and root, and stem, and bud, and leaf, and flower and fruit do we invoke thee."

Figure 3.16 Parts of a Phon glyph (an alda)

In stroke order, the way a character (now an alda, for the Quenya for tree) is expected to be written, the cermë in general come after a category called tuima, meaning 'bud'. These are small primitives that either attach to the lassë, or to the sirpë on the senseward side such that they are inside, or attached to, the lassë. These do not correspond to an existing IPA category, but each elegantly solves a problem. The lateral and retroflex hooks are examples, making retroflex and lateralized versions of whatever they are attached to, as is the 'aspirated' symbol, formally a diacritic in the IPA. Additionally, the 'ejective' and 'implosive' tuima indicate certain non-pulmonic consonants, others of which are handled by the double-stroked clicks and whistles, which are thought of as variant lassë although they could just as easily be considered lassë with overgrown tuima. Although found in a distinct region of the character, the largest logical difference between tuima and hwan is the stroke order, tuima coming before cermë of any sort and hwan after. This has implications for the sort order also, as discussed below.

Figure 3.17 The tuima

Once again, there are a large number of possible tuima, but not an infinite variety. The general rule is that the attachment has to be natural, and the stroke has to be constituted so that it is both smaller than a lasse and not an allowed lasse for that position. Thus latta is an outside tuima for helyanwe, but not a second, smaller helyanwe, nor a downward-opening hwinya. Nare is also not allowed on the outside of the lasse, because it can be easily confused for the cerme marking a closed vowel; tulwe is disallowed for the same reason. Because the

tuima are small, and are relatively hard to distinguish when inside a lasse, certain symbols are not used because of visual resemblance. This is the main reason tata, cuna and amban are not considered valid strokes for inside tuima. The greyed-out tuima are considered valid, but potentially confusing, and effort is made not to use them. Note that a tuima is named and sorted based on how it is drawn for a p-type consonant, thus the second tuima listed is 'inside helyanwe tuima' even if it is drawn as a latta for, e.g, a fricative.

Figure 3.18 Hwan

A character is built up of stem, and leaf, and bud, and fruit, and tuber. Next is hwan, literally translated as fungus but meant as 'epiphyte' or 'lichen', growing on our now mature tree. The hwan are marks conceived of as found attached on the opposite side of a character from the lassë, or as a similarly-sized mark atached to a small pendë, but a few other marks are considered hwan as well. Two important hwan have been encountered already; they are the modifiers which create additional sirpë from our categorical four. The hwan play an important role in punctuation, and as diacritics, providing further resolution of detail in pronunciation. The canonical hwan is placed on the stem across from the lasse, and is drawn smaller than lasse. Importantly, a hwan with a luva in it has to open opposite of a lasse in the same position. Thus there is no helyanwe hwan, although, as with tuima, the 'latta hwan' is realized with a helyanwe stroke in the f-type consonants. Because hwan are combined into multiple strokes, a large variety is possible, more than it would be convenient or useful to describe. The valid single stroke hwan are shown, as well as certain of

the two strokes which either have meaning or are suggestive; there are many more possible, and others not shown are already used (notably doubled latta).

Figure 3.19 Liantasse

After drawing the hwan, the next stroke category are the liantassë, or vines, symbols above the ascenders which show tone. These, like the talma that follow, are suprasegmental, and are drawn after the last sound to which they apply has been rendered. Although stretched in various ways, it will be observed that the strokes always end thin and otherwise conform to the aesthetic. The area below the descenders is the home of the talma, which covers supersegmentals such as stress, syllable breaks, rhythm and the like. The liantassë and talma are still being worked on and refined. A detailed description of current progress is given in the phonetic chapter, and a few representative symbols are shown in **<ref>.** The truth is, I don't have a good, deep feeling for tonal languages and I'm not particularly confident of my ability to render them in a correct way. However, I am confident that the job can be done and have some basic notion of the shapes that are called for. Given the ease with which Phon is extended, it is expected that, e.g, musical notation and indications of timbre in various sorts can represented, while keeping the underlying understanding that the liantassë are tonal and the talma rhythmic.

Punctuation is a catch category for many symbols of use. The elen, placed between consonants, is one way to show syllabic boundary (the proper domain of the talma, which can be left out saving space in many languages), while a connecting falma between two consonants shows dual voicing / affrication. The comma, and the period, are

one and two dental sirpë, and other punctuations of use are a dental sirpë with various senseward marks that are considered hwan. The parentheses are a large latta and helyanwë. Marks like a question mark are conventional, often indicating facets of languages that in a narrow phonetic transcription would be indicated through tone marks in an otherwise atonal language.

This discussion would be incomplete without explicitly covering modes. As said before, Phon is meant to be universal, and beautiful. I am among the roughly ten percent of the population who are left handed, and was taught to use a pen by total incompetents including, incredibly, a fellow left hander, who taught himself the right handed use of a pen for ideological reasons during my tenure as his student. The lefty can write rightic scripts (every single one in use except leftic Phon) correctly by angling the paper at ninety degrees and writing a horizontal line vertically, as well as by writing right to left, top to bottom, upside down and backwards. It can be done, I've seen it, but a universal script should serve everyone equally.

One interesting result of building the script up from these primitive movements and shapes is that, when the process is complete, you are left with a language with no symmetry across the vertical axis. There is a profound reason for this. A large part of the natural sensorium is composed of figures that are bilaterally symmetrical across the vertical axis. Most importantly, faces are symmetrical in this way, and the bodies of animals in general. Leaves, smaller plants, smaller parts of trees exhibit this form of symmetry; fruits and flowers tend to have it as well. We are deeply wired, so deeply that we have two eyes, to resolve this kind of symmetry, which can ultimately be traced to the effect of gravity.

When this natural ability encounters an alphabet with bilateral symmetry, or worse, one with characters such as d and b (db), a common reaction is what we call dyslexia. When the eye encounters a 'w' an 'M', or the like, it becomes confused as to the direction of parsing. This may not be apparent when a script is written in only one direction, but when one alternates direction every line, boustrophedonically, the difficulty is clearer. One consequence of Phon being built the way it is,

is that this reaction is impossible: the senseward direction is indicated by the sirpë and lassë of each consonant, and there are no characters which are symmetrical, either in themselves or in a pair, across the vertical axis, whatsoever. The character, backwards, still has the same meaning it did, which should aid with reading dyslexia, and the use of an angled pen makes it impossible to well-form a character backwards, aiding pedagogy.

This in itself is nearly enough to allow Phon to be read in either direction, and would be enough if the script were an alphabet, rather than an abiguda (which in my opinion is the best existing category for this sui generis script). There are great advantages to having two cermë to a vowel, of compactness and sense, but they do lead to potential issues of confusion. Although it looks best with an angled pen, it is a requirement of Phon that it be legible with a round pen, and this means that amban and pendë, which have different meanings as cermë, could potentially be confused for one another, when switching from rightic to leftic or vice versa. In addition, as vowels come next to the thin parts of a nárë, a pendë has to be a certain distance from the sirpë in order to fit.

This leads to the reasoning behind the vowels: ponderous to explain but simple to write and recognize. The mnemonic is that the consonant is like a face. Thus, the front (helyanwë) cermë points up, the rear (latta) points down and the falma indicates the middle voicing. Furthermore, the lip cermë goes next to the sirpë if and only if it is amban; pendë and nárë both go outside, with the tongue cermë next to the sirpë. Thus, the vowels look the same in yávë and sulca form, but are opposite in order depending on whether the consonant is a plosive or fricative type. For an isolated vowel or dipthong on a palatal sirpë, the direction is assumed to be senseward, that is, plosive.

There are two vertical modes as well, in which the consonantal stems are strung together. Instead of whitespace, a nárë-like stroke provides word boundaries, and the lack of an ascender or descender is indicated as a break in the stroke as shown. Vowels are placed in the familiar fashion; the whole thing works rather well, while taking up more room on the page than horizontal Phon. The vertical modes are

expected to be used mainly decoratively, or occasionally in-line with written languages such as Chinese, Japanese and Mongolian.

The mathematical symbol set has a looser formal structure and will be considered in its own chapter.

Phon and the Nature of Order

Christopher Alexander's thinking has had major influence on the process through which Phon was created. I hope in this book both to document the Phon system and to justify it as good design. In approaching the latter goal, it seems worthwhile to explore Phon in detail, through the perspective offered in Alexander's The Nature of Order.

This work is one of those sprawling, insightful books that defies easy description. Alexander delineates here the concept of wholeness in order, and how natural systems (and human processes that respect the natural design) come to be through structure-preserving transformations that elaborate patterns into existence. He describes 15 recurring forms or patterns that are generated by these kinds of processes, showing them to occur in various cases of natural beauty and good design. To justify Phon as good design, we will approach it through the lens of these 15 principles. Many of the observations made here apply to any writing system; this is to be expected, as writing systems that are in use succeed on some level as good design.

1. Levels of Scale

Phon exhibits several levels of scale. The sirpe are up to three times as large as the lasse, as a rule of thumb, and the cerme are smaller than this, with the tuima and hwan even smaller in most cases. As the same symbols are echoed at several levels, the system exhibits levels of scale directly. Writing is inherently compressed within a particular level of scale; within this, Phon exhibits strokes at varying, regular levels of

scale.

2. Strong Centers

Each stroke in the Phon palette creates a strong center, in and of itself: of these, the basic telco and luva shapes are strongest, with the telco-luva and telco-telco combinations forming weaker, still vital centers. But the center around which Phon is oriented is generated by the intersection of sirpe and lasse in making an alda, a Phon glyph. This basic T shaped intersection gives the entire character a wholeness, making it obvious for instance that the cerme are a part of the alda. The placement of tuima and hwan, liantasse and talma acts to reinforce this center in characters that have them, making it stronger.

3. Boundaries

The principle of boundaries states that patterns are strengthened by having boundaries, which must be thick to function authentically. We see this first in that Phon strokes have thickness, and that thickness is accentuated by the taper of both ends, while the thin strokes in turn serve as boundaries for the stroke as a whole. Furthermore, the use of white space to separate characters, words and lines of text is in fact the use of boundaries. Characteristically, there is often as much white space or more separating strokes as there is space claimed by the strokes and characters themselves.

4. Alternating Repetition

This is a pattern which is quite evident in Phon. The basic undulation of extended and unextended letters, different types of lasse, p-type and f-type, word and whitespace, conveys information using a limited number of contrastive differences. The alternating lines of text and space is the purest example of this principle at work.

5. Positive Space

Positive space is assured in Phon through several measures. Most important is that the telco and the luva forms both create good space around them, particularly the luva. Those formed by amban and pende are slightly less good, as can be felt when working with the cerme, but they aren't structure destroying in any sense, if used in a limited manner. The shape of the luva types is particularly good, defining a space without containing it, and six of the primitive strokes elaborate this space in one way or another. Positive space in Phon may be clearly seen when an f-type consonant is followed by a p-type: the shape between the strokes is an echo of the strokes themselves.

6. Good Shape

Phon is designed around a series of strokes which are felt to themselves have good shape. The intersection of those shapes is done in ways that are natural to them, and various rules, such as that eliminating line crossing and limiting stroke attachment, keeps the good shape of the strokes intact, building the wholeness of each individual character.

7. Local Symmetries

Phon deliberately breaks some symmetries while leaving others intact, and the process of writing forms irregular and beautiful symmetries as p- and f-type forms alternate. In general, a Phon consonant or vowel can be read upside down with a different meaning, while it is never possible to get a different meaning by reading horizontally. Words like thirst exhibit a beautiful symmetry, having the same shape when rotated 180 degrees.

8. Deep Interlock and Ambiguity

This principle is respected by Phon's principle of nonclosure of strokes. The whitespace reaches into each character, forming a common ground. The reflections of the basic forms on several levels also interlocks

the various types of symbols into a single cohesive whole.

