

# The History of Language

## From Animal to Alphabet

*A reference work, read through the Vacuum.Net theory*

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## Abstract

This book sets out the development of language as a sequence of rungs. It starts with the animal call. It passes through the click speech of the southern African hunters, the spoken languages of the world, tone, and language carried without the mouth. It then follows the mark, the image that stands for a sound, the syllable sign, the consonant letter and the alphabet. It ends with the branches that took another road: China, Korea, India, the Americas.

Every rung is given with its counts. The counts come from sources that were opened, and from one database on which new counts were made for this book. Each rung is then read through one rule from the Vacuum.Net theory. A form exists only on top of its parent. Each new form is the parent plus one turn.

Four results carry the book. First, the click inventories of the hunters are nearly full grids of place times accompaniment. Second, every click series with two or more accompaniments has its parent in the same language: 77 of 77. Third, the lXam narrators gave each animal the human language with one fixed change on the click. Fourth, the road to the alphabet runs from full to thin. It goes from a click that does several things at once to letters set one after another. It goes from 161 sounds in one language to 22 letters.

## How to read this book

The book has six parts and twenty-eight chapters.

| Part | Chapters | Subject                                  |
|------|----------|------------------------------------------|
| —    | 1        | The net and the rule                     |
| I    | 2–4      | The animals                              |
| II   | 5–9      | The hunter and the click                 |
| III  | 10–14    | Speech, tone, language without the mouth |
| IV   | 15–20    | From the mark to the alphabet            |
| V    | 21–26    | The other branches                       |
| VI   | 27–28    | The tree, and what each rung left behind |

Each chapter has the same build. The facts come first, with the numbers and their sources. A section called "The people" names who made and carried the form. A section called "In the net" gives the reading through the theory. A section called "Status" closes the chapter. It lists what was counted, what was read in a source, what rests on a secondary source, and what is open.

Each part ends with its own annotated references. Appendix A holds the counts made on the sound database. Appendix B holds the state of the sources.

Where sources disagree on a date or a count, the book prints the range and names who holds which figure.

# Chapter 1. The Net and the Rule

This chapter gives the theory in the form in which the book uses it. It takes one image, six terms and one rule. Everything in the later "In the net" sections is built from these.

## 1.1 The fishing net

The image is a fishing net that runs on in every direction, without an edge. The net is one rope. Where the rope crosses itself it forms a knot. Between the knots lie the meshes. Knots and meshes are the same rope (Konstapel 2026f).

A knot holds by its shape. It needs no glue. It is there or it is not there. A mesh is an opening with a form and a measure. The rope stands under tension everywhere.

## 1.2 The strand and the trit

The theory starts from one statement. There is one strand. Its only act is to cross itself (Konstapel 2026j).

A crossing has three states. The strand passes over: +1. It passes under: −1. It does not cross: 0. This three-valued unit is the trit. The zero is a lawful state. It stands for rest or passage, not for absence.

One step of +1, 0 or −1 is called a turn in this book.

## 1.3 Closure

The second statement is the rule of persistence. Only what returns onto itself in phase persists. "What does not close, does not last" (Konstapel 2026j).

In the register of trits closure has an exact form. Take three consecutive crossings on a strand. This is a window. The window closes when its three trits sum to zero modulo 3 (Konstapel 2026k).

Table 1.1 The 27 windows

| Window | Count | Form                  |
|--------|-------|-----------------------|
| All    | 27    | $3 \times 3 \times 3$ |
| Closed | 9     | sum is 0 modulo 3     |

|                      |    |                              |
|----------------------|----|------------------------------|
| Closed by sameness   | 3  | (---), (000), (+++)          |
| Closed by difference | 6  | the orderings of $(-, 0, +)$ |
| Open                 | 18 | two equal, one different     |

A closed window carries no tension. An open window carries tension. Closure by sameness is static. Closure by difference has a direction: its first two trits fix the third.

## 1.4 Depth, ring and address

A route is a row of turns. Its depth is the number of turns. Each further turn multiplies the number of distinguishable states by three (Konstapel 2026j).

Ring  $n$  is the set of all routes of  $n$  turns. It has  $3^n$  rooms. The largest value on ring  $n$  is the row of  $n$  pluses. It equals  $(3^n - 1)/2$  and is called the ceiling of the ring (Konstapel 2026m).

**Table 1.2 The rings**

| Rin<br>g | Room<br>s | Ceilin<br>g |
|----------|-----------|-------------|
| 1        | 3         | 1           |
| 2        | 9         | 4           |
| 3        | 27        | 13          |
| 4        | 81        | 40          |
| 5        | 243       | 121         |
| 6        | 729       | 364         |

The route is the address. An address is computed from content. It is never assigned. Every finite thing has exactly one address. This is the unique-address theorem (Konstapel 2026j). A worked case:  $43 = 81 - 27 - 9 - 3 + 1$ , written  $+ - - - +$ . The row of signs is the record of the walk.

The same theorem holds for texts. An alphabet of 27 signs is three trits per sign. A text of  $L$  signs has depth  $3L$  and one address (Konstapel 2026n).

## 1.5 The step and the parent rule

A new turn is added to a route by one step: times three, plus the turn. In symbols  $x \mapsto 3x + s$ , with  $s$  one of  $+1, 0, -1$  (Konstapel 2026g). The existing turns move one place deeper. The new turn takes the last place.

It follows that every address contains the address of its parent. A route of three turns holds its own first two turns.

This book applies the step to forms of language and calls it the parent rule.

**The parent rule.** A form exists only on top of its parent. Each new form is the parent plus one turn. Turn zero is the parent itself.

The rule is tested by counting. Take a form with two marks. Remove one mark. The rule says that the result stands in the same language. Chapter 7 counts this for click sounds and for the sounds of 3,001 languages without clicks.

## **1.6 Selection by fit**

A ring has rooms. Not every room is inhabited. Which rooms are inhabited is read off from what is found. It is never filled in.

The whale uses at least 143 of 540 cells of its grid (Chapter 3). Jul'hoan uses 12 of 32 accompaniment combinations (Chapter 7). The parent rule says one thing about the inhabited rooms: each stands next to an inhabited room one turn nearer the centre.

## **1.7 The two-layer law**

Every closure has two layers. The address layer is frozen. It counts in threes. The tension layer is where anything happens. It counts in twos: load and discharge (Konstapel 2026h).

The click shows both. Its places are few and fixed. Its accompaniments are present or absent (Chapter 5).

## **1.8 The trit cube**

Three axes with one trit each give a cube of 27 cells. A cell closes when its three values sum to zero modulo 3. Nine cells close. Seven lie in one plane through the centre. Two lie at the ends of the diagonal (Konstapel 2026l).

The cube returns in this book wherever three independent choices are made at once.

## **1.9 How the later chapters use this**

Four questions are put to every rung.

1. What is the parent of this form, and what is the one turn added?
2. Is the form a grid of independent choices, and how many of its rooms are inhabited?
3. Which parts are held at once, and which are set one after another?
4. What is frozen and what moves?

The net sections state what is found. They do not give arrows from one thing to another. Two things that hold together are named as holding together.

## **1.10 Status**

- Read in source: the statements on strand, trit, closure, window, ring, ceiling, address, the step and the two-layer law, all from the texts cited.
- Named in this book: "the parent rule". The source gives the step as "times three, plus the turn".
- Open: the parent rule as a rule for forms of language is tested in Chapter 7. The other chapters apply it as a reading.

## **References for Chapter 1**

**Konstapel, J. (2026f). Het Heelal Lijkt op een Visnet. constable.blog, 30 July 2026. <https://constable.blog/2026/07/30/how-to-visualize-the-vacuum/> Why read?** The image of the fishing net: knots, meshes, tension and mending, in plain words. *Reading advice:* Read this first. It gives the picture on which every later term rests.

**Konstapel, J. (2026g). The Step Map. constable.blog, 18 August 2026. <https://constable.blog/2026/08/18/the-step-map/> Why read?** The step "times three, plus the turn", from which the parent rule of this book is taken.

**Konstapel, J. (2026h). Why The Universe Has a Lot of Time. constable.blog, 3 September 2026. <https://constable.blog/2026/09/03/why-the-universe-has-a-lot-of-time/> Why read?** The two-layer law: the frozen address that counts in threes and the tension that counts in twos.

**Konstapel, J. (2026j). The Vacuum.Net Theory: Foundational Paper, edition 7. constable.blog, 13 September 2026. <https://constable.blog/wp-content/uploads/The-Vacuum.Net-Theory-Foundational-Paperv7.pdf> Why read?** The five ground rules and the unique-address theorem with its proof. *Reading advice:* Read the ground rules N1 to N5 and theorem T7 with its three corollaries.

**Konstapel, J. (2026k). Life and Consciousness from One Rule: Closure in the Net. constable.blog, 29 September 2026. <https://constable.blog/2026/09/29/life-and-consciousness-from-one-rule-closure-in-the-net/> Why read?** The closure rule on windows, the count of 27 windows and 9 closures, and the two kinds of closure. *Reading advice:* The first three sections suffice for this book.

**Konstapel, J. (2026l). De Kubus Waarin de volledige Natuurkunde Past. constable.blog, 2 October 2026. <https://constable.blog/2026/10/02/russell-larson-clerk-maxwell-and-the-vacuum-net-theory-on-the-clifford-algebra-of-apace/> Why read?** The trit cube of 27 cells with its nine closing cells listed one by one.

**Konstapel, J. (2026m). The Standard Reference of the Maze: From the First Distinction to E8, with the Occupants of Every Ring. constable.blog, 5 October 2026. <https://constable.blog/2026/10/05/the-maze-bottum-up/> Why read?** The rings, their rooms and ceilings, and which known sign sets sit on which ring.

**Konstapel, J. (2026n). The Comma of Pythagoras, Carried to Infinity. constable.blog, 5 October 2026. <https://constable.blog/wp-content/uploads/The-Comma-of-Pythagoras-Carried-to-Infinity.pdf> Why read?** The statement that every finite text has one address, with a 27-sign alphabet as three trits per sign.

## Part I. The Animals

Language did not begin with people. Before the first human word there were calls, calls with an added ending and calls in a fixed order. There were names, layered songs and a dance that gives a direction and a distance. This Part sets those forms out as rungs. Each rung is the one below it plus one step. Chapter 2 follows the call from the single alarm to the combinations of apes. Chapter 3 treats the forms that are built as grids, as names and as learned songs, with the sperm whale coda at the centre. Chapter 4 treats the honeybee dance and the one well-measured case in which an animal and a human signal to each other.

## Chapter 2. The Call

A call is a sound that stands for a situation. The simplest form is one call for one situation. Above it stand the call with an added ending, the pair of calls whose order counts, and the sequence of several calls. Each of these forms has been found in a wild animal and tested by playing the sounds back to it. This chapter sets them out in order, with the counts.

### 2.1 The body as sign

The lowest rung has no separate signal at all. The animal's body is the sign: where it stands, how it moves, what it does. The honeybee dance of Chapter 4 belongs here in part. The dancer's body takes an angle on the comb, and that angle is the message.

The sources collected for this Part hold no counted field study of this rung on its own. It is named here as the ground on which the call stands. A call is the body's sign with the body left out: the sound travels where the body cannot be seen.

### 2.2 One call for one situation: the vervet monkey

Vervet monkeys give acoustically different alarm calls for different predators. Seyfarth, Cheney and Marler tested three of them in 1980: the leopard alarm, the eagle alarm and the snake alarm. The adult targets are leopards, martial eagles and pythons.

The test was a playback. The recorded call was played with no predator present. The monkeys answered the sound alone. On the leopard alarm they ran into the trees. On the eagle alarm they looked up. On the snake alarm they looked down (Seyfarth, Cheney and Marler 1980).

| Call          | Adult target  | Response to playback |
|---------------|---------------|----------------------|
| Leopard alarm | leopard       | run into trees       |
| Eagle alarm   | martial eagle | look up              |
| Snake alarm   | python        | look down            |

The calls are learned in use. Infants give the leopard alarm to various mammals, the eagle alarm to many birds and the snake alarm to snakelike objects. The classification sharpens with age (Seyfarth, Cheney and Marler 1980). The young monkey has the three calls first and finds their exact places afterwards.

Wikipedia's article on the vervet gives a figure of up to 30 different alarm calls. No primary source for that figure was seen. The three tested calls are the firm count.

### 2.3 One call for one situation: the prairie dog

Gunnison's prairie dogs live in colonies and call when an intruder comes. Kiriazis and Slobodchikoff watched two colonies of about 40 to 50 animals each. The work took 214 hours in the seasons 1989 and 1990.

They found four predator categories with distinct calls and distinct escape responses (Kiriazis and Slobodchikoff 2006).

| <b>Intruder</b> | <b>Response</b>                 |
|-----------------|---------------------------------|
| Human           | run to burrow and dive in       |
| Red-tailed hawk | run to burrow and dive in       |
| Coyote          | run to burrow, stand at the rim |
| Domestic dog    | stand alert in place            |

Playbacks of the human, dog and coyote calls gave the same responses as the live intruders. There was one exception, in the second response to the human call. Control sounds gave no response.

A second study asked whether the call also carries a feature of the intruder. Three women walked through a colony in shirts of three colours: blue, green and yellow. There were 99 walk-throughs. They yielded 82 calls from 48 marked animals (Slobodchikoff, Paseka and Verdolin 2009).

A statistical sorting of the calls by shirt colour placed 45 of the 82 correctly. That is 54.9%. Chance is 33.3%. With cross-validation, a stricter check, the figure was 48.8%. Calls for blue differed from calls for yellow ( $P = 0.021$ ) and from calls for green ( $P = 0.003$ ). Calls for yellow and green did not differ ( $P = 0.487$ ).

The prairie dog call is therefore a call with a shading. The category is firm. The colour shows as a tendency in the sound, for one colour out of three.

## 2.4 A call plus an affix: Campbell's monkey

The adult males of Campbell's monkey have six loud call types: boom, krak, krak-oo, hok, hok-oo and wak-oo (Ouattara, Lemasson and Zuberbühler 2009a). An affix is a fixed piece added to a word. Here the affix is the ending "-oo". It is always the same sound. It is added to three stems: krak, hok and wak.

| <b>Call</b> | <b>Given to</b>                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------|
| boom        | non-predatory events only: falling branch or tree, start or stop of travel, neighbour disputes, group excitement |
| krak        | leopard                                                                                                          |
| krak-oo     | general alert, almost any disturbance                                                                            |
| hok         | almost only the crowned eagle; rarely a flying squirrel                                                          |
| hok-oo      | disturbances in the canopy: eagles, neighbouring groups, occasionally a flying squirrel                          |
| wak-oo      | eagles, other flying animals, eagle alarms of Diana monkeys; never neighbours                                    |

The ending widens the call. Krak is given to leopards only. In natural observations it was heard only with leopards, and in experiments only with leopard models and leopard playbacks. Krak-oo occurred in all four predator conditions of the experiments. Hok points at the eagle. Hok-oo points at anything disturbing in the canopy. The stem names the predator; stem plus ending names the wider class around it.

The boom was never given to predator models.

The third stem behaves differently. The wak stem "was never produced singly, but always followed by the 'oo' suffix" (Ouattara, Lemasson and Zuberbühler 2009a). Wak-oo exists. Wak alone does not.

The three stems and the two states of the ending make a small grid of six cells. Five are in use.

| Stem | Bare      | With -oo |
|------|-----------|----------|
| krak | krak      | krak-oo  |
| hok  | hok       | hok-oo   |
| wak  | not found | wak-oo   |

The study rests on 1,067 analysed calls and about 2,000 hours of observation. Six wild groups were followed. Two were fully used to observers and four partly. Seven males took part in the predator experiments. Real encounters were few: three with leopards and eleven with eagles.

The same males string their six call types into sequences that fit the context (Ouattara, Lemasson and Zuberbühler 2009b). The contexts are cohesion and travel, falling trees, neighbouring groups, non-predatory animals, an unspecific predatory threat and specific predator classes. For the crowned eagle there are four sequences. For the leopard there are three. Which one is given depends on how the caller learned of the predator.

The abstract of that study states three rules. The transitions between calls are not random. Adding a call to a sequence makes a different sequence. Two sequences combine into a third.

## 2.5 Order: the putty-nosed monkey

The putty-nosed monkey works with two calls, the pyow and the hack. Wikipedia's article on the species adds the boom as a third male call. A series of pyows is the leopard alarm and is heard in other contexts as well. A series of hacks is mostly the eagle alarm. A short pyow–hack sequence is neither. It goes with the movement of the troop (Arnold and Zuberbühler 2006).

The sequence is built of one to four pyows followed by one to four hacks (Arnold and Zuberbühler 2008). Three playback experiments tested it. The natural pyow–hack sequence set the group moving. A sequence built artificially from single pyows and hacks did so as well. Only the group's own male had this effect. The same sequence from a strange male did not.

Two points stand out. The meaning of the sequence is not the sum of leopard and eagle. And the sequence counts only from a known caller.

## 2.6 Order: the Japanese tit

The Japanese tit, *Parus minor*, has a repertoire of "over ten different notes" (Suzuki, Wheatcroft and Griesser 2016). Three of them, written A, B and C, form the call ABC. Its listeners scan for danger. The D notes form a second call. Its listeners approach the caller.

The birds join the two as ABC–D. Listeners then do both: they scan and they approach. Suzuki and colleagues reversed the order in a playback. To D–ABC the birds rarely scanned and rarely approached.

| Playback | Response                 |
|----------|--------------------------|
| ABC      | scan for danger          |
| D        | approach the caller      |
| ABC–D    | scan and approach        |
| D–ABC    | rarely scan and approach |

The first experiment used 21 birds, each given four treatments: ABC, D, ABC–D and background noise. The second used 34 birds, 17 per treatment, for ABC–D against D–ABC.

Here the meaning of the pair is the sum of its parts, and it holds in one order only. This differs from the putty-nosed monkey, where the pair has a meaning of its own.

Two later findings are reported by Kyoto University. The two calls are taken as one unit only when both come from one caller. Two callers giving one call each do not make the pair (Suzuki and Matsumoto 2022). And the tit has an alarm call specific to snakes. After hearing it, the birds approach a stick moved like a snake. After other calls they do not (Suzuki 2018). The release gives no counts for either study.

## 2.7 Combinations among apes

**Chimpanzees.** Girard-Buttoz and colleagues recorded 46 wild adult chimpanzees in the Tai National Park. They collected 4,826 recordings. The chimpanzees have 12 single call units. Out of these they made 390 unique sequences (Girard-Buttoz et al. 2022).

| Count                 | Number                     |
|-----------------------|----------------------------|
| Recordings            | 4,826                      |
| Animals               | 46                         |
| Single call units     | 12                         |
| Unique sequences      | 390                        |
| Two-unit utterances   | 817, in 58 unique pairs    |
| Three-unit utterances | 458, in 104 unique triples |
| Longest sequence      | 10 units, found twice      |

Twelve units allow  $12 \times 12 = 144$  ordered pairs. The chimpanzees used 58 of them, which is 40%. Twelve units allow  $12 \times 12 \times 12 = 1,728$  ordered triples. They used 104, which is 6%. These two percentages are computed here from the counts in the paper. The authors describe the sequences as ordered and recombinatorial: the same units return in different places.

**Bonobos.** Berthet, Surbeck and Townsend studied wild bonobos in the Kokolopori Bonobo Reserve in the Democratic Republic of Congo. Their abstract states that every call type takes part in at least one compositional combination. Compositional means that the meaning of the combination follows from the meanings of its parts. Three of the combinations are nontrivial: one call changes the meaning of the other (Berthet, Surbeck and Townsend 2025).

Further counts come from press reports. Scientific American gives seven call types, four compositional combinations of which three are nontrivial, and 700 recordings. Each recording was coded for more than 300 features of its context. The same report gives an example. A peep, glossed as "I would like to...", joins a whistle, glossed as "let's stay together". The pair is used in sensitive social situations.

## 2.8 The rungs in one table

| R<br>un | Form                            | Animal                               | Count                                            | Source                                                |
|---------|---------------------------------|--------------------------------------|--------------------------------------------------|-------------------------------------------------------|
| 0       | body as sign                    | (ground rung; see bee dance, Chapter | —                                                | —                                                     |
| 1       | one call, one situation         | vervet monkey                        | 3 calls tested                                   | Seyfarth et al. 1980                                  |
| 1       | one call, one situation, with a | Gunnison's prairie dog               | 4 categories; colour sorted 54.9% against 33.3%  | Kiriazis and Slobodchikoff 2006; Slobodchikoff et al. |
| 2       | call plus affix                 | Campbell's monkey                    | 3 stems, 1 ending, 6 call types; wak never alone | Ouattara et al. 2009a                                 |
| 3       | two calls, pair has its own     | putty-nosed monkey                   | 2 calls; 1–4 pyows then 1–4 hacks                | Arnold and Zuberbühler 2006, 2008                     |
| 3       | two calls, order holds the sum  | Japanese tit                         | ABC–D against D–ABC; 21 and 34 birds             | Suzuki et al. 2016                                    |
| 4       | sequences of                    | Campbell's                           | 4 eagle sequences, 3                             | Ouattara et al. 2009b                                 |
| 4       | many ordered                    | chimpanzee                           | 12 units, 390 sequences, 1–410                   | Girard-Buttoz et al. 2022                             |
| 4       | composition                     | bonobo                               | 7 call types, 4                                  | Berthet et al. 2025; Scientific American              |

## 2.9 The people

Every count in this chapter comes from people who sat with wild animals for a long time. The Campbell's monkey study took about 2,000 hours with six groups. The prairie dog study took 214 hours over two seasons. The chimpanzee study rests on 4,826 recordings of 46 named individuals.

The method is the same throughout. The observer records a call, removes the situation and plays the call back. If the animal answers the sound as it answers the situation, the call stands for the situation. Seyfarth, Cheney and Marler set this method down with the vervets in 1980. The later studies repeat it.

The playback has a human side that the papers do not hide. Three women in coloured shirts walked 99 times through a prairie dog colony. The animals called at them. The human was one of the four categories in the first prairie dog study, next to hawk, coyote and dog. In these studies people are among the things the animals have calls for.

What is absent from the animal record at this rung is the absent thing. Every call in this chapter is given in the presence of what it stands for: the leopard is there, the tree falls, the troop moves now. The playback removes the leopard, and the monkey still runs. The sound holds without the thing. But no animal in this chapter was found to call about a leopard of yesterday.

## 2.10 In the net

**The call is a closure.** A call that returns the same response each time is a route that closes. The vervet infant gives the eagle alarm to many birds. With age only the fitting uses stay. This is selection by fit: what returns in phase with the group's response stays, and the rest falls away. The three tested calls are three rooms that are inhabited. Ring 1 has three rooms.

**Each rung is its parent plus one turn.** The parent rule says that a form exists only on top of its parent. Each new form is the parent plus one turn. The rungs of this chapter read as follows.

| Rung                  | Parent       | The added turn                                            |
|-----------------------|--------------|-----------------------------------------------------------|
| Call                  | body as sign | the body is left out; the sound stands alone              |
| Call plus affix       | call         | one fixed ending, present or absent                       |
| Ordered pair          | two calls    | the order                                                 |
| Sequence              | pair         | one more call; "adding a call makes a different sequence" |
| Sequence of sequences | sequence     | "two sequences combine into a third"                      |

The rules that Ouattara and colleagues state for Campbell's monkey are the parent rule in the monkey's own material. A sequence with one call added is another sequence. That is  $x \mapsto 3x + s$ : the parent's address with one turn added.

**The affix counts in twos.** The ending -oo is present or absent: + and 0. The stems *krak*, *hok* and *wak* are the address layer: few, fixed, each tied to a class of predator. The ending is the tension layer. *Krak* is the leopard, exact. *Krak-oo* is the open alert, with the address still in it. This is the two-layer law on the smallest scale.

**Not every room is inhabited.** Three stems and two states give six cells. Five are in use. Bare *wak* is not among them. The grid is read off, never filled in.

**The parent stands inside the child.** *Wak-oo* has no bare parent in the repertoire. The stem *wak* is heard only inside the child. This is the form of reading 14 of this book: the parent stands inside the child. Later the one-consonant signs stand inside hieroglyphic writing before any script uses them alone. In the monkey the stem has not yet stepped out.

**Order is a turn.** In the Japanese tit, *ABC–D* closes and *D–ABC* stays open. The same notes are present in both. The route differs, and the route is the address. An address is computed from content in its order. Two orders are two addresses. One of them is inhabited.

**At once and one after another.** The putty-nosed monkey's pair is held as a whole: it means the troop moves, not leopard and then eagle. The tit's pair is laid out: scan, then approach. Both forms exist at the same rung. The first is a knot, turns holding each other. The second is a route walked step by step.

**The room is larger than the house.** The chimpanzee uses 58 of 144 ordered pairs and 104 of 1,728 ordered triples. With each further turn the number of rooms multiplies, and the share that is inhabited falls: 40% at two units, 6% at three. The same thinning returns in the whale grid of Chapter 3 and in the click grids of Part II.

**The known caller.** The pyow–hack sequence counts only from the group's own male. The tit's pair counts only from one bird. A closure belongs to one strand. Two halves from two callers do not close.

## 2.11 Status

- Counted (here, from source numbers): chimpanzee pairs 58 of 144 (40%), triples 104 of 1,728 (6%); Campbell's grid 5 of 6 cells.
- Read in source: Campbell's six calls and the missing bare wak; Japanese tit experiments; prairie dog categories and colour sorting; chimpanzee counts.
- Read in abstract only: vervet playbacks; Campbell's sequences; putty-nosed monkey sequences; bonobo compositionality.
- From secondary source: bonobo counts (Scientific American); the later tit studies (Kyoto University releases); the vervet figure of 30 calls (Wikipedia, no primary seen).
- Open: the full list of Campbell's monkey sequences; trial counts for the putty-nosed monkey; a counted study of the body as sign; whether bare wak is absent or only unrecorded.

## Chapter 3. Grids, Names and Songs

Three further forms stand beside the call. The first is the grid: a signal that is one point in a table of independent features. The second is the name: a signal that stands for one individual and is used to address it. The third is the learned, layered song. The sperm whale, the dolphin, the elephant, the marmoset, the humpback and the songbirds carry these forms. The whale's grid is built of clicks, and the click is the theme of Part II.

### 3.1 The click in animals

A click is a very short, sharp sound with a broad range of pitch. Toothed whales make clicks with the phonic lips, a pair of structures in the nose. They do not use the larynx (Wikipedia, "Animal echolocation"). The sperm whale's click is the loudest animal sound on record. Guinness World Records gives a source level of 236 decibels, citing Møhl and colleagues 2003.

The click serves echolocation. The animal sends a sound and reads the echo. The history of the finding runs over a century and a half. Spallanzani worked on bats in 1794. Jurine showed in 1798 that hearing was involved. Hartridge proposed ultrasound in 1920. Griffin and Galambos gave the name "echolocation" in 1944 (Wikipedia, "Animal echolocation").

Bats mostly use calls from the larynx, not clicks. The numbers show the range of the system.

| Bat call                   | Range                    |
|----------------------------|--------------------------|
| Frequency                  | about 11 kHz to 212 kHz  |
| Duration                   | under 3 ms to over 50 ms |
| Rate while searching       | about 10–20 per second   |
| Rate in the final approach | about 200 per second     |
| Intensity                  | about 60–140 dB          |

All five rows are from Wikipedia, "Animal echolocation", which cites the primary studies.

The sperm whale uses the click twice. Single clicks sound the water. Patterned clicks, called codas, pass between whales. A coda has 3 to 40 broadband clicks (Sharma et al. 2024). In this species the same sound is the sounding of the sea and the exchange between animals.

The whale click and the human click consonant share the type of sound. The whale makes it in the nose, and it is a whole signal. The human makes it in the mouth, and it is a part of a word. No source read for this book links the two by descent.

**3.2 The sperm whale coda: a grid of four features**

Sperm whales live in clans. Clan EC-1 of the Eastern Caribbean has about 400 individuals. Sharma and colleagues analysed 8,719 codas from this clan. The recordings run from 2005 to 2018. Those from 2014 to 2018 were made with tags on the animals. The data come from "at least 60 distinct whales" (Sharma et al. 2024).

Before this study a coda was counted as one of a list of fixed types. The count was 21 types in this Caribbean data and about 150 types worldwide. Sharma and colleagues show that a coda is not one item in a list. It is a point in a grid of four features.

| Feature           | What it is                                                                               | Stat<br>es |
|-------------------|------------------------------------------------------------------------------------------|------------|
| Rhythm            | the pattern of gaps between the clicks                                                   | 18         |
| Tempo             | the overall length of the coda                                                           | 5          |
| Rubato            | a gradual change of length from one coda to the next: increasing, decreasing or constant | 3          |
| Ornamentati<br>on | one extra click at the end, present or absent                                            | 2          |

The four features vary independently. Two of them, rhythm and tempo, do not depend on the context. Two of them, rubato and ornamentation, depend on the conversation in which the coda stands. The ornament is rare. It occurs in 4% of codas.

The size of the grid is  $18 \times 5 \times 3 \times 2 = 540$  cells. The paper does not print this product. It is computed here from the four state counts. Of these cells the whales use "at least 143 combinations frequently realised" (Sharma et al. 2024). That is 143 of 540, or 26%, as a lower bound.

| Count                            | Number            |
|----------------------------------|-------------------|
| Codas analysed                   | 8,719             |
| Whales                           | at least 60       |
| Clan size                        | about 400         |
| Older list of types, this data   | 21                |
| Older list of types, worldwide   | about 150         |
| Cells of the grid                | 540<br>(computed) |
| Combinations frequently realised | at least 143      |

The abstract speaks of "nearly an order of magnitude more distinguishable codas" than was believed. The step from 21 to at least 143 is a factor of 6.8. The old estimate of information was at most 5 bits per coda. The authors report that it roughly doubles.

### **3.3 Coda vowels**

A second line of work looks inside the single click of a coda. Beguš and colleagues examined the spectrum of coda clicks, the spread of sound energy over pitch. They find two categories. They name them by analogy with human vowels. The a-coda has one formant, a band of strong energy. The i-coda has two formants. There is also a long  $\bar{i}$ , since the durations fall into two groups (Beguš et al. 2025).

The data are 3,948 annotated codas, of which 1,144 remained after exclusions. They come from 15 whales of the EC-1 clan, recorded off Dominica from 2014 to 2018. The work is a preprint.

If the two categories stand, the coda grid has a fifth feature, and it sits inside the click instead of between clicks.

### **3.4 Names: the dolphin**

A bottlenose dolphin develops a whistle of its own, the signature whistle. It forms within the first year of life and stays stable for life. Dolphins recognise the whistle of a companion after more than 20 years apart (Wikipedia, "Signature whistle"). The identity lies in the contour of the whistle, the line of its rise and fall. It holds when the features of the individual voice are removed (Janik, Sayigh and Wells 2006, as reported in Wikipedia).

Other dolphins copy the whistle. King and Janik tested what the copy does. They played wild dolphins a copy of their own signature whistle and copies of the whistles of others. The dolphins answered the copy of their own. They did not answer the others (King and Janik 2013). The whistle is therefore used as an address. The abstract gives no counts.

Mothers alter their own whistle when their calf is with them. They raise or widen its pitch. This was found in 19 of 19 cases (Sayigh et al. 2023, as reported in Wikipedia).

### **3.5 Names: the elephant**

African elephants call each other with low rumbles. Pardo and colleagues analysed 625 rumbles: 527 from Samburu and 98 from Amboseli. There were 114 callers and 119 receivers (Pardo et al. 2024, numbers from the preprint).

A statistical model was given the sound of a rumble and asked to name the receiver. It was right for 20.3% of calls. A null model reached 7.6% ( $\pm 0.75$ ;  $P < 0.0001$ ). The rumble carries something specific to the elephant it is meant for.

The dolphin's name is a copy of the bearer's own whistle. The elephant's is not. Calls that diverge from the receiver's own calls were still assigned correctly: 32.4% against a null of 13.1%. For calls that converge on the receiver's own, the figures were 17.2% against 4.9%. The label is not an imitation of the one who bears it.

A playback closed the test. Seventeen wild elephants heard rumbles that had first been addressed to them, and rumbles addressed to others. They approached faster ( $P = 0.009$ ) and replied faster ( $P = 0.005$ ) to their own.

The numbers are from the preprint. The journal version may differ, and an author correction appeared on 17 July 2025.

### 3.6 Names: the marmoset

Marmosets are small monkeys. They call to each other with a high call, the phee call, in the band of 5.5 to 10 kHz. Oren and colleagues recorded 10 marmosets from three family groups. They collected 53,993 phee calls (Oren et al. 2024).

A classifier was asked to tell, from the sound, which marmoset a call was meant for. Per caller, with four possible receivers, the mean score was 0.798 ( $\pm 0.065$ ). The score is an AUC, which runs from 0.5 for chance to 1 for perfect. Pooled over all 10 receivers it was 0.754.

In playback, three monkeys heard calls over 20 sessions. They answered calls directed at themselves more often than calls directed at others ( $P < 10^{-4}$ ).

One finding concerns the group. Members of a family use similar labels for the same receiver. This holds for unrelated adults in the group as well. The label is learned within the family.

| Animal             | Form of the name                             | Key count                                            | Source                         |
|--------------------|----------------------------------------------|------------------------------------------------------|--------------------------------|
| Bottlenose dolphin | own whistle, copied by others                | stable for life; recognised after more than 20 years | King and Janik 2013; Wikipedia |
| African elephant   | label in the rumble, not an imitation        | 20.3% against 7.6% null; 625 imitations              | Pardo et al. 2024              |
| Marmoset           | label in the phee call, shared in the family | AUC 0.798; 53,993 calls                              | Oren et al. 2024               |

### 3.7 Learned layered song: the humpback whale

The song of the humpback whale is nested. Small parts sit inside larger parts, over five levels (Wikipedia, "Whale vocalization", citing Frankel 1998).

| Level      | Built of          | Length                 |
|------------|-------------------|------------------------|
| Unit       | one sound         | up to a few seconds    |
| Sub-phrase | 4 or 6 units      | about 10 seconds       |
| Phrase     | 2 sub-phrases     | —                      |
| Theme      | a phrase repeated | about 2–4 minutes      |
| Song       | a set of themes   | up to about 30 minutes |

The song is then repeated for hours or days. The units range from about 20 Hz to above 24 kHz.

The song is shared. All males of a population sing the current song. And it travels. Garland and colleagues followed songs across the western and central South Pacific for 11 years. Several song types spread eastward, in one direction, from population to population (Garland et al. 2011).

A study of 2025 looked at the inner statistics of the song. Arnon and colleagues took eight years of song from New Caledonia. They cut it where the next sound becomes hard to predict from the last. This is the method by which human infants are thought to find words in a stream of speech. The

pieces that came out follow two regularities known from human language. A few pieces are very frequent and most are rare, which is Zipf's law. And the frequent pieces are the short ones, which is Zipf's law of brevity (Arnon et al. 2025, as reported by the University of Edinburgh and Sci.News).

### 3.8 Learned layered song: the songbirds

Birdsong is learned and layered too: notes, syllables, motifs or song types. The size of the repertoire differs greatly between species.

**The nightingale.** Kipper and colleagues followed nine male nightingales from 2000 to 2003. A male sang between 151 and 231 different song types. Their Table 1 gives 3,910 song types over 21 male-years. The mean is  $3,910 \div 21 =$  about 186. A male's repertoire did not change systematically from year to year (Kipper et al. 2004). Wikipedia gives an average of 190 and a maximum of 250, without a reference.

**The Bengalese finch.** Jin and Kozhevnikov analysed two birds. Bird 1 had 7 song syllables in 1,921 song sequences. Bird 2 had 6 syllables in 845 sequences. The order of the syllables varies from one rendering to the next. The authors could describe it with a statistical model of 14 states for the first bird and 13 for the second (Jin and Kozhevnikov 2011). Six or seven syllables need twice as many states. The same syllable stands in more than one place in the song, and what follows it depends on the place.

**The zebra finch.** The zebra finch sings one stereotyped motif, about one second long. The song is learned in two overlapping periods: one of listening and one of practising against what was heard. It becomes fixed between 90 and 120 days after hatching (Mooney 2009). Song passes from bird to bird by learning, and dialects form (Wikipedia, "Zebra finch").

| Species         | Repertoire                                        | Source                   |
|-----------------|---------------------------------------------------|--------------------------|
| Nightingale     | 151–231 song types per male; mean about 186       | Kipper et al. 2004       |
| Bengalese finch | 6 or 7 syllables; variable order; 13 or 14 states | Jin and Kozhevnikov 2011 |
| Zebra finch     | one motif of about 1 second; fixed at 90–120 days | Mooney 2009              |
| Japanese tit    | over ten notes                                    | Suzuki et al. 2016       |

No word-like meaning is known for the order of syllables in these songs. The tit's ABC–D of Chapter 2 is a call, not a song.

### 3.9 The people

The coda grid rests on recordings from 2005 to 2018 of one clan of about 400 whales off the Eastern Caribbean. The whales are known as individuals. At least 60 of them are in the data, and 15 in the vowel study. The elephant study rests on knowing each animal in Samburu and Amboseli: 114 callers and 119 receivers were told apart. The marmoset study recorded 53,993 calls from 10 animals.

In each case people first had to know the animals one by one. A name can be found only by someone who knows who is being addressed.

The older way of reading the whale was the list: 21 types, each with a label. The grid replaced it. Nothing in the whales changed between the two readings. What changed was the form in which

people wrote the codas down. The same change, from a list of sounds to a table of features, returns in Part II for the human click.

The songs show what is lost and kept in learning. A zebra finch has one motif, fixed by day 120. A nightingale carries about 186 song types and keeps them over the years. A humpback population gives up its song when a new one arrives from the west. All males then sing the new one. The old song is no longer sung.

### 3.10 In the net

**The coda is an address.** A coda is a route of four steps: a rhythm, a tempo, a rubato, an ornament. The route is the address. It is computed from content. The older list assigned a label to each coda. The grid reads the address off the coda itself.

**Two layers in the coda.** Rhythm and tempo hold in every context. They are the address layer: frozen, and the same wherever the coda stands. Rubato and ornamentation move with the conversation. They are the tension layer, where anything happens. The ornament is present or absent: + and 0. That is counting in twos, as the two-layer law says for tension. The rubato has three states: increasing, constant, decreasing. That is one trit: +1, 0, −1. The zero, constant, is a lawful state.

**Not every room is inhabited.** The grid has 540 cells. The whales inhabit at least 143. Which cells are inhabited is read off the recordings, never filled in. The counts 18 and 5 do not sit on a ring number. They are what the whales have.

**The same grid at another depth.** The human click inventory of Part II is a grid as well. A click language takes a place of the tongue and an accompaniment and inhabits the combinations. The two grids correspond in form. Both have a frozen layer of few states and a moving layer counted in twos. Both are built of clicks.

| Grid                    | Address layer           | Tension layer                   | Cells | Inhabited    |
|-------------------------|-------------------------|---------------------------------|-------|--------------|
| Sperm whale coda        | rhythm × tempo (18 × 5) | rubato × ornament (3 × 2)       | 540   | at least 143 |
| !Xóõ clicks             | 5 places                | 17 accompaniment series         | 85    | 83           |
| !Xun clicks             | 4 places                | 13 series                       | 52    | 48           |
| Xhosa clicks            | 3 places                | 7 series                        | 21    | 18           |
| Sandawe clicks          | 3 places                | 5 series                        | 15    | 15           |
| Jul’hoan accompaniments | —                       | 5 turns, each present or absent | 32    | 12           |

The click rows are from the PHOIBLE computations in Appendix A of this book. The Jul’hoan row counts combinations of accompaniments only.

The two kinds of grid differ in how full they are. The human place-by-series grid is nearly full: 83 of 85, 15 of 15. The whale grid is about a quarter full. The Jul’hoan row shows where the human grid thins as well: of 32 combinations of accompaniment, 12 are in use. The fullness lies at the crossing of the two layers. Inside the tension layer selection by fit holds in both species.

**At once and one after another.** The whale lays its clicks out in time. The rhythm is the spacing of clicks one after another. The human click does several things in one sound: two closures, loading,

discharge, with the accompaniment on top. The whale's click is a single discharge, and the grid stands between the clicks. The human click is a mesh in the mouth, and the grid stands inside the click. The coda vowels of section 3.3 are a first sign of a feature inside the whale's click.

**The name is an address.** A signature whistle is one route that belongs to one animal. The dolphin's name is a turn-0 copy: the parent itself, sounded by another. The elephant's name is not a copy of the bearer. It is a route that the callers hold and the bearer answers. In the marmoset family all members hold a similar route for the same receiver. The address is shared in the group, as a mesh is shared by the strands around it.

**The song is depth.** The humpback song has five levels: unit, sub-phrase, phrase, theme, song. Each level is its parent plus one turn. A sub-phrase is units with one more closure around them. A theme is a phrase that returns onto itself. The song as a whole returns onto itself for hours. Only what closes at every level persists as song.

**Short is frequent.** In the humpback song the frequent pieces are the short ones. A short piece is a route of few turns. Routes of few turns stand on the low rings, and the low rings have few rooms. Every longer route passes through them. That the low rooms are visited most is the parent rule read as a count.

**Song types are inhabited rooms.** A nightingale holds about 186 song types and keeps them from year to year. They are closures that return. The Bengalese finch has 6 or 7 syllables and 13 or 14 places for them. One syllable at two places is two addresses, since the address is the route and not the sound.

### 3.11 Status

- Counted (here, from source numbers): whale grid  $18 \times 5 \times 3 \times 2 = 540$ ; inhabited share at least 143 of 540 (26%); nightingale mean  $3,910 \div 21 =$  about 186.
- Counted (Appendix A): click grids !Xóõ 83 of 85, !Xun 48 of 52, Xhosa 18 of 21, Sandawe 15 of 15; Jul'hoan 12 of 32 from an earlier hand count.
- Read in source: coda features and counts; coda vowels (preprint); elephant numbers (preprint); marmoset numbers; nightingale, Bengalese finch and zebra finch numbers.
- Read in abstract only: dolphin playback; spread of humpback song.
- From secondary source: echolocation figures and history, signature whistle details, humpback hierarchy (Wikipedia); 236 dB (Guinness World Records); humpback song statistics (University of Edinburgh, Sci.News).
- Open: the exact number of inhabited coda cells, given only as "at least 143"; whether the elephant numbers hold in the corrected journal version; whether coda vowels stand as a fifth feature; any link by descent between animal clicks and human clicks, for which no source exists.

## Chapter 4. The Map and the Bridge

Two forms close the animal part. The first is the honeybee dance. It is an image: a small figure on the comb that stands for a direction and a distance in the field. The second is the signal between species. A bird and a human hunter each give a sound that the other answers, and both come to the honey. The dance is the first map. The honey hunt is the first bridge between two kinds of speaker.

### 4.1 The honeybee dance: direction

A forager bee that has found food returns to the hive and dances on the vertical comb. The dance has a straight stretch, the waggle run, in which the bee shakes its body from side to side. After the run the bee circles back and repeats it.

The run has a direction on the comb. The comb hangs vertically, so "straight up" is given by gravity. The run makes an angle with straight up. The flight path to the food makes an angle with the direction of the sun. The two angles are equal (Kohl and Rutschmann 2021; Wikipedia, "Karl von Frisch"). A run straight up says: fly towards the sun. A run at a given angle to the right of straight up says: fly at that angle to the right of the sun.

The dance takes place in the dark of the hive. The sun is not seen there. Gravity stands in for it. One direction, up, is put in the place of another direction, the sun.

## 4.2 The honeybee dance: distance

The length of the waggle run in time gives the distance. A longer run stands for a farther source. The common rule is about one second of wagging per kilometre (Wikipedia, "Karl von Frisch").

Kohl and Rutschmann measured the relation again. They trained bees to feeders at nine distances, from 100 metres to 1.7 kilometres in steps of 200 metres. They recorded 90 dances from 56 bees and analysed 56 of them.

| Distance | Waggle phase duration |
|----------|-----------------------|
| 100 m    | $0.41 \pm 0.10$ s     |
| 1.7 km   | $2.20 \pm 0.19$ s     |

The distance grows 17-fold between the two ends. The duration grows 5.4-fold:  $2.20 \div 0.41$ . The average slope between the ends is  $(2.20 - 0.41) \div 1.6$  km = about 1.1 seconds per kilometre. That is about 110 milliseconds per 100 metres. This slope is computed here from the two end values. It is not a fitted value from the paper.

The relation is not a straight line. A curved model fits the data better ( $r = 0.946$ ) than a straight one ( $r = 0.935$ ). A model in two straight pieces has its bend at about 1 kilometre. Beyond the bend each further metre adds less time. Kohl and Rutschmann also remodelled the classic calibration of von Frisch and Jander of 1957. Beyond 1.4 kilometres its slope is about 0.71 seconds per kilometre.

For food close to the hive the bee dances in a circle without a waggle run. This is the round dance. The distance at which it gives way to the waggle dance differs by subspecies and by source.

| Subspecies                      | Round dance                                                   | Source                                                     |
|---------------------------------|---------------------------------------------------------------|------------------------------------------------------------|
| <i>Apis mellifera ligustica</i> | up to about 10 m; transitional at 20–30 m; waggle beyond 40 m | Wikipedia, "Waggle dance", citing Rinderer and Beaman 1995 |
| <i>Apis mellifera</i>           | 50–100 m                                                      | Wikipedia, "Karl von Frisch"                               |

Karl von Frisch set the dance out in his book of 1965, published in English in 1967 as *The Dance Language and Orientation of Bees*. He received the Nobel Prize in 1973 (Wikipedia, "Karl von Frisch").

## 4.3 What kind of sign the dance is

The calls of Chapter 2 stand for something present: the leopard is there. The dance stands for something absent. The food is up to 1.7 kilometres away in the experiment, out of sight and out of smell. The dancer was there some time ago. The followers have never been there.

The dance is also continuous. A vervet has three alarm calls and nothing between them. The dance has as many angles as there are directions, and as many durations as there are distances. It does not name the place. It draws it, at small scale, with the body. This is why the bee stands in this book as the first image, long before the first drawn mark of Part IV.

The dance also returns to the lowest rung of Chapter 2. The bee's own body is the sign.

#### 4.4 The honeyguide and the honey hunters

The greater honeyguide is a wild African bird. It leads people to bees' nests. The people take the honey, and the nest holds wax as well. The first written record of the partnership dates from 1588 (University of Cambridge 2016).

The signalling runs both ways. The bird calls and flies ahead. The people call to the bird, with a sound kept for this one purpose.

**The Yao.** The Yao honey hunters of the Niassa region in Mozambique use a loud trill followed by a grunt. It is written "brrr-hm" (University of Cambridge 2016). Spottiswoode, Begg and Begg tested it against control sounds.

| Outcome                                     | With control sounds                       | With the honey call |
|---------------------------------------------|-------------------------------------------|---------------------|
| Probability of being guided by a honeyguide | about 33%                                 | about 66%           |
| Probability of finding a bees' nest         | 17% (abstract) or 16% (Cambridge release) | 54%                 |

The two sources differ by one point on the lower figure. The abstract of the paper gives 17%. The University of Cambridge release gives 16%. Both give 54% for the honey call. The call doubles the chance of being guided:  $66 \div 33$ . It roughly triples the chance of reaching a nest:  $54 \div 17 = 3.2$ .

**The Hadza.** The Hadza of Tanzania are hunter-gatherers. Their signal to the honeyguide is a melodious whistle (University of Cambridge 2016). With the bird's help their rate of finding bee nests rose by 560%. The birds contribute an estimated 8 to 10% of the Hadza diet (Wood et al. 2014).

The Hadza do not, as a rule, pay the bird. They hide, bury or burn the comb that is left over (Wood et al. 2014). The bird leads all the same.

#### 4.5 The call is local

Two human peoples use two different sounds for the same bird. Spottiswoode and Wood tested whether the birds know the difference. They played both human signals in both places (Spottiswoode and Wood 2023, as reported by the University of Cambridge).

| Place | Local signal | Foreign signal | Result |
|-------|--------------|----------------|--------|
|-------|--------------|----------------|--------|

|                  |             |                 |                                                                |
|------------------|-------------|-----------------|----------------------------------------------------------------|
| Tanzania (Hadza) | whistle     | Yao trill-grunt | over 3 times more likely to cooperate with the local whistle   |
| Mozambique (Yao) | trill-grunt | Hadza whistle   | almost twice as likely to cooperate with the local trill-grunt |

The birds of each region answer the sound of the people of that region. The human half of the exchange is cultural: it is learned and it differs from place to place. The bird's half is fitted to it, region by region.

Neither sound resembles honey, or bees, or the bird. A trill with a grunt and a melodious whistle have nothing in common except their use.

## 4.6 Hunters and animal signals

Outside the honey hunt the sources collected for this book hold one well-read study on hunters who use animal signals. It concerns forest hunters of the Congo Basin, the BaYaka or Mbendjele. It gives descriptions without counts (Knight and Lewis 2017).

These hunters imitate the cry of a fallen young monkey. Adult males come to the cry and so come within range. The hunters also imitate the grunt that wild pigs give when they have found good food. The pigs come within reach of the spear.

Knight and Lewis draw a thesis from this. Mimicry of animal calls is vocal deception of another species. They propose that this came first, and that the same skill was later turned inward, among people, as honest signalling.

No citable primary source was found for San hunters imitating animal calls, or for Hadza hunters doing so apart from the honeyguide whistle.

## 4.7 The people

The Yao hunters of Niassa and the Hadza of Tanzania are the human half of this chapter. For the Hadza the bird is a part of the food supply that can be put in a number: 8 to 10% of the diet. Without the bird, the same search finds far fewer nests.

The calls are learned and local. A Yao hunter learns "brrr-hm". A Hadza hunter learns the whistle. The record goes back to 1588 in writing. The test of 2023 shows what stands or falls with this handing down. The birds answer the local sound. If a community stops honey hunting, its sound is no longer made, and the birds of that region have no one to answer.

The Mbendjele hunter who gives the cry of a young monkey speaks, for a moment, in the monkey's own voice. The source gives no numbers for this practice. It gives the practice itself, as the hunters do it.

In the bee research the human layer is of another kind. Fifty-six marked bees were trained to feeders that people had set out at measured distances. Ninety dances were recorded and their waggle runs timed. Von Frisch's book of 1965 made the bee's map legible to people.

## 4.8 In the net

**The dance is a reading ring.** A reading ring is a ring whose trits are the phases of other rings: representation. The waggle run on the comb is a small route whose angle and length are the angle

and length of a large route in the field. The comb is the reading ring of the flight. This is the form of the image, and the bee has it.

**Two things held at once.** The dance gives direction and distance in one run. The angle and the duration are there together. Neither comes first. This is the at-once form. A written route description lays the same two out one after another: so far, in that direction.

**One direction in the place of another.** On the comb, up stands for the sun. The route is the same; the frame it is read in is another. The same turn at another depth: the angle to the sun outside is the angle to gravity inside.

**The followers close the route.** A dance that sends followers to food brings them back loaded, and they dance in turn. A dance for a source that has run dry brings back no dancers. Only what returns in phase stays on the comb. This is selection by fit, on the scale of an afternoon.

**The parent rule in the dance.** The round dance is the parent: food is near. The waggle dance is the round dance plus one turn, the straight run with its angle and its length. The transitional forms at 20 to 30 metres stand between the two.

**The bridge is one shared turn.** The Yao hunter and the honeyguide do not share a speech. The hunter knows one turn of the bird's: the call and flight that say "follow". The bird knows one turn of the hunter's: "brrr-hm". Each side holds one turn of the other's speech. On that one shared turn the route to the nest closes, for both.

**The same form as the !Xam speech of animals.** Part II treats the speech of animals among the !Xam. There the words stay, and one fixed change on the click marks the speaker: the Tortoise, the Jackal, the Moon. The animal's speech is the parent, !Xam, plus one turn. The honey hunt has the same form from the other side. The hunter's speech stays as it is. One sound is added that belongs to the bird. In both cases the meeting of human and animal is one turn deep. In the !Xam stories the narrator knows one turn of the animal's speech. In Niassa the bird knows one turn of the hunter's.

**The local sound is an inhabited room.** The trill-grunt and the whistle are two routes. Either would serve. In Mozambique one is inhabited, in Tanzania the other. Which room is inhabited is read off, region by region. The birds' preference, over three times in one place and almost twice in the other, is the measure of how firmly each room is held.

**Mimicry is turn 0.** The Mbendjele hunter who gives the pig's grunt adds nothing to it. This is turn 0: the parent itself, sounded by another strand. The honey call is turn 1: a sound that is no animal's own. Between the two lies the first step away from the animal. What leaves the picture at each rung of this book is first the animal, then the body, then the thing, then the image. At the honey call the animal's own sound has left, and the animal is still there.

**The zero is lawful.** The Hadza leave no wax for the bird, and the bird leads the next time. The exchange holds with a zero on one side. In the net the zero is a state, not an absence.

## 4.9 Status

- Counted (here, from source numbers): average slope of the dance  $(2.20 - 0.41) \div 1.6 =$  about 1.1 s per km; 5.4-fold duration over 17-fold distance; honey call ratios  $66 \div 33 = 2$  and  $54 \div 17 = 3.2$ .
- Read in source: waggle durations at 100 m and 1.7 km, the curved fit, the bend near 1 km (Kohl and Rutschmann 2021); Mbendjele mimicry (Knight and Lewis 2017).

- Read in abstract only: Yao honey call results (Spottiswoode et al. 2016); Hadza gain of 560% and diet share of 8–10% (Wood et al. 2014).
- From secondary source: "brrr-hm", the Hadza whistle, the year 1588 and the local-against-foreign test (University of Cambridge releases); round dance ranges and von Frisch's book (Wikipedia).
- Differing sources: nest-finding without the call, 17% (abstract) or 16% (release); round dance up to about 10 m (ligustica) or 50–100 m (carnica).
- Open: counts for hunters' mimicry of animal calls; any primary source on San or Hadza hunters imitating animal calls.

## References for Part I

**Arnold, K., and Zuberbühler, K. (2006). Semantic combinations in primate calls. *Nature* 441: 303. <https://www.nature.com/articles/441303a>** *Why read?* The first report that two monkey calls in sequence mean something other than either call alone. *Reading advice:* One page. The audio captions on the page give the three contexts: pyow series, hack series, pyow–hack.

**Arnold, K., and Zuberbühler, K. (2008). Meaningful call combinations in a non-human primate. *Current Biology* 18(5): R202–R203. Abstract at <https://research-portal.st-andrews.ac.uk/en/publications/meaningful-call-combinations-in-a-non-human-primate/>** *Why read?* Gives the build of the sequence (1–4 pyows, then 1–4 hacks) and the three playback experiments, including the finding that only the group's own male counts. *Reading advice:* Only the abstract was read for this book.

**Arnon, I., Kirby, S., Garland, E. C., et al. (2025). Whale song shows language-like statistical structure. *Science* 387(6734): 649–653. As reported by the University of Edinburgh, <https://www.ed.ac.uk/news/whale-song-has-structure-similar-to-human-language>, and Sci.News.** *Why read?* Shows that humpback song, cut by the method infants use on speech, has frequent short pieces and rare long ones, as human language has. *Reading advice:* Read as a secondary report here; the paper itself was not opened.

**Beguš, G., Dabkowski, M., Sprouse, R. L., Gruber, D. F., and Gero, S. (2025). The phonology of sperm whale coda vowels. *bioRxiv preprint*. <https://www.biorxiv.org/content/10.1101/2025.06.09.658556v1.full>** *Why read?* Proposes two vowel-like categories inside coda clicks, by number of formants, and a long variant. *Reading advice:* A preprint. Read it next to Sharma et al. 2024: one looks between clicks, the other inside them.

**Berthet, M., Surbeck, M., and Townsend, S. W. (2025). Extensive compositionality in the vocal system of bonobos. *Science* 388(6742): 104–108. Abstract at <https://carta.anthropogeny.org/node/331593>. Counts as reported in *Scientific American*, <https://www.scientificamerican.com/article/bonobo-calls-are-more-like-human-language-than-we-thought/>** *Why read?* States that every bonobo call type enters at least one combination whose meaning follows from its parts. *Reading advice:* The abstract gives the three nontrivial combinations. The counts of call types and recordings come from the press report.

**Garland, E. C., Goldizen, A. W., Rekdahl, M. L., et al. (2011). Dynamic horizontal cultural transmission of humpback whale song at the ocean basin scale. *Current Biology* 21(8): 687–691. Abstract at <https://research-portal.st-andrews.ac.uk/en/publications/dynamic-horizontal-cultural-transmission-of-humpback-whale-song-a/>** *Why read?* Eleven years of song moving eastward across the South Pacific from population to population.

**Girard-Buttoz, C., Zaccarella, E., Bortolato, T., Friederici, A. D., Wittig, R. M., and Crockford, C. (2022). Chimpanzees produce diverse vocal sequences with ordered and recombinatorial properties. *Communications Biology* 5: 410. <https://www.nature.com/articles/s42003-022-03350-8>** *Why read?* The largest count of ape call sequences: 12 units, 390 sequences, from 46 wild chimpanzees. *Reading advice:* Read the counts of pairs and triples; they allow the reader to compute how much of the possible space is used.

**Guinness World Records. Loudest animal sound. <https://www.guinnessworldrecords.com/world-records/70669-loudest-animal-sound>** *Why read?* Gives the 236 dB source level of the sperm whale click, citing Møhl and colleagues 2003.

**Jin, D. Z., and Kozhevnikov, A. A. (2011). A compact statistical model of the song syntax in Bengalese finch. *PLoS Computational Biology* 7(3): e1001108. <https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1001108>** *Why read?* Shows that a song of 6 or 7 syllables needs 13 or 14 states to describe: the same syllable stands at more than one place.

**King, S. L., and Janik, V. M. (2013). Bottlenose dolphins can use learned vocal labels to address each other. *PNAS* 110(32): 13216–13221. Abstract at <https://research-portal.st-andrews.ac.uk/en/publications/bottlenose-dolphins-can-use-learned-vocal-labels-to-address-each/>** *Why read?* The playback that shows a dolphin answers a copy of its own whistle and no other.

**Kipper, S., Mundry, R., Hultsch, H., and Todt, D. (2004). Long-term persistence of song performance rules in nightingales (*Luscinia megarhynchos*). *Behaviour* 141: 371–390.** *Why read?* Counted repertoires of nine nightingales over four years: 151 to 231 song types per male. *Reading advice:* Table 1 holds the counts per male and year.

**Kiriazis, J., and Slobodchikoff, C. N. (2006). Perceptual specificity in the alarm calls of Gunnison's prairie dogs. *Behavioural Processes* 73: 29–35.** *Why read?* Four intruder categories, four responses, confirmed by playback.

**Knight, C., and Lewis, J. (2017). Wild voices: mimicry, reversal, metaphor, and the emergence of language. *Current Anthropology* 58(4). <https://discovery.ucl.ac.uk/id/eprint/1561170/1/Knight%20and%20Lewis%202017%20Wild%20Voices%20.pdf>** *Why read?* Describes how Congo Basin hunters imitate monkey and pig calls, and argues that such mimicry stands at the origin of speech. *Reading advice:* The hunting passages draw on Lewis's fieldwork with the Mbendjele. They carry no counts.

**Kohl, P. L., and Rutschmann, B. (2021). Honey bees communicate distance via non-linear waggle duration functions. *PeerJ* 9: e11187. <https://peerj.com/articles/11187>** *Why read?* Fresh measurements of the dance at nine distances, with the finding that the relation of duration to distance bends. *Reading advice:* Figure 4A sets the new data beside the calibration of von Frisch and Jander.

**Konstapel, J. (2026i). The Root of Language and the MAZE Intake. Constable Research. <https://constable.blog/wp-content/uploads/The-Root-of-Language-and-the-MAZE-Intake.pdf>** *Why read?* States the reading of the click as closure, loading and discharge, with places as the address layer and accompaniments as the tension layer. It also treats the honeyguide.

**Mooney, R. (2009). Neural mechanisms for learned birdsong. *Learning & Memory* 16(11): 655–669. <https://learnmem.cshlp.org/content/16/11/655.full.html>** *Why read?* A review of how the zebra finch learns its one motif, with the ages at which the song becomes fixed.

**Oren, G., Shapira, A., Lifshitz, R., Vinepinsky, E., Cohen, R., Fried, T., Hadad, G. P., and Omer, D. (2024). Vocal labeling of others by nonhuman primates. *Science* 385: 996–1003. <https://zoology.ubc.ca/edg/pdfs/Oren2024.pdf> *Why read?* Names in a monkey: 53,993 marmoset calls, with labels shared inside the family.**

**Ouattara, K., Lemasson, A., and Zuberbühler, K. (2009a). Campbell's monkeys use affixation to alter call meaning. *PLoS ONE* 4(11): e7808. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0007808> *Why read?* The six calls, the ending -oo, and the observation that wak never occurs alone. *Reading advice:* Open access. Read the description of each call type with its contexts.**

**Ouattara, K., Lemasson, A., and Zuberbühler, K. (2009b). Campbell's monkeys concatenate vocalizations into context-specific call sequences. *PNAS* 106(51): 22026–22031. Abstract at <https://carta.anthropogeny.org/node/309800> *Why read?* The step from single calls to sequences, with the rule that adding a call makes a different sequence. *Reading advice:* Only the abstract was read for this book; the full list of sequences is not given here.**

**Pardo, M. A., Fristrup, K., Lolchuragi, D. S., Poole, J. H., Granli, P., Moss, C., Douglas-Hamilton, I., and Wittemyer, G. (2024). African elephants address one another with individually specific name-like calls. *Nature Ecology & Evolution* 8(7): 1353–1364. Preprint at <https://www.biorxiv.org/content/10.1101/2023.08.25.554872v1.full> *Why read?* Names that are not imitations of the bearer: 625 rumbles, with a playback to 17 wild elephants. *Reading advice:* The numbers in this book are from the preprint. An author correction to the journal version appeared on 17 July 2025.**

**Seyfarth, R. M., Cheney, D. L., and Marler, P. (1980). Monkey responses to three different alarm calls: evidence of predator classification and semantic communication. *Science* 210(4471): 801–803. Abstract at <https://carta.anthropogeny.org/node/309603> *Why read?* The founding playback study: three calls, three responses, and infants who learn the classes.**

**Sharma, P., Gero, S., Payne, R., Gruber, D. F., Rus, D., Torralba, A., and Andreas, J. (2024). Contextual and combinatorial structure in sperm whale vocalisations. *Nature Communications* 15: 3617. <https://www.nature.com/articles/s41467-024-47221-8> *Why read?* Turns the list of coda types into a grid of four features and counts what the whales use. *Reading advice:* Open access. Note that the paper gives the four state counts and "at least 143" combinations; the product 540 is not printed there.**

**Slobodchikoff, C. N., Paseka, A., and Verdolin, J. L. (2009). Prairie dog alarm calls encode labels about predator colors. *Animal Cognition* 12: 435–439. *Why read?* The shirt-colour experiment, with the exact sorting rates and the pair of colours that did not differ.**

**Spottiswoode, C. N., Begg, K. S., and Begg, C. M. (2016). Reciprocal signaling in honeyguide–human mutualism. *Science* 353(6297): 387–389. Abstract at <https://carta.anthropogeny.org/node/314881> *Why read?* The test of the Yao honey call against control sounds. *Reading advice:* The abstract gives 17% for nest-finding without the call; the Cambridge release gives 16%.**

**Spottiswoode, C. N., and Wood, B. M. (2023). Culturally determined interspecies communication between humans and honeyguides. *Science*. As reported by the University of Cambridge, <https://www.cam.ac.uk/stories/human-honeyguide-communication> *Why read?* Shows that honeyguides answer the local human signal better than the foreign one, in Tanzania and in Mozambique.**

**Suzuki, T. N. (2018). Alarm calls evoke a visual search image of a predator in birds. PNAS. As reported by Kyoto University, <https://www.kyoto-u.ac.jp/en/research-news/2018-01-30> Why read?** A call that makes the listener look for a snake.

**Suzuki, T. N., and Matsumoto, Y. K. (2022). Experimental evidence for core-Merge in the vocal communication system of a wild passerine. Nature Communications 13: 5605. As reported by Kyoto University, <https://www.kyoto-u.ac.jp/en/research-news/2023-03-07> Why read?** Two calls make one unit only when they come from one bird.

**Suzuki, T. N., Wheatcroft, D., and Griesser, M. (2016). Experimental evidence for compositional syntax in bird calls. Nature Communications 7: 10986. <https://www.nature.com/articles/ncomms10986> Why read?** The cleanest experiment on order: ABC–D works, D–ABC does not. *Reading advice:* Open access. Read the two experiments in sequence; the second is the reversal.

**University of Cambridge (2016). How humans and wild birds collaborate to get precious resources of honey and wax. <https://www.cam.ac.uk/research/news/how-humans-and-wild-birds-collaborate-to-get-precious-resources-of-honey-and-wax> Why read?** Gives the sounds themselves, "brrr-hm" and the Hadza whistle, and the date of the first written record, 1588.

**Wikipedia. "Animal echolocation"; "Karl von Frisch"; "Putty-nosed monkey"; "Signature whistle"; "Vervet monkey"; "Waggle dance"; "Whale vocalization"; "Zebra finch". <https://en.wikipedia.org/> Why read?** Secondary source for the echolocation figures, the direction rule and round dance of the bee, the dolphin whistle details and the levels of humpback song. *Reading advice:* Each article names the primary studies. Those studies were not opened for this book.

**Wood, B. M., Pontzer, H., Raichlen, D. A., and Marlowe, F. W. (2014). Mutualism and manipulation in Hadza–honeyguide interactions. Evolution and Human Behavior 35(6): 540–546. Abstract at <https://carta.anthropogeny.org/node/308810> Why read?** Puts the bird's share in a number: nest-finding up 560%, and 8 to 10% of the Hadza diet.

## Part II. The Hunter and the Click

This Part describes the second rung: speech built on clicks. A click is a consonant made wholly inside the mouth, between two closures of the tongue or lips. About thirty languages of southern and eastern Africa use clicks as ordinary speech sounds. Their sound inventories are the largest on record. Chapter 5 describes the sound itself. Chapter 6 gives the inventories and the counts. Chapter 7 states the parent rule and tests it on the PHOIBLE database. Chapter 8 reports what the lXam narrators said about the speech of animals. Chapter 9 gives the families, the dates, and the positions on the age of clicks.

### Chapter 5. The Click

A click is a speech sound made with two closures in the mouth. Air is enclosed between them, the enclosed space is widened, and the front closure opens. The sound needs no air from the lungs. Five places of the front closure are in use, and each click can carry further sounds at its release.

#### 5.1 Two closures and an enclosed space

A click is an obstruent, a consonant that blocks the air. It has two closures in the mouth (Wikipedia, "Click consonant"). The front closure is made by the lips or by the front of the tongue. The back closure is made by the back of the tongue against the soft palate. Bradfield names this second contact the posterior closure (Bradfield, pre-print, p. 2).

Air is trapped between the two closures. The tongue then lowers inside the closed space. The trapped air is thinned. Bradfield writes of "creating a 'vacuum' within the oral cavity" (Bradfield, p. 2). The front closure opens. Air rushes in, and the click sounds.

The steps follow in a fixed order.

| Step | What the mouth does                                 |
|------|-----------------------------------------------------|
| 1    | Front closure: lips or front of the tongue          |
| 2    | Back closure: back of the tongue on the soft palate |
| 3    | The tongue lowers; the enclosed air is thinned      |
| 4    | The front closure opens; air rushes in              |
| 5    | The back closure opens; the accompaniment sounds    |

## 5.2 A sound without the breath

Phoneticians sort speech sounds by the airstream that carries them. Nearly all speech sounds ride on air pushed out from the lungs. A click does not. Its airstream is made by the tongue alone and runs inward. The technical name is a lingual ingressive airstream: made by the tongue, moving in.

Older work calls this airstream velaric, after the velum, the soft palate. Bradfield notes the older usage and adopts "lingual" (Bradfield, p. 2). Miller and five co-authors argue for the same change of name in their study of Nluu (Miller et al. 2009). Their abstract states the central fact in one phrase: "Plain clicks use only the lingual airstream".

A plain click is therefore complete inside the mouth. It needs no air from the lungs. The breath enters only with the accompaniment, at the back release. Miller et al. (2009) describe clicks that add lung air as airstream contours: one sound that begins on the tongue's airstream and ends on the lungs'.

## 5.3 The five places

The front closure can stand at five places. Each has its own letter in the International Phonetic Alphabet (Wikipedia, "Click consonant").

| Letter | Modern name | Name in Lloyd 1911 |
|--------|-------------|--------------------|
| ɔ      | bilabial    | labial             |
| l      | dental      | dental             |
| ll     | lateral     | lateral            |
| !      | alveolar    | cerebral           |
| ‡      | palatal     | palatal            |

The names say where the front closure stands: at the two lips, at the teeth, at the side of the tongue, at the ridge behind the teeth, at the palate.

Lucy Lloyd printed these five symbols in 1911, in the preface to *Specimens of Bushman Folklore*. She wrote that the labial click sounds like a kiss (Lloyd 1911). Her "cerebral click" is today's alveolar click !.

A sixth place, the retroflex click, is attested only in Central !Kung (Wikipedia, "Click consonant"). It is left out of the counts below.

Bradfield gives two facts on the spread of the places. "The typical Khoisan language has clicks at four places of articulation" (Bradfield, p. 3). And the alveolar click ! "is the loudest click" (Bradfield, p. 5). The lip click is the rare one. In the PHOIBLE database it stands in two inventories only: !Xóõ and Shekgalagari (Chapter 6).

## 5.4 Four tongue clicks as two distinctions

The four clicks made with the tongue can be laid out on two two-way distinctions. The first is the release: sharp or noisy. The second is the sound: high or low. Two times two gives four places.

|                  | <b>High<br/>sound</b> | <b>Low<br/>sound</b> |
|------------------|-----------------------|----------------------|
| Noisy<br>release | dental                | lateral              |
| Sharp<br>release | palatal ‡             | alveolar !           |

The lip click ǃ stands outside this square. It is not made with the tongue at the front. Five places are four plus one.

Bleek used the same proportion in 1875 without a table. He described the Jackal's click by saying it stands to the ordinary lip click as the palatal click stands to the cerebral click (Bleek 1875; Chapter 8). The pair ‡ and ! is the sharp row of the square.

## 5.5 The accompaniments

The back closure also opens. What sounds at that moment is the accompaniment. Older work calls it the efflux. Bradfield defines it as the sounds made at the rear release (Bradfield, p. 3). The main types are these (Bradfield, p. 3; Wikipedia, "Click consonant").

| <b>Accompaniment</b> | <b>What is added</b>              |
|----------------------|-----------------------------------|
| Voiced               | the vocal folds vibrate           |
| Nasal                | air passes through the nose       |
| Aspirated            | a puff of breath follows          |
| Glottalised          | the glottis closes                |
| Ejective             | a second, ejected release follows |

Accompaniments combine. A click can be voiced and aspirated, or nasal and glottalised. In the !Xóõ file of PHOIBLE one series is written with a voiced start, a click, and an ejected fricative release (Appendix A2). A series is one accompaniment pattern applied across the places.

Two analyses of the complex clicks stand side by side. One counts each as a single sound. Miller (2011) treats complex clicks as single consonants with a contour (as reported in Wikipedia, "Pulmonic-contour click"). The other counts them as clusters: a click followed by a second consonant. The choice changes the counts by a factor of two to five (Chapter 6). Miller et al. (2009) state that their approach "does away with the phonetically empty category click accompaniment". The term is kept here as a neutral name for whatever sounds at the back release.

## 5.6 The people

Clicks are ordinary consonants for the people who speak these languages. Pennisi reports that about 120,000 people use clicks, a figure that by its context leaves out the Bantu languages (Pennisi 2004). Knight and co-authors count about thirty click languages in southern Africa, spoken by Khwe and San (Knight et al. 2003).

The number is far larger when the Bantu languages with clicks are included. Xhosa has about 8 million first-language speakers. Zulu has about 12 to 13.6 million (Wikipedia, "Xhosa language"; "Zulu language"). These languages took their clicks from their neighbours (Chapter 9).

People outside Africa also make clicks, though not as speech sounds. English speakers say *tut tut*. Hebrew speakers use a dental click for "no" (Gil, WALS 142). Sands put it in one sentence: "Clicks are part of the normal language mechanism that people have." (quoted in Pennisi 2004).

The written symbols have their own people. Wilhelm Bleek and Lucy Lloyd took down !Xam from its speakers in the 1870s. Lloyd's 1911 preface fixed the five symbols for English readers. The !Xam speakers who dictated to them needed no symbols.

## 5.7 In the net

The click is a mesh in the mouth. The tongue closes at two places. Between them lies an enclosed space. It is widened, tension stands on it, and the front closure opens. Closure, loading and discharge stand in one sound (Konstapel 2026i).

A mesh is an opening between strands with a form and a measure. The click has both. Its form is the place of the front closure. Its measure is the size of the space that the tongue encloses. The tongue is the strand, and it crosses itself twice: once at the front, once at the back.

The click has two layers, as every closure has (Konstapel 2026h). The places are the address layer: frozen and few. The accompaniments are the tension layer. An accompaniment is present or absent: + or 0. The tension layer counts in twos, load and discharge. The click shows the two-layer law inside a single sound.

The four tongue clicks fill ring 2's ceiling. Ring 2 holds routes of two trits, and its ceiling is 4. Two distinctions, each taken once, give the four rooms: noisy-high, noisy-low, sharp-high, sharp-low. The lip click stands outside the tongue. Five is four plus one.

The plain click is closed in the mouth. It holds without the breath, as a knot holds without glue. The breath joins at the back release, where the tension layer begins.

Konstapel (2026i) sets the five places beside the seven primitives of his intake design and notes that five beside seven is not an equality. The count of five is left as it is: four on ring 2 and one apart.

## 5.8 Status

- **Read in source:** two closures, the enclosed space, the term posterior closure, "lingual" for the airstream (Bradfield); plain clicks use only the lingual airstream (Miller et al. 2009, abstract); the five symbols (Lloyd 1911).
- **From secondary source:** the list of five places with IPA letters and the retroflex click of Central !Kung (Wikipedia); Miller 2011 on contour clicks (Wikipedia).
- **Net reading:** the click as mesh; places as address layer, accompaniments as tension layer; the four tongue clicks as  $2 \times 2$ .
- **Open:** the square of sharp or noisy by high or low is a reading of four places. No measurement of release and pitch is given in the sources used here.
- **Open:** whether the lip click is a fifth place of the same kind or a sound of another kind. The !Xam Moon treats it as apart (Chapter 8).

## Chapter 6. The Grid

A click language does not hold a loose list of clicks. It holds a grid: places along one side, accompaniment series along the other. Nearly every cell of the grid is in use. This chapter gives the inventories as the sources report them, and then the counts made for this book on the PHOIBLE database.

### 6.1 Why the counts differ

The number of clicks in a language depends on the analysis. A click with a complex release can be counted as one sound or as a cluster of two. Taa is the clearest case. The same language is given 20, 43, 83 or 111 clicks. No count is wrong. Each follows from a stated choice.

In the tables below, "places" are the click types and "series" are the accompaniment patterns. Where sources differ, both figures are printed with the name of the source.

### 6.2 The inventories, language by language

**Table 6.1. Languages with clicks**

| Language          | Family     | Places | Series   | Clicks          | Total sounds                                                 |
|-------------------|------------|--------|----------|-----------------|--------------------------------------------------------------|
| Taa / !Xóǝ, East  | Tuu        | 5      | 17 or 19 | 83; or 20 basic | at least 58 consonants; or "130 consonant sounds"; 31 vowels |
| Taa / !Xoon, West | Tuu        | 5      | 9 or 23  | 43 or 111       | 88 or 164 consonants; 20 vowels                              |
| ǀ'Amkoe           | Kx'a       | 5      | 14–19    | 68–77           | not stated                                                   |
| Nlɯ (Nllng)       | Tuu        | 5      | about 12 | about 52        | 73 consonants; 17 vowels                                     |
| Jul'hoan          | Kx'a       | 4      | 12       | 48              | not stated; some 30 vowels                                   |
| !Xam              | Tuu        | 5      | 8        | up to 40        | not stated; 5 vowel qualities                                |
| Khoekhoe (Nama)   | Khoe-Kwadi | 4      | 5        | 20              | 31 consonants; 5 oral, 3 nasal vowels                        |

|         |                 |   |            |          |                                |
|---------|-----------------|---|------------|----------|--------------------------------|
| Sandawe | isolate         | 3 | 5          | 15       | about 44 consonants; 15 vowels |
| Hadza   | isolate         | 3 | 4          | 12 or 9  | not stated; 5 vowels           |
| Xhosa   | Bantu           | 3 | 5 or 6     | 15 or 18 | not stated                     |
| Zulu    | Bantu           | 3 | 5          | 15       | not stated                     |
| Yeyi    | Bantu           | 4 | 3 or more  | disputed | not stated                     |
| Fwe     | Bantu           | 1 | 2          | 4        | not stated                     |
| Dahalo  | Cushitic        | 1 | 4          | 4        | 62 or 50 consonants            |
| Damin   | ritual register | 3 | nasal only | about 6  | about 200 roots                |

All rows come from the Wikipedia article on each language, which names its primary source, unless a note below says otherwise.

**Taa.** For East !Xóõ the figures rest on Traill (1985, 1994). Wikipedia gives 19 series. Bradfield, reporting Traill, gives 17 series and 83 attested clicks. On a cluster analysis the same speech has 20 basic clicks and at least 58 consonants. For West !Xoon the figures rest on the DoBeS project and Naumann. The cluster analysis gives 9 series, 43 clicks and 88 consonants. The unit analysis gives 23 series, 111 clicks and 164 consonants. Ladefoged and Maddieson (1996) give a range of "45 to 115" clicks for Taa (Wikipedia, "Click consonant"). Their handbook lists the !Xóõ clicks as 85 segments, 17 times 5 (Bradfield, p. 5).

‡**Amkoe.** The count runs from 68 to 77 clicks by speaker, with 14 to 19 series (Gerlach 2015, as reported in Wikipedia).

**Nluu.** Miller et al. (2009) give 73 consonants in their abstract. The click count of about 52 and the 17 vowels are tallies of the Wikipedia table.

**Jul'hoan.** Four places times twelve series gives 48 clicks. The sources named are Dickens (2005), Miller-Ockhuizen (2003) and Snyman. The lip click is absent.

**!Xam.** Five places and eight series give up to 40 clicks by multiplication. The table is labelled "preliminary" and "reconstructed". It rests on Vossen (2013). The language is no longer spoken (Chapter 8).

**Khoekhoe.** Four places, each with five accompaniments, give 20 clicks. Beside them stand 11 consonants that are not clicks. Clicks are 20 of 31 consonants.

**Hadza.** The Wikipedia table gives 3 places, 4 series and 12 clicks. Güldemann (2007) gives nine click segments. The two counts conflict. The lip click occurs in one mimetic word.

**Sandawe.** Three places times five series give 15 clicks. The totals for consonants and vowels are tallies.

**Xhosa and Zulu.** Both have three places and five series: 15 clicks. Xhosa adds a prenasalised series in some counts, which gives 18.

**Yeyi and Fwe.** Yeyi has four places and the largest click inventory among the Bantu languages. Its series are counted as three (Seidel 2008) or more. Fwe has one click place that varies, two series, and four clicks (Gunnink 2018).

**Dahalo.** One place, dental varying with lateral. Four clicks, all nasalised. They occur in about 40 words. The consonant total is 62 (Maddieson et al. 1993) or 50 (Tosco 1991).

**Damin.** A ritual register of the Lardil, not a mother tongue. It has nasal clicks at lip, alveolar and postalveolar places. It also has an outward lip "spurt", a velar ejective, and an indrawn lateral fricative (Hale and Nash 1997, as reported in Wikipedia). Chapter 9 returns to it.

### 6.3 The count on PHOIBLE

PHOIBLE is a public database of sound inventories. Version 2.0 holds 3,020 inventories with 105,484 segments in all. A segment is one distinct speech sound of a language. The counts in this chapter and the next were computed for this book on PHOIBLE 2.0 (Appendix A). The file was downloaded on 8 October 2026.

Clicks occur in 21 of the 3,020 inventories. The 21 inventories cover 19 languages, since Sandawe, Nama and Zulu appear more than once. The source code "ph" marks PHOIBLE's own inventories. "upsid" and "spa" mark two older collections.

**Table 6.2. The 21 inventories with clicks (computed on PHOIBLE 2.0)**

| Inventory    | Source | Segments | Clicks | Clicks per place              |
|--------------|--------|----------|--------|-------------------------------|
| !Xóõ         | ph     | 161      | 83     | ! 17,    17, † 16, ! 17, Ø 16 |
| !XU          | upsid  | 141      | 48     | ! 12, † 24, ! 12              |
| !Xun         | ph     | 120      | 48     | ! 13,    10, ! 13, !! 12      |
| Nama         | upsid  | 41       | 20     | ! 5,    5, ! 10               |
| Xhosa        | ph     | 84       | 18     | ! 6,    6, ! 6                |
| Sandawe      | upsid  | 54       | 15     | ! 5,    5, ! 5                |
| Sandawe      | ph     | 64       | 15     | ! 5,    5, ! 5                |
| Hadza        | upsid  | 62       | 12     | ! 4,    4, ! 4                |
| Ndebele      | ph     | 68       | 12     | ! 4,    4, ! 4                |
| Yeyi         | ph     | 90       | 10     | ! 6, ! 4                      |
| Copi         | ph     | 68       | 5      | ! 5                           |
| Nama         | spa    | 33       | 4      | one per place                 |
| San          | ph     | 29       | 4      | one per place                 |
| Zulu         | spa    | 43       | 3      | ! 1,    1, ! 1                |
| Zulu         | upsid  | 37       | 3      | 1, ! 2                        |
| Fwe          | ph     | 60       | 3      | ! 3                           |
| Dahalo       | upsid  | 59       | 2      | ! 2                           |
| Shekgalagari | ph     | 53       | 2      | ! 1, Ø 1                      |
| Masalit      | ph     | 45       | 2      | ! 1, ! 1                      |
| Sesotho      | ph     | 46       | 1      | ! 1                           |

|       |    |    |       |
|-------|----|----|-------|
| Ronga | ph | 69 | 1 ‡ 1 |
|-------|----|----|-------|

The 21 inventories hold 311 click segments together. The UPSID rows use an older notation. Their place counts are affected by the encoding, as in the 24 under ‡ for !XU. Jul’hoan is not in PHOIBLE under that name.

Some rows differ from Table 6.1. PHOIBLE gives Fwe three clicks where Gunnink gives four. It gives Zulu three, since the two older collections list the bare places only. The tables are printed side by side and not reconciled.

## 6.4 The grid is nearly full

The four largest inventories from PHOIBLE's own collection can be laid out as grids. Each cell is one place combined with one series.

**Table 6.3. Places × series (computed on PHOIBLE 2.0)**

| Language | Places | Series | Cells possible | Cells filled | Share |
|----------|--------|--------|----------------|--------------|-------|
| !Xóõ     | 5      | 17     | 85             | 83           | 98%   |
| !Xun     | 4      | 13     | 52             | 48           | 92%   |
| Xhosa    | 3      | 7      | 21             | 18           | 86%   |
| Sandawe  | 3      | 5      | 15             | 15           | 100%  |

!Xóõ leaves two cells empty of 85. Table 6.2 shows where: the palatal click and the lip click each have 16 series where the other three places have 17. Sandawe leaves none empty.

The 17 !Xóõ series, as written in the file, are these. The underscore stands for the click.

k\_, k\_h, k\_kx', k\_x, k\_?, k\_h, q\_, q\_', η\_, η\_, g\_, g\_kx', g\_kh, g\_x, G\_, G\_qh, ?η\_

A speaker of !Xóõ does not learn 83 separate sounds. The speaker learns five places and seventeen ways of releasing them. Five plus seventeen is 22. The product is 85, and 83 are in use.

## 6.5 The world's inventories for comparison

**Table 6.4. Inventory sizes, all 3,020 inventories (computed on PHOIBLE 2.0)**

| Measure            | Value      |
|--------------------|------------|
| Median segments    | 33         |
| Mean segments      | 34.9       |
| Smallest inventory | 11         |
| Largest inventory  | 161 (!Xóõ) |
| Median consonants  | 22         |

| Size band<br>(segments) | Inventories | Share |
|-------------------------|-------------|-------|
| 1–13                    | 5           | 0.2%  |
| 14–27                   | 1,034       | 34.2% |
| 28–40                   | 1,150       | 38.1% |
| 41–81                   | 810         | 26.8% |
| 82–121                  | 17          | 0.6%  |
| 122–243                 | 4           | 0.1%  |

Only 21 inventories of 3,020 exceed 81 segments. Three of the largest hold clicks: !Xóõ with 161, !XU with 141, !Xun with 120. !Xóõ holds nearly five times the median. More than half of its segments are clicks: 83 of 161.

A click inventory is not always large. The "San" inventory in the file holds 29 segments with four clicks. Sesotho and Ronga hold one click each.

## 6.6 The feature register

PHOIBLE describes every segment by 38 features. A feature is one yes-or-no property of a sound, such as "nasal" or "voiced". Each feature takes one of three values: +, – or 0. Plus means the property is present. Minus means it is absent. Zero means the feature does not apply to this sound.

Over all values in the file the shares are: minus 59.4%, zero 23.5%, plus 17.1%. In addition 10,235 cells hold a double value such as "–,+". A double value says that the sound changes during its own course: first one state, then the other.

**Table 6.5. The register by class of sound (computed on PHOIBLE 2.0)**

| Class                  | Segments | Mean + | Mean – | Mean 0 | With a double value | Sum $\equiv 0 \pmod{3}$ |
|------------------------|----------|--------|--------|--------|---------------------|-------------------------|
| Vowel                  | 31,052   | 8.99   | 19.39  | 9.42   | 6.2%                | 25.3%                   |
| Consonant, not a click | 71,971   | 5.53   | 24.46  | 7.84   | 9.4%                | 36.8%                   |
| Click                  | 311      | 7.25   | 25.37  | 4.21   | 24.1%               | 40.7%                   |

Three things stand in this table.

First, the click has the fewest zeros. Of 38 features, 4.2 do not apply to a click on average. For another consonant the figure is 7.8. For a vowel it is 9.4. The click is the sound about which the register has most to say.

Second, the click most often carries a double value. About one click in four does so (24.1%), against one in eleven other consonants (9.4%). The click is a sound with a course: a front release, then a back release.

Third, the last column. The values of a row are added as trits, with + as 1 and – as –1. The column gives the share of rows whose sum is a multiple of three. An even spread would give one third. The

click figure of 40.7% was computed on 236 rows, the click rows without a double value. The column is reported as counted. No reading is hung on it.

## 6.7 How many features a language needs

Not all 38 features are needed to tell the sounds of one language apart. A count was made of the features needed per inventory. The method picks features one by one, each time the one that separates most. This gives a workable number, not a proven minimum.

**Table 6.6. Features needed (computed on PHOIBLE 2.0)**

| Inventory    | Segments<br>N | Features<br>needed | $\log_3$<br>N | Ratio |
|--------------|---------------|--------------------|---------------|-------|
| World median | 33            | 10                 | 3.2           | 3.05  |
| Sandawe      | 60            | 12                 | 3.73          | 3.22  |
| Xhosa        | 83            | 12                 | 4.02          | 2.98  |
| !Xun         | 114           | 14                 | 4.31          | 3.25  |
| !Xóõ         | 157           | 15                 | 4.60          | 3.26  |

The column  $\log_3 N$  is the number of three-valued marks that would suffice if every combination were used. For 33 sounds that is 3.2 marks. The inventories use about three times as many: the ratio lies between 2.98 and 3.26 in every row.

The ratio is the same for click languages and for the world median. !Xóõ does not spend its features more loosely or more tightly than other languages. It uses more of them: 15 against 10.

## 6.8 The people

Behind each row of Table 6.1 stands a community of speakers. The numbers are small for most of them.

**Table 6.7. Speakers**

| Language     | Speakers                          | Year | Note                           |
|--------------|-----------------------------------|------|--------------------------------|
| Zulu         | about 12–13.6 million             | —    | first language                 |
| Xhosa        | about 8 million                   | —    | first language                 |
| Khoekho<br>e | 200,000 ± 10,000; also<br>167,000 | 2011 | figures conflict in the source |
| Sandawe      | about 60,000                      | 2013 |                                |
| Yeyi         | about 50,000–55,000               | —    | some speakers losing clicks    |
| Fwe          | 15,000                            | —    | Zambian Fwe loses clicks       |
| Jul'hoan     | about 4,000                       | 2003 | Ju cluster about 16,000        |
| Taa          | about 2,500                       | 2011 |                                |
| Hadza        | about 1,000                       | 2012 |                                |

|         |       |      |                                 |
|---------|-------|------|---------------------------------|
| Dahalo  | 580   | 2019 | children no longer learn it     |
| ǀ'Amkoe | 20–50 | 2015 | moribund                        |
| Nluu    | 1     | 2025 | last first-language speaker     |
| ǀXam    | 0     | —    | last speakers died in the 1910s |

All figures are from the Wikipedia article on each language, except Nluu (AFP 2025).

The largest inventory ever recorded, that of Taa, is carried by about 2,500 people. The 83 clicks of !Xóǀ were set down by Traill from speakers of the eastern dialect. The DoBeS project recorded the western dialect. The 73 consonants of Nluu were recorded from a handful of elders (Miller et al. 2009; Chapter 8).

PHOIBLE itself is the work of many hands. Its 3,020 inventories were each drawn by a linguist from speakers. The counts in this chapter rest on that work.

## 6.9 In the net

The click inventory is a grid, nearly full. A language takes a place and an accompaniment and inhabits nearly every combination: !Xóǀ 83 of 85, Sandawe 15 of 15. The places are the address layer and the series are the tension layer. The grid is the two layers set at right angles.

The click is the most fully specified sound. In the register of 38 features a click row has 4.2 zeros on average, another consonant 7.8, a vowel 9.4. The zero in the register is a lawful state: the feature rests. In the click fewer features rest. A click carries two values in sequence in 24% of cases, against 9% for other consonants. Two turns stand in one sound.

Click languages read deeper, not differently. They use the same economy as other languages: features needed are about  $3 \times \log_3 N$  everywhere. They use more of the register: 15 features against a world median of 10. The same step is taken more often.

Depth is the number of trits in a route, and each further turn multiplies the rooms by three. An inventory of 33 sounds does not fit ring 3 with its 27 rooms. It needs ring 4 with 81. The 161 segments of !Xóǀ do not fit ring 4. They need ring 5 with 243 rooms. Of the 3,020 inventories, 2,994 lie between 14 and 81 segments: ring 3 and ring 4. The click languages at the top of Table 6.2 stand one ring deeper.

Not every room is inhabited. !Xóǀ uses 161 of the 243 rooms of ring 5. Which rooms are inhabited is read off from the language, never filled in.

## 6.10 Status

- **Counted:** 21 inventories with clicks in 3,020; 311 click segments; grid fill 83/85, 48/52, 18/21, 15/15; size bands; zeros, double values and features needed. All computed for this book on PHOIBLE 2.0.
- **Counted, with a limit:** the features-needed figure comes from a stepwise choice and is not a proven minimum. Table 6.6 runs on slightly fewer segments than Table 6.2 (157 against 161 for !Xóǀ); the appendix gives no reason.
- **From secondary source:** every row of Table 6.1 and Table 6.7 (Wikipedia, naming Traill, Naumann, Dickens, Vossen, Gerlach and others); the 85 segments of Ladefoged and Maddieson via Bradfield.

- **Read in source:** 73 consonants for Nluu (Miller et al. 2009, abstract); nine click segments for Hadza (Güldemann 2007).
- **Open:** Hadza 9 or 12 clicks. Taa 20 to 111 clicks. The count follows the analysis, and the analyses are not settled.
- **Open:** the UPSID rows use an older notation and cannot be compared place by place with the others.

## Chapter 7. The Parent Rule

The grid of Chapter 6 has an order inside it. A click with a complex accompaniment does not stand alone. The same click with one mark less stands in the same language. This chapter states that rule, gives two counts by hand, and then gives the test computed on PHOIBLE, with clicks and without.

### 7.1 The rule

The parent rule reads as follows.

A form exists only on top of its parent. Each new form is the parent plus one turn. Turn zero is the parent itself.

For a click the rule is concrete. Take a series with several accompaniment marks, such as voiced and aspirated. Remove one mark. The result is the parent: the voiced series, or the aspirated series. The rule says that at least one such parent is present in the same language, at the same place.

The plain click is the parent of all. It carries no mark. Every series with one mark has the plain click as parent. The test begins to bite at two marks.

The rule comes from the step "times three, plus the turn" in the Vacuum.Net theory (Konstapel 2026g). There every address is its parent's address with one turn added. Section 7.9 returns to this.

### 7.2 The count by hand on Jul'hoan

The rule was first checked by hand on Jul'hoan (Appendix A9). That count was made before the computed test and is given here as it stands. It was not recomputed.

Jul'hoan has 4 places and 12 series: 48 clicks. The 12 series were sorted by the number of accompaniment marks they carry. Each mark is one turn.

**Table 7.1. Jul'hoan series by number of turns (hand count)**

| Turn<br>s | Serie<br>s | Combinations possible with 5<br>marks | Share<br>inhabited |
|-----------|------------|---------------------------------------|--------------------|
| 0         | 1          | 1                                     | 1 of 1             |
| 1         | 4          | 5                                     | 4 of 5             |
| 2         | 5          | 10                                    | 5 of 10            |
| 3         | 2          | 10                                    | 2 of 10            |
| 4         | 0          | 5                                     | 0 of 5             |
| 5         | 0          | 1                                     | 0 of 1             |

|       |    |    |          |
|-------|----|----|----------|
| Total | 12 | 32 | 12 of 32 |
|-------|----|----|----------|

The third column is plain arithmetic. Five marks, each present or absent, give  $2 \times 2 \times 2 \times 2 \times 2 = 32$  combinations. One has no mark. Five have one mark. Ten have two, ten have three, five have four, and one has all five.

Two results follow from the hand count.

First, every one of the 12 series has its parent among the 12. The score is 12 of 12.

Second, Jul'hoan inhabits 12 of the 32 combinations. Twenty stay empty. The language thins out with depth: four of five at one turn, half at two turns, a fifth at three turns, none beyond.