9. Contrast

Phon defines itself in terms of contrasts, and limits itself sharply as to which contrasts are employed. The sirpe, for instance, differ only on the basis of height and three tagged variants, while lasse are only those strokes which contain a luva. This is done so that the symbols will visually contrast with one another, making the information conveyed apparent. The particular thickness of the stroke and its proportion to height should be carefully chosen for different levels of scale so that visual contrast is optimal.

10. Roughness

Phon is not defined in terms of an ideal type shape, but in terms of stroke paths. This gives a great flexibility in how the actual form of characters is realized. Phon is designed to be handwritten, with all the little variances that entails. Roughness is perhaps most clearly seen in how the vowels differ slightly in their placement, depending on whether they are yave or sulca, p-type or f-type, and what consonant follows. Some lasse change their shape to accommodate tuima, which is another example of this.

11. Gradients

Gradients are not as easy to see in Phon, which is inherently two valued in color: either there's ink on the page or not. But there is a gradient of color formed by each shape, and it is different in each case, and that gradient is crucial to recognizing the shapes when they are very small. The different ways that Phon characters extend, and the vowel placement, can combine to give each word a 'color', an overall shape, and this is a great boon to speedy reading. Overall, the five vertical zones tend to show a gradient of population such that the middle line is the thickest, the lines above and below are more thinly

populated, and the lines above and below that (talma and liantasse) are more sparse still (though this will not be true of the liantasse in a fully tonal language).

12. Echoes

Each Phon stroke is echoed at several levels of scale, the cerme being like small lasse and the sirpe echoed in the symbol for a close vowel. This unifies each type of symbol, making the math symbols, for example, recognizably part of the same system as the phonetic symbols, even if one doesn't know anything about the writing system.

13. The Void

Once again, the nonclosure of strokes is the principal thing that points to the Void in Phon. The background, the field, is everywhere one thing, pre-existing, untouched. The strokes dance upon this surface like ripples, but do not sunder the integrity at the heart of the Void.

14. Simplicity and Inner Calm.

Phon is bassed on a limited number of strokes, and is just as complicated as it needs to be to get the job done, and no more. The rules which limit stroke formation and attachment produce the characters almost effortlessly, and this grace is felt when the written word is apprehended. The basic morphological structure of Phon, as illustrated in fig **<ref>**, is a simple, comprehensible pattern, and the strokes and their relationships are visually obvious and compelling.

15. Nonseparateness

A written communication is a collaboration between voices, eyes and hands; by respecting the function and form of each of these living systems in its design, Phon provides a transitional zone between them, literally serving as an interface between the functions they are

evolved to serve. Phon, as it were, opens into each of these spaces, fitting into its existing form. When written, it follows the natural structure of the hand, which can hold a pen comfortably at 45 degrees to a page oriented with the field of vision. When read, it respects the division of the eyes into two sensors on a horizonal axis, and gives great care and attention as to what shapes the eye can distinguish without strain. When spoken, it is built around the structure of the vocal tract, allowing a close match between the written statement and speech.

On a pure morphology level, Phon shows nonseparateness by the way strokes begin and end thin: the thin strokes are an interface between the blankness of the page and the thickness of the stroke. Also, the nonclosure of strokes causes each Phon grapheme to be interwoven with the whitespace around it, so that the whitespace is like the ocean, or the field, with the Phon statements as islands, or eddys in the field. The Phon strokes are nonseparate in a different way, being echoes of each other at various levels of scale, with each relationship in space conveying something of meaning. A helyanwe, for example, gains meaning only on the basis of what the centers around it are conveying: attached to a sirpe it means plosive, above a lasse it means front vowel, and so on. This relational meaning is close to the heart of Phon's unity and power.

These 15 principles are the best system I have found, to date, for characterizing the degree to which a system of centers is alive. Phon was not designed with them in mind, as I only began reading The Nature of Order after the main system was in place. However, the principles are at play throughout A Pattern Language, a work with which I was quite familiar at the time. I hope this discussion will be useful, at least to those familiar with Alexander's work, and that it will encourage others to seek him out. I see in The Nature of Order the kernels of a science of good design, at any level of scale you would care to apply it. As this is our most pressing need as a species, I cannot recommend his works highly enough.

On Stroke Order and Sort Order

Phon is generated with its own underlying logic, starting from the primitives, which have been explained as the result of pruning of a combinatoric phase space through symmetry breaking on the basis of the horizontal bias of our visual system and the ergonomics of the pen. One of the things this allows us to do is assign a definite order to any stroke, or combination of strokes, we may encounter.

Towards this end, a Phon character is constructed in a definite stroke order: sirpë, lassë, tuima, cermë, hwan, liantasse, talma; the last two categories can extend across multiple characters, and must be written after the last grapheme to which they apply has been written. There is a noteworthy exception: by convention the variant sirpë, which are denoted by strokes which are hwan in the formal sense, are considered primitive sirpë, and the hwan which applies to them is drawn before lassë are added. I find that the Metahwan often flows from the pen at this time, but I'm disinclined to call that proper use.

This stroke order is similar to the sort order, but not identical. The stroke order answers the question, "What stroke do I draw next to continue this statement?" while the sort order determines what order in an alphabetic sense a character or word may be found in. We want the sort order to behave in a particular way, and I'm going to define what that way is, explain why, and suggest that it is easier to use than it is to explain.

The consonants are ordered, at the highest level, by lassë; this is because manner of articulation is thought of as a more fundamental distinction than place of articulation. Within this, the sirpë are the next ordering principle, proceeding from the front of the mouth towards the back. This is not completely accurate: lassë is the highest sorting principle, but some qualities of lassë (canonically voicedness) are considered less significant than sirpë.

This is the order in detail: the highest significance of all is given to order of sense. Thus all consonants with p-type lassë come before all consonants of the f-type. Next significance is the value of the highest-

valued lassë on the consonant: thus, in the p-types, all lassë with only a helyanwë, one or two or in principle more, come before those with a hwinya, the next valid stroke, which are in turn ordered before lócë, which comes before the helywanwë-latta combination which denotes a click. Next in significance is sirpë, and then finally the logical order of the lassë themselves is followed, such that a character consisting of a particular sirpë and one helyanwë comes before one consisting of that sirpë and two helyanwë, and a character consisting of some sirpë, one helyanwë and one hwiyna comes before that same sirpë and two hwinya, but after that sirpe and one hwinya.

What this means is that (barring tuima or other strokes of lower significance) after [p] is [b], and after [b] is [t], and after all the plosives comes [m] and then [n], with all the f-types after all the p-types. This is essentially the featural order as reproduced by a table showing place as columns and manner as ranks, which is exactly why these complications are introduced; knowing the reason for it, the formal order is easy to keep in mind.

After this deviation, the order of significance proceeds by stroke order: tuima is next, then cermë, next hwan and then liantasse and finally talma. Sirpë and lassë are not drawn in sort order because the lasse attaches to the sirpe, which must therefore be present, but it was felt that an ordering in which the plosives come first was natural in a way in which an ordering beginning with all bilabials is not.

In using the sort order to put phonetic written statements in order, we start with the first stroke area that could correspond to an utterance, that is, the *yávë* position of either the first consonant or the bare palatal sirpë used for vowels in isolation. Note that the sort order dictates that all cermë come after all consonants; regardless of modifiers of less significance, a consonant will always have a sirpë and a lassë, putting it prior to cermë which do not.

The sort order of the cermë proceeds from front to back, and open to closed, making [a] the first vowel and [u] the last. Roundeds come after the cognate unrounded vowel, and the ambi vowels are treated as regular ranks that come where they are placed in the vowel quad. The sort order of cermë follows the same logic as the vowel

quadrilateral, read left to right and bottom to top, in other words. For the cermë representing openness (which are always drawn first) this is also their primitive order: no stroke, amban, pendë and nárë.

If there are no strokes in the yávë position, this is prior in the sort to anything else; therefore, in Phon dictionaries, words beginning with a consonant of any sort come before vowel-initials. The bare palatal sirpë is by convention sorted after sirpë containing any sort of lassë, to prevent the dipthongs from getting separated from the other vowel-initials; they come before monopthongs and after consonant-initials.

Thus the first word in any Phon dictionary of American English is likely to be [pɑp], meaning 'father' or 'fizzy soft drink' or 'to explode, e.g. a balloon'; the next is likely to be [pɐp], meaning 'gruel fed to infants and the infirm'. However, if there were any words where a hwan modified the second consonant, say [pɑp̨], they would come before any words such as [pɐp]. Before that would come any words that vary only on the basis of different liantassë, essentially words that differ in intonation; prior to this would be words that differ only in stress. Two words that will be found next to each other in American English word lists are [ˈkɑn.vɪkt] meaning 'person convicted of e.g. a crime' and [kɑn.ˈvɪkt] 'to find guilty', although some accents would render the latter [kʌn.ˈvɪkt]. The point is that the least significant difference is sorted out 'inside' the more significant differences; significance nests.

The order inside of tuima, hwan, liantassë and talma is supposed to be priority of stroke order, and this is followed rigorously for tuima and hwan, with one by now familiar wrinkle. Some hwan and tuima are written with opposite symbols depending on whether they are p-type or r-type; they are sorted as though they take the p-type whether they do or not. Thus laterals come before retroflex whether one is dealing with a plosive or a fricative, because for a plosive the lateral is a helyanwë and the retroflex is a latta. Also, where tuima is concerned, all inside tuima are sorted before all outside tuima. This accords with stroke order but deserves attention nonetheless.

This gives just about the behavior we want. Tuima-modified consonants, which are quite often contrastive in their respective

languages, come after the bare consonant, and before the next unique combination of lassë and sirpë, but after all variation of vowels: thus a notional word like [pap^{h}] would come after [pup], but before [pab]. Since tuima are used to distinguish, say, [t] and [l], this is what we want; it means that after [t] comes [l] and then [ţ], all before [d] (actually the number of characters which can come between [t] and [d] is quite large). Think of the sort order as a series of nesting Russian dolls, and it becomes pretty easy to use.

Note once again that sort order is not the same as stroke order. Stroke order is the order in which strokes are placed on the page, and sort order is the order into which various written statements can be sorted after being written. The biggest difference between them is that sirpë come before lassë in stroke order but after lassë in sort order. The name shows what they're good for: knowing the stroke order tells you what stroke to put down next, knowing the sort order tells you how to sort things 'alphabetically'. It is also not the same as the order we use to sort the main Phon characters as to phonetic category, although there are broad resemblances. Because Phon is not a rigorous map of the vocal apparatus (this is believed by this author to be neither practical nor desireable), an order based on phonetic features would begin to take on the arbitrary quality that we seek to avoid whenever possible. The sort order has a few wrinkles, notably high-level separation by direction of sense and the way lasse are sorted relative to sirpe, which are added specifically to make the sort order broadly conforming to phonetic reality. In the interests of sorting chracters visually, and being able to assign a place to newly-generated characters, the sort order is as it is. In short, the relationship between shape and sound is not absolute, and the exceptions are sorted by shape, not sound.

Phon as a Phonemic Alphabet

Phon is meant to for many purposes, but to meet those purposes it must first be a tool suitable for doing phonetics. The previous chapter introduced the formal foundation of Phon, describing the logical and aesthetic processes by which the stroke primitives are derived, building up the concepts associated with the formal building blocks of a written statement in Phon: sirpë and lassë, tuima, cermë, hwan, liantassë and talma.

In this chapter we will explore how these formal categories are used to represent the empirically-determined universal phonemic categories of speech. The International Phonetic Alphabet would no longer be called that, if invented today; it is in fact a *phonemic* alphabet, concerning itself with distinctions of sound which are used in actual languages to distinguish words from one another. The fine-grained use of diacritics (or hwan etc.) allows for a more phonetic approach, but modern phonetics is done with audio recordings and spatial data of the vocal tract moving. This development is a good one; writing cannot concern itself with all aspects of the sound and visual pattern of an utterance, let alone the paralinguistic elements of body language etc.

which phonetics sometimes concerns itself with also.