### 7.3 The count by hand on !Xóõ

The same hand count was made on !Xóõ (Appendix A9). The language has 17 series at 5 places. That gives 85 cells, of which 83 are filled:  $17 \times 5 - 2 = 83$ . Of the 17 series, 16 had a parent among the 17. One did not, under the coding used by hand.

The computed test below uses a different coding and counts per place. The two counts are therefore not the same number seen twice. They are two passes over the same language.

### 7.4 The computed test on click series

The test was then run on PHOIBLE 2.0 (Appendix A6). The coding reads the marks from the notation of each click. One table of marks serves all languages.

**Table 7.2. The seven marks**

| Mark      | Read from the notation |
|-----------|------------------------|
| Voice     | g, G                   |
| Nasal     | ŋ, N                   |
| Uvular    | q, G, N                |
| Voiceless | the ring diacritic     |
| Breath    | <sup>h</sup> , h       |
| Friction  | x, χ                   |
| Glottal   | ʔ, ʔ, ʔ                |

A series has a parent when removing one of its marks gives a series that is present at the same place.

The !Xóõ series of section 6.4 show how this works.

| Serie<br>s | Marks            | A parent in the<br>inventory |
|------------|------------------|------------------------------|
| g_         | voice            | k_ (plain)                   |
| ŋ_         | nasal, voiceless | ŋ_                           |

|                  |                             |                 |
|------------------|-----------------------------|-----------------|
| ʔη_              | glottal, nasal              | η_              |
| q_'              | uvular, glottal             | q_              |
| k_kx<br>,        | friction, glottal           | k_x             |
| g_x              | voice, friction             | g_ or k_x       |
| g_               | voice, uvular               | q_ or g_        |
| g_k <sup>h</sup> | voice, breath               | k_ <sup>h</sup> |
| g_q <sup>h</sup> | voice, uvular, breath       | g_              |
| g_kx<br>,        | voice, friction,<br>glottal | k_kx'           |

The deepest series, g\_kx', has three marks. Its parent k\_kx' has two. That parent's parent k\_x has one. The parent of k\_x is the plain click. The chain runs down to the plain click without a gap.

The series written k\_h and k\_<sup>h</sup> receive the same coding, since both carry the mark breath.

**Table 7.3. The parent test on click series (computed on PHOIBLE 2.0)**

| Inventory            | Series with accompaniment | Parent present | Chance level |
|----------------------|---------------------------|----------------|--------------|
| !Xóõ (ph)            | 73                        | 73             | 91%          |
| !Xun (ph)            | 44                        | 44             | 96%          |
| Xhosa (ph)           | 15                        | 15             | 87%          |
| Sandawe (ph)         | 12                        | 12             | 100%         |
| Ndebele (ph)         | 9                         | 9              | 100%         |
| Yeyi, Copi, Fwe (ph) | 10                        | 10             | 92–100%      |
| !XU (upsid)          | 29                        | 27             | 78%          |
| Nama (upsid)         | 13                        | 7              | 48%          |
| Hadza (upsid)        | 9                         | 6              | 65%          |
| Sandawe (upsid)      | 12                        | 12             | 100%         |

The series are counted once per place. The chance level is the share of series that would find a parent without any rule, given how full the grid is.

In the eight inventories from PHOIBLE's own collection the score is 163 of 163. The sum is 73 + 44 + 15 + 12 + 9 + 10. No series lacks its parent.

Most of those series carry one mark, and their parent is the plain click. The sharper figure takes only series with two or more marks. In the inventories from PHOIBLE's own collection there are 77 such series. All 77 have a parent. The chance level for these is 87.9%.

## 7.5 What the test does and does not show

The result is 77 of 77 against a chance level of 88%. The rule has no exception. The margin over chance is twelve points.

The chance level is high for a plain reason. The grid is nearly full (Chapter 6). In a nearly full grid almost any series finds a neighbour with one mark less. Sandawe shows the limit: its grid is full, its chance level is 100%, and the test says nothing there.

The 77 are also not independent. The same series is counted once per place. A series that has its parent at one place nearly always has it at the other four.

The three weaker rows come from UPSID.

| <b>Inventory</b> | <b>Parent present</b> | <b>Share</b> | <b>Chance</b> |
|------------------|-----------------------|--------------|---------------|
| !XU (upsid)      | 27 of 29              | 93%          | 78%           |
| Hadza (upsid)    | 6 of 9                | 67%          | 65%           |
| Nama (upsid)     | 7 of 13               | 54%          | 48%           |

UPSID writes clicks in an older notation (section 6.3). The coding of Table 7.2 reads marks from the notation. Where the notation differs, the marks are read differently. In these three rows the rule holds at or just above chance. The same language Sandawe scores 12 of 12 in both collections.

A second check replaced the seven marks by the 38 features of the database. A parent is then a click that differs in one feature value. The result is weaker.

| <b>Inventor y</b> | <b>Parent present, 38 features</b> | <b>Share</b> |
|-------------------|------------------------------------|--------------|
| !Xóõ              | 53 of 78                           | 68%          |
| !Xun              | 34 of 44                           | 77%          |
| Sandawe           | 12 of 12                           | 100%         |
| Xhosa             | 10 of 15                           | 67%          |

The 38 features are not laid out per accompaniment mark. One mark need not be one feature. The count is given as it came out. The rule holds without exception on the marks and in two thirds to all cases on the raw features.

## 7.6 The test on languages without clicks

The rule was then tested where no click is involved (Appendix A7). The test ran on 3,001 inventories of PHOIBLE.

In these languages a marked sound is a letter with one or more modifier signs. A modifier sign is a small sign added to a base letter. The parent is the same segment with one modifier sign removed. The test asks whether that parent stands in the same inventory.

The chance level here is direct. The parent is looked up in a random other inventory. That gives the rate at which the parent turns up when the two sounds do not share a language.

**Table 7.4. The parent test without clicks (computed on PHOIBLE 2.0; 3,001 inventories)**

| Modifier signs | Segment s | Parent in own inventory | Parent in a random other inventory |
|----------------|-----------|-------------------------|------------------------------------|
| 1              | 27,896    | 62.0%                   | 50.6%                              |
| 2              | 4,428     | 68.7%                   | 18.5%                              |
| 3 or more      | 361       | 65.7%                   | 1.7%                               |

At depth 1 the margin is small: 62% against 51%. The parent of a sound with one sign is a bare letter. A bare letter turns up in half of all other inventories.

At depth 2 the margin is wide. A sound with two signs has its one-sign parent in its own language in 68.7% of cases. In a random other language the figure is 18.5%. That is 3.7 times chance.

At depth 3 the margin is wider still. The parent is present in 65.7% of cases at home and in 1.7% elsewhere. That is nearly forty times chance.

The share at home stays near two thirds at every depth: 62%, 69%, 66%. The chance level falls from a half to a fiftieth. The deeper the sound, the less its parent can be found by accident, and the rule holds at the same rate.

The test has one known gap. Voicing is written as a change of letter, k to g, not as a modifier sign. The test does not see it. A voiced sound whose voiceless parent is missing is not counted, and neither is one whose parent is present.

## 7.7 Do, not do, and taking away

The seven marks of Table 7.2 are of one kind, with one exception.

Six marks add something to the click: voice, nasal air, a uvular release, breath, friction, a glottal closure. Each is done or not done. In the register of the trit that is + and 0. The plain click is all zeros.

The seventh mark is "voiceless", the ring diacritic. In the !Xóõ list it stands on one series only:  $\eta_{\text{ring}}$  beside  $\eta_{\text{plain}}$ . A nasal is voiced in its ordinary state. The ring says that the voice is taken away from it. This mark does not add. It removes.

The voiceless nasal click is therefore a candidate for the third value, –. Its parent is the nasal click  $\eta_{\text{plain}}$ , which stands in the !Xóõ list. The series is one turn on from its parent like the others. The turn is of the other sign.

One series in one language is thin ground. The observation is recorded as a candidate and not as a finding.

## 7.8 The people

The 48 clicks of Jul'hoan are spoken by about 4,000 people (2003). The wider Ju cluster has about 16,000 speakers (Wikipedia, "Jul'hoan language"; "Khoisan languages"). Their sound system was described by Snyman, by Dickens in his 2005 grammar, and by Miller-Ockhuizen in 2003. The hand count of section 7.2 rests on the table those descriptions produced.

The 83 clicks of !Xóõ are spoken by a part of the roughly 2,500 Taa speakers (2011). Traill set them down in 1985 and 1994.

The rule of this chapter is a rule in the speech of these people. A Jul'hoan speaker who uses a click with three marks also uses that click with two. No speaker was asked about the rule. It was read off from the inventories that speakers gave to linguists.

The test without clicks rests on 3,001 inventories and 32,685 marked sounds. Behind it stand the speakers of those languages and the linguists who listened to them.

## 7.9 In the net

The step of the net is "times three, plus the turn":  $x \mapsto 3x + s$  (Konstapel 2026g). Every address is its parent's address with one turn added. An address is the route itself. A route of three turns contains its own first two turns. The child holds the parent inside it.

The parent rule holds in click systems. Every click series with two or more accompaniment turns has its parent in the same inventory: 77 of 77, with chance at 88%. The plain click is turn zero. The series  $g\_kx'$  of !Xóõ is the plain click plus three turns, and each station on the way is inhabited:  $k\_x, k\_kx', g\_kx'$ .

In languages without clicks the rule holds for about two thirds of marked sounds. That is far above chance at depth 2 and 3: 69% against 19%, and 66% against 2%. The same step is found at another depth and in other mouths.

Not every room is inhabited. Jul'hoan uses 12 of 32 accompaniment combinations. The count per depth is 1, 4, 5, 2. The sperm whale uses at least 143 of 540 coda cells (Part I). Which rooms are inhabited is read off, never filled in. The parent rule states one thing about the inhabited rooms: they are connected. A room is inhabited only next to an inhabited room one turn nearer the centre.

The accompaniments are the tension layer of the click (Chapter 5). The tension layer counts in twos. The marks are present or absent, + and 0, and five marks give  $2^5 = 32$  combinations, not  $3^5$ . The count in the mouth agrees with the two-layer law at this point.

The trit has a third value. The voiceless nasal click is the one series in which a mark takes away. If it stands, the register of the click is +, 0 and –, with the – rare. The address layer counts in threes; the tension layer shows the third value once.

## 7.10 Status

- **Counted:** parent present in 163 of 163 click series in the eight ph inventories; 77 of 77 at two or more marks, chance 87.9%. Computed for this book on PHOIBLE 2.0.
- **Counted:** in 3,001 inventories without clicks, parent present for 62.0%, 68.7% and 65.7% at one, two and three or more signs; chance 50.6%, 18.5%, 1.7%.
- **Counted, weaker:** UPSID rows 27 of 29, 7 of 13, 6 of 9; with the 38 raw features 53 of 78, 34 of 44, 12 of 12, 10 of 15.
- **Hand count, not recomputed:** Jul'hoan 12 of 12 and the distribution 1, 4, 5, 2; !Xóõ 16 of 17. Jul'hoan is not in PHOIBLE under that name.
- **Open:** the 77 series are not independent, and the chance level in a full grid is high. The click test alone does not carry the rule; the test without clicks does.
- **Open:** one third of marked sounds without clicks lacks a parent in its own inventory. Which sounds these are has not been sorted.

- **Open:** voicing is invisible to the test without clicks.
- **Open:** the voiceless nasal click as a – turn rests on one series.

## Chapter 8. The Speech of Animals

The !Xam told their stories to Wilhelm Bleek and Lucy Lloyd in the 1870s. In those stories animals and the Moon speak. They speak !Xam, each with a fixed change of the clicks. The narrators performed these voices and then repeated the words in ordinary !Xam. This chapter reports what they said and what Bleek concluded from it.

### 8.1 The record

Bleek published his second report on the work in 1875. Its title is *A Brief Account of Bushman Folklore and Other Texts*. It is signed "Mowbray, February, 1875". By then the collection held "about 6,600 half-pages or columns (in seventy-seven volumes quarto)". A footnote raises this to about 7,200 half-pages in eighty-four volumes (Bleek 1875).

References to the notebooks have a fixed form. B is a notebook of Bleek and L a notebook of Lloyd. The Roman numeral is the book and the last number is the page. "L II.–37. 3356" is Lloyd, book II-37, page 3356.

The notebooks are now catalogued and online as the Digital Bleek and Lloyd. Lloyd published a selection in 1911 as *Specimens of Bushman Folklore*. That book has no section on the speech of animals. Dorothea Bleek published the material in 1936 in *Bantu Studies* under the title "Special Speech of animals and moon used by the !Xam Bushmen". A modern edition stands in *Customs and Beliefs of the !Xam*, edited by Hollmann (2022), Part 9, pages 443 to 504.

### 8.2 The passage of 1875

Bleek states the matter in one passage of his General Report. He opens with the phrase "A most curious feature in Bushman folk-lore is formed by the speeches of various animals". The speeches are recited in ways of pronouncing the language that are said to be peculiar to the animals.

The passage names seven speakers.

**Table 8.1. The seven speakers in Bleek 1875**

| Speaker    | Change of speech, as Bleek gives it                                     | Bleek's notebook reference for the story |
|------------|-------------------------------------------------------------------------|------------------------------------------|
| Tortoise   | clicks changed into labials                                             | B XIV 1362–1392                          |
| Ichneumon  | clicks changed into palatals, compound dentals and sibilants            | B XXIV 2251–2255                         |
| Jackal     | a "strange labial click"                                                | B IX 921–930                             |
| Moon       | one click in place of all others, except the lip click                  | B XV 1468 rev.; L II-37 3356–3357        |
| Hare       | the same as the Moon                                                    | the same                                 |
| Anteater   | the same as the Moon                                                    | L II-3 383–475                           |
| Blue Crane | a <i>tt</i> added at the end of the first syllable of almost every word | —                                        |

**The Tortoise** turns the clicks into labials, sounds made with the lips. The words stay lXam. Where a person makes a click, the Tortoise makes a lip sound.

**The Ichneumon** is the mongoose. It turns the clicks into palatals, compound dentals and sibilants. A later gloss gives these as *ts*, *tsy*, *ty*, *dy* and the like (Wikipedia, "lXam language", citing Bleek 1875). The Ichneumon speaks lXam without clicks.

**The Jackal** uses a click that people do not use. Bleek calls it a "strange labial click". He places it by a proportion. It stands to the ordinary lip click as the palatal click stands to the cerebral click (Bleek 1875, as quoted in Wikipedia, "lXam language").

**The Moon, the Hare and the Anteater** share one way of speaking. In Bleek's words they "substitute a most unpronounceable click in place of all others, excepting the lip click". The four tongue clicks become one click. The lip click stays as it is.

**The Blue Crane** keeps the clicks. Its speech differs mainly by a *tt* placed at the end of the first syllable of almost every word.

### 8.3 Bleek's conclusion

Bleek drew a conclusion about the history of the language. The clicks of the Jackal and the Moon are not among the five clicks of lXam. He wrote that these abnormal clicks point to the probability "of the former presence of many more clicks" in the language than the five now found there (Bleek 1875).

Bleek read the animal voices as a store of older sounds. What daily speech no longer held, the special speech still showed.

### 8.4 The notebook page of 15 October 1873

Behind the printed passage stands a notebook entry. On 15 October 1873 lIkabbo dictated to Lucy Lloyd what the catalogue calls "A fragment about the animal clicks, and ways of speaking lXam". It fills pages 3356 and 3357 of Lloyd's book II-37 (Digital Bleek and Lloyd, Lloyd story 326).

The page itself was not read for this book. Its content is reported from a list in Wikipedia, "lXam language", which refers to an image of that date. The list adds two speakers that the printed passage lacks.

| Speaker | Wording in the list                                      |
|---------|----------------------------------------------------------|
| Jackal  | "has a flat lip click"                                   |
| Hyena   | "has a flat click"                                       |
| Lion    | a side click, with a guttural; both marked with a query  |
| Moon    | the tongue "turned up and back to the roof of the mouth" |

The Lion and the Hyena are secondary in this sense. They do not stand in Bleek's printed passage. They rest on the notebook as reported at second hand. The report of 1875 also has no passage on the baboon.

### 8.5 The stories with the voices

The voices belong to stories. The catalogue of the notebooks lists them.

**Table 8.2. Stories that hold a special speech**

| Story                                                      | Narrator           | Notebook                              | Date                   |
|------------------------------------------------------------|--------------------|---------------------------------------|------------------------|
| Moon and little Hare, with the Moon's speech               | la!kunta (Stoffel) | Bleek XV, 1403–1482; speech 1469–1482 | 12 March to April 1873 |
| The Jackal's speech                                        | llkabbo (Lloyd)    | Lloyd II-20 and II-21, 1760–1848      | begun 7 August 1873    |
| Fragment on the animal clicks                              | llkabbo            | Lloyd II-37, 3356–3357                | 15 October 1873        |
| The Ichneumon's speech                                     | —                  | Bleek notebooks, story 94             | —                      |
| The Blue Crane and the girls, with the Blue Crane's speech | —                  | Bleek notebooks, story 99             | —                      |
| The monster llkhwai-hemm's speech                          | —                  | Bleek notebooks, story 88             | —                      |

The story of the Moon and the little Hare runs to eighty pages of Bleek's book XV. The Moon's speech takes the last fourteen. The catalogue notes two things on the facing pages. Page 1468 verso has notes on the clicks, among them one the Moon makes. Page 1470 verso says that the Anteater, the Hare and the Moon speak in an "ugly manner". In the story the Moon says that it alone understands, since it speaks differently (Digital Bleek and Lloyd, Bleek story 66).

The Ichneumon's speech comes at the point where the Mantis, lkaggen, has taken away the possessions of the Meerkats. "The Jackal's speech" fills nearly two hundred notebook pages. The catalogue files it under "History (Early Race)" and gives it the keyword of animals with "thoughts that talk" (Digital Bleek and Lloyd, Lloyd story 266).

The publisher's summary of the modern edition gives the manner of telling. The narrators first spoke in the voice of the animal. Then they translated what they had said into ordinary lXam. Six of the narratives were recorded by Wilhelm Bleek (Hollmann 2022, summary).

## 8.6 When animals were people

The narrators placed the speaking animals in a former time. The animals were then people.

The story of the origin of death says it of the Hare: "the hare was formerly a man". A footnote adds that the Hare had been a person, and that the Moon cursed him (Bleek and Lloyd 1911, "The Origin of Death").

Bleek's report speaks of children "belonging to the First Bushmen", who came before the Flat Bushmen in their country. It speaks of a girl of the ancient race that preceded the Bushmen (Bleek 1875, §§ 15 and 23). In the story of the Leopard Tortoise the narrator notes that the misfortune happened to men of the Early Race (Bleek and Lloyd 1911). Lloyd's notebooks hold "A note on the First Bushmen" as story 297.

Theal summed it up in his introduction of 1911: some animals in former times were men, and some men in former times were animals (Theal 1911).

One text brings this into the present. On 1 February 1876 Dia!kwain told Lloyd that baboons speak the language of his people and have wives. The catalogue title is "Baboons speak Bushman, and have wives". It stands in Lloyd's book V-24, pages 5924 to 5926, in the Katkop dialect (Digital Bleek and Lloyd, Lloyd story 549).

Other titles in the catalogue show how wide the theme runs. Story 221 is "The Mantis and the Ostrich who talks". Story 226 treats the understanding and foolishnesses of various animals. Story 445 tells of a lion that spoke to a woman in a man's voice.

The Blue Crane also sings. In a footnote to its song llkabbo explains that the bird sings about its head, which is shaped like a stone knife (Bleek and Lloyd 1911).

### 8.7 The letters in the body

The lXam record holds a second kind of knowing that needs no speech. llkabbo dictated it to Lloyd between 18 February and 20 March 1873. It fills pages 2531 to 2565 of her book II-28 (Digital Bleek and Lloyd, Lloyd story 287). It was printed in 1911 as "Bushman Presentiments".

The text begins: "The Bushmen's letters are in their bodies." The letters are tappings. A man feels a tapping inside his body, for instance at his ribs. He then keeps altogether still. The tapping tells him who is coming or what game is near. llkabbo names one such feeling in the first person: "For I feel the springbok sensation."

llkabbo sets the presentiment against the dream. A dream speaks falsely. The presentiment is that which speaks the truth.

The notes on the facing pages give the lXam words. The presentiments are the lkumm, the "Bushman letters". They are also called !gwe. Bleek had mentioned them in his 1875 report, on pages 17 and 18, as a footnote in the 1911 book records.

Konstapel (2026i) reads the presentiments as an address layer: fixed places on the body, each with its own message.

### 8.8 The lXam click inventory

lXam belongs to the !Kwi branch of the Tuu family. Its click inventory is reconstructed from the notebooks. It has five places: ǀ, ǁ, ǂ, ǃ and Ǆ. It has eight accompaniment series. By multiplication that gives up to 40 clicks. The table is labelled "preliminary" and "reconstructed". The language had five vowel qualities (Wikipedia, "lXam language", citing Vossen 2013).

Against this inventory the animal voices can be set out.

**Table 8.3. The animal voices set against the five places**

| Speaker              | Tongue clicks ǀ ǁ ǂ ǃ Ǆ                                          | Lip click ǀ                                | Added                              |
|----------------------|------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| A person             | four, kept apart                                                 | kept                                       | —                                  |
| Moon, Hare, Anteater | all four become one click                                        | kept                                       | —                                  |
| Jackal               | —                                                                | a second lip click beside the ordinary one | —                                  |
| Tortoise             | become lip sounds, no click                                      | —                                          | —                                  |
| Ichneumon            | become <i>ts</i> , <i>tsy</i> , <i>ty</i> , <i>dy</i> , no click | —                                          | —                                  |
| Blue Crane           | kept                                                             | kept                                       | <i>tt</i> after the first syllable |

A dash means that the source says nothing on the point.

## 8.9 The people

Three narrators are named in the texts used here.

| Narrator   | Also called | What he gave                                                                               |
|------------|-------------|--------------------------------------------------------------------------------------------|
| llkabbo    | Jantje      | the Jackal's speech (1872); the presentiments (1873); the fragment on animal clicks (1873) |
| la!kunta   | Stoffel     | the Moon and the little Hare, with the Moon's speech (1873)                                |
| Dia!kwa in | —           | the baboons who speak (1876), in the Katkop dialect                                        |

The dated texts used here run from August 1872 to February 1876. llkabbo's story of the Jackal alone began on 7 August 1872 and runs through two notebooks.

The language did not outlive the narrators by long. The last known speakers of lXam died in the 1910s. It may have continued in part as Tum?i (Wikipedia, "lXam language", citing Traill 1995). On 27 April 2000 South Africa adopted a coat of arms with a lXam motto: "!ke e: lxarra l!ke".

Nluu is a language of the same !Kwi branch. In the 1990s it was thought extinct. Then Elsie Vaalbooi was found, aged 101, and Traill interviewed her in 1997. Twenty-five more speakers were found (Wikipedia, "Nl!ng language"). Du Plessis records the state in 1996: a few #Khomani elders still kept some knowledge, and only about 1,450 words could be retrieved (du Plessis 2009, p. 32).

Simon Sauls died in June 2021. That left Katrina Esau as the last speaker (Wikipedia, "Nl!ng language"). In October 2025 she was 92, "the last first-language speaker". She runs a school for the language with her granddaughter Claudia Snyman (AFP 2025).

A language with five click places and some fifty clicks now rests with one woman born in 1933. With lXam went the voices of the Moon and the Jackal as living speech. They stand in the notebooks, in the hand of two people who could write them but not speak them as the narrators did.

## 8.10 In the net

The speech of animals among the lXam is the parent plus one turn. The words stay. One fixed change on the click marks the speaker. The parent is ordinary lXam. Each animal is that speech with a single turn laid on it, the same turn in every word.

The Blue Crane shows the rule in its barest form. The word stands whole, and one *tt* is added after its first syllable. Parent, plus one turn.

The Moon replaces all clicks except the lip click by one click. The four tongue clicks collapse, and the lip click stays apart. This is the division of Chapter 5: four on ring 2 and one outside the tongue. The narrators drew the line between the four and the one at the same place.

The Jackal's click stands on that same square. Bleek's proportion sets it beside the ordinary lip click as ‡ stands beside !: sharp-high beside sharp-low. The lip click, single among people, has two rooms in the Jackal's mouth.

The Tortoise and the Ichneumon speak without clicks. The mesh in the mouth is absent, and the words are whole. The address of the word holds without the click. Chapter 9 takes this up.

Bleek himself concluded that the language once had many more clicks than five. In the terms of the net: rooms that people no longer inhabit are inhabited by the Moon and the Jackal. The animal voices keep the map of the rooms wider than daily speech does.

The narrators said that the animals were people of an earlier race. The animal's speech is a person's speech plus a turn; the animal is a person plus a turn. The two statements correspond.

Theappings in the body are letters without sound. A place on the body is an address, and what taps there is tension on it (Konstapel 2026i). The man is still, and the tapping is read. The zero is a lawful state here: rest, in which the passage is felt.

### 8.11 Status

- **Read in source:** Bleek's passage of 1875 with seven speakers, the changes of speech, the notebook references, and the inference of "many more clicks"; the size of the collection; the presentiments text and "the hare was formerly a man" (Bleek and Lloyd 1911).
- **Read in catalogue record only:** narrators, notebooks, page numbers and dates of the stories (Digital Bleek and Lloyd). The notebook pages themselves were not read.
- **From secondary source:** Lion and Hyena, and the wording on the Jackal's and Moon's clicks from the page of 15 October 1873 (Wikipedia); the Jackal proportion sentence; the lXam inventory of 5 × 8; the end of lXam in the 1910s.
- **Not read:** Dorothea Bleek 1936 and Part 9 of Hollmann 2022, beyond title and summary. The full texts of the animal speeches are therefore not quoted here.
- **Open:** what the Moon's click and the Jackal's click were as sounds. Bleek calls the first "most unpronounceable"; the sources give no more than the notebook wording.
- **Open:** whether Nluu holds any trace of special speech. The sources used here do not say.

## Chapter 9. How Old, and Where the Clicks Went

Click speech is often called the oldest speech. The sources do not carry that statement. They give old dates for the peoples and no date for the clicks. This chapter sets out the families, the dates, and the three positions on the age of clicks. It then follows the clicks into other languages and out of ordinary speech.

### 9.1 The families

"Khoisan" is a cover term for the click languages of Africa that are not Bantu or Cushitic. It is not a family. Güldemann calls it at best "a negative entity": its languages cannot all be related to each other or to any established lineage (Güldemann 2014). He counts at least eight independent lineages among the click languages (Güldemann 2007).

Specialists now work with three families in southern Africa and two isolates in East Africa. An isolate is a language with no proven relative.

**Table 9.1. The lineages**

| Unit | Members | Note | Source |
|------|---------|------|--------|
|------|---------|------|--------|

|           |                                                  |                                                            |                                            |
|-----------|--------------------------------------------------|------------------------------------------------------------|--------------------------------------------|
| Kx'a      | Ju (!Kung, with Jul'hoan) and                    | shown to be a family in 2010                               | Honken and Heine 2010,                     |
| Tuu       | Taa branch; !Kwi branch (!Xam,                   | named after the shared word                                | Güldemann 2005, via                        |
| Khoe-Kwad | Khoe languages (with Khoekhoe); extinct Kwadi of | homeland on the middle Zambezi, 2,000–3,000 years          | Güldemann and Elderkin 2010, via Wikipedia |
| Hadza     | one language, East Africa                        | isolate                                                    | Wikipedia                                  |
| Sanda we  | one language, East Africa                        | isolate; a link to Khoe-Kwadi is proposed, not established | Wikipedia                                  |

The older view of one Khoisan family goes back to Greenberg. Westphal rejected it. So did Sands in 1998, and Traill by 1998, who judged that it rested on one trait, the clicks. Dimmendaal wrote in 2008 that the unity could not be confirmed by later research (Wikipedia, "Khoisan languages").

One dissenting view stands. Du Plessis argues for a unity of the southern African languages. She uses the word "Khoisan" without implying a genetic classification (du Plessis 2009, p. 7). Her position returns in section 9.5.

The consequence is plain. Clicks are shared by languages that are not shown to be related. The clicks themselves are the only thing all of them share.

## 9.2 The dates

The dates come from genetics. They are dates of populations.

**Table 9.2. Dates in the sources**

| What is dated                                        | Date                               | Source                            |
|------------------------------------------------------|------------------------------------|-----------------------------------|
| First divergence among modern human                  | 350,000 to 260,000 years           | Schlebusch et al. 2017            |
| Deepest divergence, among African                    | about 300,000 years ago            | Schlebusch and Jakobsson 2018     |
| Hadzabe split from other click speakers              | 70,000 to 50,000 years             | Knight, in Pennisi 2004           |
| Common ancestor of click speakers                    | "perhaps 50,000 or more years ago" | Knight, in Pennisi 2004           |
| Ancestral click language                             | over 40,000 years ago              | Knight, via LINGUIST List 2003    |
| Sandawe and southern click speakers, common ancestry | more than 35,000 years             | Tishkoff et al. 2007              |
| Hadza and Sandawe, common ancestry                   | more than 15,000 years             | Tishkoff et al. 2007              |
| Khoisan divergence                                   | 100,000 to 150,000 years           | Konstapel 2026i                   |
| Khoe-Kwadi homeland                                  | 2,000 to 3,000 years ago           | Wikipedia, "Khoe–Kwadi languages" |

The oldest figure rests on seven ancient genomes from KwaZulu-Natal. Three are of hunter-gatherers about 2,000 years old. Four are of Iron Age farmers 300 to 500 years old. The same study finds that today's Khoe-San carry 9 to 30% of East African or Eurasian ancestry (Schlebusch et al. 2017). The review of 2018 calls these "the world's deepest population divergences".

Knight and eight co-authors compared the Hadzabe with the Jul'hoansi. They found the two separated by a genetic distance as great as, or greater than, that between any other pair of African populations (Knight et al. 2003). Two peoples who both speak with clicks stand as far apart as two African peoples can.

From this Knight et al. concluded that click consonants date to early in the history of modern humans. Their abstract adds that at least two explanations remain viable. Knight himself called the dating "the most tentative part" (Pennisi 2004).

### 9.3 First position: clicks are ancient

The first position holds that clicks are an inheritance from very early speech. Knight et al. (2003) give two ways in which this could be. Clicks "may have persisted for tens of thousands of years, independently in multiple populations, as a neutral trait". Or they were kept for an advantage in hunting.

The argument runs from distance to age. Two peoples far apart in descent share a rare sound. If neither took it from the other, both had it from a common ancestor. That ancestor lived before the split.

Linguists answered at once. Sands said of Knight's two lines of evidence: "The most he can say is that [the two] are correlative". She added that a single click family, if there were one, "must be many tens of thousands of years old" (Pennisi 2004). Güldemann found in the paper a number of misinterpretations of the linguistic data. He saw no good reason to assume with any confidence that clicks were among the earliest speech sounds (Güldemann 2007).

The inference rests on three assumptions: no language shift, no borrowing, and no independent development (Wikipedia, "Hadza language"). Each of the three is known to fail somewhere, as the next two sections show.

A related argument came from Atkinson in 2011. He took 504 languages and found that the number of sounds falls with distance from Africa. He read this as a serial founder effect in an expansion from Africa. Distance alone accounts for about 30% of the variation, and for 19% when population size is held equal. The paper does not treat clicks separately (Atkinson 2011). Three comments in *Science* in 2012 disputed the result. Cysouw, Dediu and Moran called it "artefactual". Wang and co-authors found that their data fit an origin in Europe or central Asia better. Van Tuyl and Pereltsvaig held the sound counts unreliable (as reported in Atkinson's reply, 2012).

### 9.4 Second position: clicks spread by contact

The second position starts from cases that can be seen. Güldemann writes that clicks were acquired through contact in at least three independent cases: Dahalo and several Bantu languages (Güldemann 2007).

**The Bantu languages.** The ancestor of the Bantu languages had no clicks. Xhosa today has 15 or 18. About 15% of the Xhosa vocabulary is of Khoisan origin. About 10% of basic vocabulary items hold a click (Wikipedia, "Xhosa language", citing Sands and Gunnink 2019). A study of 2022 reconstructs a large number of clicks for Proto-Nguni, the ancestor of Xhosa and Zulu. Among them is a palatal click, rare in Bantu. Clicks were present very early in the history of the Nguni languages (*Diachronica* 39(3), 2022).

**Hlonipha.** Married Nguni and Sotho women avoid words that share a root with the names of senior male in-laws (Wikipedia, "Avoidance speech", citing Herbert 1990). The spread of clicks into Nguni is linked in part to this custom (Wikipedia, "Click consonant", citing Gunnink 2023).

**A general path.** Güldemann draws a rule from this: "Clicks are initially recruited for phonemic purposes in a marked speech register." His examples are Nguni avoidance speech and Damin

(Güldemann 2007). The click enters through a special way of speaking and passes from there into daily speech.

#### Other cases.

| Language | What the sources say                                                                                      |
|----------|-----------------------------------------------------------------------------------------------------------|
| Yeyi     | clicks attributed to Ju influence; largest Bantu click inventory; some speakers are losing them           |
| Fwe      | Namibian Fwe keeps its clicks; Zambian Fwe loses them                                                     |
| Dahalo   | clicks are not Cushitic; perhaps a remnant of a Sandawe-like or Hadza-like language                       |
| Hadza    | clicks "more similar to those of languages where they are due to contact"; nine segments, few click words |

The first three rows are from Wikipedia. The Hadza row is Güldemann's judgement (2007). If it holds, one of the two peoples in Knight's comparison did not inherit its clicks.

A joint review of the linguistic and genetic evidence appeared in the *Annual Review of Anthropology* in 2008. It finds inheritance and contact about equally relevant for the spread of clicks. It notes substantial genetic drift in some click-speaking groups. It adds that clicks may reflect a much later stage than the earliest speech.

### 9.5 Third position: clicks are an innovation

The third position holds that clicks arose late, out of ordinary consonants.

Du Plessis argued this in her thesis of 2009. Clicks are "more likely than not to be innovations". She sketches ways in which clicks could have emerged from ordinary consonants. She writes that the label "ancient" is without linguistic warrant (du Plessis 2009, pp. ii, 3, 4). In 2015 she went further. She pointed to click words with a demonstrably Bantu identity. She proposed that the Khoesan groups have perhaps descended from regional Bantu languages (du Plessis 2015).

A paper in the *Penn Working Papers in Linguistics* likewise holds that clicks might be a more recent innovation (vol. 26(1), art. 22).

Güldemann stands against this position on one point. For clicks arising from ordinary sound change he finds "as yet no empirical grounds" (Güldemann 2007).

**Table 9.3. The three positions**

| Position   | Clicks are                                                  | Main source           | Main objection                                          |
|------------|-------------------------------------------------------------|-----------------------|---------------------------------------------------------|
| Ancient    | inherited from early speech                                 | Knight et al. 2003    | population age is not click age (Güldemann 2007; Sands) |
| Contact    | passed between neighbours, often through a special register | Güldemann 2007        | shows spread, not first origin                          |
| Innovation | made late from ordinary consonants                          | du Plessis 2009, 2015 | no attested sound change of that kind (Güldemann 2007)  |

### 9.6 Clicks that were lost

Clicks also disappear. The East Kalahari Khoe languages lost clicks from much of their vocabulary, presumably under Bantu influence (Wikipedia, "Click consonant", listing Traill and Vossen 1997). The journal issue of 1997 announces new data on click loss and click replacement.

Zambian Fwe is losing its clicks. Some Yeyi speakers are losing theirs.

These are the cases of click loss that the sources give. In each, a living language sheds clicks that it had.

## 9.7 The hunting question

Knight et al. proposed that clicks were kept for an advantage in hunting. Two testimonies stand behind this, both in Pennisi (2004).

The Hadzabe report that when they hunt they use clicks, and that "verbal talk disappears". And of the San it is said that using only clicks to communicate works well when stalking game.

Güldemann objects on acoustic grounds. Clicks are "auditorily the strongest consonant type attested in human languages". The loudest consonants are a poor choice for staying unheard (Güldemann 2007). Wikipedia calls the hunting hypothesis debunked ("Hadza language").

The testimony and the objection do not speak of the same thing. The Hadzabe say what they do when they hunt. Güldemann says what a click is as a sound. Chapter 5 adds a fact that neither side uses: a plain click is made without the breath. Konstapel (2026i) adds another reading: a click resembles the sounds of the surroundings and lacks the signature of the human voice.

The sources collected for this book hold no San testimony on hunters imitating animals. The matter is left there.

## 9.8 Clicks outside ordinary speech

Outside the click languages, people use clicks beside speech. Gil surveyed this in 143 languages (Gil, WALS 142).

**Table 9.4. Clicks beside speech, 143 languages**

| Use of clicks                      | Language<br>s |
|------------------------------------|---------------|
| Logical meaning: yes or no         | 47            |
| Affective meaning only:<br>feeling | 71            |
| Neither                            | 25            |
| Total                              | 143           |

In 118 of 143 languages a click means something, though it is not a speech sound. English *tut tut* expresses "irritation, impatience or disappointment". Hebrew uses a dental click for negation.

The geography has a shape. The languages where a click means yes or no form a region "more or less from Senegal to Bengal". The languages with neither use lie mostly in north-eastern Asia and North America. Gil puts it in one sentence: the load carried by clicks decreases as one moves out of southern Africa.

## 9.9 Damin

One case of clicks lies outside the African click languages. Damin was a ritual register of the Lardil and Yangkaal. Initiated men spoke it. It had about 200 roots. It had nasal clicks at several places, and three further sounds: an outward lip "spurt", a velar ejective, and an indrawn lateral fricative (Wikipedia, "Damin", citing Hale and Nash 1997).

The last ceremony of initiation was held in the 1950s. Damin is given as extinct in the 1970s, with a question mark.

Damin is a way of speaking into which clicks were built. It is Güldemann's second example of clicks entering through a marked register.

## 9.10 The people

The peoples of this chapter are few, and they are far apart.

The Hadza number about 1,000. The Sandawe number about 60,000. Both live in East Africa. The Jul'hoansi number about 4,000, the Taa about 2,500. Knight's comparison set the Hadzabe beside the Jul'hoansi and found no two African peoples further apart.

The Khoe-San of today are not a sealed remnant. They carry 9 to 30% ancestry from East Africa or Eurasia (Schlebusch et al. 2017).

Part of the traffic in clicks ran through marriages. Hlonipha is a rule for married women. Clicks came into Xhosa and Zulu, spoken today by some twenty million people. The languages they came from are spoken by thousands.

What disappears is uneven. The click as a sound is in no danger: twenty million Nguni speakers use it. The full grids are in danger. ǀAmkoe, with 68 to 77 clicks, has 20 to 50 speakers. Nluu has one. Dahalo, with 580 speakers, is no longer learned by children. The Lardil men who knew Damin held their last ceremony in the 1950s.

## 9.11 The step that has no date

The rungs of this book run from click speech to speech without clicks. For that step there is no dated evidence.

The sources give dates for populations: 300,000 years, 50,000 years, 35,000 years. They give no date for the first click. They give no date for a first language without clicks. No source used here shows an early click language turning into a language without clicks.

What is attested is recent and runs both ways. Clicks entered Nguni, Yeyi, Fwe and Dahalo. Clicks left East Kalahari Khoe and are leaving Zambian Fwe. Clicks were built into Damin. All three positions of this chapter rest on such recent evidence and on population dates.

The rung "the hunter's click speech" is therefore a rung by structure in this book. The click is the sound that needs no breath and holds most at once (Chapters 5 and 6). Its place before breath speech is a reading of that structure. It is not a dated event.

## 9.12 In the net

The two-layer law says that every closure has two layers. The address layer is frozen and few. The tension layer is where anything happens.

In the click languages the places are the address layer. Their number does not move: three, four or five, in every language of Table 6.1 that has a grid. The series are the tension layer. Their number runs from 4 in Hadza to 17 or 23 in Taa. Change shows on the series. Xhosa is counted with or without a prenasalised series; ǀ'Amkoe has 14 to 19 series from speaker to speaker. The places stay.

The three positions on the age of clicks all speak of the tension layer. Contact, register and sound change are movements of load from one language to the next. The places are the same in East Africa and in the south. The frozen layer has no history in the sources; the moving layer has only a recent one.

A language can drop the mesh in the mouth and keep the rest. The Tortoise and the Ichneumon do this in the IXam stories. The click goes, a lip sound or *ts* stands in its room, and the word is whole. Zambian Fwe and East Kalahari Khoe do the same among living people. The address of the word holds; the mesh that carried it is exchanged for a sound on the breath.

The reverse also stands. Damin and hlonipha lay a click on a word that had none. This is the parent plus one turn at the depth of a whole way of speaking. The marked register is the child, and daily speech is the parent inside it.

Gil's gradient is the same turn at decreasing depth. In Taa the click is a full grid. In Hebrew it is one sound with two states, no and not-no. In *tut tut* it is one sound with a feeling. At the far end it is absent. The mesh in the mouth is everywhere available; what differs is how deep a language reads with it.

The click does several things in one sound. Breath speech does them one after another. That is the direction in which the following Parts run: from at-once to one-after-another, and from full to thin.

## 9.13 Status

- **Read in source:** "Khoisan" is not a family and click languages form at least eight lineages (Güldemann 2007, 2014); divergence dates (Schlebusch et al. 2017; Schlebusch and Jakobsson 2018; Tishkoff et al. 2007, abstracts); Knight et al. 2003 (abstract only); the hunting testimony and Knight's dates (Pennisi 2004); du Plessis 2009 and 2015; Gil's 143 languages.
- **From secondary source:** the composition of Kx'a, Tuu and Khoe-Kwadi; who rejected Khoisan unity; Xhosa's 15% and 10%; hlonipha; Yeyi, Fwe, Dahalo; click loss in East Kalahari Khoe; Damin (all Wikipedia). Two of the three critiques of Atkinson are known only through his reply.
- **Not read:** Knight et al. 2003 in full; Traill and Vossen 1997; Sands and Güldemann 2009; Hale and Nash 1997.
- **Open:** the age of clicks. No source dates it.
- **Open:** whether Hadza clicks are inherited or acquired. Güldemann says they look acquired; Knight's argument needs them inherited.
- **Open:** the step from click speech to speech without clicks has no dated evidence. In this book it is a rung by structure.
- **Open:** San testimony on hunting with clicks and on imitating animals was not found for this book.

## References for Part II

**AFP (2025). "Last fluent speaker on a quest to keep ancient San language alive." Agence France-Presse via IOL, 10 October 2025. <https://iol.co.za/lifestyle/2025-10-10-last-fluent-speaker-on-a-quest-to-keep-ancient-san-language-alive/> Why read?** The most recent report on Nluu: Katrina Esau, aged 92, and the school she runs with her granddaughter.

**Annual Review of Anthropology 37 (2008). Review of the linguistic and genetic evidence on clicks. doi:10.1146/annurev.anthro.37.081407.085109. <https://www.annualreviews.org/content/journals/10.1146/annurev.anthro.37.081407.085109> Why read?** The joint statement of linguistics and genetics: inheritance and contact weigh about equally in the spread of clicks. *Reading advice:* Only the abstract was read for this book.

**Atkinson, Q. D. (2011). Phonemic diversity supports a serial founder effect model of language expansion from Africa. Science 332: 346. doi:10.1126/science.1199295. <https://cdanfort.w3.uvm.edu/csc-reading-group/language-science-2011.pdf> Why read?** The claim that sound inventories shrink with distance from Africa, on 504 languages. *Reading advice:* Read together with the reply below. The paper does not treat clicks separately.

**Atkinson, Q. D. (2012). Response to comments. Science 335: 657. <https://langev.com/pdf/atkinson2012response-gsc.pdf> Why read?** Gives the three critiques (Cysouw, Dediu and Moran; Wang et al.; Van Tuyl and Pereltsvaig) and the answer to each in a few pages. *Reading advice:* The critiques of Wang et al. and of Van Tuyl and Pereltsvaig are reported here only as this reply presents them.

**Bleek, D. F. (1936). Special Speech of animals and moon used by the !xam Bushmen. Reprinted from Bantu Studies, June 1936. Catalogue record: <https://bal2.cs.uct.ac.za/metadata/reports/df-bleek-items/334/index.html> Why read?** The first full publication of the animal speeches from the notebooks. *Reading advice:* Only the catalogue record was read for this book. The text itself remains to be read.

**Bleek, W. H. I. (1875). A Brief Account of Bushman Folk-lore and Other Texts. Second Report concerning Bushman Researches. Cape Town: Juta; London: Trübner; Leipzig: Brockhaus. [https://archive.org/stream/briefaccountofbu00blee/briefaccountofbu00blee\\_djvu.txt](https://archive.org/stream/briefaccountofbu00blee/briefaccountofbu00blee_djvu.txt) Why read?** The source of the passage on the speech of the animals and the Moon, and of Bleek's conclusion that !Xam once had many more clicks. *Reading advice:* Read the General Report at the start. The passage stands near page 6; the online text does not print page numbers.

**Bleek, W. H. I. and Lloyd, L. C. (1911). Specimens of Bushman Folklore. London: George Allen. <https://www.sacred-texts.com/afr/sbf/> Why read?** The !Xam texts in translation, with Lloyd's preface on the five click symbols and Theal's introduction. *Reading advice:* Read "Bushman Presentiments" and "The Origin of Death". The book has no section on the special speech of animals.

**Bradfield, J. (pre-print, v. 7.0). Clicks, concurrency and Khoisan. Later published in Phonology. <https://ibali.uct.ac.za/files/original/4805f3cc14393788cff623e1b8f8698598acc62c.pdf> Why read?** A clear account of how a click is made and of how !Xóõ comes to be counted with 83 or 85 clicks. *Reading advice:* Pages 2 to 5 give the phonetics and the terms.

**Diachronica 39(3) (2022). Study of clicks in Proto-Nguni. doi:10.1075/dia.19061.gun. <https://www.jbe-platform.com/content/journals/10.1075/dia.19061.gun> Why read?** Shows that many clicks, among them a palatal click, go back to the ancestor of Xhosa and Zulu. *Reading advice:* Only the abstract was read for this book.

**Digital Bleek and Lloyd. Catalogue of the notebooks of Wilhelm Bleek and Lucy Lloyd. University of Cape Town.** <https://digitalbleeklloyd.uct.ac.za/> *Why read?* Gives narrator, notebook, page and date for every story, among them the Moon's speech, the Jackal's speech and the fragment on animal clicks. *Reading advice:* Bleek notebooks, stories 66, 88, 94 and 99; Lloyd Ixam notebooks, stories 266, 287, 326 and 549. The page images were not read for this book.

**du Plessis, M. (2009). A Unity Hypothesis for the Southern African Khoesan Languages. PhD thesis, University of Cape Town.** <https://ibali.uct.ac.za/files/original/2fbf4c4a899ff3d4edddcc3657ffc47800ba5e261.pdf> *Why read?* The fullest statement of the position that clicks are innovations, and a record of the state of Nluu in 1996. *Reading advice:* Pages ii to 7 for the position; page 32 for Nluu.

**du Plessis, M. (2015). Seminar abstract, University of Kentucky, 25 February 2015.** <https://www.as.uky.edu/tbd-1> *Why read?* The later and stronger form of her position: Khoesan groups perhaps descended from regional Bantu languages.

**Gil, D. Para-Linguistic Usages of Clicks. The World Atlas of Language Structures Online, chapter 142.** <https://wals.info/chapter/142> *Why read?* The only world survey of clicks used beside speech: 143 languages, with the map from Senegal to Bengal.

**Güldemann, T. (2007). Clicks, genetics, and "proto-world" from a linguistic perspective. University of Leipzig Papers on Africa 29.** <https://www.iaaw.hu-berlin.de/de/region/afrika/linguistik/mitarbeiter/prof-dr-phil-tom-gueldemann/dokumente/gueldemann-2007a-clicks-and-proto-world> *Why read?* The linguist's answer to the genetic argument: eight lineages, three attested cases of contact, entry through a marked register, and the objection on hunting. *Reading advice:* The central text for Chapter 9. Read it beside Knight et al. 2003.

**Güldemann, T. (2014). "Khoisan" linguistic classification today. Amsterdam: Benjamins (Current Issues in Linguistic Theory 330).** <https://www.degruyterbrill.com/document/doi/10.1075/cilt.330.01gul/pdf> *Why read?* States why "Khoisan" is not a family and treats Khoe-Kwadi, Kx'a and Tuu as families. *Reading advice:* Abstract and contents were read for this book.

**Hollmann, J. C. (ed.) (2022). Customs and Beliefs of the Ixam. Johannesburg: Wits University Press. Part 9, "Special Speech of Animals and Moon", pp. 443–504.** <https://www.cambridge.org/core/books/abs/customs-and-beliefs-of-the-xam/special-speech-of-animals-and-moon/DFC9C7DED703DF4F46C8800E5F512612> *Why read?* The modern edition of the animal speeches, with the note that narrators first spoke in the animal's voice and then in ordinary Ixam. *Reading advice:* Only the publisher's summary was read for this book.

**Knight, A., Underhill, P. A., Mortensen, H. M., Zhivotovsky, L. A., Lin, A. A., Henn, B. M., Louis, D., Ruhlen, M. and Mountain, J. L. (2003). African Y chromosome and mtDNA divergence provides insight into the history of click languages. *Current Biology* 13(6): 464–473. doi:10.1016/S0960-9822(03)00130-1.** *Why read?* The genetic comparison of Hadzabe and Jul'hoansi and the conclusion that clicks date to early in human history. *Reading advice:* Only the abstract was read. The dates are given in Pennisi 2004.

**Konstapel, J. (2026i). The Root of Language and the MAZE Intake. Constable Research, Leiden.** <https://constable.blog/wp-content/uploads/The-Root-of-Language-and-the-MAZE-Intake.pdf> *Why read?* States the click as closure, loading and discharge in the mouth, with the places as address layer and the accompaniments as tension layer. *Reading advice:* The section on the click layer; the tests at the end are listed there as open.

**Konstapel, J. (2026g). The Step Map. Constable Research, Leiden.** <https://constable.blog/2026/08/18/the-step-map/> *Why read?* Gives the step "times three, plus the turn", from which the parent rule of Chapter 7 is taken.

**Konstapel, J. (2026h). Why The Universe Has a Lot of Time. Constable Research, Leiden.** <https://constable.blog/2026/09/03/why-the-universe-has-a-lot-of-time/> *Why read?* States the two-layer law: a frozen address layer and a tension layer in which anything happens.

**LINGUIST List 14.2498 (19 September 2003). Report relaying Discover magazine on Knight's dating.** <https://linguistlist.org/issues/14/2498/> *Why read?* The source of the figure "over 40,000 years" for an ancestral click language.

**Lloyd, L. C. (1911). Preface. In Bleek and Lloyd, Specimens of Bushman Folklore.** <https://www.sacred-texts.com/afr/sbf/sbf01.htm> *Why read?* Fixes the five click symbols and their names as used for lXam.

**Miller, A., Brugman, J., Sands, B., Namaseb, L., Exter, M. and Collins, C. (2009). Differences in airstream and posterior place of articulation among Nluu clicks. Journal of the International Phonetic Association 39(2): 129–161.** *Why read?* The argument for the term "lingual airstream", and the count of 73 consonants for Nluu, recorded from its last speakers. *Reading advice:* Only the abstract was read for this book.

**Pennisi, E. (2004). The First Language? Science 303: 1319–1320.** [https://www.bec.ucla.edu/wp-content/uploads/sites/108/archive/papers/Mountain\\_3-7-05\\_science.clicks.pdf](https://www.bec.ucla.edu/wp-content/uploads/sites/108/archive/papers/Mountain_3-7-05_science.clicks.pdf) *Why read?* Two pages that hold Knight's dates, the Hadza testimony on hunting, and the replies of Sands. *Reading advice:* The best short entry to the whole debate.

**Penn Working Papers in Linguistics 26(1), article 22.** <https://repository.upenn.edu/pwpl/vol26/iss1/22/> *Why read?* A further statement that clicks might be a more recent innovation. *Reading advice:* Only the abstract was read; the page names no writer.

**PHOIBLE 2.0. Phonetic inventory database, development file.** <https://raw.githubusercontent.com/phoible/dev/master/data/phoible.csv> (downloaded 8 October 2026). *Why read?* The 3,020 inventories and 105,484 segments on which all counts of Chapters 6 and 7 were computed. *Reading advice:* Each row is one segment of one inventory, with 38 features valued +, – or 0. The UPSID inventories use an older click notation.

**Schlebusch, C. M. et al. (2017). Southern African ancient genomes estimate modern human divergence to 350,000 to 260,000 years ago. Science, 28 September 2017. doi:10.1126/science.aao6266. Abstract: https://carta.anthropogeny.org/libraries/bibliography/southern-african-ancient-genomes-estimate-modern-human-divergence-350000** *Why read?* The oldest date in this Part, from seven ancient genomes of KwaZulu-Natal. *Reading advice:* Only the abstract was read. The date is of populations, not of speech.

**Schlebusch, C. M. and Jakobsson, M. (2018). Tales of Human Migration, Admixture, and Selection in Africa. Annual Review of Genomics and Human Genetics 19: 405–428.** <https://www.annualreviews.org/content/journals/10.1146/annurev-genom-083117-021759> *Why read?* A review that sets the deepest human divergence at about 300,000 years, among African hunter-gatherers.

**Theal, G. McC. (1911). Introduction. In Bleek and Lloyd, Specimens of Bushman Folklore.** <https://www.sacred-texts.com/afr/sbf/sbf02.htm> *Why read?* A contemporary summary of the lXam view that animals were once people.

**Tishkoff, S. A. et al. (2007). History of click-speaking populations of Africa inferred from mtDNA and Y chromosome genetic variation. *Molecular Biology and Evolution* 24(10): 2180–2195. doi:10.1093/molbev/msm155. Abstract: <https://repository.ias.ac.in/127959> Why read?** Gives the ages of common ancestry between Sandawe, Hadza and the southern click speakers. *Reading advice:* Only the abstract was read.

**Wikipedia. Articles "Click consonant", "Pulmonic-contour click", "Khoisan languages", "Kx'a languages", "Tuu languages", "Khoe–Kwadi languages", "Avoidance speech", "Damin", and the articles on !Xam, Jul'hoan, Taa, Nlɿŋ, ǀAmkoe, Khoekhoe, Hadza, Sandawe, Xhosa, Zulu, Dahalo, Yeyi and Fwe. <https://en.wikipedia.org/> Why read?** The inventories, speaker numbers and classification in this Part are taken from these articles. Each names its primary source, as given in the text: Traill, Naumann, Dickens, Vossen, Gerlach, Hale and Nash, and others. *Reading advice:* These primary works were not opened for this book. A reader who needs a count for further work should go to the primary source named.

## Part III. Speech

Part II described the click speech of the hunter. Part III describes spoken language as the whole species carries it. It starts with the body that speaks and the three ways of moving air. It then counts the sounds of the world's languages, and the tones laid over them. It follows speech where it leaves the mouth: into the whistle, the drum and the hands. It ends with the oldest full analysis of a language by its own speakers, made in India and carried without writing. Every count stands in the text, with its source.

### Chapter 10. The Body of Speech

Speech is made by a body that was not built for speech alone. The lungs, the larynx and the tongue also breathe, swallow and guard the airway. This chapter sets out what is known of that body and of its age. The dates proposed by living authors differ by a factor of four hundred. All of them are given here, each with its holder.

#### 10.1 The larynx and the vocal tract

The larynx is the voice box at the top of the windpipe. In the human infant it sits high. It begins to descend at about 3 months and reaches its adult position after 3 to 4 years. In males a second, smaller descent follows at puberty (Fitch 2000).

Philip Lieberman proposed the descended-larynx theory in 1969 (CNRS 2019). In 1971 Lieberman and Crelin reconstructed the vocal tract of a Neanderthal. They found it "similar to that of a modern human newborn" (Wikipedia, "Neanderthal anatomy").

Lieberman's measure is the proportion of the tract above the larynx. That tract has a horizontal part, the mouth, and a vertical part, the throat. In the human adult the two are about equal: a ratio of 1:1. A child reaches this ratio at 6 to 8 years of age (Lieberman & McCarthy 2007). The 1:1 tract yields the three vowels [i], [u] and [a] in their full form. Lieberman and McCarthy call these the quantal vowels. They state that other living primates cannot produce them.

Fitch (2000) set two findings against this. First, a low larynx is not unique to humans. Male red deer and fallow deer pull the larynx down when they roar. A longer tract sounds like a larger animal, and Fitch calls this the size-exaggeration hypothesis. On this reading the low larynx came first and its

use in speech came later. Second, the hyoid bone does not show where the larynx sat. In Fitch's words, the hyoid gives "no reliable indication" of larynx position.

Boë and eight colleagues (2019) reject the theory outright. Their abstract states three findings. Laryngeal descent is not uniquely human. It is not required for producing contrasting vowel qualities. Living non-human primates produce such contrasts (Boë et al. 2019, abstract as reproduced by Neuroscience News). The CNRS press release adds that about ten vocalisations in baboons count as proto-vowels. It also notes that the original theory rested on data from cadavers (CNRS 2019).

## 10.2 The hyoid

The hyoid is a small bone in the throat, above the larynx. Kebara 2 gave the first Neanderthal hyoid to be preserved.

The skeleton Kebara 2 was found in 1983 in Kebara Cave, Israel. Thermoluminescence dates the skeleton to 61,000–59,000 years (Valladas et al. 1987). Electron spin resonance dates it to 64,000–60,000 years (Schwarcz et al. 1989). The usual round figure of 60,000 years stands for a range of 59,000 to 64,000 (Wikipedia, "Kebara 2").

Arensburg and colleagues described the bone in 1989. From outside it looks like a modern human hyoid. Critics noted that the hyoid of a pig also resembles the human one (Wikipedia, "Kebara 2").

D'Anastasio and colleagues (2013) looked inside the bone. They scanned it with microCT, an X-ray method that shows the inner bone structure. They compared one Neanderthal with three modern males. The mean stress in the model of the Neanderthal bone was 6.3 MPa. In the three modern bones it lay between 6.4 and 10.8 MPa. The authors call the result "consistent with a capacity for speech". They state that it is not proof.

## 10.3 FOXP2

FOXP2 is a gene on chromosome 7, at locus 7q31. It was found through one family, known as the KE family. The family's speech disorder was linked to the locus in 1998. The mutation was identified in 2001 by Lai and colleagues (Wikipedia, "FOXP2").

The protein changes little between species. The counts are in Table 10.1.

**Table 10.1 Amino-acid differences in the FOXP2 protein (Wikipedia, "FOXP2")**

| Human compared with | Differences      |
|---------------------|------------------|
| Chimpanzee          | 2 (T303N, N325S) |
| Mouse               | 3                |
| Zebra finch         | 7                |

Neanderthals carried the same two substitutions as modern humans. They differed at one regulatory site, in intron 8 of the gene (Dediu & Levinson 2013).

Enard and colleagues reported in 2002 that the human form had spread by recent positive selection. Atkinson and colleagues tested this again in 2018 and found no evidence of it (Wikipedia, "FOXP2"). The gene is a condition of fluent speech. It does not date speech.

## 10.4 The dating positions

Three positions stand in the literature. They do not date the same thing, and the table says what each one dates.

**Table 10.2 Dating positions on speech**

| Holder                    | What is dated                            | Date                                 |
|---------------------------|------------------------------------------|--------------------------------------|
| Lieberman & McCarthy 2007 | Fully human speech                       | Between 100,000 and 50,000 years ago |
| Lieberman & McCarthy 2007 | First fully 1:1 tract in fossils         | After 50,000 years ago               |
| Dediu & Levinson 2013     | Modern speech and language               | About 500,000 years                  |
| Boë et al. 2019           | Older consensus they argue against       | About 200,000 years                  |
| Boë et al. 2019           | Capacity for contrasting vowel qualities | More than 20 million years           |
| Konstapel 2026e           | Preconditions of speech                  | At least 300,000 years               |
| Konstapel 2026e           | Symbolic behaviour                       | At least 100,000 years               |

Lieberman and McCarthy rest on the shape of the tract. An early modern human from Israel, 100,000 years old, still lacks the 1:1 ratio. Neanderthal specimens of 70,000 to 40,000 years have necks too short and faces too long. Their tract falls between that of a chimpanzee and that of a human.

Dediu and Levinson rest on several lines at once. Fossils from Sima de los Huesos, about 500,000 years old, suggest hearing like the modern kind. The canal for the nerves of the chest is enlarged in Neanderthals and in modern humans. It is not enlarged in the *Homo erectus* boy of Nariokotome. Dediu and Levinson place this under breathing. Their figure is 5 to 10 times the conventional 50,000 to 100,000 years.

Boë and colleagues date a capacity, not a language. They move the possible dawn of speech by, in their words, "two orders of magnitude".

Konstapel (2026, "Hoe Begon het Spreken?") lists what is known and unknown. The preconditions go back at least 300,000 years. The FOXP2 variant is at least 300,000 to 400,000 years old and is shared with Neanderthals. When syntax arose is unknown. The same text notes that language leaves no fossils and that writing is about 5,000 years old.

A further line concerns the base of the skull. The sphenoid is the bone at its centre. Dambricourt Malassé holds that the sphenoid flexed inward step by step along the primate line. With each flexion the larynx, the length of the throat and the jaw shift together (as reported in Konstapel 2026d).

## 10.5 The three airstreams

A speech sound needs moving air. Three parts of the body can set air in motion: the lungs, the glottis and the tongue. The glottis is the opening between the vocal folds. Each of the three can push air out or draw it in. That gives six combinations (Wikipedia, "Airstream mechanism").

**Table 10.3 The three airstreams and their two directions**

| Move<br>r | Out                            | In                         |
|-----------|--------------------------------|----------------------------|
| Lungs     | Ordinary speech; all languages | One phoneme, in Damin only |
| Glottis   | Ejectives                      | Implosives                 |
| Tongue    | One sound, in Damin only       | Clicks                     |

Four of the six are used in ordinary words. Air pushed out by the lungs carries most speech. Every human language uses it. Air pushed out by the closed glottis gives the ejective, a sharp popped consonant. Air drawn in at the glottis gives the implosive. Air drawn in by the tongue gives the click.

The other two are known as phonemes from one language. Damin was a ritual language of Australia and is extinct. It had one sound made on air drawn in by the lungs. It had one sound, a spurt at the lips, made on air pushed out by the tongue. Outside Damin, speech on indrawn lung air occurs in interjections, in Swedish and in Ewe (Wikipedia, "Airstream mechanism").

The counts in the World Atlas of Language Structures (WALS) are in Table 10.4.

**Table 10.4 Airstreams other than plain lung air, in 566 languages (Maddieson 2013c, 2013d)**

| Sound type                | Language<br>s | Share |
|---------------------------|---------------|-------|
| Ejectives                 | 92            | 16.3% |
| Implosives                | 75            | 13.3% |
| Glottalised resonants     | 29            | 5.1%  |
| Any glottalised consonant | 154           | 27.2% |
| Clicks                    | 10            | 1.8%  |

The ten click languages in this sample are !Xóõ, Jul'hoan, !lAni, Deti, Khoekhoe, Zulu, Yeyi, Sandawe, Hadza and Dahalo. All ten are spoken in Africa. The share of 27.2% is computed here from 154 of 566.

The line between lung air and glottis air is not sharp. Voiced stops in Thai, Zulu and Maïdu are weakly implosive (Ladefoged & Maddieson 1996, as cited in Wikipedia, "Airstream mechanism").

## 10.6 The people

The evidence of this chapter comes from very few bodies. One skeleton, Kebara 2, supplies the Neanderthal hyoid. Three modern men supplied the bones it was compared with. One family, the

KE family, supplied the gene. Every living child supplies the rest: the larynx descends in each infant from the third month.

One language supplied the two missing airstreams. Damin was spoken in ritual and is no longer spoken. With it, two of the six ways of moving air left ordinary human use.

## 10.7 In the net

Speech begins with a closure. The lips, the tongue or the glottis shut the passage. Tension stands on the closed space. The closure opens. This is the turn of every stop consonant. The click is its fullest form: two closures, an enclosed space, loading and discharge in one sound (Konstapel 2026i).

The three airstreams form a register of three places. Each place has three states: air out, air in, or rest. Out is +1. In is -1. Rest is 0. The rest state is lawful. In ordinary speech the glottis and the tongue move no air, and that is their state, not an absence.

The register is read off, not filled in. Of the six states that move air, four are inhabited in ordinary words. Two are inhabited in one ritual language only. Not every room is inhabited.

The same closure stands at three depths of the body: at the chest, at the throat, at the mouth. It is the same turn at another depth. The deepest place carries all languages. The shallowest, the tongue, carries the fewest languages and the most sharply bounded sound.

The dates of section 10.4 are three rungs, not three answers to one question. Each rung is the parent plus one turn.

## 10.8 Status

- Counted: 566 languages in WALS; 92 with ejectives, 75 with implosives, 10 with clicks.
- Read in source: Fitch 2000; Lieberman & McCarthy 2007; Dediu & Levinson 2013; D'Anastasio et al. 2013; Maddieson 2013c, 2013d.
- From secondary source: Boë et al. 2019 (abstract and press release); Kebara 2 dates; FOXP2 history; the airstream table and Damin.
- Open: the date of speech, between 50,000 years and 500,000 years; for the bare capacity, more than 20 million years.
- Open: whether the Kebara 2 hyoid was used in speech. Its authors do not claim proof.
- Open: the three-place register of airstreams is a reading. No count has been made of how languages combine the three.

# Chapter 11. The Sounds of the World

Every spoken language draws a fixed set of sounds from what the mouth can make. The set is called the inventory. Its members are the phonemes: the sounds that keep words apart. This chapter gives the sizes of the inventories of the world, from the smallest to the largest. It then gives the rule by which an inventory is built, and the test of that rule on 3,001 inventories.

## 11.1 Two counts of the world

Two databases supply the figures. They count different things, and they are kept apart here.

The first is **WALS**. Its chapters on consonants and vowels were written by Ian Maddieson. They rest on a sample of 562 to 566 languages; the text and the table of the consonant chapter differ, and the table sums to 563 (Maddieson 2013a). **WALS** counts consonants and vowel qualities separately.

The second is **PHOIBLE 2.0**. It holds 3,020 inventories for 2,186 distinct languages, with 3,183 different segment types (Moran & McCloy 2019). One language may appear in several inventories, each from a different describer. **PHOIBLE** counts all segments of an inventory together, consonants and vowels. The **PHOIBLE** figures in this chapter were computed for this book on **PHOIBLE 2.0** (Appendix A).

## 11.2 Consonants

In **WALS** the smallest consonant inventory is that of Rotokas, with 6. The largest is that of !Xóõ, with 122. The mean is 22.7, the mode 22 and the median 21 (Maddieson 2013a).

**Table 11.1 Consonant inventories in WALS (Maddieson 2013a)**

| Class            | Consonants | Languages |
|------------------|------------|-----------|
| Small            | 6–14       | 89        |
| Moderately small | 15–18      | 122       |
| Average          | 19–25      | 201       |
| Moderately large | 26–33      | 94        |
| Large            | 34 or more | 57        |
| Total            |            | 563       |

The largest class is the middle one. A language with 19 to 25 consonants is the common case.

## 11.3 Vowels

**WALS** counts vowel qualities: the distinct positions of tongue and lips, without length or nasality. In 564 languages the range runs from 2 to 14. The mean lies, in Maddieson's words, "just fractionally below 6" (Maddieson 2013b).

**Table 11.2 Vowel quality inventories in WALS (Maddieson 2013b)**

| Class   | Qualities | Languages |
|---------|-----------|-----------|
| Small   | 2–4       | 93        |
| Average | 5–6       | 287       |
| Large   | 7–14      | 184       |
| Total   |           | 564       |

Four languages have 2 vowel qualities; Yimas is one of them. German alone has 14. British English and Bété have 13. The five-vowel system is the most frequent: 188 languages, just over one third. Six vowels follow with 100 languages, or 17.8%.

## 11.4 Whole inventories in PHOIBLE

Across all 3,020 PHOIBLE inventories the median is 33 segments and the mean 34.9. The smallest inventory has 11 segments. The largest has 161. The median number of consonants is 22, close to the WALS median of 21 (Appendix A3).

**Table 11.3 Inventory sizes in PHOIBLE 2.0, computed for this book (Appendix A3)**

| Segment<br>s | Inventories<br>s | Share<br>e |
|--------------|------------------|------------|
| 1–13         | 5                | 0.2%       |
| 14–27        | 1,034            | 34.2%      |
| 28–40        | 1,150            | 38.1%      |
| 41–81        | 810              | 26.8%      |
| 82–121       | 17               | 0.6%       |
| 122–243      | 4                | 0.1%       |
| Total        | 3,020            | 100%       |

The band limits are the ring numbers of the net: 13, 27, 40, 81, 121, 243. Section 11.11 reads the table.

The distribution is narrow. 2,184 of 3,020 inventories, or 72.3%, have between 14 and 40 segments. Only 21 inventories exceed 81. Only 5 fall below 14.

## 11.5 The small end

Three languages are named most often at the small end.

Central Rotokas has 6 consonants and 5 vowel qualities, with a contrast of length. Its alphabet has 12 letters. The Aita dialect has 9 consonants (Wikipedia, "Rotokas language").

Pirahã has 3 vowels and 7 or 8 consonants. On Everett's analysis that makes 10 phonemes, and 9 in the speech of women. Another analysis gives up to 13 (Wikipedia, "Pirahã language").

Hawaiian has 8 consonants. Its vowels number 5 or 25, by the analysis chosen. The total is 13 or 33; the sums are computed here (Wikipedia, "Hawaiian phonology").

## 11.6 The large end: the counts for !Xóõ

The largest inventory is not one number. !Xóõ, also called Taa, is spoken by about 2,500 people (2011). Its consonants have been counted in at least six ways.

**Table 11.4 Counts for !Xóõ (Taa)**

| Count                                      | What is counted               | Source                    |
|--------------------------------------------|-------------------------------|---------------------------|
| At least 58 consonants, 31 vowels, 4 tones | East !Xoon, Traill's analysis | Wikipedia, "Taa language" |

|                                            |                           |                           |
|--------------------------------------------|---------------------------|---------------------------|
| At least 87 consonants, 20 vowels, 2 tones | West !Xoon, DoBeS project | Wikipedia, "Taa language" |
| 122 consonants                             | WALS figure               | Maddieson 2013a           |
| 130 consonants                             | A further analysis        | Wikipedia, "Taa language" |
| 164 consonants, 111 of them clicks         | Strict unit analysis      | Wikipedia, "Taa language" |
| 161 segments, 83 of them clicks            | PHOIBLE inventory         | Appendix A1               |

The difference lies in the analysis, not in the speech. The strict unit analysis counts every click with its accompaniment as one consonant. It gives the highest figure, 164. The other analyses count fewer units for the same sounds.

One famous figure belongs elsewhere. The record of 141 phonemes was assigned to !Xũ, a different language, not to !Xóõ (Crystal 2010, as reported in Wikipedia, "Phoneme"). PHOIBLE agrees: its UPSID inventory for !XU holds 141 segments, 48 of them clicks (Appendix A1).

## 11.7 Feature economy

A feature is one property of a sound, present or absent: voiced, nasal, made at the lips. Clements (2003) showed that inventories are built from few features, each used many times. Languages maximise the number of sounds per feature. He tested this on a sample balanced by family and by region.

An inventory fills rows and columns. It does not scatter.

The same economy shows in PHOIBLE. The database describes each segment with 38 features, each with the value +, – or 0. A count was made of how many features are needed to tell all segments of an inventory apart (Appendix A5).

**Table 11.5 Features needed to keep all segments apart, computed for this book (Appendix A5)**

| Inventory    | Segments<br>N | Features<br>needed | $\log_3$<br>N | Ratio |
|--------------|---------------|--------------------|---------------|-------|
| World median | 33            | 10                 | 3.2           | 3.05  |
| Sandawe      | 60            | 12                 | 3.73          | 3.22  |
| Xhosa        | 83            | 12                 | 4.02          | 2.98  |
| !Xun         | 114           | 14                 | 4.31          | 3.25  |
| !Xóõ         | 157           | 15                 | 4.60          | 3.26  |

The number  $\log_3 N$  is the count of three-way choices needed to tell N things apart. The ratio of features to  $\log_3 N$  stays near 3 in every row, from 33 segments to 157. The choice of features was greedy, so the counts are not proven minima.

## 11.8 The parent test on languages without clicks

Part II showed a rule in click systems. A click series with two accompaniments has, in the same inventory, the series with one of them. The complex sound stands on the simpler one. This book calls that the parent rule.

The rule was tested on the rest of the world. The test took 3,001 PHOIBLE inventories. In phonetic writing a modified sound carries one or more modifier signs, small marks added to the base letter. The parent of a segment is the same segment with one modifier sign removed. The test asks whether that parent stands in the same inventory.

A comparison sets the chance level. The same question is asked of a random other inventory. If the parent is found there as often, the rule says nothing.

**Table 11.6 The parent test on 3,001 inventories, computed for this book (Appendix A7)**

| Modifier signs on the segment | Segments | Parent in own inventory | Parent in a random other inventory |
|-------------------------------|----------|-------------------------|------------------------------------|
| 1                             | 27,896   | 62.0%                   | 50.6%                              |
| 2                             | 4,428    | 68.7%                   | 18.5%                              |
| 3 or more                     | 361      | 65.7%                   | 1.7%                               |

With one modifier the parent is present in 62.0% of cases, against 50.6% by chance. The parents of such sounds are plain consonants and vowels, and these are common everywhere.

With two modifiers the figures part. The parent is in the same inventory in 68.7% of cases. In a random other inventory it is found in 18.5%. With three or more the figures are 65.7% against 1.7%.

About two thirds of marked sounds have their parent beside them, at every depth. The chance level falls from one half to one in sixty. The rule holds in languages without clicks, less strictly than the 77 of 77 found in click series.

The test has one known blind spot. Voicing is written as a change of letter, *k* to *g*, not as a modifier sign. The test does not see it.

## 11.9 Atkinson 2011 and the replies

In 2011 Atkinson published a claim in *Science* under the title "Phonemic Diversity Supports a Serial Founder Effect Model of Language Expansion from Africa". He used about 500 languages (ScienceDaily 2012). The claim was that the number of phonemes falls with distance from Africa. In a serial founder model each founding group carries only part of the variety of its parent group. Atkinson read the phoneme counts as that trace.

Three replies appeared in 2012.

**Table 11.7 The replies to Atkinson 2011**

| Reply                                               | Data                        | Finding                                                                             |
|-----------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------|
| Cysouw, Dediu & Moran 2012, <i>Science</i> 335: 657 | Same method, other features | Result called "artefactual"; origin lands in East Africa, the Caucasus or elsewhere |
| Hunley, Bowern & Healy 2012                         | 908 phonemes, 725 languages | Genes fit the founder model; phonemes do not; counts peak in Eurasia                |
| Jaeger et al. 2012, <i>Science</i> 335: 1042        | Simulations                 | False positives under the method                                                    |

The first and third are known here through reports (ScienceDaily 2012; Language Log 2012). The second was read in full.

A related claim ties inventory size to the number of speakers. Moran, McCloy and Wright (2012) tested it on 969 PHOIBLE languages. Once language families are taken into the model, the correlation is near zero (as summarised by HRAF).

Konstapel (2026, "Hoe Begon het Spreken?") reports Atkinson's result and marks it as debated.

## 11.10 The people

The largest inventory in the world is carried by about 2,500 speakers of Taa. Size of inventory and number of speakers do not go together (Moran, McCloy & Wright 2012).

The 3,020 inventories are the work of field linguists and of the speakers who sat with them. Each inventory is one describer's reading of one community. Where two describers disagree, as on Taa, PHOIBLE keeps both.

What disappears with a small language is a whole column of the table. The click languages of the WALS sample number 10 of 566. Each of them holds sounds found in no language outside Africa.

## 11.11 In the net

An inventory is a grid. A language takes a few places of articulation and a few properties, and inhabits nearly every combination. Clements's feature economy is this grid, found by count. The click inventory showed it in its fullest form: !Xóõ fills 83 of 85 cells, Sandawe 15 of 15.

The parent rule holds across the world's languages. Every address is its parent's address with one turn added. A sound with two marks stands on the sound with one. Table 11.6 gives the measure: 68.7% against 18.5% at depth 2, and 65.7% against 1.7% at depth 3. The deeper the sound, the less its presence is a matter of chance, and the more it is a matter of its parent.

Depth is the number of trits in a route. Each further turn multiplies the distinguishable states by three. Table 11.5 shows this depth in speech. The features needed are about  $3 \times \log_3 N$  in every inventory, small or large. Click languages use the same economy. They read deeper: 15 features in !Xóõ against a world median of 10.

Table 11.3 sets the inventories on the rings. Ring 3 has 27 rooms. Ring 4 has 81. Ring 5 has 243.

**Table 11.8 PHOIBLE inventories by the ring that holds them**

| Ring | Room | Inventories that fit | Share |
|------|------|----------------------|-------|
|------|------|----------------------|-------|

|   |     |                           |       |
|---|-----|---------------------------|-------|
| 3 | 27  | 1,039 (up to 27 segments) | 34.4% |
| 4 | 81  | 1,960 (28 to 81 segments) | 64.9% |
| 5 | 243 | 21 (82 to 161 segments)   | 0.7%  |

The median inventory, 33 segments, needs ring 4. About two thirds of all spoken inventories lie there. One third fits on ring 3. Twenty-one inventories need ring 5, and the largest of them, !Xóõ with 161 segments, fills two thirds of it.

This is the full end of the line that Part IV follows to the thin end. The alphabet of 22 letters lands on ring 3: 27 rooms, 3 trits per sign. The median spoken inventory stands one ring deeper than the script that writes it.

The WALS medians do not sit on ring numbers. The median of 21 consonants and the mean of just under 6 vowels are what they are.

## 11.12 Status

- Counted: PHOIBLE sizes (median 33, mean 34.9, range 11–161); the parent test on 3,001 inventories; features needed per inventory. All computed for this book.
- Read in source: Maddieson 2013a, 2013b; Hunley, Bower & Healy 2012; Clements 2003 (abstract only); the PHOIBLE home page.
- From secondary source: the counts for Taa, Rotokas, Pirahã and Hawaiian; Atkinson 2011 and two of its three replies; Moran, McCloy & Wright 2012.
- Open: the parent test does not see voicing. A test on the 38 features instead of the modifier signs has been run on click languages only.
- Open: the features in Table 11.5 were chosen greedily. A proven minimum is not yet computed.
- Open: the count of 130 consonants for Taa was found without the name of its analyst.

## Chapter 12. Tone

Tone is pitch that keeps words apart. In a tonal language the same consonants and vowels, spoken high or low, are different words. Tone adds no new sound to the mouth. It adds a second line to the sound that is already there. This chapter counts the tonal languages, the numbers of tones, and the place of tone in the click languages.

### 12.1 The share of tonal languages

Maddieson's WALS chapter on tone rests on 526 languages. Its table sums to 527 (Maddieson 2013e).

**Table 12.1 Tone in the WALS sample (Maddieson 2013e)**

| Type                                    | Language<br>s | Shar<br>e |
|-----------------------------------------|---------------|-----------|
| No tone                                 | 306           | 58.2%     |
| Simple tone system (a two-way contrast) | 132           | 25.1%     |

|                     |     |       |
|---------------------|-----|-------|
| Complex tone system | 88  | 16.7% |
| All tonal           | 220 | 41.8% |

The figure of 41.8% carries its own caveat. Maddieson states that it underrepresents the true share. Families rich in tone are sampled thinly. Of the 68 Niger-Congo languages in the sample only 5 are without tone. Yet under 5% of that family is in the sample. The true share of tonal languages is above 41.8%. WALS gives no corrected figure, and none is given here.

## 12.2 Where tone is spoken

The geography is uneven. In Maddieson's words, "virtually all the languages in Africa are tonal". Complex systems dominate East and Southeast Asia. And "no Australian language has been reported to be tonal" (Maddieson 2013e).

Tone goes with larger consonant inventories. Languages with complex tone have 26.0 consonants on average. Those with simple tone have 23.3. Those without tone have 22.1 (Maddieson 2013e).

## 12.3 How many tones

**Table 12.2 Numbers of tones in named languages**

| Language   | Tones                                                            | Source                           |
|------------|------------------------------------------------------------------|----------------------------------|
| Navajo     |                                                                  | 2 Maddieson 2013e                |
| Yoruba     | 3 level tones: high, mid, low                                    | Maddieson 2013e                  |
| Mandarin   | 4, plus a neutral tone                                           | Wikipedia, "Tone (linguistics)"  |
| Thai       |                                                                  | 5 Maddieson 2013e                |
| Vietnames  | 6, written with diacritics                                       | Wikipedia, "Tone (linguistics)"  |
| Cantonese  | 6 in Hong Kong, 7 in Guangzhou; traditional count 9              | Wikipedia, "Cantonese phonology" |
| Hmong      | 7 (Hmong Daw, Mong Leeg) or 8 (Dananshan)                        | Wikipedia, "Hmong language"      |
| Kam (Dong) | 9 on open syllables plus 6 on checked ones; traditional count 15 | Wikipedia, "Kam language"        |

The highest claims are 14 tones for Wobé, which is disputed, and up to 12 in the Hmong–Mien family (Wikipedia, "Tone (linguistics)").

## 12.4 The PHOIBLE count

Of the 3,020 PHOIBLE inventories, 636 list tones. That is 21.1%. Many sources in the database do not record tone at all. The figure 636 is a lower bound, not a share (Appendix A8).

**Table 12.3 Number of tones in 636 PHOIBLE inventories, computed for this book (Appendix A8)**

| Tones | Inventories | Share of 636 |
|-------|-------------|--------------|
|-------|-------------|--------------|

|              |     |       |
|--------------|-----|-------|
| 1            | 6   | 0.9%  |
| 2            | 181 | 28.5% |
| 3            | 217 | 34.1% |
| 4            | 124 | 19.5% |
| 5            | 60  | 9.4%  |
| 6            | 25  | 3.9%  |
| 7            | 7   | 1.1%  |
| 8            | 10  | 1.6%  |
| Listed above | 630 | 99.1% |

The median is 3 tones. Three is also the most frequent count, with 217 inventories. Two follows with 181, then four with 124. The eight rows sum to 630. The appendix does not break down the remaining 6 inventories.

Single entries in the database: Mandarin 4, Cantonese 5, Vietnamese 6 or 8 by source, !Xun 4, Sandawe 5, Xhosa 2.

## 12.5 Tone in click languages

The click languages are tonal. All three Khoisan families, Khoe, Kx'a and Tuu, have tone (Wikipedia, "Tone (linguistics)"). Taa has 4 tones on Traill's analysis and 2 on that of the DoBeS project (Wikipedia, "Taa language"). PHOIBLE lists 4 tones for !Xun and 5 for Sandawe. Xhosa has 2 (Appendix A8).

The largest consonant inventories of the world carry tone on top. This fits Maddieson's averages: more tones, more consonants.

## 12.6 The people

Tone is the ordinary condition of speech for a large part of mankind. Yoruba alone, with three tones, has roughly 50 million speakers (Wikipedia, "Yoruba language"). Mandarin, Cantonese, Vietnamese, Thai and Hmong are all tonal.

Tone is easily lost on paper. Vietnamese writes its six tones with diacritics. In the 2,384 PHOIBLE inventories without a tone entry, part of the silence is the describer's, not the language's.

## 12.7 In the net

Tone is a trit in the sound itself. High, mid, low: +1, 0, −1. The mid tone is the zero, and the zero is a lawful state. It is the level from which high and low are heard.

Among 636 PHOIBLE inventories with tone, three tones is the most frequent count: 217. Two follows with 181, four with 124. The three-way register is the one most often inhabited. The two-way system holds one distinction, high against low. The three-way system holds the full trit.

Tone does not replace the address of a syllable. It is laid over it. The consonants and vowels stand as before, and the pitch stands on them at once. A syllable with tone is the same syllable plus one turn.

In a language of three tones each syllable gains a factor of three. This is the step of the net: times three, plus the turn.

Systems above three do not sit on a ring number. Four, five and six tones are what they are.

Tone and the click accompaniments stand in the same place. Both ride on a sound whose place in the mouth is already fixed. The click languages hold both at once.

**12.8 Status**

- Counted: 636 PHOIBLE inventories with tone; the distribution in Table 12.3. Computed for this book.
- Read in source: Maddieson 2013e, with its figures 306, 132, 88 and its caveat.
- From secondary source: tone counts for Mandarin, Cantonese, Vietnamese, Hmong, Kam, Wobé; tone in the Khoisan families and in Taa.
- Open: the true world share of tonal languages. WALs measures 41.8% and states that this is too low. No higher figure was found in a source that was opened.
- Open: 6 of the 636 PHOIBLE inventories are not broken down by number of tones.

**Chapter 13. Language Without the Mouth**

A language can leave the mouth and remain a language. It can be whistled across a valley, beaten on a drum across a forest, or made with the hands in silence. The first two carry a spoken language in reduced form. The third is a language in its own right, with its own parts. This chapter states for each what it carries over and what it drops.

**13.1 Whistled languages**

Whistled speech is an ordinary language transposed into a whistle. It is not a separate language. A whistler of Silbo Gomero whistles Spanish.

Two counts exist, both from Meyer. The description of his 2015 book speaks of "about twenty linguistic communities" studied, in 30 months of fieldwork (Meyer 2015, publisher's description). His 2021 review, as reported, gives "at least 80" whistled languages (Knowable Magazine 2021). Konstapel (2026, "The Root of Language and the MAZE Intake") uses the figure of about 80. The first count is of communities studied. The second is of languages known to be whistled.

The whistle travels. Its energy lies mostly between 1 and 4 kHz, and it can reach 120 dB.

**Table 13.1 Range of the voice and of the whistle**

| Signal                      | Range                           | Source                                                    |
|-----------------------------|---------------------------------|-----------------------------------------------------------|
| Ordinary speech             | About 40 m                      | Knowable Magazine 2021                                    |
| Shout                       | About 200 m                     | Knowable Magazine 2021                                    |
| Whistle                     | Over 1 km                       | Knowable Magazine 2021                                    |
| Whistle, typical            | 1–2 km; up to 5 km in mountains | Wikipedia, "Whistled language"                            |
| Whistle, La Gomera, claimed | Up to 10 km and 130 dB          | Meyer 2004, 2005, 2008, in Wikipedia, "Whistled language" |

A whistle is one line of pitch. A language must choose what to put on that line. Two choices are found (Wikipedia, "Whistled language").

A language without tone whistles its vowels. The whistle follows the second formant, the resonance that sets one vowel apart from another. Spanish and Turkish are whistled this way.

A language with tone whistles its tones. The whistle carries the tone melody of the sentence. Most of the consonants and vowels are lost. Hmong and Mazatec are whistled this way. Chinantec, with 7 tones, whistles its tones. Gavião, with 2 tones, is limited to a few fixed sentences (Knowable Magazine 2021). Two tones on one line do not keep enough words apart.

**Table 13.2 Four whistled languages**

| Language     | Place                                   | What the whistle follows | Detail                                              |
|--------------|-----------------------------------------|--------------------------|-----------------------------------------------------|
| Silbo Gomero | La Gomera                               | Vowels of Spanish        | UNESCO list 2009; school subject since July 1999    |
| Kuş dili     | Kuşköy, Turkey                          | Vowels of Turkish        | Words recognised about 70%; common sentences 80–90% |
| Hmong        | China, Laos, Myanmar, Thailand, Vietnam | Tones                    | Also on leaf or flute, in courtship                 |
| Mazatec      | —                                       | Tone contours            | Described by Cowan 1948; used by                    |

Silbo Gomero has been reduced to its units in several ways. Trujillo (1978) found 2 vowels and 4 consonants. Meyer finds 4 classes of vowel. Meyer and Rialland find 8 consonants, or 10 if gradual decay is counted (Wikipedia, "Silbo Gomero"). Spanish passes through two to four whistled vowels. The hearer restores the rest from the sentence.

Silbo is of Guanche origin, from before the Spanish conquest. It was adapted to Spanish in the 16th century (Wikipedia, "Silbo Gomero"). The whistle outlived the language it was first made for.

The brain treats the whistle as language. Whistlers of Silbo use the same language areas for it as for spoken Spanish (Carreiras et al. 2005, in Wikipedia, "Silbo Gomero"). Whistled Turkish removes the usual dominance of the left half of the brain (Güntürkün 2015, as reported in Konstapel 2026i).

## 13.2 Drum languages

A drum has no vowels and no consonants. It has pitch and timing. The usual account says that drums carry the tones of a tonal language. The best-measured case reverses this.

**Bora.** The Bora of the Amazon use the manguaré, a pair of slit drums about 2 m long. The pair has four pitches. In talking mode only two are used, with one beat per syllable (Seifart et al. 2018). The drums are heard up to about 20 km away. That extends the range of the voice by a factor of up to 100.

Bora has two tones, high and low. Seifart and colleagues found that the two tones alone keep few words apart. The rest is carried by rhythm. The interval between two beats follows the syllable. Four lengths are kept distinct, in rising order:

**Table 13.3 The four rhythmic units of Bora drumming (Seifart et al. 2018)**

| Unit | Shape between two vowels (V vowel, C consonant) | Interval     |
|------|-------------------------------------------------|--------------|
| 1    | V                                               | Shortest     |
| 2    | VC                                              | Longer       |
| 3    | VVC                                             | Longer still |
| 4    | VCC                                             | Longest      |

The measure is in the names. Among 18 names of three syllables, the drum shows 7 different rhythm patterns. It shows 2 different tone patterns. Rhythm keeps apart more than three times as many names as tone.

The corpus holds 169 drummed messages from 5 speakers. A message has about 15 words and 60 beats.

**Kele.** The older account comes from John Carrington (1914–1985), a Baptist missionary at Yakusu from 1938. He published *The Talking Drums of Africa* in 1949 (Wikipedia, "John F. Carrington"). The Kele language has two tones, high and low. The drum uses the same two. Vowels and consonants are lost (Dyson 2011, reporting Carrington).

Two tones leave many words alike. In Dyson's report, a single sequence of tones "may have hundreds of meanings". Kele repairs this by length. A short word is replaced by a fixed long phrase. The word *songe*, "moon", is drummed as *songe li tange la manga*, "the moon looks down to the earth" (Language Hat, citing Carrington). About 8 drum words convey 1 word of Kele (Dyson 2011). A drummed message takes up to 8 times as long as the spoken sentence (Wikipedia, "Talking drum").

One drum reaches 4 to 5 miles, or 6.4 to 8 km; Carrington gives 3 to 7 miles. By relay a message crossed 100 miles in about an hour (Wikipedia, "Talking drum"; "Drums in communication").

**Yoruba.** The dũndún is an hourglass drum with cords along its sides. Squeezing the cords changes the pitch within one beat. The drum follows the 3 tones of Yoruba (Wikipedia, "Talking drum").

### 13.3 Sign languages

Sign languages are not spoken languages on the hands. They are "independent of spoken languages" and follow their own development. British Sign Language and American Sign Language are mutually unintelligible, though both countries speak English. Ethnologue listed 150 sign languages in 2021. The SIGN-HUB Atlas lists over 200 (Wikipedia, "Sign language").

**Their own parts.** In 1960 Stokoe published *Sign Language Structure*. He showed that a sign breaks down into parts without meaning, as a word breaks down into phonemes. He found three kinds of part and called the units cheremes (Wikipedia, "Stokoe notation").

**Table 13.4 Stokoe's parts of the sign in American Sign Language (Wikipedia, "Stokoe notation")**

| Part     | Stokoe's term | Units |
|----------|---------------|-------|
| Location | tab           | 12    |

|           |     |    |
|-----------|-----|----|
| Handshape | dez | 19 |
| Movement  | sig | 24 |
| Total     |     | 55 |

The counts are taken from the tables on that page; the total is computed here. Later work added two parts: the orientation of the palm, and signals not made by the hands. That makes five (Wikipedia, "American Sign Language phonology").

A spoken syllable sets its parts one after another. A sign holds its handshape, its location and its movement at the same moment.

**Nicaraguan Sign Language.** In 1977 a school in Nicaragua brought together 50 deaf children. By 1979 there were 100. A vocational school opened in 1980. By 1983 the two schools had over 400 pupils (Wikipedia, "Nicaraguan Sign Language"). The children had no common language. They made one.

Senghas, Kita and Özyürek (2004) describe the outcome: "a new sign language has been created by deaf Nicaraguans over the past 25 years". They tested 30 deaf signers in three cohorts of 10: those who entered before 1984, between 1984 and 1993, and after 1993. Ten hearing speakers of Spanish served for comparison. The community then numbered about 800 signers, aged 4 to 45 (University of Bristol 2004).

The finding concerns the children. They split events into elements and recombine them. A whole became parts that can be set in sequence.

**Al-Sayyid Bedouin Sign Language.** In the village of Al-Sayyid about 120 to 150 deaf people live among about 3,000 to 3,500 inhabitants. Their sign language arose in the last 70 years. It has a fixed word order: subject, object, verb (Sandler et al. 2005, in Wikipedia, "Al-Sayyid Bedouin Sign Language").

It lacks what Stokoe found. Its signs "cannot be analyzed as being composed of smaller, meaningless units". The language works without that layer. The third generation signs twice as fast as the first.

**Signs among hearing people.** Plains Indian Sign Language was a common language between nations. Cabeza de Vaca recorded it in 1527 and Coronado in 1541. An estimate of 1885 gives over 110,000 signers. They spoke at least 37 languages of 12 families, across 2.6 million km<sup>2</sup>. Mallery described it in 1881 (Wikipedia, "Plains Indian Sign Language").

In the Kalahari, hunters use hand signals. Mohr, Fehn and de Voogt (2019) compared the hunting signs of Ts'ixa, Buga and lAni, which are Khoe languages, with those of Jul'hoan, a Kx'a language. The spoken languages belong to two families. The signs cross that boundary. The authors call them "an areal feature". A cross-cultural test by Divale and Zipin supports a link between hunting and the use of signs (HRAF summary).