We are left, however, with the need for a notation that *points* to phonetics, and that represents phonemic distinctions quite rigorously. The IPA does this, and is the tool used by phoneticians and linguists generally in the modern era. Phon will be demonstrated in this chapter to be capable of all representations defined by the IPA. Before this task is begun, however, a case for reform must be made. Science, in general, is not interested in replacing a standard which works unless a new one is substantially better suited to the purpose. While this awaits the judgment of our peers, the case shall be made here.

The Case For Reform

The International Phonetic Alphabet is an unqualified success. Refined for over one hundred years, it is the de facto tool of linguistic analysis worldwide, with extensions, rather than total revisions, the norm where needed. The core character set meets the design goal of representing all phonemic distinctions, and in general, utterances faithfully rendered in the IPA can usually be spoken with some degree of intelligibility by a trained speaker.

It is easy for a mathematically minded individual to see the IPA in abstract terms. Under the hood, it is a sound construction, mapping a state space with dimensions that are derived from the physics of our vocal apparatus. The fact that this has been done well means that the IPA can be used, and is used, for acceptably tight isomorphic mappings between one voice and another; in strictly functional terms, a taxonomic success.

There is a desire to go further, however, and for several reasons. The first among these is that the IPA is a magpie symbol set, with characters collected from Latin, Greek, Cyrillic, and modified in various semi-rational ways to form variants. The reason for this choice has been explored, and one consequence was easy adoption for printing, but there are others which could use explication.

One of these is that the IPA privileges speakers of European languages. This was of no particular concern at the time of the Association's founding, but it is a fact that is becoming increasingly problematic in a globalized world. At the time, both the use of existing type fonts and rapid adoption by speakers of European languages were design goals, but this leaves us with a supposedly international system that is much easier for a Spanish speaker than for a speaker of Min Nan, and in which an Arabic writer faces difficulties putting phonetic expressions in-line which are not evident for a Hungarian.

On can easily argue that there's no inherent advantage to using IPA over Phon in rendering, say, Tamil; the problems that arise when using IPA to render languages already written with Latins are of a different nature. To begin with, there's no general way to tell whether you have an IPA statement or a statement in the orthography of the host language. Consider [the boy chased the dog], where the brackets indicate that the statement is an IPA one (no brackets are needed to distinguish Phon from other types of writing). The pronunciation of this statement, at speed, would not be comprehensible to an English speaker; said slowly it could be reconstructed, just as severely deviant speech is understandable, but it cannot be said to be correct in any sense.

To render "the boy chased the dog" in IPA, using Standard American pronunciation, we might get [ðʌ boɪ tʃesʈ ðʌ dɑg̠]. This poses its own problems. It is recognizable to the native reader as probable English, but is obviously, and troublingly, variant. One has the feeling that one is dealing with a dialect, or with a user who isn't familiar with correct English spelling. Nine of the twelve unique symbols are used in English, and they aren't even particularly misleading in their meaning; the mnemonic succeeds in this way. But this very similarity backfires; our brain, accustomed to the correction of spelling, treats these near matches as improper variants. This poses a formidable barrier to certain types of use: even those proficient in the IPA are unlikely to want to read large passages in their native language transcribed using it, and the fact that learning a language (particularly English) phonetically can interfere with learning its orthography is well known.

The IPA has featural elements, but being a magpie set, they are inconsistent. The r like symbols are used for trills, taps, approximants and a fricative, which sound 'r' like to the ear sensitive to rhoticity; the capitalized variants are further back in the throat, but it isn't at all clear why the approximant is upside-down. The hooks that are used to denote retroflexion are particularly confusing to the eye, and difficult to render correctly in handwriting, and the incorporation of l type symbols into the lateralized characters is also muddy in appearance, whereas the profusion of upside-down and typographically variant vowels is just an embarrassment. In contrast, the featural elements of Phon characters are highly (although not perfectly) regular, and various marks used to distinguish features from each other are easy to see, with placement and shape both providing information about the utterance.

This is worth exploring in more detail. Consider the following symbols from the IPA: [ʎɣʏyʏ]. Care to guess which are vowels and which consonants? These are all vowels: [ɛɜɐəɵ]; how are they pronounced? What about these: [æaɐɑɒ] or these: [ʉʊuɯ]? Check out the rhotics: [ɻɽɾɹrʀʁ]. Which is which? Consider these n-like symbols [ɴnɳɲŋ]. Which one is the retroflex, which the velar, which the palatal?

Lets try and tackle the last one. Half-height capitals such as ɴ symbolize uvular sounds in IPA (compare to ɢ,ʀ,ʁ but contrast with q), so there's some regularity there. The palatal hook is based on j, so the ɲ is kind of a portmanteaux of j and n; similarly, the ŋ is a blend of n and g... but of some other g than that used in Garamond! This leaves ɳ as the retroflex, which is also consistent if tough to recognize in the other retroflex consonants. These decisions aren't arbitrary; one can trace the logic of most symbols. The overall result is much like the grammar of a natural language: ad hoc blends of rule following and exceptions, which must simply be learned through experience.

Phon, by comparison, offers the following rhotics **<add>**: . These are the nasals: **<add>**. This is much more regular, and the family resemblance between rhotics and nasals pronounced in the same place is obvious. The only thing which must be memorized is the three rhotics found in the alveolar-dental region, and even here a logic is followed.

The retroflex symbols are regular and easy to identify. Furthermore, although a single example doesn't make this clear, each shape is specified as a combination of other shapes, with great flexibility in the ultimate shape of the render.

This brings us to another great downside of the IPA. The typographic shapes of IPA characters are very specific. This leaves relatively little room for variance of rendering from font to font, for italic and bold forms, et cetera. Those of us who enjoy calligraphy are stuck; I'm sure someone with great talent could render IPA attractively but approaching the kind of fluidity evidenced in Chinese, Arabic or Western calligraphy would be a great deal more difficult. The Phon set, being defined in formal terms, offers great variance in render possibilities, and was designed based on calligraphy rather than typography. It is intended to be beautiful as well as useful, and a later chapter will explore the very beginnings of what is possible here.

Another reason for redesigning the existing phonemic space, is to give each phonemic category within it a unique symbol. This is simply not possible with Latin characters. Due to the variance of use over time, there will always be a population that reads any given letter as a phoneme at variance to its assignment in the IPA scheme. Our character 'ﮊ' cannot be confused for the beginning of an 'ﯡ' in English orthography (such as 'the'); it represents exactly one phoneme in acrographic use. Moreover, it represents nothing but that phoneme; Phon provides a set of purely symbolic markers for, e.g., mathematical variables such as 't', which is used alongside 'x' 'y' and 'z' in common algebra. To use an 'ﮊ' as a mathematical symbol (or any sort of meta-symbol) would be basigraphic usage of Phon. The assigment of letters to variables, constants and units is made possible through hwan, as described in the section on mathematical and symbolic use.

The phonemic space, as we understand it, is featural; that is, the categories are based on aspects of articulation, related to features of our vocal apparatus. The use of a featural writing system is, therefore, a natural fit. This results in a highly regular character set, with less to memorize, and with that which must be learned laid out whenever possible in an easy mnemonic form: either visual, or related to aspects

of the natural world which any human can be expecttted to be familiar with, specifically the cycle of plant growth. It is therefore not just easier for a non-Latin using reader to learn, it is easier for that reader (or any other) to use, because it makes more sense. Despite the regularity of the system, the differentiating symbols were carefully chosen so that the eye can distinguish different symbols as different easily: spirals vs. hoops and waves, etc. all based on existing distinctions in known character sets.

Another advantage of Phon is extensibility. IPA has a sort of ad hoc style for developing new characters, based on the historical process and certain guidelines such as not choosing the italic form of a character as the basis for a new symbol, and the deliberate non-use of any base symbols other than Latin, Greek and Cyrillic ones. These principles have been used by other parties to extend IPA into hundreds of well-nigh unintelligible characters, each of which must in essence be memorized, with a regularity less like that of a mathematical construct and more like that of an Indo-European grammar. The combinatoric nature of Phon allows for great flexibility in extension: for example, characters containing three lassë are unknown, as are characters in which a helyanwë or latta follows a higher-ordered lassë of some sort (one such is used as a mesogram for &). The tuima and hwan can be extensively developed, and one can imagine an entire family of characters which use a tulwë rather than an alda for a vertical, although this cannot really be envisioned as a consonant, and some of these are in fact used in the mathematical symbol set. By envisioning Phon as phonemic rather than phonetic in the proper sense, the set of base symbols is minimized; for those who wish to distinguish between, say, sixteen types of sibilants, it is easy enough to do so.

The Phon handling of suprasegmentals is also more sophisticated than the IPA, and ripe for extension; indeed, it is only barely developed, in keeping with what is available for the existing IPA. One envisions a development of markings like key and time signatures, and a more robust system for marking up intonation and stress, that will allow correct rendering of song, for example, or the wide range of paralanguage in general.

The fact that Phon can be rendered in four modes is an advantage that IPA does not even consider providing. Every writing system which has ever been in common use has been written in one of these fashions, and this allows phonemic content to be included in Arabic and Mongolian texts without breaking the line of flow. It is envisioned that long blocks of text in Phon will be written horizontally and boustrophedontically, that is, alternating left-to-right and right-to-left. This will give the brain equal fluency in either mode, and ease strain on the eyes. Vertical Phon is envisioned as mostly useful for titles and decorative/calligraphic purposes; the ability to put phonetic information inline with Classical Chinese writing is a benefit also.

Phon is in beta at the moment, with certain assignments tentative. When it is released, it will contain a subset that is an isomorphic map onto the complete IPA character set, as of the latest revision. It is for this reason that we are confident in offering it as a tool for professional linguists to do science with. We hope this short exploration of the advantages in doing so will prove a spur; we believe that science can be beautiful as well as true, and that beautiful science is used more often and with better results than merely functional science. Phon exists for many purposes: to provide calligraphers with a key to all the world's languages, to provide those who dream of a global culture with an important piece of it, to enable the correct rendering of many languages that are new, obscure, or found where logographs predominate, as well as for professional linguists of various stripes. The rest of this chapter concerns itself with Phon as a phone(m/t)ic writing system; having established the virtues of doing so, we present it in all sobriety as a scientific tool, useful enough to supplant the IPA entirely.

Phon in Phonetic Terms.

When the Phon project expanded in scope to encompass the IPA state space, that was the moment it truly came to life. There is one unique Phon character for each consonant and vowel in the base IPA system, at the present time, and the tuima and hwan, liantassë and talma are between them to be used for the remaining diacritic and suprasegmental qualities. The organizing principles of the IPA have guided those of Phon, however Phon is answerable ultimately only to itself, and aspects of how the writing system is organized differ from how the IPA, in any of its revisions, is presented.

As introduced in the formal section, utterances in Phon are divided between vowels and consonants. Consonants are considered the skeleton of speech, in Phon; they are the largest letters, and are drawn on the main line. A consonant, in formal terms, is distinguished by having an alda, called here sirpë, and a connecting stroke from the category known as lassë. The sirpë may be extended upwards and downwards, or not, and the three extended forms can take a hwan, and are considered different sirpë by convention in that case. All lassë are in principle the same height, corresponding to x height in typography, in Phon called lassë height. A consonant may have other strokes but the lassë must be on only one side of the sirpë, the other side being reserved for hwan.

This gives us the two fundamental families of Phon consonants, the plosive-type and the fricative-type, or p-type and f-type. Plosives, being shorter as a rule, get logical priority: also the stop is more consonant like than the fricative, as the airflow is disrupted completely and not just made turbulent. Lastly, we consider the sound 'p' to be like that of rain falling on parched earth, and the sound 'f' to be like that of steam and smoke escaping a log and rising into the sky. With these in mind, we say that the group of consonants defined by the helyanwë stroke are plosive, while those defined by the latta are fricative; furthermore, we designate the direction of sense in utterance to be in the direction of a plosive stroke, which is also the horizontal direction of an amban, our first nonsymmetrical primitive.