## 13.4 What each carries over and what it drops

**Table 13.5 Speech moved to another carrier**

| Carrier | Carries over | Drops | Repair |
|---------|--------------|-------|--------|
|---------|--------------|-------|--------|

|                             |                           |                            |                                          |
|-----------------------------|---------------------------|----------------------------|------------------------------------------|
| Whistle, non-tonal language | Vowel line                | Voice; most contrasts      | Hearer restores from the sentence        |
| Whistle, tonal language     | Tone melody               | Most consonants and vowels | Hearer restores from the sentence        |
| Drum, Bora                  | Two tones; four intervals | All consonants and vowels  | Rhythm of the syllables                  |
| Drum, Kele                  | Two tones                 | All consonants and         | Fixed long phrases, about 8              |
| Sign                        | Nothing from speech       | —                          | Own parts: handshape, location, movement |

## 13.5 The people

About 1,500 Bora remain, and about 20 pairs of manguaré drums (Seifart et al. 2018). The drummed language depends on those twenty pairs.

Nicaraguan Sign Language was made by children, 50 at first and about 800 a generation later. Al-Sayyid Bedouin Sign Language was made in one village, by 120 to 150 deaf people over 70 years. Plains Indian Sign Language had over 110,000 signers in 1885.

## 13.6 In the net

Whistle and drum are speech reduced to one line that still closes. Language survives reduction to one line of pitch (Konstapel 2026i). The inventory of Chapter 11 needs ring 4. The whistle of Silbo holds 2 to 4 vowels and 4 to 10 consonants. The line is shallow. What persists is what returns: the hearer gives back the sentence that was sent. Kuş dili gives the measure, 70% for the single word and 80 to 90% for the sentence. The longer route closes more often than the short one.

Kele shows the same in the drum. The single word *songe* stays open on two tones: one tone sequence, hundreds of words. The phrase of five words closes. An open window carries tension; the long phrase is the route on which it comes to rest. Eight drum words for one spoken word is the measure of that route.

Bora shows the two-layer law. The two tones are few and fixed. The four intervals carry the difference: 7 patterns against 2. The count of the tones is two. The count of the intervals is four.

The drum and the whistle are the spoken language plus nothing. They are the parent with turns taken away, and the parent is still read in them. The reduced form exists only on top of the full one.

The sign is another case. It is not a reduction. It holds three parts at once: handshape, location, movement. This is the at-once of the click, in another body part. The children of Nicaragua show the next step in the open. What was held as one event was split into elements and laid out one after another. From at-once to one-after-another: the step that writing takes in Part IV was taken there on the hands, within one generation.

Al-Sayyid shows that the layer of meaningless parts is not the first rung. A language stands without it. The parts come after, as a further turn.

The hunting signs of the Kalahari stand beside the click, among the same people. Both are made for the hunt. One is sound without the signature of the human voice (Konstapel 2026i). The other is no sound at all.

## 13.7 Status

- Counted in source: Bora, 169 messages, 5 speakers, 18 names, 7 rhythm patterns against 2 tone patterns (Seifart et al. 2018).
- Read in source: Seifart et al. 2018; Senghas, Kita & Özyürek 2004 (abstract); Mohr, Fehn & de Voogt 2019 (abstract); Meyer 2015 (publisher's description).
- From secondary source: all figures on whistled languages; Kele and Carrington; Stokoe's counts; Nicaraguan cohorts; Al-Sayyid; Plains Indian Sign Language.
- Open: the number of whistled languages. "About twenty" communities studied (2015) and "at least 80" languages (2021) are both in print.
- Open: the number of hunting signs per Kalahari group is not in the abstract that was read.
- Open: no count has been made of how many sign languages have Stokoe's layer of parts and how many, like Al-Sayyid, do not.

## Chapter 14. Sound, Meaning and the Analysed Language

Two things stand at the end of the spoken rung. The first is the tie between a sound and what it means, which is not wholly free. The second is a language whose speakers took it apart, sound by sound and root by root, and carried the result for centuries without writing. That language is Sanskrit. This chapter gives the counts for both, and closes with the marks that count without being writing.

### 14.1 Sound symbolism

The link between sound and meaning is not wholly arbitrary. The best-known test uses two drawn shapes, one rounded and one spiky, and two invented words, "bouba" and "kiki".

Ćwiek and colleagues (2022) ran the test across cultures. They collected 976 participants and analysed 917. The participants spoke 25 languages of 9 families and used 10 writing systems. The matching of "bouba" to the round shape reached 72% (95% credible interval 56–82%). In 17 of the 25 languages the result lay reliably above 50%. Three languages fell under 50%: Romanian, Mandarin Chinese and Turkish.

Earlier work gave higher figures in narrower groups. Ramachandran and Hubbard (2001) reported 95% to 98% among American undergraduates and Tamil speakers. Köhler used "takete" and "maluma" in 1929. Newly hatched chicks also show the effect. In people blind from birth it is much weaker (Wikipedia, "Bouba/kiki effect").

Blasi and colleagues (2016) looked at real words. They used 6,452 word lists, covering nearly two thirds of the world's more than 6,000 languages. Each list holds 100 basic words. Certain meanings draw certain sounds: "small" goes with *i*, "full" with *p* or *b*, "tongue" with *l*, "nose" with *n*. The pairings arose independently. They are not inherited from one source and not borrowed.

Some languages have a whole word class for this. An ideophone is, in Dingemanse's definition, a word that depicts sensory imagery. Doke coined the term in 1935: "a vivid representation of an idea in sound". Dictionaries of Japanese, Korean, Xhosa, Yoruba and Zulu list thousands (Wikipedia, "Ideophone").

### 14.2 Pāṇini

Sanskrit was described by Pāṇini, born at Śalātura in Gandhāra, in the north-west of present Pakistan. His grammar is the *Aṣṭādhyāyī*, "the eight chapters". Each chapter has 4 sections, so 32 in all. The whole can be recited in about two hours (Wikipedia, "Pāṇini").

The rules are sūtras, very short statements. Their number and their date are both given as ranges.

**Table 14.1 Pāṇini: the counts and dates in the sources**

| Ite     | Figure                                      | Holder                                                                                 |
|---------|---------------------------------------------|----------------------------------------------------------------------------------------|
| Sūt ras | 3,959                                       | Wikipedia, "Pāṇini"                                                                    |
| Sūt ras | 3,996                                       | Wikipedia, "Pāṇini"                                                                    |
| Sūt ras | 3,983                                       | Wikipedia, "Aṣṭādhyāyī"                                                                |
| Sūt ras | About 4,000                                 | Konstapel 2026i                                                                        |
| Dat e   | Mid-4th century BCE, about 350 BCE          | von Hinüber 1989, Falk 1993, Houben 2009, Witzel 2009; Bronkhorst as earliest possible |
| Dat e   | Not later than early to mid-4th century BCE | Cardona 1997                                                                           |
| Dat     | About 400 BCE                               | Konstapel 2026i                                                                        |
| Dat     | 5th or 6th century BCE                      | Scharfe 1977; Staal 1996                                                               |
| Dat     | 7th–5th century BCE                         | Bod 2013                                                                               |

The scholars' dates are as reported in Wikipedia, "Pāṇini". The mid-4th century is now the majority view. The rule count runs from 3,959 to 3,996.

The grammar has five kinds of auxiliary rule: the metarule, the heading, the extension, the restriction and the negation (Wikipedia, "Aṣṭādhyāyī"). It is a set of rules about rules. Rajpopat (2022) showed that where two rules conflict the right-hand one wins, and that the grammar then runs as an algorithm (as reported in Konstapel 2026i).

The first commentators were Kātyāyana, about 250 BCE (Scharfe), and then Patañjali's *Mahābhāṣya* in the late Mauryan era (Wikipedia, "Pāṇini").

### 14.3 The three lists

The grammar rests on three lists that stand outside it.

**The fourteen Śiva-sūtras.** These are 14 lines that order the sounds of the language. Each line is a run of sounds closed by a marker letter. A sound and a marker together form an abbreviation for a run of sounds, a pratyāhāra. The 14 lines allow 280 abbreviations. Pāṇini uses 41. A 42nd was added later (Wikipedia, "Shiva Sutras", citing Kiparsky and Petersen). Kiparsky holds that the ordering is the shortest that serves the grammar (as reported in Konstapel 2026i).

**The Dhātupāṭha.** This is the list of verbal roots. A root, *dhātu*, names an act. It holds about 2,300 roots, of which 522 are often used in classical Sanskrit (Wikipedia, "Aṣṭādhyāyī"). Konstapel (2026, "The Root of Language") gives about 2,000. The roots fall into ten classes, each named after its first member: *bhū-*, *ad-*, *hu-*, *div-*, *su-*, *tud-*, *rudh-*, *tan-*, *krī-*, *cur-*. Every word is derived from a root that names an act.

**The Gaṇapāṭha.** This is the list of groups of nominal stems.

## 14.4 The sound table

The Sanskrit sound order is itself an analysis. The 25 stop consonants are set in a grid of five rows and five columns. The rows are the places of articulation, from the back of the mouth to the lips. The columns are the manners (Wikipedia, "Shiksha").

**Table 14.2 The 5 × 5 grid of Sanskrit stops (Wikipedia, "Shiksha")**

| Place     | Voiceless | Voiceless aspirated | Voiceless | Voiced aspirated | Nasal |
|-----------|-----------|---------------------|-----------|------------------|-------|
| Velar     | ka        | kha                 | ga        | gha              | ṅa    |
| Palatal   | ca        | cha                 | ja        | jha              | ña    |
| Retroflex | ṭa        | ṭha                 | ḍa        | ḍha              | ṇa    |
| Dental    | ta        | tha                 | da        | dha              | na    |
| Labial    | pa        | pha                 | ba        | bha              | ma    |

All 25 cells are filled. Staal compared the table to the periodic system of the elements: it was "the result of centuries of analysis" (quoted in Wikipedia, "Shiksha").

The study of sounds was a discipline of its own, Śikṣā, one of the six auxiliary sciences of the Veda. A text of the Taittirīya school is dated to 600 BCE at the latest. Each Vedic school had its own sound manual, a Prātiśākhya. These grew out of the word-by-word recitation around 800 BCE. The surviving texts are likely from 500 to 150 BCE (Wikipedia, "Shiksha"; "Pratishakhya").

**Table 14.3 Number of sounds counted by each school (Wikipedia, "Shiksha")**

| Text               | Sounds   |
|--------------------|----------|
| Ṛgveda Prātiśākhya | 47       |
| Taittirīya         | 52       |
| Sāmaveda           | 57       |
| Pāṇinīya Śikṣā     | 63 or 64 |
| Śukla Yajurveda    | 65       |

## 14.5 Carrying a text without writing

The oldest parts of the Ṛgveda date from about 1500–1200 BCE. The text was written down only after 500 BCE. The oldest surviving manuscripts are of the 11th century, from Nepal, and the 14th, from Varanasi. In between the text was carried by voice: 1,028 hymns in 10,600 verses (Wikipedia, "Vedas"; "Vedic chant").

It was carried by recitation patterns, called pāṭhas. There are 11. Three follow the natural order of the words. Eight reverse it.

**Table 14.4 Five of the eleven recitation patterns (Wikipedia, "Vedic chant")**

| <b>Patter<br/>n</b> | <b>Order of the words a, b, c, d</b> |
|---------------------|--------------------------------------|
| Samhitā             | Words joined, in running order       |
| Pada                | Words separated                      |
| Krama               | ab, bc, cd ...                       |
| Jaṭā                | ab ba ab; bc cb bc ...               |
| Ghana               | ab ba abc cba abc ...                |

The other six are mālā, śikhā, rekhā, dhvaja, daṇḍa and ratha. Jaṭā, dhvaja and ghana were developed after the 5th century BCE.

The patterns check one another. A reciter who knows the same words joined, separated, paired and woven back and forth cannot shift a word unnoticed. The texts were "proof-read" by comparing the recited versions. The Ṛgveda is fixed within its school "without any variant readings" (Filliozat, in Wikipedia, "Vedas").

Oral memory reaches further back elsewhere. Nunn and Reid (2016) collected Aboriginal stories from 21 places around the coast of Australia. Each tells of land that the sea now covers. The authors set the water depth required by each story against the sea-level curve. The sea reached its present level about 7,000 years ago. The stories date from between about 13,070 and 7,250 years before present.

## 14.6 Counting aids that are not writing

Marks that count are far older than writing. Three notched bones are named most often. The sources correct the usual account on each.

**Table 14.5 Three notched bones**

| <b>Obj</b>   | <b>Find</b>                                       | <b>Age</b>                                                          | <b>Marks</b>          | <b>Correction</b>                                                                        |
|--------------|---------------------------------------------------|---------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------|
| Lebombo bone | Baboon fibula, about 8 cm, Border Cave            | 42,000–43,000 years (Wikipedia, "Lebombo bone"); 44,200–43,000      | 29 notches ("Tally    | Notches cut with different edges; the finder, Beaumont, reads ritual marks; tally use is |
| Wolf bone    | Dolní Věstonice, found 1937                       | About 30,000 years                                                  | 55                    | —                                                                                        |
| Ishango bone | Semliki River, Congo, found 1950 by de Heinzelin; | First 9,000–6,500 BCE; site re-dated to about 20,000 years; debated | 168, in three columns | Species undetermined; not a baboon fibula                                                |

The three columns of the Ishango bone sum to 60, 60 and 48. Marshack read them as a lunar count. One column holds 11, 13, 17 and 19, the primes between 10 and 20; this may be chance (Wikipedia, "Ishango bone").

Two aids carry a message without holding it. The Aboriginal message stick has a median length of 17 cm. The messenger speaks the message and points to the marks. Four museums hold 640 of them: 283, 230, 74 and 53 (Wikipedia, "Message stick"). The wampum belt of north-eastern

America is made of white whelk beads and purple quahog beads. Belts served as memory aids for treaties (Wikipedia, "Wampum"). In both, the bearer speaks and the object vouches.

## 14.7 The people

Sound symbolism was measured on 917 people in 25 languages. The ideophone is everyday speech for the speakers of Japanese, Korean, Xhosa, Yoruba and Zulu.

The Sanskrit analysis was the work of the Vedic schools, each with its own sound manual. Pāṇini stands at the end of that line. The reciters carried 10,600 verses by voice from about 1500–1200 BCE until after 500 BCE. The discipline is alive; UNESCO proclaimed Vedic chanting in 2008 (Wikipedia, "Vedic chant").

The Australian stories were carried by the coastal peoples of 21 places, across at least 7,000 years.

## 14.8 In the net

**Sound and thing held at once.** At the low rungs the sound and the thing stand together. "Bouba" goes with the round shape in 25 languages. The ideophone depicts. The chick, with no language, makes the same match. This is correspondence: no arrow runs from the shape to the sound. The free tie between sound and meaning holds only at the top of the ladder (Konstapel 2026i). The 72% of Ćwiek and the 100 words of Blasi are the measure of what remains of the low rungs in every language.

**The sound table is a grid.** The Sanskrit table is place  $\times$  manner, the same form as the click grid of Part II. !Xóõ inhabits 83 of 85 cells. Sanskrit inhabits 25 of 25. The rows are the address layer: five places, frozen. The columns are the tension layer. Voice is present or absent. Breath is present or absent. That is counting in twos:  $2 \times 2 = 4$  columns. The nasal stands outside as the fifth. Five is four plus one, as in the clicks, where four tongue clicks stand beside the lip click.

The parent rule is visible in each row. *Kha* is *ka* plus one turn, breath. *Ga* is *ka* plus one turn, voice. *Gha* carries both, and both its parents stand in the same row. The grid is full: every child has its parent.

Twenty-five is not a ring number. The 25 stops lie inside the 27 rooms of ring 3, and the count is left at that. The full sound lists of the schools, 47 to 65, need ring 4, like the median inventory of Chapter 11.

**Not every room is inhabited.** The fourteen Śiva-sūtras allow 280 abbreviations. The grammar uses 41. Which rooms are inhabited was read off from the language, not filled in.

**The root is the act under the word.** The Dhātupāṭha lists acts, not things. Every word is its root plus turns: the root is the parent, the derived word the child. The root of language is not the word and not the stem; it is the event (Konstapel 2026i). Where two words meet, their sounds join by fixed rules. This joining, sandhi, is closure at the seam.

**Recitation is closure by voice.** The patterns go out and come back: ab, ba, ab. A text recited so returns onto itself at every pair of words. Only what returns in phase stays. A shifted word does not return, and it does not last. The R̥gveda held on this alone from about 1500–1200 BCE until after 500 BCE.

**From at-once to one-after-another.** Sanskrit is the spoken rung read to its full depth. The click does several things in one sound. The Sanskrit table lays those things out in rows and columns,

while the language is still only spoken. The analysis that the alphabet later carries in its letters was complete in the mouth and the memory. Writing lays out in sequence what speech holds at once; India laid it out first without writing.

**The notched bone** is the turn with nothing else: one cut, one more, one more. It holds the count and no sound. The message stick shows the two layers in the hand. The marks are fixed. The message lives in the bearer.

## 14.9 Status

- Counted in source: 917 participants, 25 languages, 72% (Ćwiek et al. 2022); 6,452 word lists (Blasi et al. 2016, abstract); 21 story locations (Nunn & Reid 2016, abstract).
- From secondary source: all figures on Pāṇini, the Śiva-sūtras, the Dhātupāṭha, the sound table, the recitation patterns and the notched bones.
- Open: the number of sūtras (3,959, 3,983 or 3,996) and Pāṇini's date (7th to mid-4th century BCE).
- Open: the root count, about 2,300 or about 2,000.
- Open: the age range of the Australian stories should be checked against the article; the abstract's range sign was unclear in the copy read.
- Open: the age and the notch count of the Lebombo bone differ between two pages; the Ishango date is still debated.
- Open: the reading of the four non-nasal columns as two present-or-absent turns is made here. It has not been tested on the sound tables of other languages.

## References for Part III

Computed figures marked "Appendix A" are in Appendix A of this book (PHOIBLE 2.0 development file, downloaded 8 October 2026).

**Blasi, D.E., Wichmann, S., Hammarström, H., Stadler, P.F. & Christiansen, M.H. (2016). Sound–meaning association biases evidenced across thousands of languages. PNAS 113(39): 10818–10823. <https://pubmed.ncbi.nlm.nih.gov/27621455/> Why read?** The largest test of sound symbolism in real vocabulary: 6,452 word lists. *Reading advice:* Only the abstract was read for this book; the number of associations is in the full text.

**Boë, L.-J., Sawallis, T.R., Fagot, J., Badin, P., Barbier, G., Captier, G., Ménard, L., Heim, J.-L. & Schwartz, J.-L. (2019). Which way to the dawn of speech? Science Advances 5(12): eaaw3916. Abstract as reproduced at <https://neurosciencenews.com/speech-evolution-15321/> Why read?** The full rejection of the descended-larynx theory, with the date of more than 20 million years. *Reading advice:* Known here through the reproduced abstract and the CNRS press release.

**Clements, G.N. (2003). Feature economy in sound systems. Phonology 20(3): 287–333. <https://www.cambridge.org/core/journals/phonology/article/abs/feature-economy-in-sound-systems/92564226892C68403A5C9F0624D55F29> Why read?** States and tests the rule that inventories use few features many times. *Reading advice:* Abstract only was read.

**CNRS (2019). Speech could be older than we thought. Press release, 11 December 2019. <https://www.cnrs.fr/en/press/speech-could-be-older-we-thought> Why read?** Plain summary of Boë et al., with the baboon proto-vowels and the year 1969 for Lieberman's theory.

**Ćwiek, A. et al. (2022). The bouba/kiki effect is robust across cultures and writing systems. Phil. Trans. R. Soc. B 377: 20200390. <https://royalsocietypublishing.org/doi/10.1098/>**

**rstb.2020.0390** *Why read?* The cross-cultural measure: 917 people, 25 languages, 72%. *Reading advice:* Read the per-language results; three languages fall under 50%.

**D'Anastasio, R. et al. (2013). Micro-biomechanics of the Kebara 2 hyoid and its implications for speech in Neanderthals. PLoS ONE 8(12): e82261. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0082261>** *Why read?* The only look inside a Neanderthal hyoid. *Reading advice:* Note the sample: one Neanderthal against three modern men.

**Dediu, D. & Levinson, S.C. (2013). On the antiquity of language. Frontiers in Psychology 4: 397. <https://www.frontiersin.org/articles/10.3389/fpsyg.2013.00397/full>** *Why read?* The case for about half a million years, from hearing, breathing and genes together.

**Divale, W.T. & Zipin, C. Hunting and the development of sign language: a cross-cultural test. Journal of Anthropological Research 33: 185–201. Summary at <https://hraf.yale.edu/ehc/documents/735>** *Why read?* An ethnographic test of the link between hunting and signing. Known here through the HRAF summary.

**Dyson, F. (2011). Review of J. Gleick, "The Information". New York Review of Books. Archived at <https://www.guern.net/docs/www/www.nybooks.com/e7a8526ff8f2aadf28a098dfb348d2ee72182c61.html>** *Why read?* Reports Carrington's findings on the Kele drum: two tones, eight drum words for one. *Reading advice:* A report at two removes; Carrington's own book of 1949 was not opened.

**Fitch, W.T. (2000). The evolution of speech: a comparative review. Trends in Cognitive Sciences 4(7): 258–267. [https://www.ece.uvic.ca/~bctill/papers/numacoust/Fitch\\_2000.pdf](https://www.ece.uvic.ca/~bctill/papers/numacoust/Fitch_2000.pdf)** *Why read?* Shows that deer lower the larynx and that the hyoid does not reveal larynx position.

**Hunley, K., Bowern, C. & Healy, M. (2012). Rejection of a serial founder effects model of genetic and linguistic coevolution. Proc. R. Soc. B 279(1736): 2281–2288. <https://pmc.ncbi.nlm.nih.gov/articles/PMC3321699>** *Why read?* The fullest reply to Atkinson 2011: 725 languages, 908 phonemes.

**Knowable Magazine (2021). Article on whistled languages, reporting Meyer, J. (2021), Environmental and Linguistic Typology of Whistled Languages, Annual Review of Linguistics 7. <https://knowablemagazine.org/article/mind/2021/whistled-languages>** *Why read?* Source of "at least 80", the ranges, and the recognition rates for whistled Turkish.

**Konstapel, J. (2026e). Hoe Begon het Spreken? constable.blog, 6 June 2026. <https://constable.blog/2026/06/06/the-origin-of-spoken-language-currentevidence-and-outstanding-questions/>** *Why read?* Sets out what is known and unknown about the origin of speech, with dates.

**Konstapel, J. (2026i). The Root of Language and the MAZE Intake. constable.blog, 11 September 2026. <https://constable.blog/wp-content/uploads/The-Root-of-Language-and-the-MAZE-Intake.pdf>** *Why read?* The source of the net reading of the click, the whistle and the Sanskrit root. *Reading advice:* Read the three rungs in order: Sanskrit, whistle, click.

**Konstapel, J. (2026d). Understanding Language and Evolution Through the Sphenoid. constable.blog, 23 May 2026. <https://constable.blog/2026/05/23/understanding-language-and-evolution-through-the-sphenoid/>** *Why read?* Reports Dambricourt Malassé on the flexing skull base and the vocal tract.

**Language Hat. Drum Language. <https://languagehat.com/drum-language/>** *Why read?* Gives the Kele drum phrase for "moon", from a reader citing Carrington's monograph.

**Language Log (2012). Phonemic SFE disconfirmed.** <https://languagelog.ldc.upenn.edu/nll/?p=3742> *Why read?* Reports the technical comment of Jaeger et al. on Atkinson 2011.

**Lieberman, P. & McCarthy, R. (2007). Tracking the evolution of language and speech. Expedition 49(2).** <https://www.penn.museum/sites/expedition/tracking-the-evolution-of-language-and-speech/> *Why read?* Lieberman's position in his own words: the 1:1 tract and the date after 50,000 years.

**Maddieson, I. (2013a). Consonant Inventories. WALS Online, ch. 1.** <https://wals.info/chapter/1>  
**Maddieson, I. (2013b). Vowel Quality Inventories. WALS Online, ch. 2.** <https://wals.info/chapter/2>  
**Maddieson, I. (2013c). Glottalized Consonants. WALS Online, ch. 7.** <https://wals.info/chapter/7>  
**Maddieson, I. (2013d). Presence of Uncommon Consonants. WALS Online, ch. 19.** <https://wals.info/chapter/19>  
**Maddieson, I. (2013e). Tone. WALS Online, ch. 13.** <https://wals.info/chapter/13> *Why read?* The standard world counts of consonants, vowels, airstreams and tone, each with its map. *Reading advice:* In the tone chapter, read the passage on Niger-Congo: the author states why 41.8% is too low.

**Meyer, J. (2015). Whistled Languages: A Worldwide Inquiry on Human Whistled Speech. Springer.** <https://link.springer.com/book/10.1007/978-3-662-45837-2> *Why read?* The reference work on whistled speech. Only the publisher's description was read.

**Mohr, S., Fehn, A.-M. & de Voogt, A. (2019). Hunting for signs: Exploring unspoken networks within the Kalahari Basin. Journal of African Languages and Linguistics 40(1): 115–147.** <https://www.degruyterbrill.com/document/doi/10.1515/jall-2019-0005/pdf> *Why read?* Hunting signs shared across two language families of the Kalahari. Abstract only was read.

**Moran, S. & McCloy, D. (eds.) (2019). PHOIBLE 2.0.** <https://phoible.org/> *Why read?* The database behind every computed count in this Part: 3,020 inventories.

**Moran, S., McCloy, D. & Wright, R. (2012). Revisiting population size vs. phoneme inventory size. Language 88(4): 877–893. Summary at** <https://hraf.yale.edu/ehc/documents/1421> *Why read?* Shows that speaker numbers and inventory size are unrelated. Known here through the HRAF summary.

**Nunn, P.D. & Reid, N.J. (2016). Aboriginal memories of inundation of the Australian coast dating from more than 7000 years ago. Australian Geographer 47(1): 11–47. Abstract at** <https://rune.une.edu.au/web/handle/1959.11/22097> *Why read?* Twenty-one coastal stories dated by sea level. Abstract only was read.

**ScienceDaily (2012). Report on Cysouw, Dediu & Moran, Science 335(6069): 657, a reply to Atkinson (2011), Science.** <https://www.sciencedaily.com/releases/2012/02/120215143001.htm> *Why read?* Summarises Atkinson's claim and the first reply. Atkinson's paper itself was not opened.

**Seifart, F., Meyer, J., Grawunder, S. & Dentel, L. (2018). Reducing language to rhythm: Amazonian Bora drummed language exploits speech rhythm for long-distance communication. Royal Society Open Science 5: 170354.** <https://royalsocietypublishing.org/doi/10.1098/rsos.170354> *Why read?* The measured case that rhythm, not tone, carries drummed speech. *Reading advice:* Read the comparison of 18 names: 7 rhythm patterns against 2 tone patterns.

**Senghas, A., Kita, S. & Özyürek, A. (2004). Children creating core properties of language. Science 305(5691): 1779–1782. Abstract at** <https://pubmed.ncbi.nlm.nih.gov/15375269/> *Why read?* A language watched as it formed. Abstract only was read.

**University of Bristol (2004). Press release on Senghas, Kita & Özyürek.** <https://bristol.ac.uk/news/2004/503.html> *Why read?* Gives the design: three cohorts of 10 and a community of about 800.

**Wikipedia (consulted 2026).** Articles "Airstream mechanism", "Al-Sayyid Bedouin Sign Language", "American Sign Language phonology", "Aṣṭādhyāyī", "Bouba/kiki effect", "Cantonese phonology", "Drums in communication", "FOXP2", "Hawaiian phonology", "Hmong language", "Ideophone", "Ishango bone", "John F. Carrington", "Kam language", "Kebara 2", "Lebombo bone", "Message stick", "Neanderthal anatomy", "Nicaraguan Sign Language", "Pāṇini", "Phoneme", "Pirahã language", "Plains Indian Sign Language", "Pratishakhya", "Rotokas language", "Shiksha", "Shiva Sutras", "Sign language", "Silbo Gomero", "Stokoe notation", "Taa language", "Talking drum", "Tally stick", "Tone (linguistics)", "Vedas", "Vedic chant", "Wampum", "Whistled language", "Yoruba language". <https://en.wikipedia.org/> *Why read?* The secondary source for every fact in this Part that is cited to a Wikipedia page, including the scholars named there (Lieberman & Crelin, Arensburg, Stokoe, Carrington, Staal, Cardona, Sandler and others). *Reading advice:* The primary works behind these pages were not opened. Check them before quoting.

## Part IV. From the Mark to the Alphabet

This Part follows the written sign in the Near East and Europe. It starts with scratched ochre more than 70,000 years old and ends with the 26 letters of the Latin alphabet. Between them stand six rungs. They are the mark, the counted token, the image read for its sound, the syllable sign, the consonant sign and the vowel sign. Each chapter gives the finds, the dates and the counts, and names the people who wrote. Where the sources give different numbers, the range is printed with the name behind each figure. Each chapter then reads its rung in the terms of the net: strand, turn, closure, ring and address.

### Chapter 15. Marks Before Writing

A mark is a line or a shape that a person leaves on a surface on purpose. It stays when the person has gone. No sound is tied to it, so it is not yet writing. This rung holds three kinds of mark: the engraved pattern, the sign beside a painted animal, and the clay counter that stands for a unit of goods.

#### 15.1 Blombos

Blombos Cave lies on the south coast of South Africa. The first report described two finely engraved pieces of ochre from the Still Bay layers, called the M1 phase (Henshilwood et al. 2002). The M1 layers are dated by optically stimulated luminescence to between  $74,900 \pm 4,300$  and  $72,500 \pm 4,600$  years before present. A later study added six more engraved pieces from layers between 70,000 and 100,000 years old (Henshilwood, d'Errico and Watts 2009). Two and six make eight engraved ochres. In 2018 a drawing was reported: nine red lines drawn with an ochre crayon on a stone flake, 73,000 years old (Henshilwood et al. 2018).

The pieces carry engraved lines; the drawing is a cross-hatch. No sign in them is tied to a sound.

#### 15.2 The signs in the caves

In the caves of Ice Age Europe geometric signs stand next to the painted animals. G. von Petzinger built a database that starts from nearly 370 known rock art sites. In 2013 and 2014 she visited 52 cave sites in Spain, Portugal, France and Italy. Her result is a short list: "a mere 32 signs" recur across the whole of Europe over a span of 30,000 years (von Petzinger 2016). An earlier study of hers, limited to France, found 26 distinct shapes at 146 sites.

A set of 32 shapes held for 30,000 years is a small and stable stock.

### 15.3 Line, dot and Y

Bacon and five colleagues took three of these signs: the line, the dot and a sign shaped like a Y (Bacon et al. 2023). Their material comes from at least 400 European caves. The non-figurative signs go back to at least about 42,000 years before present. The figurative images go back to at least 37,000 years. The database itself spans about 37,000 to 13,000 years before present. About 66% of the figurative images have signs with them, a figure the authors take from Sauvet (1987).

The authors analysed sequences of marks placed with animal images.

| Item                | Number   |
|---------------------|----------|
| Sequences without Y | 606      |
| Sequences with Y    | 256      |
| Sequences in all    | 862      |
| Longest sequence    | 13 marks |

The total of 862 is the sum of the first two rows. No sequence in the database holds more than 13 marks. The authors read the lines and dots as a count of lunar months. The count starts at the *bonne saison*, the late spring. The marks beside an animal give a month in that animal's year. The Y sign is read as "to give birth". Its place in the sequence gives the birth month.

The authors call this a proto-writing system and a phenological calendar. Phenology is the study of when things happen in the yearly round of plants and animals. They add that the data "do not explain everything". They leave open whether the system should be called writing.

Two older finds show counting by notches. The Lebombo bone is 42,000 years old and carries 29 notches; it is broken at one end (d'Errico et al. 2012). The Ishango bone is dated to 25,000 years ago, and its purpose is debated.

### 15.4 Tokens and bullae

The third kind of mark is a small object. Denise Schmandt-Besserat collected the small clay counters found at sites across the Near East. She calls them tokens. In her account, tokens stood for units of goods and were used for accounting from 8000 to 3500 BC (Schmandt-Besserat n.d.). The earliest tokens named in the literature come from Tell Abu Hureyra, in the 10th millennium BC, and Ganj-i-Dareh, in the 9th millennium BC. The idea that tokens stand behind writing was first proposed by Pierre Amiet and Maurice Lambert in 1966.

Her sequence has five steps.

| Step               | Date           | What happens                                                                        |
|--------------------|----------------|-------------------------------------------------------------------------------------|
| Tokens             | 8000–3500 BC   | Clay counters, "some three hundred types", stand for units of goods                 |
| Envelopes (bullae) | around 3500 BC | Tokens are sealed inside hollow clay balls                                          |
| Impressed tablets  | about 3200 BC  | The marks pressed on the outside replace the tokens; the ball becomes a flat tablet |
| Pictographs        | about 3100 BC  | Signs are incised with a point                                                      |
| Phonetic signs     | about 3000 BC  | Signs joined "in a rebus fashion" write personal names                              |

A bulla is a hollow clay ball. The tokens went inside and the ball was closed. The tokens were pressed on the wet outside first, so the contents could be seen without breaking the ball. Impressions on bullae start around the middle of the 4th millennium BC. Once the outside told what was inside, the inside was no longer needed.

## 15.5 The criticism

The theory has two halves, and they have fared differently.

The numerical half is accepted. Englund, Friberg and Damerow take the plain tokens as the precursors of the impressed number signs on the first tablets. They add two limits. There was no single coherent token system from the 9th millennium onward. The first tablets also use more than a dozen counting systems, so the counting was not simply one token for one thing.

The other half is the claim that incised "complex" tokens became the non-numerical signs. Zimansky reviewed the catalogue and counted (Zimansky 1993).

| Item in the catalogue                 | Number    |
|---------------------------------------|-----------|
| Tokens claimed                        | 8,162     |
| Entries counted by the reviewer       | 7,412     |
| Subtypes                              | 508       |
| Subtypes attested once or not at all  | about 58% |
| Subtypes with more than four members  | 93 (18%)  |
| Examples of the "sheep" token in all  | 15        |
| Of these, from the 4th millennium BC  | 3         |
| Complex tokens linked to signs        | 50        |
| Of these, known from one example only | 18        |

Zimansky's point is that the links between token and sign rest on visual likeness alone. A token type that exists in one example cannot have been a common counter. He concludes that the data "virtually disprove" the complex-token link.

Michalowski made a second criticism in the same year, known here through the abstract by Buccellati. The tokens are too varied and too scattered in place and time to form one system. The first tablets were "a quantum leap" and "a completely new semiotic form".

A recent study agrees: "token-to-sign comparisons, numerical notations aside, are rarely demonstrable" (Kelley, Cartolano and Ferrara 2025). The same study traces some early signs to the motifs on cylinder seals. The first script then has at least two parents: counters for the numbers, seal images for some of the word signs.

## 15.6 The people

The makers of the Blombos marks are known by eight pieces of ochre and one flake. The makers of the cave signs worked in at least 400 caves over some 30,000 years and kept to 32 shapes. They were hunters. In the reading of Bacon and colleagues, the marks hold what a hunter needs to know: in which month each animal mates and gives birth.

The token users kept account of goods: Schmandt-Besserat's tokens stand for units of goods over 4,500 years. The bulla added a third person: someone who was not present at the sealing and had to trust the ball.

What disappears at this rung is the need to be present. Before the mark, knowledge lived in a body and was passed by voice, dance and showing. Recitation is the form of the oldest bodies of knowledge: the *odù* of Ifá are "recited, not read" (Konstapel 2026a). In Plato's *Phaedrus* the king Thamus tells the inventor of writing that the new art will produce forgetfulness, and that a written text cannot answer back (Konstapel 2010; Konstapel 2026a). The mark opens that road. With it the answering voice is no longer part of the message.

## 15.7 In the net

**The mark outlasts the speaker.** A spoken word is a closure in a living body. It holds for as long as breath and ear hold it. A mark is a closure laid in ochre, rock or clay. The body goes and the sign stays. In the net, only what returns onto itself in phase persists. The spoken word returns only through another speaker. The mark returns each time an eye passes over it. The Egyptian word *ren*, the name, says the same from the other side: a name lasts while it is spoken, and the rope of the cartouche protects it (Konstapel 2009). The mark is the name that no longer needs the speaking.

**The animal is still in the picture.** In the caves the sign stands beside the animal. Sign and animal hold at once; neither stands for the other. This is the first state on the ladder of what leaves the picture: first the animal, then the body, then the thing, then the image. On the cave wall nothing has left yet except the living animal itself. Its image is there and the count is beside it.

**Thirteen.** The sequences of Bacon and colleagues stop at 13 marks. Thirteen is the ceiling of ring 3:  $(3^3 - 1)/2 = 13$ . The authors read the marks as lunar months. The two counts meet on the same number, and the match is left as it is.

**The token is the count without the animal.** A token for a sheep is not a picture beside a sheep. The animal has left; a unit remains. The bulla is a closed mesh in the plain sense: an enclosed space with a measure, sealed, with its content marked on its skin. When the outside carries the count, the inside is the parent that the child no longer shows. The flat tablet is the bulla with one turn added: the same marks, the enclosure gone.

**The other counts.** Thirty-two sign types and some three hundred token types sit on no ring number and are left as they are.

## 15.8 Status

- Counted: 8 engraved ochres at Blombos (2 + 6); 862 sequences in Bacon et al. (606 + 256).
- Read in source: von Petzinger; Bacon et al.; Schmandt-Besserat; Zimansky; Kelley, Cartolano and Ferrara.
- From secondary source: Blombos finds and dates; Lebombo and Ishango bones; earliest token sites; Michalowski; Englund, Friberg and Damerow.
- Open: whether line, dot and Y are a calendar; the meaning of the other 29 cave signs; the share of early word signs that come from seal motifs.

## Chapter 16. Sumer: The Tablet

The first tablets come from the city of Uruk in southern Mesopotamia. They are bookkeeping: lists of goods, people and amounts, written on clay. The signs stand for things and for numbers, not yet for sounds. Over some six centuries the same signs come to stand for syllables, and the script becomes able to write a spoken sentence.

### 16.1 Dates and tablets

The script of the first tablets is called proto-cuneiform. The name means the forerunner of cuneiform, the later wedge-shaped script. The phases are named after building layers at Uruk.

| Phase    | Date (Unicode proposal L2/17-157, on CDLI data) | Tablets from Uruk |
|----------|-------------------------------------------------|-------------------|
| Uruk V   | c. 3500–3350 BC                                 | 190               |
| Uruk IV  | c. 3350–3200 BC                                 | 1,776             |
| Uruk III | c. 3200–3000 BC                                 | 3,094             |

Englund gave an older and shorter dating: Uruk IV and III together at about 3200–3000 BC (Englund 2001). The sources also count the tablets in different ways.

| Count                                              | Number                                                 | Who                                                                    |
|----------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------|
| Tablets and fragments from Uruk, seasons 1928–1976 | "nearly 5000"                                          | Unicode proposal L2/17-157; Woods 2010 ("approximately five thousand") |
| Whole corpus                                       | "over 6000 tablets and fragments", more than 38,000    | Englund 2001                                                           |
| Whole corpus, state of 2020                        | 6,726 artefacts; 5,274 with at least one readable sign | Born and Kelley 2021                                                   |
| Jemdet Nasr                                        | 236                                                    | Wikipedia, "Proto-cuneiform"                                           |
| Umma                                               | 398                                                    | Wikipedia, "Proto-cuneiform"                                           |

### 16.2 How many signs

The number of signs depends on how they are counted. Born and Kelley (2021) show this on one and the same body of data.

| Count                  | Number | Who and how          |
|------------------------|--------|----------------------|
| Sign names in the CDLI | 1,990  | Born and Kelley 2021 |

|                                     |                                                                    |                                    |
|-------------------------------------|--------------------------------------------------------------------|------------------------------------|
| After merging variants              | 1,299                                                              | Born and Kelley 2021               |
| After also splitting compound signs | 705                                                                | Born and Kelley 2021               |
| The same, for Uruk IV–III           | 659                                                                | Born and Kelley 2021               |
| Round figure                        | "approximately 800"                                                | Kelley, Cartolano and Ferrara 2025 |
| Round figure                        | about 2,000: c. 350 numerical, 1,100 single ideograms, 600 complex | Wikipedia, "Proto-cuneiform"       |

The answer is therefore a range from about 700 to about 2,000. The low figure counts each basic shape once. The high figure counts every named variant and every compound. Born and Kelley count 52,943 readable non-numerical sign occurrences in the corpus.

The numbers have their own signs. The Unicode proposal lists 64 numeric signs; the Wikipedia count gives about 350. The tablets use thirteen counting systems (Nissen, Damerow and Englund 1993). Among them are a sexagesimal system, which counts in sixties, a bisexagesimal one, and systems for grain, fields and time. The system used depends on what is counted.

### 16.3 What the tablets record

The tablets record rations, grain, fish, animals, textiles, land and labour (Spar 2004). One early list names 120 officials. The texts fall into two kinds.

| Kind of text, Uruk III | Number | Share |
|------------------------|--------|-------|
| Administrative         | 4,167  | 85.6% |
| Lexical (word lists)   | 703    | 14.4% |
| Together               | 4,870  | 100%  |

The figures are from the Unicode proposal. A lexical list is a fixed list of words of one kind: officials, vessels, animals, places. The lists were copied to train new writers. They are 1% of the Uruk IV texts and 20% of the Uruk III texts. Within a few generations of the first tablet, one text in five was written to pass the script on.

The language behind the first tablets is not proven. Englund finds "no definitive evidence". Sumerian is "the favorite candidate", and Englund himself argues against it from the silence of the texts (Englund 2001). A list of goods and amounts can be read in any language. That is the mark of this rung: the sign is tied to the thing, and the tongue of the reader is free.

### 16.4 The rebus

A rebus is a picture used for a word that sounds like its name. The meaning of the picture is dropped and only the sound is kept. Spar gives an English model: a picture of an eye for "I", a picture of a reed for "read"; together they make "I can read" (Spar 2004).

The Sumerian case is the arrow. The word for arrow is *ti*. The word for life is *til*. The arrow sign was used to write "life". Later the same sign wrote the syllable *ti* wherever it occurred.

The dates for the first rebus differ by source.

| Statement                            | Date                                                      | Who                    |
|--------------------------------------|-----------------------------------------------------------|------------------------|
| Rare cases of rebus                  | c. 3200–3000 BC                                           | Spar 2004              |
| First appearance, Jemdet Nasr period | c. 3100–2900 BC                                           | Wikipedia, "Rebus"     |
| Personal names written by sound      | "about 3000 BC"                                           | Schmandt-Besserat n.d. |
| Rebus becomes important              | "not before the first quarter of the third millennium bc" | Woods 2010             |
| Consistent writing of sound          | "only after 2600 B.C."                                    | Spar 2004              |

The first use is for personal names. A list of rations must say who received them. A name cannot be drawn, so it is spelled with the signs of things that sound like its parts.

## 16.5 To syllabic cuneiform

From about 2800 BC signs are used for their syllable value, and the texts are clearly in Sumerian. Around 2700 BC the wedge-tipped stylus comes into use, and the drawn line becomes a pressed wedge. Later the signs turn 90° counter-clockwise, about the time of Lugalzagesi.

By the texts of the Royal Cemetery of Ur, about 2700–2600 BC, writing has left accounting (Schmandt-Besserat n.d.). It now records names and dedications for the dead.

The stock of signs shrinks as the sound signs take over.

| Stage                 | Number of signs                   | Source                 |
|-----------------------|-----------------------------------|------------------------|
| Early cuneiform       | "some 1,500"                      | Wikipedia, "Cuneiform" |
| Later cuneiform       | "some 600"                        | Wikipedia, "Cuneiform" |
| Working syllabary     | "about 400"                       | Schmandt-Besserat n.d. |
| Old Persian cuneiform | 36 phonetic signs and 8 logograms | Wikipedia, "Cuneiform" |

A logogram is a sign for a whole word. Cuneiform is a mixed script: word signs and syllable signs side by side. Only the late Old Persian form, with 36 sound signs and 8 word signs, comes close to a pure sound script.

## 16.6 The last tablet

From the first Uruk tablets to the last text, cuneiform was written for more than three thousand years. The last known text is an astronomical tablet. The source gives two dates for it: AD 75 and AD 79/80. Grotefend made the first step toward reading it again in 1802, on the Old Persian form. The decipherment was complete by 1857.

## 16.7 The people

The first writers were the accountants of temples and large estates (Spar 2004). They counted what came in and what went out. The corpus is about 6,000 to 6,700 pieces from a few sites over three or four centuries. That is the work of a small group.

They trained their successors with the word lists. The script had its school lists before it wrote sentences.

For the later periods the older view is that only scribes could read. Wilcke and Charpin argue that a working literacy was "somewhat widespread" in the Old Babylonian period.

What disappeared with the rebus is the freedom of the reader's tongue. A list of things can be read in any language. A sign read as *ti* can be read only by someone who speaks the language in which an arrow is *ti*.

## 16.8 In the net

**The tablet is the flat bulla.** The bulla enclosed its tokens. The tablet carries the same marks and encloses nothing. Each form stands on its parent: token, bulla, impressed tablet, incised tablet. Each is the parent plus one turn. At no step does a form appear without the one before it.

**The count stays with the thing.** The number signs keep their own road from the first tablet on. Thirteen counting systems, chosen by what is counted, is counting that has not yet left the thing.

**The rebus is one turn.** Before the rebus the arrow sign stands for an arrow. That is the parent. The rebus adds one turn: the image now stands for its sound. Nothing new is drawn. The same sign is read at another depth. This is the step "times three, plus the turn" in writing: the existing form moves one place deeper and a single turn is added on top.

**Turn zero remains.** Turn 0 is the parent itself, and it is lawful. The arrow sign went on writing "arrow". Cuneiform kept word signs beside the syllable signs. The parent was not replaced; it stands inside the child. A mixed script is a script in which the zero turn and the new turn are both in use.

**The thing leaves the picture.** On the cave wall the animal left and its image stayed. With the token the body of the witness left. With the rebus the thing leaves: the arrow is no longer meant. With the wedge and the quarter turn of the signs the image itself begins to go. All four steps of the ladder are present in Sumer, the last one only begun.

**From at-once to one-after-another.** A word sign holds a whole word at once. A row of syllable signs lays the word out in sequence. The stock of signs falls from some 1,500 to some 600, with about 400 in working use. Fewer signs, longer rows: the route gets deeper as the stock of signs gets smaller.

## 16.9 Status

- Counted: 4,870 Uruk III texts (4,167 + 703), shares 85.6% and 14.4%.
- Read in source: phase dates; tablet counts; sign counts 1,990, 1,299, 705, 659 and "approximately 800"; contents; the language question; rebus dates of Spar, Woods and Schmandt-Besserat.
- From secondary source: tablets per phase and site; the count of about 2,000 signs; thirteen numeral systems; the arrow example; syllabic use from 2800 BC; the last tablet.
- Open: the language of the first tablets; the date of the first rebus (3200 to 2600 BC by source); the number of distinct signs.

## Chapter 17. Egypt: Image and Sound

Egyptian writing appears at about the same time as the first tablets of Uruk. It keeps the picture for more than three thousand years. Each written word joins up to three kinds of sign: a picture of the thing, signs for the consonants, and a silent sign for the class the word belongs to. This rung is image-sound writing in its fullest form.