The first in this family are the plosives, proper, and we find the assignment of these straightforward. We have seven basic stems,

and assign them as bilabial, labiodental, dental, palatal, velar, uvular and glottal. For our first row, this leaves out retroflex, which brings us to the first variation between Phon and IPA: the retroflex consonants are marked through the use of a distinctive tuima to modify their recognizable (dental) equivalent, therefore they come later. Retroflexion is both a place and a means of articulation, similar to that used for 'ɹ', and is represented with tuima to efficiently generate variant symbols.

The unvoiced consonants of this series receive a single helyanwë, while the voiced ones take two. We come next to the nasals, which are marked with hwinya drawn senseward. Because nasals are all voiced, we save ink and paper and draw them with a single lassë, reserving the option of unvoicing a nasal using hwan. The nasals, too, are quite regular and easy to assign, and the hwinya is both logically after the unassignable telco types and resembles a sinus in some mnemonic sense.

Now we come to two sparsely populated rows, the trill and the tap or flap family. Here, we make another choice, and invoke the concept of rhoticity to cluster consonants along a different logic than that of strict articulation. The trill, tap, flap, and certain of the approximants all make a sound which can be characterized as 'r' like, at least by those sensitive to the sound in the first place as rhotics are unknown in many languages. We assign a senseward lócë to this family. There are three existing symbols in the dental region: we assign the approximant first, as shortest, then the tap and finally the trill. The shape of the lócë might remind one of the wiggling of the tongue during a trill; the approximant also receives the first symbol because it is most suitable to representing the sound of a rhotacized vowel with a metahwan (see below).

Everything above the fricatives on the classic IPA chart has been characterized, or in the case of the retroflex set aside. We come to the fricatives, a rich and regular family. Each point of articulation in the table contains exactly one, voiced and unvoiced. Trouble is, we have eleven points and seven stems. We solve this, first by setting aside the retroflex, and then by rolling up our sleeves and tackling the very crowded dental region. An anti-senseward hwinya gives us 'ʃ' and 'ʒ',

Figure 4.1 Pulmonic Consonants

	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Retro-flex	Palatal	Velar	Uvular	‡ Pharyngeal	Glottal
Plosive	p b		t d			ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ	n			ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap/Flap				ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral Fricative				ɬ ɮ							
Approx-imate		ʋ		ɹ		ɻ	j	ɰ			
Lateral Approx-imate				l		ɭ	ʎ	ʟ			

while the anti-senseward lócë gives us ‘s’ and ‘z’; the mnemonic is that the tongue tip is down for the alveolar sounds, up for the postalveolar. The dental symbols, proper, take the dental stem unmodified; we argue that most ears would consider ‘θ’ not ‘s’ the fricative equivalent of ‘t’. The pharyngeal forms are given the hwinya, as first in logical order, modifying the glottal.

But we are following our own order, not that of the IPA. Therefore the main seven fricatives are found serene in their own rank, while below that are all symbols composed of the combination of anti-senseward hwinya and latta forms of lassë. Many of these are approximants, and some are from the nebulous ‘other symbols’ region. The logic of their assignment is dense, in some cases, and they alone have been known to move around since these symbols were first derived. As mentioned before, ‘ʃ’ and ‘ʒ’ are found here, and such assignments as ‘j’ are easy to see. ‘ʍ’ and ‘w’ were chosen to show commonality between them; although ‘ʍ’ is properly labio-velar, it has the sound of a glottal fricative combined with the ‘w’ sound, and is given a glottal sirpë for this reason. The old symbol used a velar sirpë and combined a hwinya and a lócë for the lassë; this is featurally more correct but less easy to distinguish from ‘w’.

Lastly we have the (anti-senseward) lócë and latta family, cleaning up remaining non-lateralized non-retroflex approximants, ‘other symbols’ and the occasional stray fricative. Below this we have the retroflex symbols, which are simple enough to assign, as retroflex hook variants of most of the possibilities in the dental region; lastly the laterals, including my favorite symbol from the consonant set, ’ the retroflex lateral ‘ɭ’, which is also a poster child for IPA reform.

Our non-pulmonic consonants come next, with two types covered through tuima: a falma for ejectives and an alda for implosives, respectively. Clicks take a unique symbol, considered a single lassë though composed of two strokes, a truncated helyanwë with an attached latta. This can be lateralized through the usual tuima, and rendered voiced by attaching it to a helyanwë, in the familiar way.

Whistles, in a sense, are opposite in intonational form from clicks, and are assigned the opposite symbol, despite having no

representation in the existing IPA. I personally can whistle in a bilabial, alveolar, and palatal position, and in voiced and unvoiced manner: laterals are possible, and one should adopt some sort of symbol for a bilabial whistle which has been bi-dactylized (a finger whistle, in plain terms). Here, as is common, more variety is possible than can probably be voiced; but we should, perhaps, let the ease of creating these symbols serve as a spur for effort. Wookies, I am sure, can manage a voiced glottal whistle, and perhaps Tibetan lamas as well.

Figure 4.2 Non-Pulmonic Consonants

Clicks	Voiced Implosives	Ejectives	Whistles
ʘ ǀ ǃ ǂ ǁ	ɓ ɗ ʄ ɠ ɢ	pʼ tʼ kʼ sʼ	bilab. dent. pal. bilabial bidactyl

Figure 4.3 Other Symbols

It is easy to see that there can be far, far more consonants than provided in the table. Formally, these do not have meaning at the present time, but all combinations of lassë and tuima which obey

the other rules of consonant formation, with up to three lassë, are formally considered protograms if they have no assigned meaning, and are thus being saved for some later use. Combinations of four lassë are likely to prove both completely unnecessary for handling consonantal reality, and unwieldy in use, and are considered idiograms if considered at all.

Consonants, including the mysterious 'other symbols', have been given representation. Vowels are next. The vowel quadrilateral, with its iconic points, conceals a morass of shifting tongues and lips, a continuum of sound sketched out merely adequately by the IPA. For reasons of our own, we have not tried to improve this situation. The main reason for this is that vowels are kind of gravy anyway, suspending the chunks of consonant that make up our rich utterance stew. The IPA aims to preserve phonemic distinctions, and we do the same. Our vowels, following the logic of the quadrilateral, are quite regular, and composed of two isolated strokes, called cermë. One of these strokes, composed of an amban, a pendë, an alda or nothing, represents the degree of openness of the air passage. The other symbol encompasses the other dimensions, namely roundedness of the lips and raisedness and loweredness of the mid-sagittal section of the tongue.

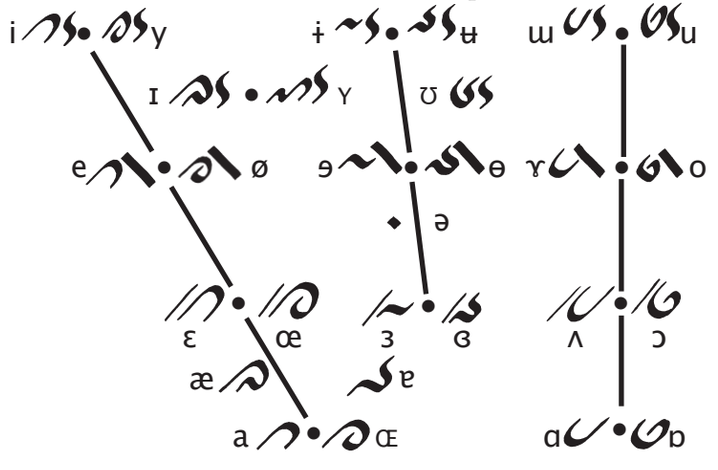


Figure 4.4 Vowel Grid

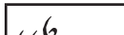
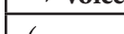
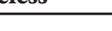
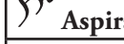
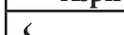
The vowels are given in the same table shape as the IPA vowels, and the assignment is straightforward enough. Vowels are rendered in a variety of ways depending on what is useful. The default mode places them above and below a consonant, in the yávë and sulca positions respectively, which in turn are sounded before and after a consonant, or above and/or below a palatal sirpë without an attached lassë. In this mode an isolated vowel is written senseward, that is plosively or how it would be rendered above a p-type consonant, while above f-type consonants the stroke's position with respect to sense is reversed. This is the only arcographic mode, and the only one considered here.

We have come this far: each of the consonants and vowels of the IPA has a unique assignment. But we are not finished; there are all the diacritics, suprasegmentals and tone and word accents to be accounted for. This task is not complete at the present time, and the assignments made should be considered alpha at present. With that said, here's what we have, so far.

Diacritics are not a recognized category in Phon; the relevant distinctions are handled mostly through the use of tuima and hwan, which are formal distinctions based on the shape and placement of the strokes. Most of the tuima, but not all, relate to aspects of air release: tuima are used to define some of the non-pulmonic consonants, the lateralization of the airstream, aspiration, non-aspiration, and the like. The hwan, in general, are reserved for making fine distinctions as to precise place of articulation, the tuima in general as to precise method, with airstream considerations primary. This is mnemonic, however; the distinction is not featural but formal. That said, all functions played by diacritics in the IPA have an analogue in Phon; we will explore those categories here, in the order presented by the IPA table.

Voiced and unvoiced variant consonants are marked with hwan. Voiced takes two latta for p-types, two helyanwë for f-types, but drawn with the opposite end connected as for lassë, cermë sized in the hwan position. Vowels are modified by drawing the hwan plosively on a bare palatal sirpë.

Figure 4.5 Diacritics

 **Voiceless**	**Breathy voiced**	 **Alveolar**
 **Voiced**	 **Creaky voiced**	 **Apical**
 **Aspirated**	 **Linguolabial**	 **Laminal**
 **More rounded**	 **Labialized**	 **Nasalized**
 **Less rounded**	 **Palatalized**	 **Nasal release**
 **Advanced**	**Velarized**	 **Lateral release**
 **Retracted**	 **Pharyngealized**	 **No audible release**
 **Centralized**	**Velarized or Pharangealized (Obsolete)**	
 **Mid-Centralized**	 **Raised**	**‡ bottom vowel of diphthong**
 **Syllabic**	**Lowered**	
Non-Syllabic (‡)	**Advanced tongue root**	
 **Rhoticity**	 **Retracted tongue root**	

Aspiration, common to many languages, is drawn as a tuima, a falma off the last lassë in a consonant. IPA appears to lack a symbol showing lack of aspiration, but Phon includes this as a tuima also, in the form of a helyanwë attached on the later end for p-types, and a latta attached on the earlier end for f-types; this is also a way of showing 'no audible release', which is in context equivalent. This is another distinction between concepts of normality in Phon vs. IPA: Phon

conceives of the normal stop as slightly aspirated, with the variants unaspirated and fully aspirated, while IPA appears to assume that there is no aspiration in a normal plosive consonant; we suggest that this is, in general, not true for languages which lack aspiration as a phonemic distinction, as a comparison of the educated accents of an American and an Indian English speaker will reveal.

There follow, on the IPA chart, several marks which are vowel specific. We will lose our hwan if we start assigning them to this, before we even get underway. Therefore, we introduce the most versatile hwan of the lot, known affectionately as metahwan, the shwa of hwan: a single amban attached on the anti-senseward side of the sirpë, that is, in the hwan position. This hwan, attached to our bare palatal sirpë, shows that the cermë in the sulca position are to be read as modifying the yávë cermë. Up to two cermë can be made to fit, making this system as versatile as the IPA one, while giving much more room for advance, as only six of the nineteen primitives are used for this purpose. The palatal stem with metahwan, with no vowel in the yávë, serves to apply the same modifier to the preceding consonant, should it be needful.

The syllable marker is found in the talma, and has a characteristically small shape. Non-syllabic vowels will be found in the below position of a dipthong. To support this, a tripthong should be written with a second palatal sirpe and the vowel below, it, as opposed to above.