## 17.1 Tomb U-j

The oldest Egyptian writing known comes from tomb U-j at Abydos. Günter Dreyer of the German Archaeological Institute in Cairo found it in 1988. The tomb has 12 chambers. In it lay small tags of bone and ivory, and inscribed jars. The tags carry numbers or short groups of signs. The sign groups are read as place names; Bast and Buto have been proposed.

The sources count the tags differently.

| Count         | Number                                                             | Who                                           |
|---------------|--------------------------------------------------------------------|-----------------------------------------------|
| Labels        | "some 150", of which 43 carry numbers only                         | <i>The Past</i> , "The discovery of Tomb U-j" |
| Tags          | "160 +"                                                            | Raffaele, citing Dreyer 1998                  |
| Tags and jars | "some two hundred" tags and "more than one hundred inscribed jars" | Woods 2010                                    |

The dates also form a range.

| Date                                                        | Who                     |
|-------------------------------------------------------------|-------------------------|
| Naqada IIIa2, c. 3150 BC                                    | Raffaele                |
| "3300–3200 bc" for the earliest writing                     | Woods 2010              |
| Five calibrated radiocarbon ranges between 3490 and 3030 BC | Wikipedia, "Scorpion I" |

A rebus has been claimed for Abydos at about 3400 BC. If the place names on the tags are spelled by sound, Egyptian writing used sound signs from its first known day.

The finds at Abydos made Egyptian writing "contemporaneous with the Mesopotamian invention" (Woods 2010). Whether the two arose apart is not settled. Regulski (2016) points to the differences "in structure and style" and concludes that Egypt developed its script separately. Sampson holds it "probable that the general idea" of writing was brought to Egypt from Sumerian Mesopotamia.

## 17.2 How many signs

The number of hieroglyphs changed over time, and the sources differ for each period.

| Period         | Number of signs | Who                               |
|----------------|-----------------|-----------------------------------|
| Old Kingdom    | "over 1,000"    | Biblical Archaeology Society 2022 |
| Middle Kingdom | "about 750"     | Biblical Archaeology Society 2022 |
| Middle Kingdom | "about 900"     | Wikipedia, "Egyptian hieroglyphs" |

|                                               |                   |                                   |
|-----------------------------------------------|-------------------|-----------------------------------|
| Middle Kingdom, Gardiner's list with variants | 760               | Lehmann 2007                      |
| Ptolemaic and Roman period                    | "up to 8,000"     | Biblical Archaeology Society 2022 |
| Ptolemaic and Roman period                    | "more than 5,000" | Wikipedia, "Egyptian hieroglyphs" |
| All periods together                          | "almost 7000"     | Lehmann 2007                      |

The working stock of the classical language was therefore 750 to 1,000 signs. In the Ptolemaic and Roman period the count rose to between 5,000 and 8,000.

### 17.3 Signs for one, two and three consonants

Egyptian sound signs write consonants only. Vowels are not written. A sound sign stands for one, two or three consonants.

| Kind of sign                | Consonants per sign | Number                                                     | Source                                                        |
|-----------------------------|---------------------|------------------------------------------------------------|---------------------------------------------------------------|
| Uniliteral                  | 1                   | 24 consonants, shown today with 26 glyphs (two alternates) | Wikipedia, "Egyptian uniliteral signs"                        |
| Biliteral                   | 2                   | 102                                                        | Lehmann 2007                                                  |
| Biliteral, by another table | 2                   | 161 rows, 152 distinct signs                               | count from the table in Wikipedia, "Egyptian biliteral signs" |
| Triliteral                  | 3                   | 48                                                         | Lehmann 2007                                                  |

The 24 one-consonant signs cover the 24 consonants. The Egyptians used them beside the two- and three-consonant signs and the word signs. The small set stood inside the large script long before anyone used such signs alone.

### 17.4 The class sign

A determinative is a silent picture sign placed after a word. It has no sound value. It shows the class to which the word belongs. Goldwasser describes determinatives as classifiers: they "never stand in arbitrary relation to the word they classify". One word can take up to four of them (Goldwasser n.d.a).

The house sign shows how the three parts work together. As a picture it writes the word "house", which in Egyptian has the consonants *pr*. The same sign also writes the sound *pr* in other words. The verb "go out" has the same consonants *pr*. It is written with the house sign for the sound and a pair of walking legs after it for the class: movement.

| Written                   | Image     | Sound     | Class sign | Reads    |
|---------------------------|-----------|-----------|------------|----------|
| House sign alone          | house     | <i>pr</i> | —          | "house"  |
| House sign + walking legs | (dropped) | <i>pr</i> | movement   | "go out" |

A royal name shows the rebus at work. Ramesses is written Ra-mes-su: the sign of the sun god for *Ra*, the sign of a child for *mes*, the sign of a sedge plant for *su*.

## 17.5 How one word holds three parts

The script mixes three kinds of sign: word signs, sound signs for one, two or three consonants, and silent class signs. A written word can use all three:

1. a picture may write the word itself;
2. sound signs give the consonants;
3. up to four class signs follow the word and show its kind.

The same picture can serve in more than one role. The house sign is an image in "house" and a sound in "go out". What a sign does is read off from its place in the word.

The three roles were described as three layers in an earlier text: ideogram, phonogram and silent determinative (Konstapel 2026c). That text adds that hieroglyphs were sung. The written word was meant to be voiced.

## 17.6 Hieratic and demotic

Beside the hieroglyphs stood two cursive forms. Cursive means written with a running hand, the signs simplified.

| Script      | In use                                                    | Notes                                            |
|-------------|-----------------------------------------------------------|--------------------------------------------------|
| Hieroglyphs | to AD 394                                                 | Last text: the graffito of Esmet-Akhom at Philae |
| Hieratic    | from Naqada III, c. 3200–3000 BC, into the 3rd century AD | Cursive; religious use into the 3rd century AD   |
| Demotic     | from around 650 BC                                        | Second cursive                                   |

Hieratic is about as old as the hieroglyphs themselves. From the start there were two hands. The numerals show the difference. In hieroglyphs the number 9,999 takes 36 signs. In hieratic it takes 4.

The last hieroglyphic text is dated AD 394. Champollion deciphered the script in the 1820s with the Rosetta Stone.

## 17.7 The people

Few Egyptians could read. The estimates come from Baines and Eyre, as reported by Zinn (2013).

| Place and time                     | Share that could read              | Source                                    |
|------------------------------------|------------------------------------|-------------------------------------------|
| Egypt, 3rd millennium BC           | about 1%                           | Baines, in Zinn 2013                      |
| Egypt, overall                     | "1 to 5 percent of the population" | Baines, in Zinn 2013                      |
| Egypt, 4th century BC              | 7%                                 | Baines, in Zinn 2013                      |
| Deir el-Medina (workmen's village) | "5 percent or above"               | Lesko 1994 and Janssen 1992, in Zinn 2013 |
| Lahun (town)                       | up to 15%                          | UCL Digital Egypt                         |

The figures rest on indirect counts and give an order of magnitude. In the Old Kingdom one person in a hundred could read. In a town of craftsmen and officials it could be one in seven.

A reader had to know 750 to 1,000 signs and the roles each could take. The script and its small circle of readers held each other up.

Much was kept on this rung. The picture stayed. The class sign stayed. What went missing in the writing is the vowel. An Egyptian word on the wall is a row of consonants with a picture at its end. The voice that filled in the vowels is not on the wall.

## 17.8 In the net

**Three parts held at once.** The Egyptian written word holds an image, a sound and a class sign. They are not three steps in a sequence. They hold together in one written word, each from its own side: what the thing looks like, how the word sounds, what kind of thing it is. This is the rung of image-sound writing. Chinese stayed on this rung and went deep. The alphabet later kept one of the three parts.

**The class sign closes the word.** An open window carries tension; a closed one carries none. A row of consonant signs without vowels stays open: *pr* can be "house" or "go out". The class sign after it settles the reading and marks the end of the word. With the walking legs in place the word is closed. Reading goes on to the next.

**One sign, three states.** The house sign can be image, sound or class sign. Which one it is in a given word is not written on the sign. It is read off from where the sign stands. One form in three states is the shape of the trit.

**The parent stands inside the child.** The 24 one-consonant signs stood inside hieroglyphic writing as a part of the large script. The alphabet, when it came, was not a new principle. It was a part of the parent, used alone. The same holds one step earlier: a rebus is claimed for the oldest Egyptian writing at Abydos.

**Two layers.** Hieroglyphs and hieratic are about as old as each other. The hieroglyphic form holds still from the tags of tomb U-j to the graffito of AD 394. The cursive form is where the change happens: hieratic, then demotic. The script has an address layer that stands still and a layer in which things move, as the two-layer law says of every closure.

**The vowel is not written.** The consonants are the frame of the Egyptian word and they are fixed in the sign. The vowels are the breath that passes through the frame, and they are left to the speaker. The written word holds the frozen layer. The living layer stays in the mouth.

**The counts.** The sign counts of this chapter are 24, 102 or 152, 48, and 750 to 1,000. Twenty-four is the count of ring 3 without its three uniform rooms:  $27 - 3 = 24$ . The other counts sit on no ring number and are left as counted.

## 17.9 Status

- Counted: 152 distinct two-consonant signs in the Wikipedia table.
- Read in source: tag counts and dates of *The Past*, Raffaele and Woods; sign counts per period; Goldwasser on class signs; literacy in Deir el-Medina and Lahun.
- From secondary source: radiocarbon ranges; content of the tags; Regulski and Sampson; counts of one-, two- and three-consonant signs; hieratic and demotic; the Baines figures, through Zinn (2013).
- Open: the date of tomb U-j; whether Egyptian writing arose apart from Mesopotamia; the number of class signs (not found); the vowels of Egyptian.

## Chapter 18. The First Alphabet

The alphabet was made once. Speakers of a Semitic language, working for Egyptians, took a few dozen picture signs and read each one by the first sound of its name in their own tongue. The result was a script of fewer than thirty signs. This chapter gives the finds, the disputed dates and the question of who made it.

### 18.1 Serabit el-Khadim

Serabit el-Khadim is a site in the Sinai with turquoise mines. Petrie found 10 inscriptions in an unknown script in 1905. Later work added 37 (Wilson-Wright 2019). The whole early corpus is about 50 texts: "nearly 40" from Serabit and 2 from Wadi el-Hol (Unicode proposal L2/19-299).

In 1916 Gardiner read one group of signs as *b'lt*, "Lady". The Lady is Baalat, the Semitic name for Hathor. That reading showed two things. The language is Semitic. The signs are letters, each for one consonant.

The texts are short: the name of a god, the name of a person, a few words.

### 18.2 Wadi el-Hol

Wadi el-Hol lies on a desert road near Thebes in Upper Egypt. John and Deborah Darnell found two rock inscriptions there, each a single line. The year of the find is given as 1993 in one Wikipedia article and as 1999 in another.

The inscriptions are dated to the reign of Amenemhat III. A nearby Egyptian text names a man called Bebi, "general of the Asiatics". Darnell and his colleagues propose that Semitic soldiers under this general wrote the two lines (Wilson-Wright 2019). Goldwasser calls Wadi el-Hol "a small, two-line example" and places it "a little later than the Sinai inscriptions" (Goldwasser 2010).

### 18.3 The date

The date of the first alphabet is disputed across six centuries.

| Date                                                  | Who                                          |
|-------------------------------------------------------|----------------------------------------------|
| Reigns of Amenemhat III–IV, 1831–1777 BC              | Gardiner 1916                                |
| New Kingdom, 1550–1065 BC                             | Leibovitch 1963                              |
| 19th century BC                                       | Sass 1988                                    |
| 13th century BC                                       | Sass 2004/2005                               |
| "circa 1840 B.C.E.", probably under Amenemhat III     | Goldwasser                                   |
| 17th or 16th century BC for most texts                | Wilson-Wright 2016, as reported in Wikipedia |
| 1850 BC Proto-Sinaitic; 1600 BC first Proto-Canaanite | timeline in Woods 2010                       |
| "about 1500 BC"                                       | Schmandt-Besserat n.d.                       |

All figures except the last three are as reported by Wilson-Wright (2019) and the Unicode proposal. Sass stands in the table twice. In 1988 he placed the script in the 19th century BC. In 2004/2005 he moved it to the 13th. The range of dates is therefore the 19th to the 13th century BC, and one scholar has held both ends.

## 18.4 How many signs

| Count                        | Who                                                                                         |
|------------------------------|---------------------------------------------------------------------------------------------|
| "at least 27 signs"          | Unicode proposal L2/19-299                                                                  |
| "initially twenty-<br>-----" | Naveh, quoted in the same proposal                                                          |
| 22                           | summary of Goldwasser's position, Biblical Archaeology Society; also Schmandt-Besserat n.d. |
| number and order<br>unknown  | Wikipedia, "History of the alphabet"                                                        |

The count is 22 or at least 27. The Ugaritic alphabet, some centuries later, has 27 letters and 3 added ones. The order of the letters in the earliest Sinai texts is not known.

## 18.5 Acrophony

Acrophony is the rule by which a picture stands for the first sound of its name. A whole word shrinks to one consonant. Goldwasser states it in one sentence: "Only the first sound is taken from the picture" (Goldwasser n.d.b).

The rule works in the language of the makers, not in Egyptian. The Egyptian house sign has the value *pr*. The Semitic word for house is *bayt*. The makers of the alphabet looked at the house sign, said *bayt*, and kept the *b*. The Egyptian sign for a head is read *tp* in Egyptian. The Semitic word is *raš*. The sign becomes *r*.

The table gives the signs for which the sources record the picture, the Semitic name and the sound.

| Picture          | Egyptian model                 | Semitic name | Meaning     | Consonant | Later letter            |
|------------------|--------------------------------|--------------|-------------|-----------|-------------------------|
| Ox head          | Gardiner sign F1               | ʾalp         | ox          | ʾ         | aleph → Greek alpha → A |
| House plan       | Gardiner sign O1 ( <i>pr</i> ) | bayt         | house       | b         | bet → beta → B          |
| Throw-stick      | Gardiner sign T14              | gaml         | throw-stick | g         | gimel → gamma → C, G    |
| Door             | —                              | dalt         | door        | d         | dalet                   |
| Arm, hand        | —                              | yad          | hand        | y         | yod                     |
| Palm of the hand | —                              | kap          | palm        | k         | kaf                     |
| Ox-goad          | —                              | lamd         | goad        | l         | lamed                   |
| Water ripple     | —                              | maym         | water       | m         | mem                     |
| Snake            | —                              | naḥš         | snake       | n         | nun                     |
| Eye              | —                              | ʾayn         | eye         | ʾ         | ayin                    |

|            |                                   |     |      |   |      |
|------------|-----------------------------------|-----|------|---|------|
| Head       | Gardiner sign D1<br>( <i>tp</i> ) | raš | head | r | resh |
| Cross mark | —                                 | taw | mark | t | taw  |

The names and meanings are those reconstructed in the Unicode proposal L2/19-299. That proposal also lists *qop* and *šamš*, "sun". The Gardiner numbers refer to the standard list of hieroglyphs.

Twelve everyday things make twelve consonants: an ox, a house, a stick, a door, a hand, a palm, a goad, water, a snake, an eye, a head, a mark. Hamilton (2006) finds Egyptian models for almost all the letters. The shapes are Egyptian. The names and the sounds are Semitic. Nothing else was taken over: no two-consonant signs, no class signs, no rules of spelling.

## 18.6 Who made it

Two answers stand against each other.

Goldwasser holds that the makers were Canaanite workers at the turquoise mines of Serabit el-Khadim. They "could not read Egyptian". The alphabet was made on the "periphery of society, in Sinai". The expeditions to the mines were staffed by "trained soldiers, sailors and donkey drivers". The alphabet then "spent hundreds of years on the 'bottom' of the cultural market" (Goldwasser n.d.b). The Biblical Archaeology Society sums up her position as "illiterate Canaanite miners".

Rainey holds the opposite. The makers were "highly sophisticated Northwest Semites" who knew Egyptian writing and wrote on papyrus that is now lost.

Goldwasser's argument rests on what the makers did not do. A person who could read Egyptian would know that the house sign is *pr*. The makers read it as *bayt*. They saw the pictures and did not know the values. For Wadi el-Hol the proposal of Darnell and colleagues points the same way: soldiers, not scribes.

## 18.7 Lachish: dagger, sherd and comb

For several centuries after Sinai the finds are few. Three come from Tel Lachish in the southern Levant.

| Obj        | Found                                      | Text                                    | Date                                         | Source                |
|------------|--------------------------------------------|-----------------------------------------|----------------------------------------------|-----------------------|
| Dagger     | 1934, tomb 1502                            | "four potential early alphabetic signs" | late Middle Bronze Age                       | Höflmayer et al. 2021 |
| Sherd      | 2018                                       | two lines of three letters              | context 1460–1430 BC (1σ), 1485–1425 BC (2σ) | Höflmayer et al. 2021 |
| Ivory comb | excavated 2016; text noticed December 2021 | 17 letters, seven words                 | c. 1700–1550 BC by letter shape              | Vainstub et al. 2022  |

The dagger was accepted by Sass in 1988; later he grew cautious. His low view is that Palestine has no sure alphabetic text before the 14th century BC, and perhaps none before 1300 BC. The sherd of 2018 answers this. It comes from a context dated by radiocarbon to the 15th century BC. Höflmayer and colleagues call it the "missing link" between Sinai and the later Levant.

The comb is of elephant ivory and measures 3.66 by 2.51 cm. Its text is a full sentence.

*ytš ḥt d lqml š'[r w]zqt* — "May this tusk root out the lice of the hai[r and the] beard."

The date of the comb is not secure. It rests on the shape of the letters only. Radiocarbon dating failed twice. The comb was found in a much later layer, of Iron Age II.

The sentence on the comb is seventeen letters about lice, scratched on an object of daily use.

### 18.8 Umm el-Marra

In 2004 G. Schwartz of Johns Hopkins University excavated a tomb at Umm el-Marra in Syria. In it were four lightly baked clay cylinders, each the length of a finger. They carry incised signs.

| Item               | Detail                                                         | Source                          |
|--------------------|----------------------------------------------------------------|---------------------------------|
| Date, 2021 release | "about 2300 BCE"                                               | JHU Hub 2021                    |
| Date, 2024 release | "around 2400 BCE", by radiocarbon                              | JHU Hub 2024                    |
| Claim              | "precedes other known alphabetic scripts by roughly 500 years" | JHU Hub 2024                    |
| Reading            | one cylinder read <i>silanu</i> , perhaps a name               | <i>Scientific American</i> n.d. |

The status is open. C. Rollston finds that the letter forms match the early alphabet. S. Ferrara says: "It's an alphabet." P. Steele has doubts: the signs are too few, and "we have to hope for more finds". Schwartz himself calls it "certainly not a definitive case".

If the cylinders are alphabetic, the alphabet is some five centuries older than the other known texts. Four small cylinders have not settled that.

### 18.9 Ugaritic and the two orders

Ugarit lay on the Syrian coast, at Ras Shamra; the script was found in 1928. Its scribes wrote an alphabet on clay with a reed. The signs are made of wedges and look like cuneiform. The system is alphabetic.

| Item          | Detail                                                                 |
|---------------|------------------------------------------------------------------------|
| Letters       | 30                                                                     |
| Build         | 27 + 3: the last three (‘i, ‘u, s <sub>2</sub> ) were added at the end |
| In use        | from c. 1400 or c. 1300 BC to c. 1190 BC                               |
| Letter lists  | about twelve tablets give the letters in order                         |
| Orders        | two                                                                    |
| Short variant | a shorter alphabet, found at Beth Shemesh                              |

A list of the letters in fixed order is called an abecedar. The Ugaritic abecedaries show two orders.

| Ord        | Begi          | Evidence                | Lives on in             |
|------------|---------------|-------------------------|-------------------------|
| ‘abg<br>ad | ‘, b,<br>g, d | Ugarit, 14th century BC | Hebrew,<br>Greek, Latin |

|             |               |                                                                                                    |                     |
|-------------|---------------|----------------------------------------------------------------------------------------------------|---------------------|
| hala<br>ḥam | h, l,<br>ḥ, m | Ugarit tablet RS 88.2215; oldest list on an ostrakon from tomb TT99<br>near Luxor, 15th century BC | Ge'ez<br>(Ethiopic) |
|-------------|---------------|----------------------------------------------------------------------------------------------------|---------------------|

The oldest halaḥam list was read by Ben Haring of Leiden University and published in 2015 (Leiden University 2015). It is a piece of limestone from a Theban tomb, written in hieratic. An Egyptian scribe of the 15th century BC wrote down the first letters of a foreign alphabet in his own cursive. Both orders are thus older than Phoenician. Both "proved remarkably stable": the first is the order of A, B, C; the second is the order of the Ethiopic script today.

## 18.10 The people

The first alphabet has no named author. Its makers were among the Semitic speakers whom the Egyptian state brought to its mines and desert roads. Goldwasser names the kinds of people on such expeditions: soldiers, sailors, donkey drivers, miners. The corpus they left is about 50 short texts.

They stood beside a script of 750 to 1,000 signs, written by the one person in a hundred who had learned it. They could not read it. They could see it. They took the pictures and gave them their own names.

At Ugarit the alphabet was in the hands of scribes who wrote on clay. About twelve of their practice tablets give the letters in fixed order.

What disappeared with the alphabet is the profession's hold on the script. A script of 22 to 30 signs is a small thing to learn beside one of 750 to 1,000. It also dropped the class sign and the picture of the thing. A hieroglyphic word shows what it is about. A row of letters shows nothing until it is sounded.

## 18.11 In the net

**The makers did not know the large script.** A reader of Egyptian holds the house sign at its address in the Egyptian script: *pr*, with its three roles. The makers of the alphabet did not hold that address. They saw the picture and said its name in their own tongue: *bayt*. The sign was placed anew, from its content, in another language. An address is computed from content and never assigned. The alphabet came from people for whom the assigned values did not exist.

**Acrophony is one more turn.** The rebus was one turn: the image stands for the sound of its name. Acrophony adds one turn to that: of the sound of the name, only the first sound. Image, then name, then first consonant. Each step is the parent plus one turn, and the earlier steps remain visible inside the later one: the letter is still a picture, and its name is still the word.

**The parent stands inside the child.** The one-consonant signs stood inside hieroglyphic writing before the alphabet used them alone. The makers in Sinai did not borrow those 24 signs. They made the same step again with other pictures. The principle was in the parent; the child stands on it with new signs. In the same way the cuneiform wedge stands inside the Ugaritic letter, and the hieratic hand stands under the oldest halaḥam list.

**One part of three.** Image-sound writing holds image, sound and class sign at once. The alphabet keeps one part: the sound. The class sign goes. The image stays for a time as the shape of the letter and then fades. Of what leaves the picture at each rung — first the animal, then the body, then the thing, then the image — this is the fourth step.

**The alphabet on ring 3.** Ring 3 has 27 rooms, and one sign of a 27-sign alphabet is 3 trits (Konstapel 2026n). The early alphabet is counted as "at least 27" or "initially twenty-seven". Ugaritic is 27 with 3 added at the end. On this count the first alphabet fills ring 3. The other count, 22, lies inside ring 3 and leaves five rooms empty. Thirty lies above it: the three Ugaritic additions go past the ring. The scribes placed them at the end, outside the old order.

**From full to thin.** A click language such as !Xóõ has 161 segments in the PHOIBLE register. The median spoken inventory has 33 segments and needs ring 4, with 81 rooms. The alphabet has 22 to 27 signs and lands on ring 3. Writing took one ring less than speech. The sounds that have no letter are left to the reader.

**A text has a depth.** With 3 trits per sign, a text of L signs has depth 3L. The two lines on the Lachish sherd hold 6 letters: depth 18. The sentence on the comb holds 17 letters: depth 51. Every finite text has exactly one address, and the address is the text itself, read as a route.

**The order is frozen.** The two letter orders are attested in the 15th and 14th centuries BC and both still stand. The order carries no meaning and has held for some 3,400 years. It is the address layer of the alphabet: frozen, counted, the same for every user. What is written with the letters is the layer in which things happen.

## 18.12 Status

- Counted:  $10 + 37 = 47$  Serabit texts by Wilson-Wright, against "nearly 40" in the Unicode proposal; text depths 18 and 51.
- Read in source: Wilson-Wright (2019); Unicode proposal L2/19-299; Goldwasser; Höflmayer et al. (2021); Vainstub et al. (2022); the Umm el-Marra reports; the Leiden release.
- From secondary source: Gardiner's reading; the Wadi el-Hol find; the 17th–16th century date; the chains for ox, house and throw-stick; all Ugaritic figures.
- Open: the date (19th to 13th century BC); the sign count (22 or at least 27); the makers (miners or scribes).
- Open: the Wadi el-Hol find year (1993 or 1999); the date of the Lachish comb; the status of Umm el-Marra; the earliest letter order.

## Chapter 19. From Consonants to Vowels

For its first centuries the alphabet wrote consonants only. A script of this kind is called an abjad. The Phoenicians fixed it at 22 letters, and from them it went east and south as a consonant script. The Greeks took the same letters and gave some of them to vowels. From Greek come all the alphabets of Europe.

### 19.1 Phoenician

Phoenician has 22 letters, all consonants, written from right to left. The oldest texts date to the 10th century BC. The epitaph of King Ahiram is placed at about 1000 BC, a dating that is disputed. Naveh puts the start of the Phoenician script in "the mid-eleventh century B.C." The script stayed in use from about 1050 to 146 BC.

### 19.2 The Semitic daughters

| Script           | Letters         | Date                                              | Parent            | Notes                                                            |
|------------------|-----------------|---------------------------------------------------|-------------------|------------------------------------------------------------------|
| Phoenician       | 22              | c. 1050–146 BC                                    | Early             | Right to left                                                    |
| Paleo-Hebrew     | 22              | 10th century BC (Gezer calendar) to AD 135        | Phoenician        | Mostly replaced by the Aramaic script by the 5th century BC      |
| Aramaic          | 22              | c. 800 BC – AD 600                                | Phoenician        | Separate from Phoenician by the 8th century BC; Imperial Aramaic |
| Square           | 22              | from about the 3rd                                | Aramaic           | The Hebrew script of today                                       |
| Arabic           | 28, on 18 basic | first texts AD 328–568                            | Nabataean Aramaic | Dots tell the shapes apart                                       |
| Ancient South    | 29              | late 2nd millennium BC, or 9th century BC, to the | Early alphabetic, | Cursive form <i>zabur</i> on palm-leaf stalks                    |
| Ge'ez (Ethiopic) | 26 consonants   | vowels added c. AD 350                            | South Arabian     | Order <i>halāḥamä</i>                                            |

**Aramaic.** In Aramaic some consonant letters also serve as marks for long vowels. They are called *matres lectionis*, "mothers of reading". This is the first step toward writing vowels: a consonant letter does a second duty.

**Arabic.** The Arabic script comes from Nabataean Aramaic. Four early texts mark its growth.

| Text             | Date         | Notes                               |
|------------------|--------------|-------------------------------------|
| Namara           | AD 328       | Arabic language in Nabataean script |
| Zabad            | AD 512       | 15 letter shapes for 28 sounds      |
| Jabal Usays      | AD 528       |                                     |
| Harran           | AD 568       |                                     |
| Papyrus PERF 558 | April AD 643 | First sure use of dots              |

Arabic has 28 consonants and inherited fewer shapes: 15 at Zabad, 18 in the developed script. Several sounds shared one shape. Dots above or below the shape tell them apart. The first sure use of dots is in a papyrus of April 643. The marks for short vowels came later. The modern system was "finalized around 786 by al-Farahidi".

**South Arabian.** The sources date its start differently: the late 2nd millennium BC by the Wikipedia article, the 9th century BC by the Unicode proposal L2/19-299. The earliest pieces are sherds from Raybun in Hadhramaut.

**Ethiopic.** Ge'ez descends from South Arabian. It began as a consonant script written right to left. In the 4th century AD, under King Ezana, about AD 350, each consonant sign was given a mark for the vowel that follows it. The direction changed to left to right. The result has 26 consonants in 7 vowel orders:  $26 \times 7 = 182$  basic forms. A script in which each sign is a consonant with a built-in vowel is called an abugida. Ge'ez keeps the *halāḥamä* order of the 15th-century ostrakon from Thebes.

### 19.3 Greek and the vowel letters

The Greeks took the Phoenician letters in the early 8th century BC, perhaps on the island of Euboea. The earliest fragments date to 770–750 BC. The first longer texts are the Dipylon jug and the Cup of Nestor, both of the late 8th century BC.

Greek has no use for several consonants of the Semitic throat. The letters for them were given to vowels.

| Phoenician letter | Semitic value | Greek letter        | Greek value           |
|-------------------|---------------|---------------------|-----------------------|
| aleph             | ʾ             | alpha               | a                     |
| he                | h             | epsilon             | e                     |
| yod               | y             | iota                | i                     |
| ayin              | ʿ             | omicron             | o                     |
| waw               | w             | upsilon and digamma | u and w               |
| het               | ḥ             | eta                 | first h, later long e |

Five letters were added at the end: upsilon, phi, chi, psi and omega. Greek is the first script that writes vowels as a rule, with the same standing as consonants.

The early Greek alphabets differed from region to region. Kirchhoff (1887) sorted them into three groups by colour: green for Crete, red for Euboea and the West, blue for Ionia, Attica and Corinth. The direction also varied. The first texts run right to left or boustrophedon, which means turning at each line end as an ox turns when ploughing. Left to right became the norm in the classical period.

Athens adopted the Ionic alphabet in 403/2 BC, under the archon Eucleides. That is the standard Greek alphabet of 24 letters. Three older letters were dropped from writing: digamma, san and koppa. They were kept as numerals, so the Greek number alphabet has  $24 + 3 = 27$  signs (Schmandt-Besserat n.d.).

## 19.4 Etruscan and Latin

The Etruscans of central Italy took the alphabet from Euboean Greeks at Pithekoussai and Cumae, from about 700 BC. The Marsiliana tablet of about 700 BC lists 26 letters. By 400 BC the Etruscans used 20. They wrote mostly right to left.

The Latin alphabet came from Etruscan in the 7th century BC. Its growth to 26 letters took some 2,300 years.

| Stage           | Letters | What changed                                               | Date                  |
|-----------------|---------|------------------------------------------------------------|-----------------------|
| Archaic Latin   | 21      | With Z, without G                                          | 7th century BC onward |
| G               | 21      | G takes the place of Z; Plutarch credits Spurius Carvilius | 3rd century BC        |
| Classical Latin | 23      | Y and Z added at the end, after the conquest of Greece     | 1st century BC        |
| W               | 24      | A doubled V; common from the later 11th century            | 11th century AD       |
| U               | 25      | The rounded capital U is told apart from V                 | 16th century          |

|        |    |                                                                       |                     |
|--------|----|-----------------------------------------------------------------------|---------------------|
| J      | 26 | Trissino first separates I and J in 1524; in English in 1629 and 1633 | 16th–17th century   |
| Modern | 26 | Standard                                                              | by the 18th century |

The running count in the second column is the sum of the additions. Y and Z were taken from Greek. W is a doubled V. U is a rounded V. J was separated from I. Z lost its place to G in the 3rd century BC and came back at the end of the row two centuries later.

## 19.5 The alphabets made by one person

After Greek and Latin, several alphabets were made at one time for one language. A Greek model stands behind most of them.

| Scri       | Date                             | Maker                                        | Letters                             | Model                                     |
|------------|----------------------------------|----------------------------------------------|-------------------------------------|-------------------------------------------|
| Copt       | from the 2nd century AD          | not named                                    | 24 Greek + 6 or 7 from Demotic      | Greek, with Demotic influence             |
| Gothic     | c. AD 350                        | Wulfila                                      | 27, of which two are numerals only  | mainly Greek                              |
| Armenian   | c. AD 405                        | Mesrop Mashtots                              | 36; 38 after two medieval additions | Greek                                     |
| Georgian   | oldest text AD 430 (Bir el Qutt) | unknown                                      | 38 at first, 33 now                 | Greek (debated)                           |
| Glagolitic | AD 862/863                       | Cyril (Constantine) of Thessalonica          | 41 known; original number unknown   | invented, with Greek influence            |
| Cyrillic   | c. AD 893                        | not named; Preslav Literary School, Bulgaria | not found in the sources read       | Greek uncial plus letters from Glagolitic |

Coptic has the 24 Greek letters and six or seven more from Demotic: ϣ ϣ ϣ ϣ ϣ ϣ. Demotic comes from hieratic and hieratic from hieroglyphs. In Coptic the old script of Egypt and its distant descendant stand in one row.

For Georgian the maker is unknown. A claim for Mashtots is rejected in Georgia, and a legend names King Pharnavaz. For Cyrillic the earliest dated text is from 921.

## 19.6 Letter names and letter order as fossils

The names of the letters are Semitic words for the pictures the letters once were.

| Letter | Meaning                | Letter | Meaning           |
|--------|------------------------|--------|-------------------|
| ʾalp   | ox                     | lamd   | goat              |
| bet    | house                  | mem    | water             |
| gaml   | throw-stick (or camel) | nun    | snake (or fish)   |
| dalt   | door                   | samek  | pillar (?)        |
| he     | window                 | ʾayin  | eye               |
| waw    | hook                   | pe     | mouth (or corner) |

|       |                       |      |                        |
|-------|-----------------------|------|------------------------|
| zayin | weapon                | šade | plant or fish-hook (?) |
| ḥet   | wall or courtyard (?) | qop  | monkey or needle (?)   |
| ṭet   | wheel                 | roš  | head                   |
| yod   | arm, hand             | šin  | tooth (or sun)         |
| kap   | palm                  | taw  | mark                   |

These are the 22 Phoenician names with their meanings as given in the Wikipedia article "Phoenician alphabet". The question marks are in the source.

The names were kept in Samaritan, Aramaic, Hebrew, Arabic and Greek. Greek kept them as sounds without meaning: *alpha* and *beta* mean nothing in Greek. Latin and Cyrillic dropped the names. Other scripts made new names by the old rule. The runes are called *fé*, *ur*, *purs*. The Ogham letters carry tree names: *beith*, birch; *coll*, hazel. The Slavic letters begin *az*, *buky*, *vedi*. In each case the letter is named by a word that begins with its sound.

The order of the letters is as old as the oldest lists.

| Order    | Oldest evidence                  | Date            |
|----------|----------------------------------|-----------------|
| halaḥa m | hieratic ostrakon, Thebes (TT99) | 15th century BC |
| ʾabgad   | abecedaries of Ugarit            | 14th century BC |
| Greek    | Fayum tablets                    | c. 800 BC       |
| Etruscan | Marsiliana tablet, 26 letters    | c. 700 BC       |

Scribes of the Northwest Semitic languages first used the order to sort words in the 1st millennium BC (Lehmann 2012).

A child who recites A, B, C, D repeats an order attested on clay at Ugarit in the 14th century BC.

## 19.7 The people

With the short script, writing passed out of the hands of the profession, slowly.

| Place and time                    | Share that could read        | Source                                       |
|-----------------------------------|------------------------------|----------------------------------------------|
| Classical Greece                  | 5–10%                        | Harris, as reported in Wikipedia, "Literacy" |
| Roman Judea                       | about 3%                     | Bar-Ilan, as reported in the same article    |
| England, 1500 → 1800              | 6% → 53%                     | Allen, as reported in the same article       |
| Netherlands, 1500 → 1800          | 10% → 68%                    | same                                         |
| France, Italy, Spain, 1500 → 1800 | 7% → 37%; 9% → 22%; 9% → 20% | same                                         |

The figures are rough. They show that an alphabet alone does not make a people of readers. Classical Greece, with 24 letters, reached 5 to 10%. The Egyptian town of Lahun, with a script of hundreds of signs, is put at up to 15%. The large rise in Europe came after 1500.

Three makers of alphabets are known by name: Wulfila for Gothic, Mesrop Mashtots for Armenian, Cyril for Glagolitic. Each made a script for one language at one time.

What disappeared at this rung is the reader's share. A consonant text must be completed by someone who knows the language. The reader supplies the vowels from knowledge of the words. A Greek text can be sounded out by someone who does not know what it says. The older oral bodies of knowledge kept meaning in the voice. Vedic mantras carry meaning in tone, and the chant marks of the Torah are older than its vowel points (Konstapel 2026a). In the full alphabet the voice is on the page, and the page can be read without a teacher.

## 19.8 In the net

**Consonant and vowel are two layers.** A consonant is a closure in the mouth: lips, tongue or throat shut or narrow the passage. A vowel is the open passage with breath going through. In the click, the places of closure are the address layer and the accompaniments are the tension layer. The same holds in every spoken word at a smaller measure. The consonants are the frozen frame. The vowels are the layer in which the word lives and changes. The consonant script writes the address layer and leaves the tension layer to the speaker.

**The vowel letters are the last turn.** The Greek step adds one turn to the Phoenician row. Nothing was invented. The letters aleph, he, yod and ayin kept their shape, their place in the order and their name. Their value turned from a closure of the throat to an open vowel. The parent stands inside the child: alpha is still the ox, in first place, with a name that means nothing in Greek. With this turn the tension layer is written too. After it, the ladder of this Part has no further rung. Every sound of the word now has a sign.

**Mothers of reading.** The Aramaic use of consonant letters for long vowels is the same turn, held half-way. The letter stands in two states: consonant, or mark of a vowel. Which one holds is read off from the word. Greek took one of the two states and made it the only one.

**The parent rule in the Latin row.** W is V doubled. U is V rounded. J is I set apart. Each of these letters exists on top of its parent and differs from it by a single turn. In the click systems every series with two or more accompaniment turns has its parent in the same inventory. The Latin row grew by the same rule: three of its five additions have their parent standing beside them. The other two, Y and Z, are the Greek parent taken in again.

**Selection by fit.** Greek had no use for the throat consonants; their letters stayed and took vowels. Arabic had 28 sounds and 15 to 18 shapes; dots filled the rest. Coptic took 24 Greek letters and filled the rest with six or seven Demotic signs. Each language inhabits the rooms that fit its sounds. Which rooms are inhabited is read off from the language, never filled in beforehand.

**Ring 3.** One sign of a 27-sign alphabet is 3 trits (Konstapel 2026n). Three alphabets of this Part count exactly 27: the early alphabet by Naveh's count, the Greek letters with the three kept as numerals, and Gothic. Ugaritic is 27 plus 3. The others count 20, 21, 22, 23, 24 and 26, all inside ring 3. Arabic with 28, South Arabian with 29, Coptic with 30 or 31, Armenian with 36, Georgian with 38 and Glagolitic with 41 pass the 27 rooms and need ring 4. Ge'ez, with 182 forms, needs ring 5. The alphabets of the Phoenician line and its Greek and Latin daughters stay on ring 3. That is what the counts are.

**Names and order as the frozen layer.** The names kept their sound for three thousand years after the pictures were gone. The order kept its sequence through every change of shape, direction and language. Neither carries meaning for the user. Both are address: frozen, the same for all, counted. Ox and house still stand at the door of every text.

## 19.9 Status

- Counted: 182 Ge'ez forms ( $26 \times 7$ ); 27 Greek number letters ( $24 + 3$ ); five Latin additions from 21 to 26.
- Read in source: Naveh's date for Phoenician; the 9th-century date for South Arabian; the Greek count of 27; the Leiden release on the ostrakon.
- From secondary source: all other figures of this chapter, from the Wikipedia articles named in the references.
- Open: the date of the Ahirom epitaph; the start of South Arabian; the makers of Georgian and Cyrillic.
- Open: the original number of Glagolitic letters; the early Cyrillic count (not found); the meaning of six of the 22 letter names.

## Chapter 20. Side Branches and Numbers

Not every script stands on the line from Sinai to Latin. Two alphabets of northern Europe, the runes and Ogham, took the idea and changed the shapes and the order. The scripts of the Aegean and Anatolia are older and of another kind: syllable signs with word signs beside them. The numerals form a third line, apart from both. They stayed signs for things counted and never became letters.

### 20.1 Runes

The oldest runic row is the Elder Futhark. It has 24 runes in three groups of eight.

| Item              | Detail                                                      |
|-------------------|-------------------------------------------------------------|
| Signs             | 24, in three groups of eight                                |
| In use            | 2nd to 8th century AD                                       |
| Oldest dated text | Vimose comb, c. AD 160                                      |
| Oldest rune stone | Hole stone (Svingerud), dated c. 50 BC–AD 275               |
| First full row    | Kylver stone, c. AD 400                                     |
| Corpus            | about 350 inscriptions: 267 in Scandinavia, 81 in the south |

The view most favoured is that the runes come from a North Italic alphabet, Etruscan or Raetic. Latin has also been proposed. A Greek origin by way of the Goths is ruled out by the dates: the runes are older than the Gothic script.

The rune names follow the old rule of acrophony: *fé, ur, þurs*.

### 20.2 Ogham

Ogham is written along the edge of a stone, from bottom to top.

| Item           | Detail                                                                               |
|----------------|--------------------------------------------------------------------------------------|
| Signs          | 20, in four groups of five ( <i>aicmi</i> ), plus 5 later letters ( <i>forfeda</i> ) |
| Stones         | 4th to 6th century AD                                                                |
| Manuscript use | 6th to 9th century                                                                   |
| Corpus         | "roughly 400" or "roughly 380" in the same article; McManus counts 382               |

Four views on the origin are on record. The majority takes the Latin alphabet as the model. Carney and MacNeill see a secret cipher. McManus sees an early Christian invention. Thurneysen and Vendryes see tally marks on base 5 and 20.

The 20 letters stand in four groups of five. The letters carry the names of trees.

## 20.3 The Aegean and Anatolia

These scripts do not descend from the alphabet. They are syllabaries with word signs added. A syllabary is a script in which each sign stands for a syllable. Only Linear B, the Cypriot syllabary and the Anatolian hieroglyphs have been read.

| Script                   | Date                         | Signs                                       | Corpus                                                       | Read?             |
|--------------------------|------------------------------|---------------------------------------------|--------------------------------------------------------------|-------------------|
| Cretan<br>hieroglyphs    | c. 2100–1700<br>BC           | 96 syllabic signs                           | 150 seals, 120 clay documents<br>(mostly c. 1800)            | No                |
| Linear A                 | 1800–1450<br>BC              | core of 90; over 300<br>with variants       | about 1,400 texts; 7,400 sign<br>occurrences                 | No;<br>language   |
| Linear B                 | c. 1450–1200<br>BC           | around 87 syllabic,<br>over 100 ideographic | about 6,058 texts                                            | Yes;<br>Mycenaean |
| Cypriot<br>hieroglyphs   | 11th–4th<br>century BC       | 56                                          | —                                                            | Yes               |
| Phaistos<br>disc         | c. 1850–1400<br>BC, disputed | 45 different signs                          | one disc: 242 stamped signs<br>(241 in one table), 61 groups | No                |
| Anatolian<br>hieroglyphs | 14th–7th<br>century BC       | some 500                                    | —                                                            | Yes; Luwian       |

**Linear A** has about 7,400 sign occurrences in about 1,400 texts. That is some five signs per text on average. The texts are too short and too few for a decipherment, and the language is unknown.

**Linear B** descends from Linear A and writes Mycenaean Greek. Its texts come from the palaces: about 4,158 from Knossos, about 1,026 from Pylos, 368 from Thebes. Michael Ventris read the script in 1952, building on the groundwork of Alice Kober and working with John Chadwick. The hands of the writers can be told apart: 66 at Knossos and 45 at Pylos.

**The Cypriot syllabary** has 56 signs and descends from the older Cypro-Minoan script. It is written right to left. George Smith read it with the help of a bilingual text from Idalion. It stayed in use until the 4th century BC.

**The Phaistos disc** was found on 3 July 1908 by Luigi Pernier. It is about 16 cm across. Its 242 signs are stamped; 45 of them are different. The signs stand in 61 groups. The disc is unread.

**Anatolian hieroglyphs** have some 500 signs and write Luwian. The lines run boustrophedon. That the language is Luwian was confirmed in 1973 by Hawkins, Morpurgo Davies and Neumann.

## 20.4 Numerals: a separate line

Number signs are older than word signs. They follow their own road and are not drawn into the alphabet.

**Tallies.** The oldest count is one notch for one thing: 29 notches on the Lebombo bone, 42,000 years old. The cave sequences run to 13 marks (Bacon et al. 2023).

**Sumer.** The first tablets use thirteen counting systems. The sexagesimal system, which counts in sixties, comes from the Sumerians of the 3rd millennium BC. Place value in base 60 is in use by about 2100 BC (Robson 2007) or around 2000 BC. Place value means that the position of a sign tells its size. The Babylonian system needs two marks only, one for the unit and one for ten. With them it writes the 59 digits from 1 to 59. A placeholder for an empty position appears on a tablet from Kish, perhaps of 700 BC. By 300 BC two slanted wedges mark the empty position. This sign is not yet a number.

**Egypt.** Egyptian numerals count in tens without place value. There is a separate sign for 1, 10, 100, 1,000, 10,000 and 100,000, in use from around 3000 BC. A sign is repeated as often as needed. The number 9,999 takes  $9 + 9 + 9 + 9 = 36$  signs. Of the labels in tomb U-j, 43 carry numbers only. Hieratic made its own signs for 1 to 9, 10 to 90, 100 to 900 and 1,000 to 9,000. In hieratic 9,999 takes 4 signs.

**India.** The Brahmi numerals appear from the 3rd century BC. The full set is in place by the 1st or 2nd century AD: signs for 1 to 9, for the tens, for 100 and for 1,000. They have no zero and no place value. The full place-value system is in use in India by the 8th or 9th century.

**Zero.** The written zero has several first dates.

| Evidence                       | Date                                                                 | Notes                              |
|--------------------------------|----------------------------------------------------------------------|------------------------------------|
| Maya, Stela 2, Chiapa de Corzo | 36 BC                                                                |                                    |
| Lokavibhāga (text)             | AD 458                                                               |                                    |
| Brahmagupta                    | AD 628                                                               | First rules for zero as            |
| Sambor inscription,            | AD 683                                                               |                                    |
| Gwalior inscription            | AD 876                                                               | "first indisputable" zero in India |
| Bakhshali manuscript, dot zero | AD 799–1102 by radiocarbon in one account; "unclear date" in another | disputed                           |

**To the west.** The Indian numerals reach the Arab world with al-Khwarizmi, about 825, and al-Kindi, about 830. In Europe they stand in the Codex Vigilanus of 976 and in the *Liber Abaci* of Fibonacci of 1202. General use comes after printing, about 1482.

The digit has no sound of its own. Each language reads the sign 5 with its own word. In the middle of an alphabetic text the numeral is an image-sign, as the Uruk number signs were.

## 20.5 The people

The runes stand on combs and stones: about 350 inscriptions over six centuries. Ogham is known from some 380 to 400 inscriptions. Both corpora are small. They are the marks of a few who could write among many who could not.

The Linear B writers were palace clerks: 66 hands at Knossos, 45 at Pylos, 111 known writers in all. Their tablets are accounts. The script ends about 1200 BC. The Cypriot syllabary was in use from the 11th to the 4th century BC, seven centuries.

The numerals had their own carriers. The first were the accountants of Uruk. The last cuneiform tablet is astronomical. The numerals passed from India to the Arab world and to Europe, across three families of script, and kept their kind.

What disappeared with the side branches is whole scripts. Cretan hieroglyphs, Linear A and the Phaistos disc are unread. What their writers recorded cannot be reached.