Rhoticity is easily handled by tagging the rhotic approximant with the metahwan, and it is felt that this is enough of a symbol, as rhoticized vowels tend to be thought of as having a consonant after them by the native speakers (that is, an 'r' is written). Mesographic versions of these languages will often leave off the metahwan for convenience, as meaning is seldom disturbed by this.

Nasalization is common, and happens in two ways. Some languages, such as French, nasalize vowels but treat the utterance as a consonant, others such as Hindi nasalize but treat the utterance as a vowel. Thus there is a hwan for nasalizing, as well as a metahwan applied to the (usually dental) nasal, but meaning the same thing: the

yávë vowel is being modified. For nasalized consonants, the hwan is reused on the consonant in question: it is drawn as hyalma in p- and t-type, although upside down. This also allows a distinction between, e.g., palatal nasalization of vowels and dental nasalization, which is potentially useful.

It seems somewhat strange to us that the 'alveolar dental' region is considered alveolar by default in IPA, when the dental articulation would appear to be preferred by languages which have retroflexion (and hence are more precise about the tongue placement for what we may as well call dentals). Phon calls the doubly-extended sirpë the dental, and therefore has a mark to indicate unambiguously an alveolar articulation of dental consonants, which is a tuima in the form of an elen inside the first lassë; the elen combined with a retroflex luva can serve to mark an unambiguous postalveolar, with the elen modifying the retroflex position just as it modifies the dental.

Apical and laminal realization of a consonant are marked by a small-lúva upside-down lampa for apical and a tata for laminal. It is felt that the shapes might be mnemonic of the distinction in tongue contact realized by these diacritics, as apical consonants touch with the tip and laminal consonants with the blade, behind the tip.

The linguo-labial is a weird one, and is marked by a hwan in the form of an allin attached to the top of a dental stem, where a labiodental stem receives a falma.

There are several contrastive groups, which are assigned hwan accordingly. Voiced and unvoiced have already been explored; we have also raised and lowered, which a falma and a nare which are mnemonic enough. Breathy and creaky voicing are at least contrastive; the allin of breathy continues the theme of the aspiration tuima while the tulwe may be said to point 'down' the throat, showing the chest noises that are characterized as 'creaky'. There are also marks for advanced and retracted tongue root, lampa and salpe respectively. Lampa means 'tongue' due to the shape, and a salpe is a rotated and reflected lampa.

Next there are four markers for consonants that signify a secondary narrowing at one of four points: the labial, palatal, velar and pharyngeal. We have not used the bare labial, velar, or uvular sirpë for

any purpose, and they are easily drafted for use, the uvular serving for the pharyngeal. The palatal takes a falma to the top, as though it were an extended sirpë. A variant symbol, not listed on the chart, denotes labial narrowing without protrusion, and is symbolized with a bare labiodental sirpë. These are drawn on the hwan side of a character, as close as possible; some of them may be ligatured to advantage, although this is not formal.

Lateral, nasal, and 'no audible' release all require that no vowel follow the consonant, therefore they are symbolized by hwan in the sulca position, in this case of the 'free floating' form, attached to a short pendë: a helyanwë early-ended to the pendë for lateral, a hwinya to the bottom of the pendë for nasal, and a falma on the bottom for no audible. Lack of audible release can also be symbolized by tuima as described under aspiration.

Suprasegmentals are another category Phon does not maintain; the tasks met by the suprasegmentals are handled as needed. Length and stress are the domain of the talma, and intonation that of the liantassë; however many languages can be written without one or both of these ranks, making for a thinner line of text on the page, and various extensions to the writing system allow for in-line marking of some of these qualities.

The suprasegmentals are, simply put, not in a mature state. I intend to write a monograph/revision in the near future to correct this; in the meantime, I'll conclude with a discussion on how length is represented.

Many languages distinguish between short and long vowels. In Phon, this can be shown in a number of ways: placing the same vowel on top of and below a bare palatal sirpë is one approach, while a quicker one is to put the vowel in the sulca position and then place a bare palatal sirpë senseward of it, with no cermë in either position. For a long consonant, we can write this same bare palatal sirpë, senseward, as long as we don't put a vowel in the sulca position of the consonant. An extra-long consonant or vowel would have a tulwe instead of a sirpe, of lasse (palatal) height. A extra-short vowel or consonant has no standard representation at the present time: the talma will offer a

more fine-grained way of approaching length and stress, but this is not elaborated at the presetn time.

The current talma are the syllabic marker, and a simple pende to indicate stress, with double stress indicated by two pende. There are tentative liantasse pictured in the form and morphology chapter, showing high, middle and low tones, as well as the global rise and fall symbols; it is felt that the symbols are so intuitive as to need no identification as to which is which.

I have resisted work on the liantasse and talma largely because I want them to be more effective than the IPAs scheme. It should be possible to represent the main qualities of sung speech, such as more precise duration, tone over several octaves, and the qualities by which tones shift within a phrase. This is left possible by not merely reimplementing the IPA tone scheme. There may end up being several visually distinct approaches to the liantasse depending on how much information needs to be conveyed; for singing this may prove to be as large as the vertical area covered by a dental sirpe.

This chapter introduces all of the Phon that maps to the IPA, and a few more pieces that are not precisely IPA but which serve similar functions or can be classified within that structure. The chapter kind of jumps from strictly defining Phon in IPA terms and defining it in its own terms; in the beta revision I'll do the job twice, once to show IPA compatibility and once to show how the intrinsic order of Phon is adapted to the various distinctions in phonetics. Phon is useful for more than phonetics, and the following chapters will discuss extensions to Phon and cultural aspects of its use.

Extensions to Phon

The Phon system, at its core, is a way of representing language. It is powerful enough, however, to do a great deal more than this. The combinatoric nature of the system encourages us to generate diverse symbols, far more than are needed for merely representing phonemic speech accurately. While there may be other areas that Phon will prove useful for, mathematical and musical notation have been chosen as fields which will, eventually, be incorporated into the Phon system. There is some work done on math, but none to speak of where music is concerned.

Mathematical Notation in Phon

Phon is inherently mathematical in a way other writing systems are not. Each stroke has an order, and hence a number. In a sense, the primitive strokes are generated like the natural numbers; the elen is the empty set, the amban the set containing the empty set (and hence zero) etc. The numerals of Phon were worked out shortly after the vowels, and exist in multiple bases. In an ideal world, Phon users would be natively hexadecimal, having taught themselves a verbal system for numbering that breaks the tyranny of decimal thought; but here on my home planet we think in tens, so the decimal system is considered first. The

elen is reserved for marking the decimal point, and the numerals are the second through tenth symbols, thus: zero is amban, one is pende, two is helyanwe, three is latta, four is falma, five is anare, six is hwinya, seven hyalma, eight is loce and nine is sire. They are written the size of lasse and in the same position, thus can't be confused for punctuation or vowels.

The hexadecimal system uses elen for the hexadecimal point, skips amban and pende, and uses the four remaining groups of four as the decimals. The fact that no two symbols have the same value merely makes regular a fact that applies above 9 for the standard notation. This makes the hexadecimals mnemonic, which should in principle make it easier to do arithmetic operations with them. In practice, for this to be easier, one would have to have a distinct set of sounds for each hexadecimal numeral (distinct from whatever decimal counting words one knows, and ideally mnemonic like the symbols), and would have to learn the times tables by rote, all over again, up to 256. At that point, one would be ready to practice long multiplication and division a little, and at that point the Kingdom is yours. More trouble than Dvorak and Reverse Polish Notation combined! But the merits of hexadecimal are considerable.

The basic arithmetic operators are addition '  ', subtraction '  ', multiplication '  ' and division '', and symbols are supplied. The general shape of each two stroke combination shows whether the result of the operation is larger or smaller (for the elementary school case of the operation), and the falma shows addition/subtraction and the nare multiplication/division. In short, the four basic symbols group in two ways, so two strokes are used to show this relationship explicitly. The standard arithmetic symbols, I must note, do a decent job of this, although ours are more regular still. There are other operators, but this section is incomplete at the present time. In particular I have no symbols at all for the basic logical operators, which needs to change

The existing symbols for arithmetic do the job well enough, and we've only invented new ones because the old ones weren't Phon. Some modest improvement, however, can be seen in the symbols for variables. x, y, and z have been the workhorses of the mathematical

profession for centuries. It's an interesting hack, actually; the last three symbols of the alphabet, leaving the first three for another set of variables, although in geometry the tradition is to begin with A. While this kind of usage is typical of the Latin alphabet, which is incredibly adaptable, Phon has to be handled differently. '  ', '  ' and '  ' can mean only the sounds they represent, and nothing else; this is basic to the system and a major advantage it has over the IPA. The basic metavariables, then, are  ,  and  , mnemonic to their roles as axes; no name has been given to the symbols at present, and we may as well call them ecks, wai and zi or what have you. The system extends to '' and '  ', after which other symbols can be generated from the basic model if needed. These symbols are conceived of as dental sirpe sized, hence larger than numbers and operators.

There is a more general way to designate a variable, and this allows for mnemonics between the variable and the quantity measured. The hwan '' means that a consonant is to be read as referring to a variable rather than a sound, and the hwan '  ' means the consonant should be interpreted as a unit or constant. Thus (these symbols) represent the basic metric units of grams, meters, liters, seconds, and others such as watts, radians etc. have been developed, and the variables are used in a functional notation that is visually similar to the familiar f(x) etc.

Other important variables have their own distinct symbols. Theta and r get '  ' and '  ' respectively, while i is '  ' and e is '  '. Theta is mnemonic in both the shape suggesting a swept angle, and the combining of the symbols "th" and "t", while R is more mnemonic of the consonant 'r', and should be drawn carefully so it won't be confused with '  '. i and e, it is hoped, are mnemonic of their identities also. The six trigonometric functions are represented as well, with sin, tan and sec as basic and cosin, cotan and cosec as variations; it can readily be seen how the consonants in each function are borrowed for the symbol.

Only the very rudiments of math have been covered, and there is much work to be done here; I am not a mathematician and could use some help in this department.

Phon Culture

To write is to live. Our thoughts, that part of ourselves that thinks, thinks with words. Those words, written, can survive death, can live in principle forever. We may admire cave paintings, or feel a kinship with the makers of stone tools; but what is this compared to Odysseus? What is Odysseus but words? Yet he is alive with us today, as alive, maybe, as ever he was.

Odysseus was born as oral poetry, and if Gurdjieff is to be believed, the epic of Gilgamesh survived as a poem in the Caucasus into modern times. Even if not, the Rg Veda has been faithfully memorized by each new generation of Brahmins for six thousand years; with enough dedication, the oral method can pass on certain words for quite a long time, and oral traditions are rich in a way that writing, perhaps, dilutes.

But the efficiency of the thing! Something written once can survive hundreds of years, with luck, and can be copied faithfully and propagated across continents and aeons. Writing can standardize a rich soup of local microlanguages, forge national and religious identities, preserve ideas, all for better and for worse.

Writing, at the most basic level, is an activity wherein a person

makes certain marks or impressions that convey language to anyone who is skilled at this form of writing. There is a tension created between the inherently open-ended nature of our ability to make marks, and the need to convey language, which is far more constrained due to the physics of vocalization.

In most places and times, writing has flowed from the hand, through the pen or brush, onto the surface, be it paper, cloth, leather, papyrus or anything else. In Sumeria, the earliest writing was pictographic, carved with a stylus into the surface of the clay, but later we see something oddly modern: the actual shapes of semi-representational objects (analogous to and perhaps inspiring Egyptian Hieroglyphs) give way to abstract impressions, rendered with a wedge-shaped stylus of a single shape. This form of writing is very similar to type, or perhaps even to dot-matrix printing, which is also created with a single shape, a dot.