## 20.6 In the net

**The runes on ring 3.** The Elder Futhark has 24 runes in three groups of eight. Ring 3 has 27 rooms. Three of them are the uniform rooms: all plus, all rest, all minus.  $27 - 3 = 24$ . The 24 runes are listed among the occupants of ring 3 (Konstapel 2026m). The map from rune to room is open.

**Ogham is a count.** Ogham has four groups of five letters:  $4 \times 5 = 20$ . One view takes its origin in tally marks on base 5 and 20. The four tongue clicks are  $2 \times 2 = 4$  places with the lip click apart: four plus one. Ogham is four groups with five later letters apart. The counts are fours and fives, not threes. They sit on no ring number and are left there.

**The parent stands inside the child.** Linear B stands on Linear A: the same signs, one turn added, another language. The Cypriot syllabary stands on Cypro-Minoan. The runes stand on a North Italic row. In each case the child keeps the parent's signs and changes one thing. For the Phaistos disc no parent is recorded. A form without its parent in the record cannot be placed, and the disc is unread.

**What does not close, does not last.** Linear B was held by 111 known hands in a few palaces, and it ends about 1200 BC. The alphabet returned through miners, soldiers, scribes and pupils, in each generation, in many places. A form persists where it returns onto itself. The measure is the number of circles through which the form returns.

**The syllabary is the rung between.** A syllable sign holds its sounds at once. The alphabet lays them out one after another. With 56 to 90 signs the syllabaries need ring 4, as the median spoken inventory of 33 segments does. The alphabet, with 22 to 27, fits ring 3.

**Numerals stayed image.** The word went through every turn of this Part: image, sound of the name, first sound, consonant, vowel. The number sign took none of these turns. A tally is one notch for one thing. The Egyptian 100 is a picture repeated. The digit 5 is read in every language and spelled in none. On the ladder of what leaves the picture, the numeral stopped at the third step: the thing has left, the image has not.

**Place value is depth.** In a place-value numeral the position of a sign is its depth, and each further place multiplies by the base. This is the step "times the base, plus the digit". In the net the same step reads "times three, plus the turn". The Babylonians took it with base 60 and India with base 10. Neither base is three. The step is the same step.

**The zero is a lawful state.** The trit has three states: +1, 0 and -1. The zero is rest or passage, not "nothing". The history of the written zero is the slow admission of that state. At first the empty place

was left open. Then two wedges held the place and were not a number. In AD 628 Brahmagupta gave rules for zero as a number among numbers. From then on the rest state has a sign and a law of its own.

## 20.7 Status

- Counted: 111 Linear B hands (66 + 45); 20 Ogham letters (4 × 5); 36 signs for 9,999; 27 – 3 = 24.
- Read in source: the 13-mark limit; the 43 number-only labels of tomb U-j; the runes as occupants of ring 3 (Konstapel 2026m).
- From secondary source: all figures on runes, Ogham, the Aegean and Anatolian scripts and the numerals, from the Wikipedia articles named in the references.
- Open: the origin of the runes and of Ogham; the languages of Linear A and the Phaistos disc; the Bakhshali date; the map from 24 runes to 24 rooms.

## 20.8 Summary table of the scripts in this Part

| Script                | Date                                    | Type                     | Number of signs                      | Parent                                         |
|-----------------------|-----------------------------------------|--------------------------|--------------------------------------|------------------------------------------------|
| Proto-cuneiform       | c. 3350–3000 BC                         | Word signs with numerals | c. 700 to c. 2,000, by count method  | None (tokens for numerals; seal motifs)        |
| Sumero-Akkadian       | c. 2800 BC – AD 75/80                   | Word and syllable signs  | c. 1,500 falling to c. 600           | Proto-cuneiform                                |
| Egyptian hieroglyphs  | c. 3250 BC – AD 394                     | Word, consonant and      | 750–1,000; 5,000–8,000 in Ptolemaic– | None proven                                    |
| Hieratic              | c. 3200 BC – AD 640                     | The same,                | As hieroglyphs                       | Hieroglyphs                                    |
| Demotic               | from c. 650 BC                          | The same,                | Not found                            | Hieratic                                       |
| Cretan hieroglyphs    | c. 2100–1700 BC                         | Word and syllable signs  | 96 syllabic                          | Unknown                                        |
| Linear A              | c. 1800–1450 BC                         | Word and syllable signs  | c. 90 core; 300+ with variants       | Cretan hieroglyphs (?)                         |
| Linear B              | c. 1450–1200 BC                         | Syllabary with word      | c. 87 + 100+                         | Linear A                                       |
| Cypriot               | 11th–4th c. BC                          | Syllabary                | 56                                   | Cypro-Minoan                                   |
| Anatolian hieroglyphs | 14th–7th c. BC                          | Word and syllable signs  | c. 500                               | None known                                     |
| Early alphabetic      | 19th to 13th c. BC, by scholar          | Consonant script         | 22 or at least 27                    | Egyptian hieroglyphs (shapes only)             |
| Ugaritic              | c. 1400/1300–1190 BC                    | Consonant script         | 30 (27 + 3)                          | Early alphabetic (order, inventory); cuneiform |
| Phoenician            | c. 1050–146 BC                          | Consonant script         | 22                                   | Early alphabetic                               |
| Paleo-Hebrew          | 10th c. BC – AD 125                     | Consonant script         | 22                                   | Phoenician                                     |
| Aramaic               | c. 800 BC – AD 600                      | Consonant script         | 22                                   | Phoenician                                     |
| Square Hebrew         | from 3rd c. BC                          | Consonant script         | 22                                   | Aramaic                                        |
| Arabic                | from 4th–6th c. AD                      | Consonant script         | 28 (18 shapes)                       | Nabataean Aramaic                              |
| Ancient South         | late 2nd mill. or 9th c. BC – 6th c. AD | Consonant script         | 29                                   | Early alphabetic, southern branch              |
| Ge'ez                 | vowels from c. AD 350                   | Abugida                  | 26 × 7 = 182                         | South Arabian                                  |

|                 |                    |                             |                              |                           |
|-----------------|--------------------|-----------------------------|------------------------------|---------------------------|
| Greek           | from c. 800–750 BC | Alphabet                    | 24 (27 with numeral letters) | Phoenician                |
| Etruscan        | from c. 700 BC     | Alphabet                    | 26, later 20                 | Greek (Euboean)           |
| Latin           | from 7th c. BC     | Alphabet                    | 21 → 23 → 26                 | Etruscan                  |
| Elder Futhark   | 2nd–8th c. AD      | Alphabet                    | 24                           | North Italic or Latin     |
| Ogham           | 4th–9th c. AD      | Alphabet                    | 20 + 5                       | Latin as model (majority) |
| Coptic          | from 2nd c. AD     | Alphabet                    | 24 + 6 or 7                  | Greek + Demotic           |
| Gothic          | c. AD 350          | Alphabet                    | 27                           | Greek                     |
| Armenian        | c. AD 405          | Alphabet                    | 36 (later 38)                | Greek as model            |
| Georgian        | by AD 430          | Alphabet                    | 38 (now 33)                  | Greek as model (debated)  |
| Glagolitic      | AD 862/863         | Alphabet                    | 41 known                     | Invented (Cyril); Greek   |
| Cyrillic        | c. AD 893          | Alphabet                    | Not found                    | Greek uncial + Glagolitic |
| Brahmi numerals | from 3rd c. BC     | Numeral set, no place value | 1–9, tens, 100, 1,000        | Debated                   |

## References for Part IV

**Bacon, B., Khatiri, A., Palmer, J., Freeth, T., Pettitt, P. & Kentridge, R. (2023). An Upper Palaeolithic Proto-writing System and Phenological Calendar. *Cambridge Archaeological Journal* 33(3): 371–389. DOI 10.1017/S0959774322000415.** *Why read?* The source for the reading of line, dot and Y as a lunar calendar of animal life, with the 606 and 256 sequences and the 13-mark limit. *Reading advice:* Read the method section for how a sequence is defined, then the authors' own closing caveats.

**Biblical Archaeology Society (2022). Quiz: How Many Hieroglyphs are There. *Bible History Daily*, 10 November 2022. <https://www.biblicalarchaeology.org/daily/ancient-cultures/quizzes/quiz-how-many-hieroglyphs-are-there/>** *Why read?* Gives the sign counts per period used in Chapter 17: over 1,000, about 750, up to 8,000.

**Biblical Archaeology Society (n.d.). Who Really Invented the Alphabet—Illiterate Miners or Educated Sophisticates? *Bible History Daily*. <https://www.biblicalarchaeology.org/daily/biblical-artifacts/inscriptions/who-really-invented-the-alphabet-illiterate-miners-or-educated-sophisticates/>** *Why read?* A short summary of the debate between Goldwasser and Rainey on who made the alphabet. *Reading advice:* Read it together with Goldwasser's rebuttal; the summary sharpens both positions.

**Born, L. & Kelley, K. (2021). A Quantitative Analysis of Proto-Cuneiform Sign Use in Archaic Tribute. *Cuneiform Digital Library Bulletin* 2021:6. <https://cdli.earth/articles/cdlb/2021-6.pdf>** *Why read?* Shows on one data set how the sign count moves from 1,990 to 1,299 to 705 with the counting rule. Also gives the corpus size of 6,726 artefacts. *Reading advice:* The opening sections on the corpus and the sign list hold the counts.

**Englund, R. K. (2001). The State of Decipherment of Proto-Elamite. Max Planck Institute for the History of Science, Preprint 183. <https://mpiwg-berlin.mpg.de/sites/default/files/migrated/p183.pdf>** *Why read?* States the size of the proto-cuneiform corpus and the open question of its language, by the scholar who edited most of the tablets. *Reading advice:* The passages on proto-cuneiform stand in the introduction, before the Elamite material.

**Goldwasser, O. (2010). How the Alphabet Was Born from Hieroglyphs. *Biblical Archaeology Review* 36(2): 40–53. <https://library.biblicalarchaeology.org/article/how-the-alphabet-was-born-from-hieroglyphs/> Why read?** The main statement of the view that miners in Sinai made the alphabet. Only the opening and the notes were available for this book. *Reading advice:* Endnote 2 gives her placing of Wadi el-Hol.

**Goldwasser, O. (n.d.a). A Comparison between Classifier Languages and Classifier Script: The Case of Ancient Egyptian. In the Festschrift Polotsky, pp. 17–39. [https://pluto.huji.ac.il/~orlygoldwasser/Goldwasser\\_Classifiers\\_Fs\\_Polotsky.pdf](https://pluto.huji.ac.il/~orlygoldwasser/Goldwasser_Classifiers_Fs_Polotsky.pdf) Why read?** Defines the determinative as a classifier and shows that it is never arbitrary.

**Goldwasser, O. (n.d.b). Goldwasser's first rebuttal [to A. Rainey]. *Bible History Daily*. <https://www.biblicalarchaeology.org/daily/biblical-artifacts/inscriptions/goldwassers-first-rebuttal/> Why read?** Her own words on acrophony and on the makers: people who could not read Egyptian, on the edge of society. *Reading advice:* Short; read whole.

**Henshilwood, C. S. et al. (2002). Emergence of Modern Human Behavior: Middle Stone Age Engravings from South Africa. *Science* 295: 1278–1280. As reported in Wikipedia, "Blombos Cave". Why read?** The first report of the two engraved ochres.

**Henshilwood, C. S., d'Errico, F. & Watts, I. (2009). *Journal of Human Evolution* 57(1): 27–47. As reported in Wikipedia, "Blombos Cave". Why read?** Adds six engraved pieces from layers between 70,000 and 100,000 years old.

**Henshilwood, C. S. et al. (2018). *Nature* 562: 115–118. As reported in Wikipedia, "Blombos Cave". Why read?** The nine red lines on a stone flake.

**Höflmayer, F., Misgav, H., Webster, L. & Streit, K. (2021). Early alphabetic writing in the ancient Near East: the 'missing link' from Tel Lachish. *Antiquity* 95(381): 705–719. DOI 10.15184/aqy.2020.157. Why read?** Publishes the Lachish sherd with its radiocarbon context and reviews the dagger and the low dating of Sass. *Reading advice:* The dating section carries the argument.

**Johns Hopkins University (2021; 2024). Hub news releases on Umm el-Marra, 13 July 2021 and 21 November 2024. <https://hub.jhu.edu/2021/07/13/alphabetic-writing-500-years-earlier-glenn-schwartz/> ; <https://hub.jhu.edu/2024/11/21/ancient-alphabet-discovered-syria/> Why read?** The excavator's account of the four clay cylinders and the claim for an alphabet 500 years older. *Reading advice:* The two releases give different dates (about 2300 and around 2400 BC); read both.

**Kelley, K., Cartolano, M. & Ferrara, S. (2025). Seals and signs. *Antiquity* 99(403): 64–82. DOI 10.15184/aqy.2024.165. Why read?** The current view on where the first signs came from: tokens for numbers, seal motifs for some word signs.

**Konstapel, J. (2009). About the Nine Spiritual Bodies of Ancient Egypt. constable.blog, 1 August 2009. <https://constable.blog/2009/08/01/about-ancient-egyptian-pyramid-texts-and-time-travel/> Why read?** On the *ren*, the name that lasts while it is spoken, and the cartouche as a rope around the name.

**Konstapel, J. (2010). About Magic and the Memory Palace. constable.blog, 1 June 2010. <https://constable.blog/2010/06/01/about-magic-and-the-memory-palace/> Why read?** The art of memory, and Plato's account of writing as the source of forgetfulness.

**Konstapel, J. (2026c). Language Is Sound: A Unified Physical Theory of Meaning Across Ancient and Modern Frameworks.** constable.blog, 17 May 2026. <https://constable.blog/wp-content/uploads/Language-Is-Sound-A-Unified-Physical-Theory-of-Meaning-Across-Ancient-and-Modern-Frameworks.pdf> *Why read?* Describes the three layers of the hieroglyph: ideogram, phonogram and silent determinative.

**Konstapel, J. (2026a). The Ancient Story Engine of Ifá, I Ching, Torah and the Universal Architecture of Change.** constable.blog, 23 March 2026. <https://constable.blog/2026/03/23/the-ancient-story-engine-ifai-ching-torah-and-the-universalarchitecture-of-change/> *Why read?* On the oral origin of the great bodies of knowledge and on what was lost when they were written down. *Reading advice:* Read the part on Plato's *Phaedrus* and the three losses.

**Konstapel, J. (2026m). The Standard Reference of the Maze: From the First Distinction to E8, with the Occupants of Every Ring.** constable.blog, 5 October 2026. <https://constable.blog/wp-content/uploads/The-Standard-Reference-of-the-Maze-From-the-First-Distinction-to-E8-with-the-Occupants-of-Every-Ring.pdf> *Why read?* Lists the occupants of each ring; the 24 runes of the Elder Futhark stand on ring 3.

**Konstapel, J. (2026n). The Comma of Pythagoras, Carried to Infinity.** constable.blog, 5 October 2026. <https://constable.blog/wp-content/uploads/The-Comma-of-Pythagoras-Carried-to-Infinity.pdf> *Why read?* States that every finite text has one address: a 27-sign alphabet is 3 trits per sign, a text of L signs has depth 3L.

**Lehmann, C. (2007). Hieroglyphs.** christianlehmann.eu. [https://www.christianlehmann.eu/ling/sprachen/languages\\_antiquity/egypt/hieroglyphs.html](https://www.christianlehmann.eu/ling/sprachen/languages_antiquity/egypt/hieroglyphs.html) *Why read?* A linguist's compact account of the sign classes, with the counts of 102 two-consonant and 48 three-consonant signs.

**Leiden University (2015). Earliest known alphabetic word list discovered.** News release, 5 November 2015. <https://www.universiteitleiden.nl/en/news/2015/11/earliest-known-alphabetic-word-list-discovered> *Why read?* Reports Ben Haring's reading of the 15th-century BC ostrakon with the halaḥam order.

**Michalowski, P. (1993). Tokenism.** *American Anthropologist* 95: 996–999. As summarised in the abstract by G. Buccellati. <https://urkesh.org/abstracts/923Michalowski1951.htm> *Why read?* The argument that the first tablets were a new form and not the end of a token system.

**Raffaele, F. (n.d.). Corpus of 1st-dynasty labels.** <https://www.francescoraffaele.com/egypt/hesyra/tagcorpus.htm> *Why read?* Gives a tag count and a date for tomb U-j, with reference to Dreyer's excavation report of 1998.

**Schmandt-Besserat, D. (n.d.). The Evolution of Writing.** University of Texas. <https://sites.utexas.edu/dsb/tokens/the-evolution-of-writing/> *Why read?* The author's own short statement of the path from token to tablet to alphabet, with her dates. *Reading advice:* Read it beside Zimansky (1993); the two together show which half of the theory holds.

**Scientific American (n.d.). World's Oldest Alphabet Discovered.** <https://www.scientificamerican.com/article/worlds-oldest-alphabet-discovered/> *Why read?* Gathers the views of Rollston, Ferrara, Steele and Schwartz on the Umm el-Marra cylinders.

**Spar, I. (2004). The Origins of Writing.** Metropolitan Museum of Art. <https://www.metmuseum.org/essays/the-origins-of-writing> *Why read?* A clear account of what the Uruk tablets record, with the rebus explained.

**The Past (n.d.). The discovery of Tomb U-j.** <https://the-past.com/shorts/the-picture-desk/the-discovery-of-tomb-u-j> *Why read?* A short report on the tomb, its 12 chambers and its labels.

**UCL Digital Egypt (n.d.). Literacy. University College London.** <https://www.ucl.ac.uk/museums-static/digitalegypt/literature/literacy.html> *Why read?* The higher literacy estimates for single towns.

**Unicode Consortium (2017). Proposal L2/17-157 to encode proto-cuneiform.** <https://www.unicode.org/L2/L2017/17157-n4797-proto-cuneiform.pdf> *Why read?* Phase dates, tablet counts and the split of administrative and lexical texts, built on the CDLI data.

**Unicode Consortium (2019). Proposal L2/19-299, Revisiting Proto-Sinaitic.** <https://www.unicode.org/L2/L2019/19299-revisiting-proto-sinaitic.pdf> *Why read?* The corpus of about 50 early alphabetic texts, the count of at least 27 signs and the reconstructed letter names. *Reading advice:* The sign table is the part to keep at hand.

**Vainstubb, D., Mumcuoglu, M., Hasel, M. G., Hesler, K. M., Lavi, M., Rabinovich, R., Goren, Y. & Garfinkel, Y. (2022). A Canaanite's Wish to Eradicate Lice on an Inscribed Ivory Comb from Lachish.** *Jerusalem Journal of Archaeology* 2: 76–119. [https://jjar.huji.ac.il/sites/default/files/jjar/files/jjar2\\_art4\\_lachish\\_p76-119\\_2022-10-12\\_01.pdf](https://jjar.huji.ac.il/sites/default/files/jjar/files/jjar2_art4_lachish_p76-119_2022-10-12_01.pdf) *Why read?* The publication of the comb: object, 17 letters, reading and the problem of its date.

**von Petzinger, G. (2016). What the mysterious symbols made by early humans can teach us about how we evolved.** *ideas.ted.com* (excerpt of *The First Signs*). <https://ideas.ted.com/what-the-mysterious-symbols-made-by-early-humans-can-teach-us-about-how-we-evolved/> See also her page at the Bradshaw Foundation: [https://bradshawfoundation.com/geometric\\_signs/index.php](https://bradshawfoundation.com/geometric_signs/index.php) *Why read?* The count of 32 recurring cave signs and the fieldwork behind it.

**Wikipedia (consulted 2026).** Articles used as secondary sources: "Blombos Cave"; "History of ancient numeral systems"; "Denise Schmandt-Besserat"; "Proto-cuneiform"; "Cuneiform"; "Rebus"; "Scorpion I"; "History of writing"; "Egyptian hieroglyphs"; "Egyptian uniliteral signs"; "Egyptian biliteral signs"; "Hieratic"; "Acrophony"; "Proto-Sinaitic script"; "Wadi el-Hol"; "History of the alphabet"; "Ugaritic alphabet"; "Alphabetical order"; "Abecedarium"; "Phoenician alphabet"; "Aramaic alphabet"; "Paleo-Hebrew alphabet"; "History of the Arabic alphabet"; "Ancient South Arabian script"; "Ge'ez script"; "History of the Greek alphabet"; "Greek alphabet"; "Etruscan alphabet"; "History of the Latin script"; "J"; "Gothic alphabet"; "Coptic script"; "Armenian alphabet"; "Georgian scripts"; "Glagolitic script"; "Early Cyrillic alphabet"; "Cyrillic script"; "Elder Futhark"; "Ogham"; "Cretan hieroglyphs"; "Linear A"; "Linear B"; "Cypriot syllabary"; "Phaistos Disc"; "Anatolian hieroglyphs"; "Sexagesimal"; "Babylonian cuneiform numerals"; "Egyptian numerals"; "Brahmi numerals"; "0"; "History of the Hindu–Arabic numeral system"; "Literacy". <https://en.wikipedia.org/> *Why read?* Chapters 19 and 20 rest almost wholly on these articles. Scholars named in the text without an entry of their own are cited as these articles report them. Sass, Leibovitch, Hamilton and Darnell are cited through Wilson-Wright (2019) and Höflmayer et al. (2021). *Reading advice:* Each figure taken from them should be checked against a handbook of writing systems before it is quoted further.

**Wilson-Wright, A. (2019). On the Origin of Alphabetic Writing.** *The Bible and Interpretation.* <https://bibleinterp.arizona.edu/sites/bibleinterp.arizona.edu/files/images/On%20the%20Origin%20of%20Alphabetic%20Writing.pdf> *Why read?* A short survey of the Serabit finds and of every proposed date, from Gardiner to Sass. *Reading advice:* The best single entry to the dating dispute.

**Woods, C. (ed.) (2010).** *Visible Language: Inventions of Writing in the Ancient Middle East and Beyond*. **Oriental Institute Museum Publications 32**. <https://isac.uchicago.edu/sites/default/files/uploads/shared/docs/oimp32.pdf> *Why read?* An exhibition catalogue that treats Mesopotamia, Egypt and the alphabet side by side, with a timeline. *Reading advice:* The introduction by Woods sets the four inventions of writing next to each other.

**Zimansky, P. (1993).** Review of D. Schmandt-Besserat, *Before Writing*, volumes I–II. *Journal of Field Archaeology* 20(4): 513–517. <https://urkesh.org/attach/Zimansky1993.pdf> *Why read?* The counts that test the token theory: 508 subtypes, 58% attested once or not at all, 15 "sheep" tokens. *Reading advice:* Five pages; read whole.

**Zinn, K. (2013).** Literacy, Pharaonic Egypt. *The Encyclopedia of Ancient History*, pp. 4100–4104. <https://repository.uwtsd.ac.uk/569/1/Literacy%20C%20Pharaonic%20Egypt.pdf> *Why read?* Reports the literacy estimates of Baines and Eyre (1 to 5 percent) and the higher figures for Deir el-Medina. *Reading advice:* The original article of Baines and Eyre (1983) was not reached; the figures are cited through Zinn.

## Part V. The Other Branches

The line from Sumer and Egypt to the alphabet is one route through the history of writing. It is not the only one. China stayed on the rung of image and sound and built it out to tens of thousands of characters. Korea drew the movement of the mouth. India kept the syllable whole and showed how it is built. The Americas wrote in glyphs and in knots, and a handful of men in the last two centuries made scripts from nothing within one lifetime. This Part sets out these branches with their counts, and closes with the tree of all scripts in one table.

### Chapter 21. China: The Rung That Went Deep

Chinese writing is the one script of the image-sound rung that is still in daily use. It was never reduced to a short list of sound signs. Its characters grew in number for three thousand years, and nearly all of that growth took one form: a part for meaning joined to a part for sound. This chapter gives the marks before writing, the first texts, the styles, the counts, and the way one character is built.

#### 21.1 Marks before writing

Marks on pottery, shell and bone in China go back to the seventh millennium BC. The oldest are from Jiahu. Three Wikipedia articles date them differently: 6600–6200 BCE ("Neolithic signs in China"), about 6500 BCE ("Chinese characters") and around 6000 BC ("Jiahu symbols"). Seventeen groups of signs were first reported. Eleven are definitely incised, nine on tortoise shell and two on bone (Wikipedia, "Jiahu symbols").

| Site     | Date                                                    | Count                          | Carrier                  |
|----------|---------------------------------------------------------|--------------------------------|--------------------------|
| Jiahu    | 6600–6200 BCE; c. 6500 BCE; c. 6000 BC (three articles) | 17 groups reported; 11 certain | 9 tortoise shell, 2 bone |
| Banpo    | 5th millennium BCE                                      | 22 different symbols           | 113 sherds               |
| Dawenkou | c. 2800–2500 BCE                                        | 18 pictograms of 8 types       | 16 pots                  |

The key paper on Jiahu is by Li Xueqin, Harbottle, Zhang Juzhong and Wang Changsui (2003), in *Antiquity*. It carries the question in its title, "The earliest writing?". As reported in Wikipedia, it reads the signs "not as writing itself".

The specialists cited agree on the status. Qiu Xigui sees no basis to say that the marks recorded language. He calls the Dawenkou pictograms forerunners of primitive writing. Boltz calls the comparison of such marks with later characters risky and inconclusive. Keightley reads them as emblems of ownership or identity (Wikipedia, "Neolithic signs in China"; "Chinese characters"). The marks belong to the rung of marks, described earlier in this book. They are not yet the image-sound rung.

## 21.2 The oracle bones

Writing proper is first attested at Anyang in Henan, on the site called Yinxu. The texts belong to the late Shang. The script is dated about 1250 to about 1050 BC. The inscriptions of king Wu Ding are radiocarbon-dated to 1254–1197 BC, with a margin of ten years (Wikipedia, "Oracle bone script").

| Item                                  | Number            |
|---------------------------------------|-------------------|
| Inscriptions uncovered                | about 150,000     |
| Distinct written forms                | over 30,000       |
| Individual characters these represent | about 4,000       |
| Characters that can be read           | 1,500–2,000       |
| Share read                            | 38 to 50 per cent |

The share is plain arithmetic: 1,500 of 4,000 is 37.5 per cent, and 2,000 of 4,000 is 50 per cent. Half or more of the oldest Chinese characters cannot be read today. Over 30,000 forms for 4,000 characters gives seven to eight written shapes per character. The script was not yet fixed in its shapes.

The script is already fully formed at Anyang. No earlier stage of it has been found. Wang Yirong recognised the inscribed bones as writing in 1899 (Wikipedia, "Oracle bone script").

## 21.3 The styles

The same script passed through five main styles. Each is a way of drawing the same characters, fitted to a material and an office.

| Style              | Date                        | Note                                                          |
|--------------------|-----------------------------|---------------------------------------------------------------|
| Oracle bone script | c. 1250 – c. 1050 BC        | cut in bone and shell; about 150,000 inscriptions             |
| Bronze script      | main period c. 1250–771 BC  | cast in ritual vessels; about 12,000 inscribed bronzes extant |
| Small seal         | Qin standard, around 220 BC | Cangjiebian primer, claimed 3,300 characters                  |
| Clerical script    | early Han, c. 200 BC        | proto-clerical in Warring States and Qin                      |
| Regular script     | c. 150 AD; dominant 420–589 | mature under the Tang                                         |

Sources: Wikipedia, "Chinese bronze inscriptions", "Small seal script", "Chinese script styles".

The Qin state standardised the small seal script around 220 BC. Li Si was among the compilers of its primer, the Cangjiebian. Regular script emerged in the Han and Three Kingdoms period.

## 21.4 Xu Shen and the six categories

Xu Shen compiled the first analytic dictionary, the *Shuowen Jiezi*. He finished it in 100 CE and it was presented to the throne in 121 CE. It holds 9,353 characters and 1,163 variants, sorted under 540 radicals. A radical is the part of a character under which a dictionary files it. A second count, 10,516 characters, is the sum of the two figures: 9,353 plus 1,163 (Wikipedia, "Shuowen Jiezi"; "Written Chinese").

Xu Shen sorted characters into six categories, the *liushu* (Wikipedia, "Chinese character classification").

| Category                 | Chinese | What it is                         | Examples |
|--------------------------|---------|------------------------------------|----------|
| Pictographs              | 象形      | a drawing of the thing             | 日 月 木    |
| Indicatives              | 指事      | a sign that points                 | 一 上 下    |
| Compound ideographs      | 會意      | two meanings joined                | 林 休      |
| Phono-semantic compounds | 形聲      | one part meaning, one part sound   | 沐 淋 菜    |
| Loangraphs               | 假借      | a character borrowed for its sound | 來        |
| Derivative cognates      | 轉注      | related characters                 | 考 老      |

The fourth category is the one that grew. DeFrancis counted the categories at three points in time (DeFrancis 1989).

| Period               | Characters counted | Sound-plus-meaning compounds | Share |
|----------------------|--------------------|------------------------------|-------|
| Shang (oracle bones) | 977                | 334                          | 34%   |
| Xu Shen, 100 CE      | 9,353              | 7,697                        | 82%   |
| Kangxi, 1716         | 48,641             | 47,141                       | 97%   |

The Shang sample has two further groups: 227 pictographic characters (23 per cent) and 396 compound indicatives (41 per cent). The three Shang groups add up to 957 of the 977.

The arithmetic of the growth is short. Between the Shang sample and Xu Shen the total rose by 8,376 characters. The compounds rose by 7,363. Between Xu Shen and Kangxi the total rose by 39,288 and the compounds by 39,444. Nearly every character added after the Shang was a compound of sound and meaning.

For characters in use now two figures stand side by side. Of the 3,500 frequent characters, 58 per cent are sound-plus-meaning compounds. Of all characters in use, over 90 per cent began as such (Wikipedia, "Chinese character classification"). The sound part does not always give the present sound. DeFrancis found that about two thirds of characters carry useful sound information in their phonetic part (DeFrancis 1984).

## 21.5 How one character is built

A compound character has two parts. The semantic part names the class of thing. The phonetic part is an existing character with a similar sound. The sources collected for this book hold three examples (Wikipedia, "Chinese character classification").

| Character | Reading | Meaning   | Semantic part | Phonetic part |
|-----------|---------|-----------|---------------|---------------|
| 沐         | mù      | to wash   | 氵 water       | 木 mù (tree)   |
| 淋         | lín     | to pour   | 氵 water       | 林 lín (wood)  |
| 菜         | cài     | vegetable | 艹 grass       | 采 cǎi         |

The first two rows share a chain. 木 is a pictograph, a tree. 林 is a compound ideograph, two trees, a wood. 淋 adds the water sign to 林 and means to pour. Three characters stand in a line, each built on the one before. In 菜 the tone of the phonetic differs from the tone of the whole: cǎi against cài. The sound part gives a hint, not a spelling.

Boltz and Boodberg hold that no character was ever created as a pure compound of meanings. In their view the apparent cases rest on second readings that are now lost. Button contests this (Wikipedia, "Chinese character classification").

## 21.6 The counts: Kangxi and the modern lists

The Kangxi dictionary of 1716 is the standard count of the old script. Its figures differ by source.

| Source                          | Count                            | Basis                                     |
|---------------------------------|----------------------------------|-------------------------------------------|
| Wikipedia, "Kangxi Dictionary"  | 47,043                           | entries                                   |
| Wikipedia, supplemented version | 47,035 + 1,995 variants = 49,030 | entries plus variants                     |
| DeFrancis 1989                  | 48,641                           | characters counted for the category table |

The dictionary files its characters under 214 radicals. That list was taken from the *Zihui* of 1615. Xu Shen had used 540.

Modern official lists are far shorter (Wikipedia, "List of Commonly Used Characters in Modern Chinese"; "Table of General Standard Chinese Characters"; "Simplified Chinese characters").

| List                                         | Date                               | Characters                                          |
|----------------------------------------------|------------------------------------|-----------------------------------------------------|
| Scheme of simplified characters              | 1956                               | 515 simplified characters, 54 simplified components |
| Complete list of simplified characters       | 1964, reissued 1986 with 6 changes | count not given in the source                       |
| Second round of simplification               | 1977                               | poorly received                                     |
| List of general-use characters               | 26 January 1988                    | 7,000                                               |
| Table of General Standard Chinese Characters | 5 June 2013                        | 8,105                                               |

The 2013 table has three tiers. Tier 1 holds 3,500 characters and tier 2 holds 3,000. Tier 3 holds the rest: 8,105 minus 6,500 is 1,605. Tier 1 is 3,500 characters against a dictionary stock of more than 47,000, or about seven per cent.

## 21.7 The syllables of Mandarin

Each character is spoken as one syllable. Mandarin has few of them. DeFrancis counts 398 syllables without tone and 1,277 with tone (DeFrancis 1989). Wikipedia gives rounder figures: about 400 and about 1,300 ("Standard Chinese phonology").

| Count                       | DeFrancis<br>1989 | Wikipedia      |
|-----------------------------|-------------------|----------------|
| Syllables without tone      | 398               | about 400      |
| Syllables with tone         | 1,277             | about<br>1,300 |
| Tonal forms per<br>syllable | 3.2               | about 3.3      |

The last row is 1,277 divided by 398. 3,500 characters of tier 1 against 1,277 syllables is 2.7 characters to one spoken syllable. The script keeps apart in the eye what the ear hears as the same.

## 21.8 DeFrancis: morphosyllabic

A morpheme is the smallest piece of a language that carries meaning. DeFrancis placed Chinese among the "morphosyllabic" systems: a character writes one syllable that is also one morpheme. He set the exception at about 11 per cent of characters, which have no meaning of their own (DeFrancis 1989).

His thesis is that Chinese characters are a system of sound, not of ideas. He denies that an ideographic system of writing has ever existed or can exist. He traced the word itself. "Ideographic" was first used in 1822, for Egyptian, from Champollion's "idéographique" (DeFrancis 1984). The 1984 book names six myths about Chinese: the ideographic, the universality, the emulatability, the monosyllabic, the indispensability and the successfulness myth (Wikipedia, "The Chinese Language: Fact and Fantasy").

## 21.9 The people

The first writers of Chinese known are those of the late Shang at Anyang. About 150,000 of their inscriptions have been uncovered. About 12,000 inscribed ritual bronzes are extant.

Three names mark the later steps. Li Si worked on the Qin primer of 3,300 characters around 220 BC. Xu Shen described 9,353 characters in 100 CE. Wang Yirong recognised the oracle bones as writing in 1899, some three thousand years after they were cut.

What disappeared is visible in the counts. Of the 4,000 oracle bone characters, between 2,000 and 2,500 can no longer be read. The variety of shapes went too: over 30,000 written forms were reduced to one form per character. With the simplification of 1956 the older shapes of 515 characters left daily use in mainland China.

## 21.10 In the net

Image-sound writing holds three parts at once: image, sound and class sign. A Chinese compound character shows all three in one square. 沐 holds the tree as image, mù as sound and water as class sign. Egyptian held the same three. The alphabet kept one part, the sound. Chinese kept all three and went deep.

The two branches stand as two directions on one rung. The alphabet thinned to 22 letters, each doing one thing. Chinese deepened: from about 4,000 characters to 9,353 to more than 47,000. The share of three-part characters rose with the depth: 34, 82 and 97 per cent. What was added at each depth has one form.

That form is the parent rule. A form exists only on top of its parent, and each new form is the parent plus one turn. 木 is the parent. 林 is 木 with one turn added. 淋 is 林 with one turn added. The parent stands inside the child, and here it stands there in ink. The route to a character is its address, and the address can be read off from its parts.

The class sign is the frozen layer. Xu Shen counted 540 radicals and the Kangxi dictionary 214. The stock of characters grew fivefold between the two; the list of classes shrank. The address layer is frozen and few. The filling under each class is where the growth stands.

Tone is a trit in the sound itself. Mandarin shows it in its counts: 398 syllables without tone stand as 1,277 with tone. The tone adds no sign to the page. It is a turn inside the syllable.

Two older Chinese systems sit on rings in the count of the earlier texts. The I Ching counts in twos: six lines, each whole or broken, give  $2^6 = 64$  hexagrams. Ring 6 has 729 rooms. Of these, 64 carry no zero, and the hexagrams are placed there (Konstapel 2026m). Yang Xiong's *Taixuanjing* of about 2 BCE adds a third line state: whole, broken once, broken twice. Four such lines give  $3^4 = 81$  figures, the whole of ring 4 (Konstapel 2026o). The hexagram uses two states of the trit. The *Taixuanjing* uses three.

The character counts themselves sit on no ring number. 4,000, 9,353 and 48,641 are counts of what was inhabited, read off from bones and dictionaries.

## 21.11 Status

- Counted: share of oracle characters read, 38–50%; growth of compounds between the three DeFrancis counts.
- Counted: tier 3 of the 2013 table, 1,605; 3.2 tonal forms per syllable.
- Read in source: DeFrancis's category table (977; 9,353; 48,641), the syllable counts 398 and 1,277, the term morphosyllabic, the origin of "ideographic" in 1822.
- From secondary source (Wikipedia): Neolithic marks, oracle bone figures, styles, Shuowen and Kangxi counts, the six categories, the three example characters, the modern lists.
- Open: the Jiahu date differs between three articles. The Kangxi count stands at 47,043, 49,030 or 48,641. The count of the 1964 list was not found. Whether any character began as a pure compound of meanings is contested.
- Open in the net reading: the 64 hexagrams among the 64 zero-free rooms of ring 6 is a count. A map from line to trit is not written out.

## Chapter 22. The Chinese Sphere

Japan, Korea and Vietnam first wrote in Chinese. Then each used Chinese characters for the sounds of its own language. From that shared start three different roads lead away. Japan wore the sound characters down to two syllabaries. Korea replaced the system with a designed alphabet. Vietnam

built new characters on the Chinese model and later dropped them for Latin letters. On the northern and western rim four states and peoples made character scripts of their own.

## 22.1 Japan: from borrowed characters to kana

Chinese characters, kanji, reached Japan in stages. First contacts date to the first century AD. Literacy probably began in the fourth century and wider use in the fifth (Wikipedia, "Japanese writing system").

Japan then used Chinese characters for their sound alone. These sound characters are the man'yōgana. The name comes from the *Man'yōshū*, a collection of poems. One Wikipedia article says it was compiled sometime before 759 ("Japanese writing system"). Another says after 759 ("Kana").

Two sets of syllable signs grew out of man'yōgana. A syllabary is a script in which each sign writes one syllable.

| Set           | Made from                          | Date                   | First use                 |
|---------------|------------------------------------|------------------------|---------------------------|
| Hiragan<br>a  | cursive forms of whole man'yōgana  | Heian period, 794–1185 | not stated in the source  |
| Katakana<br>a | parts of regular-script man'yōgana | c. 9th century         | glosses on Buddhist texts |

Kana as a whole is dated about 800. Each set has 46 basic signs, or 71 with diacritics. A diacritic is a small mark added to a sign to change its value. The sets were standardised in 1900. The variants that were dropped are called hentaigana (Wikipedia, "Kana").

Japan did not drop the characters. It limited them.

| List                               | Year             | Kan<br>ji |
|------------------------------------|------------------|-----------|
| Tōyō kanji                         | 1946             | 1,850     |
| Jōyō kanji                         | 2010<br>revision | 2,136     |
| Of these, taught in primary school |                  | 1,026     |

A Japanese page today runs three scripts through each other: 2,136 kanji and two kana sets of 46. The count of everyday signs is 2,136 plus 92, which is 2,228.

## 22.2 Korea before Hangul

Korea also wrote its language with Chinese characters first. The system called Idu arose in the Three Kingdoms period. It stayed in official use from 958 to 1894. A second system, hyangchal, served vernacular poetry (Wikipedia, "Idu script").

## 22.3 Hangul

Hangul was made on purpose and by a known person. King Sejong, who reigned from 1418 to 1450, is named as its maker. The process itself is poorly documented. The script was shown to the court between December 1443 and January 1444. It was promulgated in 1446 in the

*Hunminjeongeum*, together with a commentary, the *Haerye*, of about October 1446 (Wikipedia, "Hangul"; "Hunminjeongeum Haerye").

| Item                          | Number                        |
|-------------------------------|-------------------------------|
| Letters in 1446               | 28                            |
| Basic letters today           | 24 (14 consonants, 10 vowels) |
| Base shapes of the consonants | 5                             |
| Base shapes of the vowels     | 3                             |
| Possible syllable blocks      | 11,172                        |
| Blocks in common use          | about 2,000                   |

The consonant letters are drawings of the mouth. The *Haerye*, as reported in Wikipedia ("Origin of Hangul"), gives five base shapes taken from the speech organs.

| Letter | What the shape shows                      |
|--------|-------------------------------------------|
| ㄱ      | the back of the tongue against the palate |
| ㅋ      | the tip of the tongue at the upper palate |
| ㆁ      | the mouth, the lips                       |
| ㆁ      | a tooth                                   |
| ㅇ      | the throat                                |

Stronger sounds of the same place receive added strokes. The letter for a sound therefore shows where it is made and how hard. Sampson coined the term featural for this in *Writing Systems* (1985): the parts of a letter stand for features of the sound. DeFrancis rejects the term (Wikipedia, "Featural writing system").

The vowel letters are built from three shapes: a dot ·, a horizontal line — and a vertical line |. They stand for heaven, earth and the human. Here the sources differ. Wikipedia's "Origin of Hangul" gives the dot as heaven (yang), the horizontal line as earth (yin) and the vertical line as the human (neutral). Wikipedia's "Hangul" assigns dot and horizontal line differently. The *Haerye* itself was not consulted for this book.

The letters are not written in a row. They are stacked into square blocks, one block per syllable: an initial consonant, a vowel, and an optional final consonant. The 24 letters give 11,172 possible blocks. About 2,000 are in common use, which is 18 per cent of the possible ones.

One hypothesis ties part of Hangul to an older script. Ledyard (1966, 1997) holds that a few base consonants were modelled on 'Phags-pa, a script of 1269 (Wikipedia, "Origin of Hangul").

The *Haerye* was lost and found again in 1940. UNESCO entered it in the Memory of the World register in 1997.

## 22.4 Vietnam

Vietnam wrote in Chinese and then built its own characters on the Chinese model. This script is chữ Nôm. Its earliest trace is a title of the late eighth century, written 布蓋. A stele of 1209 carries 21 names in it. A national standard of 2001 lists 9,299 glyphs. A set of 2005 holds nearly 20,000 (Wikipedia, "Chữ Nôm").

The present script, quốc ngữ, is Latin. Jesuits made it in the early seventeenth century; Francisco de Pina is named first. Alexandre de Rhodes printed a dictionary in it in Rome in 1651. It has 29 letters and five tone marks for six tones. The French colonial administration enforced it in 1910 (Wikipedia, "Vietnamese alphabet").

| Script   | Kind                            | Signs                    |
|----------|---------------------------------|--------------------------|
| Chữ Nôm  | characters on the Chinese model | 9,299 to nearly 20,000   |
| Quốc ngữ | Latin alphabet with tone marks  | 29 letters, 5 tone marks |

The step from the one to the other is the largest thinning in this Part: from at least 9,299 signs to 34.

## 22.5 The rim: Khitan, Jurchen, Tangut, Yi, Nüshu

North and west of China, new states made scripts of their own by order of the ruler. Chinese was the model, not the parent.

| Script               | Date         | Maker        | Signs              | Last use                |
|----------------------|--------------|--------------|--------------------|-------------------------|
| Khitan large script  | 920          | under Abaoji | —                  | —                       |
| Khitan small script  | 924 or 925   | Diela        | —                  | —                       |
| Tangut               | 1036         | Yeli Renrong | 5,863 (2004 count) | 1502                    |
| Jurchen large script | 1119 or 1120 | Wanyan Xiyin | —                  | 1526 (last inscription) |
| Jurchen small script | 1138         | —            | —                  | —                       |

Sources: Wikipedia, "Khitan scripts", "Tangut script", "Jurchen script". A dash marks a figure that the sources consulted do not give.

The Jurchen script derives from the Khitan. It is read only in small part. The Tangut date of 1036 rests on the *History of Song*. The Tangut script lasted 466 years, from 1036 to 1502.

The Yi of south-west China have a script of their own. Its earliest dated text is a bronze bell of 1485; tradition places its origin in the Tang. The classical script had up to 90,000 variant glyphs. A modern syllabary was standardised in 1974 and ratified in 1980. It has 756 basic signs plus 63 more, 819 in all (Wikipedia, "Yi script").

Nüshu is a script of women. It was used in Jiangyong in Hunan. It is syllabic and has 600 to 700 signs, of which 396 are in Unicode. Its origin is undated (Wikipedia, "Nüshu").

## 22.6 The people

Most makers of these scripts are known by name. Sejong stands for Korea, Yeli Renrong for the Tangut, Wanyan Xiyin for the Jurchen and Diela for the Khitan. De Pina and de Rhodes stand for Vietnam. Kana has no named maker. Katakana came from the glossing of Buddhist texts, hiragana from cursive writing.

The numbers of users are not in the sources consulted. What disappeared is. The Tangut script ended in 1502 and the Jurchen in 1526. Korea's Idu left official use in 1894 after 936 years. The hentaigana left Japanese schools in 1900. Chũ Nôm gave way to 29 Latin letters in 1910.

Nüshu was carried by a few women to the end. Yang Huanyi died on 20 September 2004. He Yanxin died on 23 October 2025 (Wikipedia, "Nüshu").

## 22.7 In the net

The Chinese sphere shows three ways to leave the image-sound rung, and one way to stay on it.

Japan dropped the class sign and the image and kept the sound of the whole syllable. Man'yōgana is the parent; kana is the parent with one turn added. The parent stands inside the child: each kana sign is a worn Chinese character. Hiragana kept the whole character in cursive. Katakana kept one part of it.

Korea did something that no other script in this book did. Hangul draws the turn itself. The letter ㅓ shows the back of the tongue rising to the palate. The letter ㅕ shows the closed lips. The letter does not stand for the sound by agreement. It shows the movement of tongue and lip that is the sound.

In the click, described earlier in this book, the tongue closes at a place and tension stands on it. Hangul writes the place of closure as a shape and the tension as added strokes. The five base shapes are the address layer: few and fixed. The added strokes are the tension layer: present or absent. The two layers of the click and the two layers of the Hangul letter correspond.

The syllable block is the same statement at the next depth. Initial, vowel and final are three positions in one square. They are read as one closed unit. The alphabetic line lays sounds out one after another. The Hangul block holds them at once, as the mouth does.

The three vowel shapes are a trit read as cosmos: heaven, earth and the human between them. Whichever of dot and line is heaven, the third term is the middle one. The human stands at the zero, the lawful state of rest and passage.

Vietnam went the full distance on the thinning road: from characters to letters. Its tone marks keep what Chinese keeps in the syllable. Tone is a trit in the sound itself, and quốc ngữ writes that turn as a mark above or below the vowel.

The rim scripts stayed on the rung. Tangut is the image-sound rung built anew in one stroke, with 5,863 characters. It kept the depth of its model and not its parentage.

## 22.8 Status

- Counted: 2,228 everyday signs in Japanese; 18% of Hangul blocks in common use; Tangut in use 466 years; 34 signs in quốc ngữ.
- Read in source: none of this chapter rests on a primary source opened for this book.
- From secondary source (Wikipedia): all dates, makers and counts in this chapter.