However, Sumerian writing died with all its heirs; our non-Chinese writing systems are descended from Hieratic, as discussed in the first Chapter. So it is that writing and calligraphy have always flowed from the same hand. There is a satisfying connection between the way words work, where a word like 'finger' applies to an infinitude of different actual instances which share a common form, and how a letter may be represented in an unbounded number of ways. Each handwriting is unique, and yet most can be read and understood by anyone who reads the language written.

Calligraphy, literally beautiful writing, is writing produced as and considered as art. Be it decoration, flourish on a text, holy exercise or recognized form of high art, the written word is recognized as beautiful by most cultures and written in an elevated style which reflects this. The examples range widely: from the Hieroglyphic writing that sacralizes and decorates the tombs of Egyptian nobility, to the veneration of calligraphy and its incorporation into painting in China, the Islamic calligraphy which at its peak displaced all other visual arts in the Muslim world, illumination of manuscripts in the Christian medieval world, to the modern development of graffiti into an art form on par with dancing and poetry, calligraphy is found in almost any

culture that adopted writing before modern type.

This is possible because our pattern recognizing systems, which are able to recognize the many things we refer to as 'cups', is quite capable of parsing a wide variety of drawings as the same letter. The extremes of this, whether graffiti, Chinese 'grass writing', some of the more abstract Islamic medallions, and some of the most flourished Copperpoint, are quite hard to read, but it can usually, eventually, be done. At the same time, a consistent form that submerges the writing into the background has the effect of bringing the content to the foreground. As this is often all that the writer wishes to convey, we have from the beginning of Hieratic the use of book hands which are regular in shape and easy to read. From the desire to standardize shapes, and produce many copies, it is easy to see the roads which lead to movable type, an invention parallel to the Sumerian but not related, the Sumerians being long forgotten at that time.

The Latin alphabet has certain distinct advantages for type writing: it has few diacritics, no variant forms to begin and end sentences, a default writing style with unconnected characters, and a small number of symbols overall. When the IPA was developed, it was the writing system in use by all the people involved in the project, and the use of movable type was a firmly established practice, with typewriters in use throughout the literary world. Thus it is that the IPA is based around a type-centric idea of letter shape; many of the symbols were chosen so they could be rendered either with variant types (the two types of small 'a', 'z' with or without the tail) or with an upside-down letter, or a greek one used for mathematics, or by typing, backspacing and overstriking with another key.

This strategy was quite successful. Systems like Visible Speech failed to thrive at least partially because they would have required each printer to maintain a full font library, while publishing texts with IPA required keeping fewer variant forms around. It seems inevitable, in fact, that the Roman alphabet would be the basis of a scientific writing system, given the paradigm of science in the late 19th century, which saw itself as a proud and important part of the European culture which was demonstrating its Enlightenment by colonizing much of the rest of

the world, as well as the simple fact that the vast majority of scientists in the field used Roman letters for their native language.

But in basing the IPA on type, its potential for calligraphy was limited. I am sure it could be done, but it would be at odds with the goals of the IPA project, which is narrowly focused on representing each phoneme with a single, easy to distinguish symbol, based on Roman letters by preference, then Greek, then Cyrillic. There is always leeway, of course, to design a particular typeface or adapt one so that it has all the needed symbols; this is in fact one of the best things about the IPA, the fact that one can often take an existing typeface, especially if it has a Greek character set, and adapt it to IPA by adding a limited number of additional characters. One could easily make a bold typeface, and if one ignores the guidelines against doing so, one could design an italic one as well. But it becomes harder to imagine something like Islamic calligraphy based on the IPA, or graffiti; the IPA is simply too grounded in type, too staid.

Phon returns to the pen for its inspiration, and defines the characters in terms of strokes and position in space rather than by an archetypal 'look' defined by a particular type font. There is a huge flexibility in rendering, and the surface is barely scratched. A few examples of the variety possible are provided, but my talents and interest in calligraphy are modest, and I am no kind of graffiteur.

Hip-hop culture, which includes graffiti and rap, is marginalized in discourse but vital in our culture and art. Graffiti is marginal because, by the original definition, it is executed without permission on the property of others. Rap is marginal because it is in Black dialect.

The issue of graffiti, land use, and the urban landscape is not one I'm going to get into. But the fact is that rap is not done in the forms of English modeled on writing and reflected in it. The effect of this on our thought is profound and mostly unexamined. The Black dialect of English has no standard way it is written, and attempts to render it have the painful effect of looking ill-educated. This is because in American English there is exactly one way to spell each word, and if you spell words differently to indicate their pronunciation the effect is as though one simply doesn't know how to spell.

I'm gong to run through one lyric, from dead prez's 'Still Bigger Than Hip Hop'. Here's an attempt to render it with standard English spelling: "What the hell a brother going to do, huh, when the rent due, when the lights and the gas going to get cut off, drop them raps or cock them gats?". One might also replace 'going to' with 'gonna', which is recognized as a word by most people who don't teach English. There are parts of this that are only correct in Black grammar, so someone who knows how could back-construct what it should actually sound like. But it lacks a certain authenticity.

Here's an attempt to render, using loose phonetics and the ordinary characters, the same line with more of the actual pronunciation intact. "Wha the hell a brutha gon' do doe, huh, whe' the ren' due, whe' the ligh's n de gas gon ge' cut' awf, dra dem raps or cock dem gats?" This is awful Pidgin. It looks even worse without the apostrophes. Here the IPA can help us some: "wʌ ðʌ hɛl ʌ brʌdʌ gʌn du do, hə, wɛ̃ dɛ rɛn du, wɛ̃ de laɪs ɛ̃ dɛ gɐs gã gɛ kʊ aʊf, dra dem rɐps ɘ kak dɐm gɐʔs?". This looks silly, perhaps, but it is at least precise, and a bit of standard American English rendered in the same way would come out just as silly.

But graffiti culture embraces creative spelling, as well as a very free and beautiful relationship to letter and word form. It is as far from the type based shapes of the IPA as something can be and stay basically Roman. But Phon is capable of being overlapped, made puffy, angular, stretched and distorted without changing meaning, and can render any phonetic statement without making it look ridiculous. It is my hope that some part of the global hip-hop culture will be attracted to this part of Phon, and adopt it for the correct render of marginalized dialects within a grassroots art form.

Phon, Standards, and Universal Culture

The third millennium works as well as it does largely on the basis of standards. Quiet, and hence often overlooked, these standards

make things work together smoothly; they exist to make it easier to get work done. The stellar example of this is the metric system. Although some U.S. readers may not believe me, it is actually easier to think in metric, and that ease is the foundation of scientific pedagogy. Science would be harder to learn in Imperial units, so fewer people would do so; if the metric system didn't exist, we would have to invent it.

The metric system could probably be improved (perhaps more natural units like the mass of a single hydrogen nucleus at rest) but this is unlikely. It works well enough, and that's that, and the units are defined (for a first pass at least) in a way that references a single substance, namely water.

The tendency to standards lead to standard forms of most national languages in the 18th and 19th centuries, and these have been refined since. Some languages, such as French, have governing bodies, while in others such as English the job is left to the academic world, but a standard form of a language is common, especially in the West.

A sort of natural move from this would be to try and define a universal language, one that everyone could use, like the metric system, to communicate with anyone anywhere. Ideally it would make it easier to think and express ideas, and many inventors of languages have made that claim. The success story in universal languages is Esperanto, and it is not particularly widespread.

Interestingly, there is a single standard writing system, called the International Phonetic Alphabet or the IPA. It is based on the Roman alphabet and promises to represent all phonemic distinctions in any language written with it. It is widely used as a key for pronunciation in dictionaries, and is universally used by linguists to write phonemic statements, as well as being adopted to define orthographies for languages which were previously oral in nature.

This is perhaps not surprising. A language embodies thousands of concepts, while a writing system needs far fewer. A natural language such as English is a good example, embodying tens of thousands of words and an irregular and sometimes complex grammar, while using only 26 symbols for sounds. To design a standard language, one would not only have a much larger task given the number of words and grammatical

principles which must be created (or more commonly adapted); furthermore, it is not at all clear how to begin such a project.

In Europe, there used to be a standard language, namely Latin, which was used by the learned, both for access to the classics (which was the bulk of what learning consisted of in the medieval period) and for communication between people of different vernacular languages. Such was the prestige of Latin, and the strength of its association with literacy, that its alphabet was adapted to the writing of the various Romantic, Germanic and Celtic languages which made up the vast majority of languages in Western Europe, as well as some of the Slavic languages and such exotics found among the majority families such as Finnish and Basque.

So, in a sense, the Latin writing system was already a standard. While Greek was used essentially in the writing of Greek, and the Cyrillic alphabet largely for Slavic tongues (until the Soviet era), Latin letters were used far and wide. By the time the IPA was developed, Spanish and Portuguese explorers had documented dozens of languages from the Americas, Africa and India, using the Latin alphabet to do so. Add to this the fact that the actual scientists designing the IPA all spoke languages written with Latin characters, and you have fertile ground for the design of a standard based on the Roman character set.

The advantages of Phon relative to the IPA have been touted elsewhere, and one may imagine a scenario in which it is widely used for phonetic purposes. Unlike learning a new language, learning Phon is a task which takes a matter of weeks. The IPA, by sheer weight of use, can be expected to retain pride of place, but a bigraphic scientific culture is possible to imagine.

Here at the dawn of the third millennium, English and the Latin alphabet are the lingua franca for the entire world. This situation will not last. Assuming for a moment that the future will continue to allow easy travel and international communication, the spoken language will continue to mutate and incorporate local flavor. Already we have a rich variety of dialects of English, particularly in the Carribean, which are practically (or fully) languages in their own right, and everywhere English is not the first language there is a code-switched, irregular blend

of English and the native tongue that is for many the most common way of speaking.

The infrastructure of English spelling in the Latin script obscures this richness, while Phon displays it as faithfully as practical. If a critical mass of users in various countries can be established, then the Phon culture will exist as a record of the emergence of these idiolects, as well as perhaps coming to be the dominant form for writing them in some groups and places.

Phon is offered as a universal script, but specifically as a universal auxiliary script, one that due to its simplicity and power exists alongside existing ways of writing. Esperanto, for an example from the auxiliary language movement, was conceived of as a language that people would learn for communicating with speakers of other foreign language rather than as a replacement for native tongues. Phon, similarly, is intended mainly as a way of writing languages that is standard across cultures, such that any major language would have a corpus written in Phon in addition to the native script.

It is hoped that by directing attention to scientists working in the relevant fields, as well as by appealing to those who write attractively as an art form, we can establish a living culture for the refinement and development of the system and the production of a corpus of works. Those with an interest in universal languages and culture will also find much of value in Phon.

Phon and Computing.

Phon, to be useful, must be a printed script as well as a written one. A hundred years ago, this would be a real challenge, albeit one that could be met. Today, we know we can do it, but there are challenges nonetheless.

The design of a Phont (the contraction is irresistible) is one of our highest priorities, so that we can represent readable samples to each other even as the script is being refined and tested. This is nowhere near as easy as in orthographic English.

Consider orientation. English goes left to right, Arabic right to left; classically, Chinese is written vertically, right to left, while Mongolian is written vertically left to right. Phon has leftic, rightic, and both vertical modes; it is the only script, to my knowledge, which does this, and which has (in the final rendering) a unique form for each character in each of these scripts. It would be absurd to have Phon character values represented four times, not to mention against the spirit of the project: it should be easy to reorient a Phon passage from horizontal leftic to vertical rightic, with a single mouse click, given astute enough software. Unicode would not accept a fourfold Phon, regardless, so we are left hoping they've thought of this problem and support it. There's something called the Bidirectional Algorithm: in short you can specify the direction of text, but not the verticality, which is broken wrt. existing scripts of great antiquity and beauty. Hope I'm wrong about that but my reference is Unicode 5.0 annex #9 section 5.4. Fonts themselves should give us more flexibility in this regard, and I'm barely literate on the Unicode possibilities.

We want the default printing mode of Phon to be boustrophedontic. This is to facilitate acquisition of both horizontal modes as well as to forestall the eyestrain caused by the muscular 'carriage return/line feed' twitch. Some hacking is going to be needed to make this work, as this doesn't appear to be a standard feature of any program I'm aware of.

This is the first issue but not the tricksy one. Vowels fall above and below the line, and this in itself is no great issue, although there are questions of placement and scale. But the fact that vowels render backwards on fricatives and plosives is a challenge, because again, we don't want the vowels to be doubled in the font, so that you can remember that a "th" is not a "t", change the consonant, and not have a backwards vowel messing up your render. The idea is that one 'symbol' has one number and the render might change depending on higher level context: Fortunately, the Phon formal order gives us a fully segmented representation under the hood, even if the render on the page poses various challenges. There's also the fact that a vowel can be written (typically) two places, and some sort of non-printing character

will be needed to specify which consonant a vowel is stuck to.

Oh yeah, what's a symbol? It's tempting to break it down, make numbers for seven (or even four) sirpë, the lassë doubled for compounding, cermë as separate units etc. This is the logic of the script, but not the render, and this form of representation imposes a burden in rendering complexity and a penalty in length, as the Unicode scheme makes each symbol worth at least sixteen bits and often thirty-two. Fonts use a pseudo-code to do anything complicated, and they take forever to do it; we are well served by making each consonant and vowel its own thing, with other families (hwan, liantassë, talma) rendered as additional 'characters' and sometimes as parenthesis-like pairs of characters marking out a domain. Thing is, particularly for consonants there are quite a few we can make what with the tuima; some of these we aim to get into the Basic Multilingual Plane and others should live in an austere and high plane of their own, far from their merely meaningful brethren.

The question of how to get Phon into Unicode is worth considering also. We build our Phont in the private use area of Unicode, but from the beginning we need to be writing our petition for the Basic Multilingual Plane. This is a bit of a bootstrap, as we will need to demonstrate our user community uses Phon to communicate about Phon (the Klingon's Dilemma) and that requires a Phont, but it is quite doable if we can work out our practical issues, which someone, I'm sure, can.

Haven't addressed all of those, as it turns out. Little stuff: the vowels get moved around a little depending on whether there's a tag on the sirpë next to them, and are slightly smaller on top because there's a shade less space. The vowel is centered over a plain palatal sirpë, and the amban that symbolizes a mid-open air channel is placed over the sirpë if it has no ascender, or under if if it has no descender. There are other issues, no doubt, that add up to the look of Phon, and as the hwan and tuima are fully worked in these will influence kerning and the like also, simple example is that a fricative followed by a plosive creates a 'period' like double curve which is kerned slightly, as is the period itself (represented as two commas in code). A more complex

example is that cermë which are doubled over a bare palatal sirpë look better if they're kerned so as to line up with the sirpë on the senseward side, which should be done when it can be, although diphongs that stand on their own as words (such as English 'I') should be centered over their sirpë.

The question of input is there also, as there are a lot of vowels and placement has to be specified. There's just no good way to do this; we're going to have to kludge it. Phon is for the pen, and until someone solves this on the hardware level we're going to have to thrash out language-specific keymappings and rely extensively on character palettes. The palette is in fact the first thing we need, after the Phont, because that can be used immediately if slowly by anyone.

Placement might work by making the caret move thusly: consonant placement, vowel space above the consonant, vowel space below the consonant, next consonant slot. So for a naked "L" followed by a space: you say L-space-space-space, "EL" is L-E-space-space and "LE" is L-space-E-space. There's a challenge for an ambitious programmer! It does solve the vowel problem, because there's now ten since capitals aren't an issue here, and the uppercases Y, V and maybe W (useful for hw also) are available, and that's enough or nearly for English. Might get tedious working that spacebar like a champion but it'd get the job done quickly and that's the name of the game here in rapid prototyping land. Again, this job isn't solved elegantly by a mapping, it takes a chunk of plastic with a USB cable attached.

An early design goal would be an IPA font that renders legible Phon, albeit of a single direction and with some simplifying rules determining vowel placement. That would let us render an IPA statement in Phon simply by composing it in IPA and changing the font to the IPA Phont.

In order to be usable, Phon must be legible in 12 point type, with 10 point preferred. This is the rock upon which many an enterprise of this sort has foundered; the original Visible Speech is a strain to read at 18 points, and at 10, forget it. The counterexample, of course, is Chinese, but 'easier to read than Chinese' is a pretty loose design constraint! 'As easy to read as Latin' is a tough target to hit, as the Latin

shapes have been evolved for millennia for ease of recognition. We can aim for 'easier to read than IPA', perhaps...

For words to be legible, the characters themselves are not enough. We read by large chunks when we're going at any decent speed, and this is done by recognizing word shape and the color of the word on the page. Phon has the potential to be read this way, as each of the lasse has a color and the shape of the entire sirpe changes for each stem.

To really make this work, the vowels must each have a distinct color, because they will be extremely small at 12 points. The biggest challenge will be making back rounded and front rounded vowels stand out from each other: the openness will have to be emphasized, without sacrificing the overall rounded shape. A good thick black pende for mid-closed will contrast nicely between those and mid-opens, and a close vowel is probably distinct enough as it is. Gradients of color are also visible, and that will help with the front and back roundeds. A different stroke weight for the sirpe and cerme will also help resolve all the action above and below the main line, as the sirpe should be thicker than a equivalent amban cerme.

The tuima pose another challenge. The hwan, not so much; they hang out in open space, making the shape easier to resolve, and anyway a text which is peppered with hwan is going to be read slower in real life. But great care must be taken to symbolize the retroflex and lateral hooks correctly, and to distinguish them from explosive consonants. This is another place where careful color manipulation, attention to gradient, and perhaps stretching of the lasse comes into play. A lasse with a hwinya tuima, should such become meaningful, will surely require a longer lasse so as not to look like a pool of black, and so as to be distinguishable from the retroflex lateral, another character which requires a delicate hand.

This section is likely to expand before it contracts: the challenges are numerous. Ultimately, however, they are finite. Phon was deliberately designed with little to no regard for the computer, as it was felt that computers can be programmed to do anything we want them to, while pens, paper, hands, eyes and voices are pretty much

going to stay the way they are. As a result, there's a non-trivial amount of programming to do, in order to render Phon the way we want it rendered.

The task completed, we will have an engine for rendering writing that is designed around human factors and human needs. Phon's vitality comes from the pen: for it to have a future, it must be easy to read and write on the screen.

Glossary

alda: means 'tree' in Quenya. Refers to an entire Phon glyph, consisting of **sirpë**, **lassë, tuima, cermë, hwan, liantassë** and **talma.**

allin: means 'lake' in Quenya. 16th primitive, formally LRLR, value of C in hexadecimal.

amban: means 'uphill' in Quenya. 2nd primitive, formally R, value of 0 in decimal and binary. **Cermë** for mid-open vowels, and **metahwan.**

ampa: means 'hook' in Quenya. 15th primitive, formally RLRR, value of B in hexadecimal. Used as **hwan**, reserved for use as **lassë**.

anti-senseward: the direction opposite that of the meaningful flow of speech. Right to left in the **Rightic** mode, left to right in the **Leftic**. **F-type** lassë are found on the anti-senseward side of the consonant.

cermë: means 'grains or harvest' in Quenya. Found above and below the **lassë**, in the **yávë** and **sulca** positions respectively. Always paired, with one representing air passage openness and the other combining lip roundedness and tongue position, though for fully open vowels the air passage **cermë** is represented by no stroke at all.

cúna: means 'bend' in Quenya. 18th primitive, formally RLLR, value of E in hexadecimal.

elen: means 'star' in Quenya, 1st primitive. Used to mark syllable boundaries, as a **cermë** for the shwa vowel, as **tuima** for demarcating variant positions of the tongue, as a decimal point, and other versatile uses.

f-type: all consonants which are drawn with the **lassë** on the anti-senseward side. A formal category in Phon, rather than a phonemic category as such, the f-type consonants are generally turbulent in nature rather than percussive. Also refers to **cermë** drawn in the order found above an f-type consonant.

falma: means 'wave' in Quenya, 6th primitive, formally LR, value of 4 in decimal and 2 in hexadecimal. Part of the **telco** group of primitives. Symbolizes a central vowel as **cermë**, aspiration as an outside **tuima**, and ejection as an inside tuima.

helyanwë: means 'rainbow' in Quenya. 4th primitive, formally LL, value of 2 in decimal and 0 in hexadecimal. Part of the **luva** group of primitives. Represents plosive consonants as **lassë**, front vowels as **cermë.**

hwan: means 'fungus' in Quenya. The hwan are a catch-all category for various modifiers. The main group of hwan are attached on the side of the **sirpë** opposite the **lassë**, or **anti-senseward** in the case of a bare palatal sirpë. The tags which modify the sirpë for variant positions are considered hwan, and there are certain marks, differentiated from **cermë** by virtue of being attached to a short **pendë**, which can be placed in the positions proper to the **cermë**.

hwinya: means 'swirling' in Quenya. 8th primitive, formally LLLL, value of 6 in decimal and 4 in hexadecimal. Symbolizes nasalization on the senseward side of a consonant, and usually refers to an approximant on the anti-senseward side. Represents a front rounded vowel as **cermë.**

hyalma: means 'shell' in Quenya. 9th primitive, formally RRRR, value of 7 in decimal and 5 in hexadecimal. Represents a back rounded vowel as **cermë.**

lassë: means 'leaf' in Quenya. Attached to the **sirpë**, signifying the mode of articulation of a consonant. Of uniform height and near uniform length.

lamba: means 'tongue' in Quenya. 12th primitive, formally LLLR, value of 8 in hexadecimal. Represents an ambiguous forward vowel as **cermë.**

latta: means 'pit' in Quenya. 5th primitive, formally RR, value of 3 in decimal and 1 in hexadecimal. Represents the primary fricatives as **lassë** and back vowels as **cermë**.

liantassë: means 'vine' in Quenya. Found above the **yávë** of a Phon **alda**. Indicates tone.

lócë: means 'dragon' in Quenya. 10th primitive, formally LLRR,

value of 8 in decimal and 6 in hexadecimal. Represents rhotic sounds on the senseward side of a consonant and an irregular class of sounds on the anti-senseward side, such as [ʂ].

metahwan: a single **amban** drawn in the **hwan** position. On a consonant, means the consonant is to be interpreted as a shading for the vowel, e.g. nasalization. Found above another hwan on a consonant, indicates that the hwan is to be interpreted as applying to the vowel in the **yávë** position. Placed on a bare palatal **sirpë**, indicates that the **cermë** found below the sirpë (in the **sulca** position) is to be interpreted as modifying the vowel found above it.

nárë: means 'flame' in Quenya. 7th primitive, formally RL, value of 5 in decimal and 3 in hexadecimal. Part of the **telco** group of primitives. The nárë stroke is the basis of the **sirpë**, and signifies a close air passage as a **cermë**.

p-type: all consonants which are drawn with the **lassë** on the anti-senseward side. A formal category in Phon, rather than a phonemic category, generally percussive rather than turbulent, or in the case of the nasals, at least resulting from a closure of the primary air passage. Also refers to **cermë** drawn in the order found above a p-type consonant.

pendë: means 'downslope' in Quenya, 3rd primitive, value of 1 in base ten. Signifies a mid-closed air passage as **cermë**. A small **pendë** forms the attachment point for free-standing **hwan.**

salpë: means 'bowl' in Quenya. 14th primitive, formally RRLR. Represents A in hexadecimal. Symbolizes an ambiguous back vowel as **cermë**.

senseward: the direction corresponding to the flow of meaningful speech. Left to right in the **Rightic** mode, right to left in the **Leftic**. **P-type** lasse are found on the senseward side.

sírë: means 'river' in Quenya. 11th primitive, formally RRLL, value of 9 in decimal and 7 in hexadecimal.

sirpë: means 'stem' in Quenya. Signifies the place of articulation of a consonant, when connected to one or more **lassë** on exactly one side. Of four heights, ascended, descended, both and neither, or bilabial, velar, dental and palatal. The bilabial can take a **hwan** in the form of a **falma** to form the labiodental, while the dental and velar can

take a hwan in the form of an **alda** to form the glottal and uvular. The bare dental sirpë is used to mark major and minor foot groups, while the bare palatal sirpë is used to show a lengthened phoneme as well as for displaying a vowel without an accompanying consonat.

sulca: means 'edible tuber or root' in Quenya. Area below the **lassë** of a consonant, or under a bare palatal **sirpë**. Ordinarily the location of **cermë**, also takes certain **hwan** to mark variant expulsion of air such as nasal or lateral.

táta: means 'hat' in Quenya. 17th primitive, formally LRRL, value of D in hexadecimal.

telco: means 'leg' in Quenya. Refers to either a **falma** or an **alda** when considered as part of a group. From the part of a letter in Tengwar corresponding in appearance to the **sirpë**, although different in function.

tuima: means 'bud' in Quenya. Strokes attached to the **lassë** or found within them. Most tuima modify the type of airstream phenomenon, such as degree of aspiration, but the category is also used for variants of position such as retroflex, and lateralization.

tulwë: means 'pole' in Quenya. 19th primitive, formally RLRL, representing F in hexadecimal.

ulumpë: means 'camel' in Quenya. 13th primitive, formally LRLL, 9 in hexadecimal.

yávë: means 'fruit' in Quenya. Area above the **lassë** of a consonant, or above a bare palatal **sirpë**. Takes **cermë**.

Appendix n: Rational Definition of Phon Characters

At the moment, Phon is loosely defined in terms of the International Phonetic Alphabet. This was a good choice, because the IPA is self-evidently successful at its job and showing that Phon can do that job is the first requirement for it to be taken seriously as a tool for linguists.

At some point, however, each Phon character needs to be defined mathematically, with reference to experimental data which are made publically available as part of the Phon release package. That means we do something along the lines of collecting recordings of native speakers representing each phonemic group we are trying to define, and then analyze those recordings, defining an abstract phoneme as an equation which, with the default parameters, gives a particular sound. This will let us define the use of a phoneme to represent allophony, as ranges of values on that equation, or to contrast realizations of the 'same' phoneme in different languages, dialects or accents.

No Phon character can be considered 'out of beta' until this kind of rigor is applied. At minimum the auditory characteristics of a phoneme will be analyzed and rendered as an equation, and this is considered the 'official' definition of the character: a default sound, with an envelope of variations that are considered the same sound. No

two characters will have the same equation, but it is expected that some will be capable of rendering the same sound by setting the parameters appropriately. Additional data, particularly cross-sectional video and lip movement video, will be collected where possible, but it is hoped that phonemes can in fact be defined in terms of allowable variation from an abstract harmonic equation of sound: this would seem to underly the idea implied by the Greek root of these words.

Phon is envisioned as defined by a central governing body, the Phon Foundation, but at the moment it's just me. Either way, part of the richness of Phon is that any arbitrary sequence of strokes can be classified into categories, and keeping these categories well-defined is the primary job of the Phon Foundation.

The most common category of strokes are basigrams: strokes which, because they violate our stroke-forming rules, are not part of Phon at all. The letter o is a perfect glyph for the basigram: any shape which encloses space is not a part of Phon, unless the Foundation says it is, but this rule applies without exception at present. Basigraphic usage of Phon is related to basigrams, in that both are deprecated, but it is possible, indeed typical, to engage in basigraphic usage with perfectly valid Phon characters.

The next largest category are idiograms, which will inevitable be confused with ideograms, but which should not be. Idiograms are any formally valid combination of Phon strokes which do not have an otherwise assigned meaning. Calligraphy in Phon can compose idiograms which represent names or other words, and which are partially or fully legible, but these will never have their own Unicode number, for example, outside of a Private Use Area. One could draw an entire cityscape with valid Phon strokes and call it an idiogram, and we won't argue unless we find something that isn't well-formed.

Protograms may form the next largest category: these are Phon characters which do not have a defined meaning, but which are recognized as being generable from the rules of character formation. Thus, no one may be able to pronounce a uvular ejective voiced trill with a retracted tongue and a bilabial narrowing, but it can be written, and is a protogram, as are other combinations that don't even make

sense, or use strokes that are being reserved for future meaning but are unassigned at present. The protograms could be compiled by some autist and registered high up in the far Unicode hinterlands, but really they're generated by combining rules and can probably exist in Unicode terms as combined characters.

Mesograms and acrograms are what remain to us. Once again: a mesogram might be used as a mesograph (such as & in mesographic English use), but an acrogram might just as easily be used as a mesograph, such as the use of shwa to replace the 'i' in '-ing' when writing mesographic English. Acrograms have a well-defined meaning, eventually in purely phonetic terms, but for now official forms which have reference to IPA characters are as much acrogram as we have. A mesogram is any protogram which is being used as a simpler or more visually distinct version of an utterance which already has an acrographic rendering. As languages are adapted to Phon, users will discover that it is more convenient to render certain things particular to their language in abbreviated or variant form. If the Phon Foundation considers these variants to be in accordance with the values of Phon, they are declared mesographic use and any protograms used in the rendering are considered mesograms, and they are periodically added to a Unicode petition.

The arcograms should all be placed in the Basic Multilingual Plane, if possible, since they are by far the most commonly used characters. They consist of all primitives, all official consonants, all vowels, combining forms for all the sirpë, lassë, tuima, hwan, liantassë and talma, punctuations and some of the mathematical series. We currently consider all characters to be in Beta or Alpha, at the moment, that is we allow that even such rock-solid basics as '' are not as well-defined as we'd like and could in principle change, whether in rendering (extraordinarily unlikely in this case) or in some detail of their meaning (I could still be persuaded that alveolar rather than dental pronunciation is normative).

The reason for these categories, and for the envisioned process of review whereby informal or experimental usage is formalized over several steps, is that Phon is not a perfectly regular nor perfectly featural

writing system. It was never meant to be. The character ᦎ , for 'ʃ', uses a lassë that is otherwise used for approximants, for example, to be contrastive with ᦋ. The approximants are not particularly regular, and the 'other symbols' consonants were worked out on a case-by-case basis. One might be able to trace the logic behind every stroke, in fact this is what we want, but Phon isn't meant to be something that could be assembled correctly and entirely just from knowledge of the various strokes and their featural meanings. There are questions of logic, precedence in order, ease of rendition and recognition, cognate use within the existing writing system, aesthetics, and existing practice to be balanced.

The mnemonic and visual nature of the script is compelling; I have often had a student sound out a character that they hadn't heard in the middle of the first word I explain. The system seems complicated, but the underlying logic is embodied both as visual pattern and as images of the face, trees, and the natural world. This is the key to understanding Phon for most people; those who are turned on by symmetry theory and nesting levels of significance will have plenty to chew on in this chapter.

Appendix n:

On the subject of Quenya vocabulary.

Phon, whenever possible, uses existing terminology from linguistics and phonetics; it is expected that these will be translated into the various other languages of science when and as needed. When terms are needed which are felt to be general to writing systems, such as archigraphic, mesographic and basigraphic, as well as protograms and idiograms and the like, the usual process of mining Greek and Latin is followed.

Where terms are felt to be specific to the Phon writing system, they are whenever possible chosen from Quenya, the most fully developed of the languages invented by distinguished linguist and author J.R.R. Tolkein. This is done in homage of our script's ancestry in Tolkein's Tengwar, as well as to emphasize the transnational and universal nature of the script. In addition, words are chosen when possible to refer to common aspects of the natural world, or to artifacts which were ubiquitous at least a thousand years ago; as most Quenya nouns refer to exactly these things, this is easy enough. It is expected that these words will remain in Quenya, rather than be translated, regardless of the language in which Phon is being discussed.

Quenya is a language which is highly inflected, and as such, the final form of a noun changes based on plurality, person, gender,

and case. The Phon Foundation is not opposed to the use of 'correct' Quenya for, eg one lassë, two lasset, three lassi, three of four lassili, however it is not felt that this is in the interest of clear communication and this form is not followed here. In general, the same form is used for singular and plural (one cermë, two cermë, many cermë) as being simplest and well within the norm for English usage. The Phon Foundation recommends that the morphology of the host language, rather than Quenya, be followed in scientific use, but considers either to be good practice in other settings, and certainly any Tolkeinist who has mastered the intricacies of Quenya grammar should not be discouraged from displaying that knowledge.

Appendix n:

Phon Equivalents of IPA Characters

Figure 2.1 Pulmonic Consonants

	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Retro-flex	Palatal	Velar	Uvular	‡	Glottal
Plosive	p b		t d			ʈ ɖ	c ɟ	k g			ʔ
Nasal	m	ɱ	n			ɳ	ɲ	ŋ	ɴ	‡ Pharyngeal	
Trill	ʙ			r					ʀ		
Tap/Flap				ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ		ç ʝ	x ɣ	χ ʁ		h ɦ
Lateral Fricative				ɬ ɮ							
Approx-imate		ʋ		ɹ		ɻ	j	ɰ			
Lateral Approx-imate				l		ɭ	ʎ	ʟ			

Figure 2.2 Non-Pulmonic Consonants

Clicks	Voiced Implosives	Ejectives	Whistles
ʘ ǀ ǃ ǂ ǁ	ɓ ɗ ʄ ɠ ʛ	pʼ tʼ kʼ sʼ	bilab. dent. pal. bilabial bidactyl

Figure 2.3 Other Symbols

ʍ ɷ
w ɺ
ɥ ɢ
ʜ ʡ
ʢ ɧ

Figure 2.4 Vowels

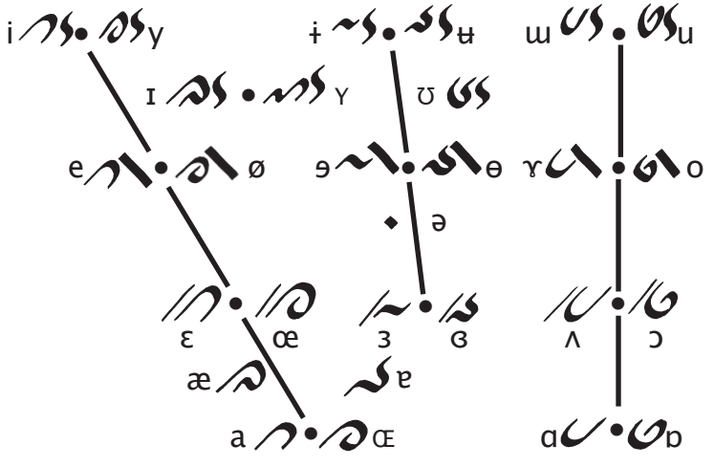


Figure 2.5 Diacritics

◌̥ Voiceless	◌̤ Breathy voiced	◌̪ Alveolar
◌̬ Voiced	◌̰ Creaky voiced	◌̺ Apical
◌ʰ Aspirated	◌̼ Linguolabial	◌̻ Laminal
◌̹ More rounded	◌ʷ Labialized	◌̃ Nasalized
◌̜ Less rounded	◌ʲ Palatalized	◌ⁿ Nasal release
◌̟ Advanced	◌ˠ Velarized	◌ˡ Lateral release
◌̠ Retracted	◌ˤ Pharyngealized	◌̚ No audible release
◌̽ Centralized	Velarized or Pharangealized (Obsolete)	
◌̈ Mid-Centralized	◌̝ Raised ‡ bottom vowel of diphthong	
◌̩ Syllabic	◌̞ Lowered	
Non-Syllabic (‡)	◌̙ Advanced tongue root	
◌˞ Rhoticity	◌̘ Retracted tongue root	