- Open: the *Man'yōshū* is dated before 759 in one article and after 759 in another. Which Hangul vowel shape is heaven and which is earth differs between two articles; the *Haerye* was not opened. Sign counts for Khitan and Jurchen and dates for hyangchal were not found. The origin of Nūshu is undated.
- Open in the net reading: whether the 'Phags-pa model, if it holds, touches the reading of the five base shapes as drawings of the mouth.

## Chapter 23. India: The Built Syllable

India wrote twice. The first time is the Indus signs, short strings on seals, whose status as writing is open. The second time begins about 1,600 years later, with two scripts in the edicts of Ashoka. These scripts write the syllable as a consonant with a vowel built on to it. From one of them, Brahmi, descend nearly all scripts of South and Southeast Asia.

### 23.1 The Indus signs

The Indus signs stand on seals and tablets. The main corpus dates to about 2800–1900 BCE, the mature phase to 2600–1900 BCE. The signs mostly run from right to left (Wikipedia, "Indus script"). There is no bilingual text and no long text.

| Item                               | Number                                      | Source                                               |
|------------------------------------|---------------------------------------------|------------------------------------------------------|
| Inscribed objects                  | 2,905                                       | Mahadevan's concordance, in Farmer et al. 2004       |
| Inscribed objects, later counts    | c. 4,000 (Fairervis 1992); c. 5,000 by 2025 | Wikipedia, "Indus script"                            |
| Distinct signs                     | 417                                         | Mahadevan, in Farmer et al. 2004 and Rao et al. 2009 |
| Distinct signs, same               | 419                                         | Wikipedia, "Indus script"                            |
| Distinct signs, most               | 300–400                                     | Farmer et al. 2004                                   |
| Distinct signs, Wells              | over 600; c. 694 (2015)                     | Farmer et al. 2004; Wikipedia                        |
| Sign occurrences                   | 13,372                                      | Mahadevan, in Farmer et al. 2004                     |
| Average length of an inscription   | 4.6 signs                                   | Farmer et al. 2004                                   |
| Longest inscription on one surface | 17 signs                                    | Farmer et al. 2004                                   |

Two figures follow from the table. 13,372 occurrences over 2,905 objects is 4.6 signs per object, which matches the stated average. 13,372 occurrences over 417 signs is 32 occurrences per sign on average.

### 23.2 The debate

Two papers set the terms. Both were read for this book.

Farmer, Sproat and Witzel (2004) hold that the Indus signs are not writing. Their grounds are five. The inscriptions are brief. There are no long texts on durable material. Signs repeat little within one inscription. The share of rare signs rises as the corpus grows. The system does not change in 600 years. For repetition they give a matched count: 48 repeats in a sample of Egyptian cartouches, against 8 and 7 in two Indus seal samples of the same size.

Rao and five co-authors (2009) hold that the sign sequences have the structure of language. They measured conditional entropy: how far one sign fixes the next. Their corpus was 1,548 lines with about 7,000 sign occurrences and 417 signs. The Indus value lay close to Sumerian and Old Tamil. It lay between English words and English letters. It lay far from DNA, protein, the programming language Fortran and two control sets.

|            | <b>Farmer, Sproat &amp; Witzel 2004</b> | <b>Rao et al. 2009</b>              |
|------------|-----------------------------------------|-------------------------------------|
| Claim      | not writing                             | structure like language             |
| Corpus     | 2,905 objects, 13,372 occurrences       | 1,548 lines, c. 7,000 occurrences   |
| Key number | repeats: 48 against 8 and 7             | entropy near Sumerian and Old Tamil |
| Measure    | length, repetition, rare signs, change  | order of signs in sequence          |

The debate went on. Sproat replied that the same entropy result is obtained for systems that are not language. The exchange ran in *Computational Linguistics* in 2010 and in *Language* in 2014–15. Parpola answered Farmer and his co-authors point by point in 2005 and 2008 (Wikipedia, "Indus script").

### 23.3 Brahmi and Kharosthi

Writing reappears in the third century BCE. Brahmi is fully developed in the edicts of Ashoka, dated 250–232 BCE. The Rummindei pillar dates to about 248 BCE. Between the end of the mature Indus phase in 1900 BCE and these edicts lie about 1,650 years.

An earlier Brahmi is claimed for sherds from Anuradhapura, dated sixth to early fourth century BCE. This is disputed; Falk holds that they may date after 250 BCE (Wikipedia, "Brahmi script").

|                 | <b>Brahmi</b>                               | <b>Kharosthi</b>                                       |
|-----------------|---------------------------------------------|--------------------------------------------------------|
| Region          | Ashoka's edicts                             | Gandhara                                               |
| Date            | by 3rd century BCE                          | 4th/3rd century BCE to 3rd century CE; later in Khotan |
| Direction       | not stated in the source                    | right to left                                          |
| Letters         | 33 consonants, plus <i>la</i> ; vowel marks | not found                                              |
| Origin          | debated                                     | from Aramaic                                           |
| Read by moderns | James Prinsep, 1837–1838                    | 1835–1838, from Indo-Greek coins                       |

On the origin of Brahmi three positions stand. The majority holds that it follows a Semitic model, with Aramaic the likeliest; Bühler named Phoenician. Falk holds that it was designed under Ashoka from Kharosthi and Greek. A link to the Indus signs is unproven, and a gap of about a millennium separates the two (Wikipedia, "Brahmi script").

### 23.4 The abugida principle

Both scripts spell in the same way, and all their descendants do. The type is called an abugida. Each consonant sign carries a built-in vowel, usually a. Any other vowel is shown by a mark added to the consonant sign. A further stroke, the virama, removes the vowel altogether (Wikipedia, "Abugida").

| Written | Read | What was done                            |
|---------|------|------------------------------------------|
| क       | ka   | the bare sign: consonant with built-in a |
| कि      | ki   | a mark for i added                       |
| को      | ko   | a mark for o added                       |
| प्      | p    | virama added: the vowel removed          |

A syllabary gives each syllable a sign of its own. An alphabet gives consonant and vowel each a letter. The abugida stands between them. The syllable is one sign, and the sign shows its parts.

The letters have a fixed order, and the order is a table of the mouth. The Devanagari list, the varṇamālā, sorts the consonants by place and manner of articulation. The first row is ka kha ga gha ṇa. The rows that follow start with ca, ṭa, ta and pa. Each row is one place of articulation (Wikipedia, "Devanagari"; "Brahmic scripts"). This is the order of the Sanskrit sound table. Sanskrit grammar worked from act-roots and ordered sounds: Pāṇini, about 400 BCE, with some 4,000 rules and some 2,000 verbal roots (Konstapel 2026i).

The Indian list is ordered by the mouth.

## 23.5 The descendants

Brahmi spread over South and Southeast Asia and Tibet. The table gives the main descendants with the counts and dates in the sources. Where two figures stand, the sources differ.

| Scrip      | Date                                                                       | Signs                                                       | From                       |
|------------|----------------------------------------------------------------------------|-------------------------------------------------------------|----------------------------|
| Devanagari | Nāgarī forms from 1st c. CE; regular use 7th/8th c.; modern form c. 1000   | 48 primary (14 vowels, 34 consonants); 47 in another count  | Brahmi, via Gupta and      |
| Tamil      | date not given in the source                                               | 12 vowels, 18 consonants, 1 āyṭam; 216 compound forms       | Pallava                    |
| Tibetan    | traditional c. 620; 630s–640s (van Schaik); "8th century" in another table | 30 consonants, 4 vowel marks                                | Gupta                      |
| Khmer      | oldest dated inscription 611 CE; "11th century" in another table           | 35 consonants, 33 in use                                    | Pallava                    |
| Burmese    | first attested 1035 CE                                                     | 33 consonants                                               | Mon, in the end of Pallava |
| Thai       | 1283, King Ramkhamhaeng                                                    | 44 consonants for 21 sounds; 16 vowel symbols; 4 tone marks | Old Khmer                  |
| Javanese   | from Kawi (8th–15th c.); modern form 14th–15th c., attested mid-16th       | 20 basic letters                                            | Kawi                       |

Sources: Wikipedia, "Devanagari", "Tamil script", "Tibetan script", "Khmer script", "Mon–Burmese script", "Thai script", "Javanese script", "Brahmic scripts".

Some notes on the rows. Devanagari is used for over 120 languages. The Tamil count is a full grid: 12 vowels times 18 consonants gives 216 compound forms. With the 12 vowels, the 18 consonants and the single āyṭam the total is 247. The Tibetan script is attributed to Thonmi Sambhota under king Songtsen Gampo. The Thai script is dated by a stele of 1292, whose authenticity is questioned. Thai has more than two consonant letters for each consonant sound: 44 for 21.

## 23.6 The people

No name stands by the Indus signs. The mature signs were in use for about 700 years, from 2600 to 1900 BCE. After that the signs are gone. Whatever they recorded went with them.

The second writing of India is tied to a ruler. The edicts of Ashoka date to 250–232 BCE. Later scripts carry a maker's name in tradition: Thonmi Sambhota for Tibetan, King Ramkhamhaeng for Thai.

Brahmi had to be deciphered. James Prinsep did so in 1837–1838. Kharosthi was read in the same years from Indo-Greek coins.

Sanskrit learning was carried by voice. Vedic mantras carry meaning in tone (Konstapel 2026a).

## 23.7 In the net

The abugida keeps the build of the syllable visible. The consonant sign is the parent. The vowel mark is one turn added to it. The bare sign with its built-in a is turn zero: the parent itself. Zero is here a lawful state, not an absence. The virama, which silences the vowel, is a further turn and not a return to nothing.

Every consonant takes every vowel. The script is a grid of consonant times vowel. Tamil prints the grid in full: 12 times 18 is 216, every cell inhabited. The click inventories of this book showed the same form: a place times an accompaniment, with nearly every combination inhabited. A Tamil primer and a !Xóõ click chart are grids of one kind at two depths.

The two-layer law is visible on the page. The consonants are the address layer: a fixed list in a fixed order, 33 in Brahmi, 34 in Devanagari. The vowel marks are the layer that moves, added and removed on each consonant.

The order of the list is itself a route. It walks through the mouth, one row per place of articulation. Hangul draws the place of closure in each letter. The Indian list sets the letters out by place of closure. Korea put the mouth into the shape. India put the mouth into the order.

Two rungs hold at once in the abugida: the syllable as one sign and the single sound as a part of it. The alphabet, by contrast, lets go of the syllable. The abugida is the rung on which both remain.

One Indian count sits on a ring in the earlier texts. The 27 nakshatras, the lunar mansions, fill ring 3 with its 27 rooms (Konstapel 2026m). The letter counts of the Indian scripts are left as they are: 33, 34, 30, 44 and 20 are counts read off from the scripts.

The Indus signs cannot be read in the net until their status is known. Their numbers stand: 417 signs, 4.6 to an inscription.

## 23.8 Status

- Counted: 4.6 signs per object and 32 occurrences per sign from Mahadevan's totals; about 1,650 years between the Indus signs and Ashoka; the Tamil total of 247.
- Read in source: Farmer, Sproat & Witzel 2004; Rao et al. 2009 (authors' copy).
- From secondary source (Wikipedia): the Indus dates, Brahmi and Kharosthi, the abugida principle, the order of the sound table, all descendants.
- Open: whether the Indus signs are writing. The sign count stands at 417 or 419 for one concordance and above 600 for Wells. The origin of Brahmi. Devanagari has 48 or 47 primary characters. Tibetan is dated 7th or 8th century and Khmer 611 or 11th century, depending on the table.

- Open: no source consulted states that the Sanskrit sound table was the model for the build of the abugida. The two are set side by side here, not derived from each other.

## Chapter 24. The Americas and the Pacific

Writing arose in Mesoamerica without contact with the Old World. It is the one accepted independent invention in the Americas. In the Andes the Inca state kept its records on knotted cords, a record without image and without sound signs. On Rapa Nui, in the Pacific, a script was cut in wood that no one can read. This chapter sets out the three.

### 24.1 Olmec, Zapotec, Isthmian

The oldest candidate is the Cascajal block. It is a slab of serpentine measuring 36 by 21 by 13 centimetres. It carries 62 glyphs. It is assigned to the San Lorenzo phase of the Olmec, which ended about 900 BCE. Road builders found it, and its context is lost. It was published in *Science* on 15 September 2006 under the title "Oldest Writing in the New World" (Wikipedia, "Cascajal Block").

Its status is disputed. Bruhns and Kelker doubt it. Freidel and Reilly (2010) read it as a layout of sacred objects, not a text. Englehardt and co-authors (2020) support its authenticity.

Dated texts follow in two regions.

| Script                  | Period                 | Key monuments                                                    | Status                            |
|-------------------------|------------------------|------------------------------------------------------------------|-----------------------------------|
| Olmec<br>(Cascajal)     | before c. 900 BCE      | one block, 62 glyphs                                             | disputed                          |
| Zapotec                 | 5th c. BCE – 8th c. CE | San José Mogote Monument 3, "before 500 BCE" (dating questioned) | undeciphered; logosyllabic (Urcid |
| Isthmian<br>(Epi-Olmec) | c. 500 BCE – 500 CE    | Chiapa de Corzo stela, 36 BCE; La Mojarra Stela 1, 156 CE        | decipherment claimed and rejected |

Sources: Wikipedia, "Zapotec script", "Isthmian script", "Mesoamerican writing systems".

The La Mojarra date is a Long Count date: 8.5.16.9.7, which is 156 CE. Justeson and Kaufman claimed a decipherment of Isthmian as a Zoquean language, in *Science* in 1993 and 1997. Houston and Coe rejected it in 2004. A second Wikipedia article gives the years of the debate as 1997 and 1998.

### 24.2 Maya

Maya is the only script of the Americas that is read. Its earliest texts date to the third century BC, at San Bartolo. It stayed in use to the Spanish conquest, and perhaps to the seventeenth century at Tayasal (Kettunen & Helmke 2011). That is a life of some 1,900 years.

The script is logosyllabic. It has signs for whole words and signs for syllables. The counts differ by author and by what is counted.

| Count                          | Number          | Source                                    |
|--------------------------------|-----------------|-------------------------------------------|
| Different signs, with variants | more than 1,000 | Kettunen & Helmke 2011                    |
| Signs                          | 800             | Coe, in Kettunen & Helmke 2011            |
| Glyphs documented              | about 700       | Wikipedia, "Mesoamerican writing systems" |

|                                             |                  |                                |
|---------------------------------------------|------------------|--------------------------------|
| In use at one time                          | no more than 500 | Kettunen & Helmke 2011         |
| In use at one time                          | 200–300          | Coe, in Kettunen & Helmke 2011 |
| Syllabic signs                              | about 200        | Kettunen & Helmke 2011         |
| Syllables these write                       | about 80         | Kettunen & Helmke 2011         |
| Share of syllabic signs that are homophones | about 60%        | Kettunen & Helmke 2011         |

The range for the whole stock is therefore 700 to more than 1,000. The syllabic part is a grid. Each sign writes a consonant plus a vowel, and the signs are set out in a table of consonants against vowels. About 200 signs fill about 80 cells, which is 2.5 signs per syllable.

How much can be read is also given as a range. Wikipedia's "Maya script" says that over 90 per cent of the texts can be read. It cites a 2008 estimate that the sound of 80 per cent of the glyphs is known and the meaning of 60 per cent. "Mesoamerican writing systems" says that about 75 per cent of some 700 glyphs are deciphered.

### 24.3 The decipherment

The reading of Maya turned on one paper. Yuri Knorozov published it in 1952 in *Sovetskaya Etnografiya*, on pages 100 to 118. Knorozov showed that the "alphabet" recorded by Landa is a syllabary. He also stated the rule of synharmony. J. E. S. Thompson opposed the reading until his death in 1975 (Wikipedia, "Yuri Knorozov").

| Year      | Who                   | Step                                          |
|-----------|-----------------------|-----------------------------------------------|
| 1952      | Knorozov              | Landa's "alphabet" is a syllabary; synharmony |
| 1958      | Berlin                | emblem glyphs                                 |
| 1959/1960 | Proskouriakoff        | the texts of Piedras Negras record history    |
| 1973      | Palenque Mesa Redonda | a meeting of the field                        |

Source: Wikipedia, "Maya script".

### 24.4 Aztec and Mixtec

The books of the Aztecs and the Mixtecs are mainly pictures. Names of people and places are spelled by rebus: a picture is used for the sound of its word. The name Tenochtitlan is built this way from the parts te-noch-ti-tlan. Lacadena argued in 2008, in "A Nahuatl Syllabary", that the Aztec sound signs form a syllabary. The Codex Mendoza dates to about 1541 (Wikipedia, "Aztec script").

Mixtec writing belongs to the Postclassic period. One source starts it about 1000, another in the thirteenth century. It is pictographic, with sound signs for names. Four Mixtec codices from before the conquest survive, on deerskin (Wikipedia, "Mixtec writing").

### 24.5 The khipu

A khipu is a set of knotted cords. The Inca state kept its accounts this way. The first undisputed khipus are older: they belong to the Wari, in the Middle Horizon, about 600–1000 CE. Shady has reported a proto-khipu about 5,000 years old from Caral; this has not been independently evaluated (Wikipedia, "Quipu").

The number of surviving khipus is given as a range.

| Count                                  | Number           | Source              |
|----------------------------------------|------------------|---------------------|
| Surviving khipus                       | about 600        | Urton 2003          |
| With data in the Open Khipu Repository | 702              | January 2026        |
| Surviving khipus                       | just under 1,400 | Medrano 2021 survey |
| Held in Berlin                         | 298              | —                   |

All four as reported in Wikipedia, "Quipu".

L. L. Locke showed in 1912 and 1923 that the knots write numbers. The system is decimal and positional: the place of a knot on the cord gives its value in units, tens or hundreds. Ascher and Ascher analysed several hundred khipus from the late 1960s on. They found them mostly numerical.

Whether cords also record words is open. Urton proposed in 2003 that the cords carry binary choices and may hold content that is not number. Urton and Brezine (2005) studied the khipus of Puruchuco. Medrano and Urton (2018) reported a match for khipus from the Santa valley.

## 24.6 The Collata khipus

The strongest case for sound-writing in cords is the two Collata khipus. S. Hyland published them in 2017. They are colonial, of the eighteenth century.

| Item               | Number                                            | Source                |
|--------------------|---------------------------------------------------|-----------------------|
| Khipus             | 2                                                 | publisher's release   |
| Different symbols  | 95                                                | Hyland 2017, abstract |
| Colours            | 14                                                | publisher's release   |
| Animal fibres      | 6: vicuña, alpaca, guanaco, llama, deer, vizcacha | publisher's release   |
| Lineage names read | 2                                                 | publisher's release   |

Hyland notes that 95 symbols is "a quantity within the range of logosyllabic writing". The cord sequences appear to represent the names of lineages, called ayllu (Hyland 2017).

## 24.7 Rongorongo

Rongorongo is the script of Rapa Nui, Easter Island. It is undeciphered.

| Item | Number | Source |
|------|--------|--------|
|------|--------|--------|

|                                           |                                    |                         |
|-------------------------------------------|------------------------------------|-------------------------|
| Objects                                   | 27 wooden objects; "fewer than 30" | Ferrara et al. 2024     |
| Accepted texts                            | 26, about half beyond doubt        | Wikipedia, "Rongorongo" |
| Glyphs in all                             | over 15,000                        | Wikipedia               |
| Glyph types, Barthel                      | 600 codes; 120 basic claimed       | Wikipedia               |
| Glyph types, Pozdniakov & Pozdniakov 2007 | 52 cover 99.7%                     | Wikipedia               |

The texts run in reverse boustrophedon: the lines alternate in direction, and every other line stands upside down. One reading is accepted: a lunar calendar on the tablet called Mamari.

The question is the age of the script. If it predates European contact in the 1720s, it is one more independent invention of writing. Before 2024 only two tablets had been dated. Ferrara and eight co-authors then dated four tablets kept in Rome by radiocarbon (Ferrara et al. 2024).

| Tablet | Name          | Date of the wood (cal AD)  |
|--------|---------------|----------------------------|
| A      | Tahua         | 1862–1887                  |
| B      | Aruku Kurenga | 1832–1857                  |
| C      | Mamari        | 1694–1840 (peak 1694–1727) |
| D      | Échancrée     | 1493–1509                  |

Tablet D predates contact by more than two centuries. From 1509 to the 1720s is over 210 years. The wood of tablet D is not native to the island; it may be driftwood. The date is that of the wood, not of the carving.

## 24.8 The people

The Maya script was written for about 1,900 years. Maya books were burned in 1562 (Konstapel 2026d). Four codices survive, the fourth authenticated in 2015 (Wikipedia, "Maya script"). The knowledge of how to read was lost and was recovered between 1952 and 1973.

Of the Mixtec books four from before the conquest remain. Of the Inca records between 600 and 1,400 khipus remain, and their numbers can be read, not their words.

On Rapa Nui 26 or 27 objects are left, with some 15,000 glyphs. No reader is left.

## 24.9 In the net

The khipu is writing in knots. It is the one record in this book that is made of the thing the net is made of: a strand with turns. It has no image and no sound. Every other script first draws a thing or catches a sound and then becomes abstract. The khipu was never anything but strand, knot and position.

Its number system is depth. A knot one position further is one step deeper, and each position multiplies by ten. The net multiplies by three at each depth; the khipu multiplies by ten. The step is the same and the base differs.

The knot holds by its shape, without glue. On a khipu this is literal. A knot can also be untied, and then the record is gone and the strand remains.

The Collata khipus hold their distinctions in the strand itself: 14 colours and the fibre of six animals. Urton reads the Inca cords as binary. That is counting in twos, the count of the tension layer. The count of 95 symbols sits on no ring number and is left as it is.

The Maya script is the image-sound rung once more, reached without contact with Sumer, Egypt or China. It holds word signs and sound signs at once. Its sound part is a grid of consonant times vowel, the form that the abugida and the click chart also take. Four inventions that never met stand on the same rung. Selection by fit shows in that: only this form returned.

The grid is not thin. About 200 signs stand for about 80 syllables. The script kept several signs to a cell. The alphabet keeps one sign to a sound. The Maya script kept the choice.

Rongorongo cannot be read in the net, and nothing is filled in. What is known is the path of the line: back and forth, every other line inverted. The line of text is one strand that does not break at the edge. It turns.

## 24.10 Status

- Counted: 2.5 syllabic signs per Maya syllable; about 1,900 years of Maya writing; over 210 years between the wood of tablet D and contact.
- Read in source: Kettunen & Helmke 2011 (Maya counts); Ferrara et al. 2024 (rongorongo dates); Hyland 2017 (abstract only) and the publisher's release.
- From secondary source (Wikipedia): Cascajal, Zapotec, Isthmian, the decipherment history, Aztec and Mixtec, the khipu counts, Locke, the Aschers, Urton.
- Open: whether the Cascajal block is writing. Whether Isthmian is deciphered. Whether khipus record words; the full text of Hyland 2017 was not available, so cord counts and the names read are not given here. Whether rongorongo predates contact: the 2024 date is of the wood.
- Open: the number of Maya glyphs stands at about 700, 800 or more than 1,000.
- Open: surviving khipus stand at about 600, 702 or just under 1,400; rongorongo objects at 26 or 27.

## Chapter 25. Scripts Made in One Lifetime

In the last two centuries a number of scripts were made by one person or a small group, within years. Their makers knew that writing existed. Several of them could not read any script. These cases show a thing that the old scripts hide under millennia: what a person reaches for first when a language must be written from nothing. The chapter adds the scripts of Africa beyond Egypt, old and recent.

### 25.1 Cherokee

Sequoyah completed a script for Cherokee in 1821. He was illiterate and knew no English. He knew that writing existed. His script has one sign for each syllable. It had 86 signs, cut to 85 in 1828. The Cherokee Nation adopted it in 1825. A newspaper in it, the *Cherokee Phoenix*, appeared in 1828 (Wikipedia, "Sequoyah"; "Cherokee syllabary").

From completion to adoption took four years, and to a newspaper seven. Many of the sign shapes look like Latin letters. Their values are new.

## 25.2 Vai

The Vai script of West Africa was made around 1833 by inventors who could not read (Kelly et al. 2021). A university release on the same study says about 1834 and names eight illiterate men. Wikipedia names Momolu Duwalu Bukele and the years 1832/33. It also mentions a Cherokee, Austin Curtis, who lived among the Vai; it calls the link tenuous ("Vai syllabary").

The script is a syllabary of about 200 signs. Kelly, Winters, Miton and Morin (2021) followed the shapes of its letters through time. The release states that 200 syllabic letters were tracked. The finding is in the abstract: visual complexity fell steadily, and the script became "increasingly compressed over the first 171 years". The letters that were most complex at the start were simplified most.

From about 1833, 171 years run to about 2004. The title of the paper states the comparison: a new script of West Africa repeats the change that older writing systems went through.

## 25.3 Bamum

King Ibrahim Njoya of Bamum made a script and then remade it for twenty years. The counts show the path (Wikipedia, "Bamum script").

| Stage  | Date       | Signs                     |
|--------|------------|---------------------------|
| First  | 1896–97    | 465 (511 in some sources) |
| Second | c. 1902    | 371                       |
| Third  | c. 1907–08 | 285                       |
| Fourth | c. 1907–08 | 195                       |
| Fifth  | c. 1910    | 80–82                     |
| Last   | c. 1918    | 80                        |

The first stage was a set of pictures for words. The last was a syllabary. From 465 signs to 80 is a fall of 83 per cent in about 21 years.

The script fell out of use about 1931, when Njoya was sent into exile.

## 25.4 N'Ko

Solomana Kanté made N'Ko on 14 April 1949. It has 27 letters: 7 vowels and 20 consonants. It is written from right to left (Wikipedia, "N'Ko script"). N'Ko is an alphabet. Its maker was literate. He knew scripts that write single sounds, and he made one.

## 25.5 Pahawh Hmong

Shong Lue Yang made a script for Hmong in 1959. He was illiterate. His script splits the syllable in two: the onset, which is its start, and the rime, which is the rest. It has one set of signs for onsets and one for rimes (Wikipedia, "Pahawh Hmong").

| Stage             | Onset signs | Rime signs | Total |
|-------------------|-------------|------------|-------|
| Stage 1, 1959     | 60          | 91         | 151   |
| Final stage, 1971 | 20          | 13         | 33    |

In twelve years the script went from 151 signs to 33.

## 25.6 Cree syllabics

James Evans, a literate missionary, made the Cree syllabics at Norway House in 1840. The script has 10 basic shapes. Each shape is a consonant. The vowel is shown by rotation: the same shape, turned. Evans drew on Devanagari, on Pitman's shorthand and on Cherokee (Wikipedia, "Canadian Aboriginal syllabics").

## 25.7 The six compared

| Script       | Year      | Maker                        | Could read? | First unit            | Signs        |
|--------------|-----------|------------------------------|-------------|-----------------------|--------------|
| Cherokee     | 1821      | Sequoyah                     | no          | syllable              | 86, then 85  |
| Vai          | c. 1833   | Bukele and others; eight men | no          | syllable              | about 200    |
| Cree         | 1840      | James Evans                  | yes         | syllable, by rotation | 10 shapes    |
| Bamum        | 1896–1918 | King Njoya                   | not stated  | word, then syllable   | 465, then 80 |
| N'Ko         | 1949      | Solomana Kanté               | yes         | single sound          | 27           |
| Pahawh Hmong | 1959      | Shong Lue Yang               | no          | half-syllable         | 151, then 33 |

The pattern is in the fourth and fifth columns. The three makers who could not read produced signs for syllables or half-syllables. Njoya started from words and arrived at syllables. Evans, who could read, still chose the syllable. Only Kanté, who was literate, made an alphabet. No maker without letters reached for the single sound.

## 25.8 Africa beyond Egypt

Africa has old scripts apart from Egyptian, and sign systems that stand next to writing.

| Script           | Date                        | Type                           | Signs                                    | From                      |
|------------------|-----------------------------|--------------------------------|------------------------------------------|---------------------------|
| Meroitic         | c. 300 BC – 600 AD          | alphasyllabary with built-in a | 23 (4 vowels, 15 consonants, 4 syllabic) | Egyptian                  |
| Ge'ez (Ethiopic) | c. 1st c. CE; vowels 4th c. | abugida                        | 26 consonants × 7 orders                 | Ancient South Arabian     |
| Libyco-Berber    | probably 6th c. BCE         | abjad                          | eastern form 24 letters, 22 read         | Phoenician model or local |
| Neo-Tifinagh     | adopted by Morocco 2003     | alphabet                       | 33 letters                               | Libyco-Berber             |

|         |                           |                                    |                 |             |
|---------|---------------------------|------------------------------------|-----------------|-------------|
| Nsibidi | "c. 400 AD" in one source | pictographic and ideographic signs | several hundred | independent |
| Adinkra | oldest cloth 1817         | symbols, not writing               | 53–98 listed    | —           |

Sources: Wikipedia, "Meroitic script", "Ge'ez script", "Tifinagh", "Nsibidi", "Adinkra symbols".

Meroitic has a hieroglyphic and a cursive form; about 90 per cent of the texts are cursive. Words are divided by two or three dots. F. Ll. Griffith read the signs in 1909–1911. The sounds are known, and the language is poorly understood.

Ge'ez began as a consonant script. Its oldest texts, at Hawulti and Matara, date to about the first century CE. Vowels were added in the fourth century, under king Ezana. Since then each consonant has seven forms, one for each vowel order. 26 consonants times 7 orders is 182 signs. Four consonants, q, ḥ, k and g, have a further series of five forms each, which adds 20. The total is 202.

Libyco-Berber is a pure abjad: it writes consonants only. Its origin is uncertain. Its modern form, Neo-Tifinagh, is a full alphabet of 33 letters, in the IRCAM standard; Morocco adopted it in 2003.

Nsibidi belongs to the Cross River region of Nigeria and Cameroon and to the Ejagham people. The Ekpe society used it. It has several hundred signs. Europeans first recorded it in 1904, and Macgregor described it in 1909. Adinkra are symbols of the Akan of Ghana, printed on cloth and tied to proverbs. The oldest cloth, collected by Bowdich in 1817, is in the British Museum. Adinkra is not treated as writing.

A third African system was never written at all. Ifá, of the Yoruba, has 256 figures called odù, built on 16 principal figures, the meji. The odù are "recited, not read" (Konstapel 2026a). Its corpus is put at more than 65,000 text units, carried in memory (Konstapel 2026b).

## 25.9 The people

These scripts have faces. Sequoyah could not read. The release on Vai speaks of eight illiterate men. Njoya was a king who revised his own work five times. Shong Lue Yang could not read. Kanté was literate. Evans was a missionary.

The fates differ. Cherokee had a nation behind it within four years. Vai was followed through 171 years of use. Bamum ended with its maker's exile about 1931, after some 35 years. Meroitic lasted 900 years and left texts in a language that no one now understands.

## 25.10 In the net

Scripts made in one lifetime reach for the syllable. The syllable is the unit that closes in the mouth. It opens, sounds and shuts, and then the next begins. A single consonant does not close by itself; it leans on the vowel beside it. A person who listens to speech without knowing letters hears what closes. What does not close, does not last, and it is not heard as a unit either.

Sequoyah, the Vai makers and Shong Lue Yang each wrote down what returns onto itself in the mouth. The letter came only to those who had already seen letters. The alphabet is a rung that is reached from the syllable, with the syllable as its parent.

Bamum walks the rungs of this book in 21 years: from 465 pictures of words to 80 syllables. It is the same route at another depth of time. What left the picture in Bamum is what left it in the old scripts: the thing and the image went, and the sound stayed.

Vai shows the thinning within one rung. The letters lost complexity for 171 years, and the most complex lost the most. No one ordered it. Only what returned easily from hand to hand stayed. That is selection by fit, and here it has dates.

Cree writes the vowel as a turn in the plain sense. The consonant is the shape. The vowel is the direction in which the shape points. One shape and its turns make a row of syllables. Parent and turn are both on the page, and the turn is a rotation.

Ge'ez is the grid again: 26 consonants times 7 orders, every cell inhabited. The parent stands inside the child. The South Arabian consonant sign is still there in each of its seven Ethiopic forms.

Ifá sits on a ring in the count of the earlier texts. Ifá counts  $2^8 = 256$  odù. Ring 8 has 6,561 rooms. Of these, 256 carry no zero, and the 256 odù are placed there (Konstapel 2026m). The 16 principal figures are placed on ring 4, which has 16 zero-free rooms of 81. Ifá counts in twos, as the I Ching does, two rings deeper. It was never written, and it lost nothing.

The sign counts of the invented scripts sit on no ring and are left as counts: 85, about 200, 80, 33. N'Ko has 27 letters, which is the number of rooms on ring 3. That is noted as a count that coincides, and no more is read into it.

## 25.11 Status

- Counted: Bamum's fall of 83% in about 21 years; Pahawh Hmong 151 to 33; Ge'ez 182 + 20 = 202; Vai's 171 years run to about 2004.
- Read in source: Kelly et al. 2021 (abstract page) and the university release on it.
- From secondary source (Wikipedia): Cherokee, Bamum, N'Ko, Pahawh Hmong, Cree, the Vai inventor, and all of section 25.8.
- Open: the Vai date stands at 1832/33, around 1833 or about 1834. The first Bamum count is 465 or 511. The age of Nsibidi rests on one undocumented figure.
- Open: that unlettered makers reach for the syllable is read off from six cases in this chapter. It is a finding of six, not a law.
- Open in the net reading: the 256 odù among the zero-free rooms of ring 8 is a count. The map from mark to trit is not written out.

## Chapter 26. The Kinds of Writing

The scripts of this book fall into a small number of kinds. The kinds differ in the unit that one sign writes: a word, a syllable, a consonant, a single sound, or a feature of a sound. This chapter gives the kinds and who named them, the accepted independent inventions, the number of scripts now, and the share of languages that are written. It ends with one table of all the scripts of Part V.

### 26.1 The typology

Six types are in general use (Wikipedia, "Writing system").

| Type                                       | One sign writes    | Example in               | Term from                             |
|--------------------------------------------|--------------------|--------------------------|---------------------------------------|
| Logographic<br>(morphographic); with sound | a word or morpheme | Chinese,<br>Maya, Tangut | older usage;<br>"morphosyllabic" from |
| Syllabary                                  | a syllable         | kana,<br>Cherokee, Vai,  | older usage                           |
| Abjad                                      | a consonant        | Libyco-Berber            | Daniels 1990                          |

|          |                                                  |                      |              |
|----------|--------------------------------------------------|----------------------|--------------|
| Abugida  | a consonant with built-in vowel; other vowels by | Brahmi, Devanagari,  | Daniels 1990 |
| Alphabet | a consonant or a vowel                           | N'Ko, quốc ngữ, Neo- | older usage  |
| Featural | parts of the sign show features of the sound     | Hangul               | Sampson 1985 |

The names have a short history.

I. J. Gelb published *A Study of Writing* in 1952, with a revised edition in 1963. He held that writing develops in one direction: from logography to syllabary to alphabet. He coined the word *grammatology* for the study of writing (Wikipedia, "Ignace Gelb").

Peter T. Daniels added two types in 1990, in a paper called "Fundamentals of Grammatology". Abjad comes from the Arabic letter order. Abugida is an Ethiopic term; W. Leslau suggested it to Daniels. W. Bright proposed alphasyllabary in 1997 as another name for the abugida (Wikipedia, "Peter T. Daniels"; "Abugida").

G. Sampson introduced featural in *Writing Systems* (1985), for Hangul. DeFrancis rejects the type (Wikipedia, "Featural writing system").

DeFrancis offers a different cut. In his typology all full writing is based on sound. Chinese is then not a script of ideas beside scripts of sound. It is a meaning-plus-sound syllabic system, for which his word is morphosyllabic (DeFrancis 1989).

The standard handbook is Daniels and Bright, *The World's Writing Systems* (1996): 968 pages, 79 contributors, 74 articles in 13 parts (Wikipedia, "The World's Writing Systems").

Gelb's single line does not fit all the cases of this Part. Chinese did not move to a syllabary in 3,000 years. Hangul went from characters to a featural alphabet in one act. The abugida is neither a stage before the alphabet nor one after it.

## 26.2 The independent inventions

Most scripts descend from another script, or were made by someone who knew that writing existed. Four inventions are most commonly recognised as independent (Wikipedia, "History of writing").

| Place       | Date              | Doubt                                                                                            |
|-------------|-------------------|--------------------------------------------------------------------------------------------------|
| Mesopotamia | c. 3400–3100 BC   | —                                                                                                |
| Egypt       | c. 3250 BC        | possibly stimulated by Sumer (Sampson); the Abydos labels of 3400–3200 BC argue for independence |
| China       | before c. 1250 BC | —                                                                                                |
| Mesoamerica | before c. 1 AD    | —                                                                                                |

Two further cases are open. The Indus signs would be a fifth if they are writing; that is not agreed. Rongorongo would be a further case if it predates contact; the wood of one tablet dates to 1493–1509 (Ferrara et al. 2024). The khipu stands apart: an independent record, whose status as writing of words is open.

All other scripts of this Part have a parent or a known maker.

## 26.3 How many scripts exist now

The count depends on who counts and what counts as one script.

| Source                | Count                           | Note                                                                        |
|-----------------------|---------------------------------|-----------------------------------------------------------------------------|
| Unicode 18.0          | 175 scripts; 172,808 characters | version dated 16 September 2026; page still marked preliminary draft        |
| Unicode 17.0          | 172 scripts; 159,801 characters | September 2025                                                              |
| Unicode 16.0          | 168 scripts; 154,998 characters | —                                                                           |
| SIL script index      | 324 scripts                     | count made for this book, $\pm 2$ ; 217 with an ISO 15924 code, 107 without |
| Daniels & Bright 1996 | 294 writing systems             | publisher's phrase: "all 294 known writing systems"                         |
| Omniglot              | 34 scripts in active use        | basis not explained                                                         |

Sources: Unicode Consortium 2026a, 2026b; Wikipedia, "Unicode", "Writing system"; SIL; Omniglot.

Unicode is the standard that gives every written character a number for use in computers. Version 18.0 adds three scripts to the 172 of version 17.0: Proto-Cuneiform, Jurchen and Seal. Two of the three stand in this Part: Jurchen, made in 1119 or 1120, and Seal. Version 18.0 has 13,007 more characters than version 17.0.

The figures agree on the order of size. Between 175 and 324 scripts are known, living and dead. Omniglot puts the scripts in active use at 34.

## 26.4 How many languages are written

The 29th edition of *Ethnologue* (2026) counts 7,170 living languages (Wikipedia, "Ethnologue"). How many of them are written is known less well. Two sets of figures are reported by Omniglot.

| Source                    | Written | Unwritten | Uncertain | Total |
|---------------------------|---------|-----------|-----------|-------|
| ScriptSource              | 3,661   | 719       | 2,586     | 6,966 |
| Ethnologue, older edition | 3,909   | —         | —         | —     |

The share follows by division. 3,661 of 7,170 is 51 per cent. 3,909 of 7,170 is 55 per cent. Against the ScriptSource total of 6,966 the first figure is 53 per cent. About half of the world's languages are written. The ScriptSource site has since been retired.

The other half is not small. For 2,586 languages it is not known whether they are written at all. For 719 it is known that they are not. Speech came first, by a very long span, and for at least 719 living languages it is still the whole of the language.

## 26.5 The people

The kinds of writing were named by a few scholars within forty years: Gelb in 1952, Sampson in 1985, DeFrancis in 1984 and 1989, Daniels in 1990, Bright in 1997. The scripts were made by a far larger and mostly nameless company. Of the four independent inventions no maker is known. Of the scripts made in historical times most makers are known.

The table that ends this chapter lists 41 rows. A fair number of them are closed. Oracle bone script, Khitan, Tangut, Jurchen, Indus, Kharosthi, Olmec, Zapotec, Isthmian, Maya glyphs, Meroitic and rongorongo have no living writers. For four of them, Indus, Zapotec, Isthmian and rongorongo, there are no living readers either.

## 26.6 In the net

The image-sound rung holds three parts at once: image, sound and class sign. The tree of scripts is the set of choices of what to drop at that rung.

| Choice at the image-sound rung                      | Kept                          | Scripts                                     |
|-----------------------------------------------------|-------------------------------|---------------------------------------------|
| Drop nothing                                        | image, sound, class           | Chinese, Tangut, chũ Nôm; Maya              |
| Drop image and class sign; keep the closed syllable | sound, as syllable            | kana, Cherokee, Vai, Bamum (last stage), Yi |
| Keep the syllable and show its build                | sound, as consonant plus turn | Brahmi and its descendants, Ge'ez, Cree     |
| Drop the vowel as well                              | sound, as consonant           | Libyco-Berber                               |
| Keep every single sound                             | sound, one after              | N'Ko, quốc ngữ, Neo-Tifinagh                |
| Draw the movement of the mouth                      | sound, as the turn            | Hangul                                      |
| Never take image or sound                           | strand, knot, position        | kipu                                        |

The rows are not stages on one road. They hold side by side, each on its own branch. Every branch has the image-sound rung as its parent, and the parent stands inside the child. Kana signs are worn characters. The abugida consonant is an old consonant sign. Only the kipu and Hangul have no such parent, and each of the two went straight to the net's own terms: the knot, and the turn.

What leaves the picture at each rung of this book is first the animal, then the body, then the thing, then the image. This Part adds what the branches kept. Chinese kept the image. Hangul kept the body, in the shape of tongue and lip. India kept the body in the order of its letters. The alphabet kept neither.

From full to thin is one direction. From shallow to deep is the other. The alphabet lands on ring 3: 27 rooms, three trits per sign. A text in it has depth three times its length. A Chinese text reaches the same depth with fewer and fuller signs. The address of what is said is the same in both, for an address is computed from content and never assigned. The script is the route by which a reader gets there.

The oral systems stand beside the scripts and not below them. The 64 hexagrams on ring 6 and the 256 odù on ring 8 are registers in twos that were kept in memory (Konstapel 2026m). About half of the living languages are unwritten. The net holds them at the same depth as the written ones.

## 26.7 Status

- Counted: the share of written languages, 51–55% against 7,170 and 53% against 6,966; 13,007 characters added in Unicode 18.0; 41 rows in the summary table.
- Read in source: Unicode 18.0 (172,808 characters; 175 scripts); the SIL script index (324, own count ±2); DeFrancis 1989 for his typology; Ferrara et al. 2024.
- From secondary source: the six types and their authors, the four inventions, Unicode 16.0 and 17.0 (Wikipedia); the written-language figures and the 34 active scripts (Omniglot).
- Open: Ethnologue's own figure for written languages was not confirmed. The Unicode 18.0 page was still marked as a preliminary draft. The basis of Omniglot's 34 is not given.
- Open: whether Egypt, the Indus signs and rongorongo are independent inventions.

## 26.8 Summary table of scripts

A dash in the last column means that the row is not writing. "Not found" means that the sources consulted give no figure.

| Script                   | Date                                   | Type                          | Number of signs                       | Parent or                            |
|--------------------------|----------------------------------------|-------------------------------|---------------------------------------|--------------------------------------|
| Jiahu / Banpo / Dawenkou | 7th mill. BC / 5th mill. BC / c. 2800– | marks, not writing            | 11 / 22 / 8 types                     | —                                    |
| Chinese (oracle bone)    | c. 1250 BC                             | morphosyllabic (logosyllabic) | c. 4,000 (1,500–2,000 read)           | independent                          |
| Chinese (modern)         | 2013 table                             | morphosyllabic                | 8,105 (3,500 in tier 1)               | oracle bone, seal, clerical, regular |
| Kana (hiragana,          | c. 800–9th c. AD                       | syllabary                     | 46 each                               | Chinese (man'yōgana)                 |
| Hangul                   | 1443/1446                              | alphabet, featural, in        | 28, now 24                            | invented ('Phags-pa influence        |
| Chữ Nôm                  | late 8th c. on; stele 1200             | morphosyllabic                | 9,299 – c. 20,000                     | Chinese                              |
| Quốc ngữ                 | early 17th c.; 1610                    | alphabet                      | 29 letters, 5 tone                    | Latin                                |
| Khitan large /           | 920 / 924 or 925                       | character script              | not found                             | Chinese (model)                      |
| Tangut                   | 1036                                   | logographic                   | 5,863                                 | Chinese (model)                      |
| Jurchen large /          | 1119 or 1120 / 1138                    | character script              | not found                             | Khitan                               |
| Yi (modern)              | 1974/1980; classical 1485              | syllabary                     | 819                                   | classical Yi                         |
| Nüshu                    | undated                                | syllabary                     | 600–700                               | Chinese                              |
| Indus                    | c. 2600–1900 BC                        | undeciphered; status disputed | 417 or 419; 300 to c. 694 by count    | open                                 |
| Brahmi                   | by c. 250 BC                           | abugida                       | 33 consonants, vowel marks            | Aramaic model (majority) or          |
| Kharosthi                | 4th/3rd c. BC – 3rd c. AD              | abugida                       | not found                             | Aramaic                              |
| Devanagari               | 7th/8th c.; modern 1000                | abugida                       | 47 or 48                              | Brahmi, Gupta, Nāgarī                |
| Tamil                    | not found                              | abugida                       | 12 + 18 + 1; 247                      | Brahmi, Pallava                      |
| Tibetan                  | c. 620–640s; or 8th c.                 | abugida                       | 30 + 4                                | Gupta                                |
| Khmer                    | 611 (oldest dated); or 1111            | abugida                       | 35 consonants, 33 in                  | Pallava                              |
| Burmese                  | 1035                                   | abugida                       | 33 consonants                         | Mon, Pallava                         |
| Thai                     | 1283                                   | abugida with tone marks       | 44 consonants, 16 vowel signs, 4 tone | Old Khmer                            |
| Javanese                 | 14th–16th c.                           | abugida                       | 20                                    | Kawi                                 |

|                |                                  |                                  |                                        |                                  |
|----------------|----------------------------------|----------------------------------|----------------------------------------|----------------------------------|
| Olmec          | before c. 900 BC                 | status disputed                  | 62 glyphs on the                       | independent                      |
| Zapotec        | 5th c. BC – 8th c. AD            | logosyllabic,                    | not found                              | Mesoamerican                     |
| Isthmian       | c. 500 BC – 500 AD               | undeciphered<br>(claim rejected) | not found                              | Mesoamerican                     |
| Maya           | 3rd c. BC – 16th/17th<br>c. AD   | logosyllabic                     | 700 to over 1,000; c.<br>200 syllabic  | Mesoamerican<br>(independent)    |
| Aztec / Mixtec | Postclassic – 16th c.            | pictography with                 | not found                              | Mesoamerican                     |
| Khipu          | Wari 600–1000; Inca;<br>colonial | cord record of<br>numbers; words | Collata: 95 symbols                    | independent                      |
| Rongorongo     | wood of one tablet<br>1493–1509  | undeciphered                     | over 15,000 glyphs;<br>52 to 600 types | independent if<br>before contact |
| Cherokee       | 1821                             | syllabary                        | 86, then 85                            | invented (Latin<br>shapes, new)  |
| Vai            | c. 1833                          | syllabary                        | c. 200                                 | invented                         |
| Cree syllabics | 1840                             | syllabic, vowel                  | 10 base shapes                         | invented                         |
| Bamum          | 1896 – c. 1918                   | word signs, then                 | 465 (or 511), then 80                  | invented                         |
| N'Ko           | 1949                             | alphabet                         | 27                                     | invented                         |
| Pahawh         | 1959–1971                        | onset–rime script                | 60 + 91, then 20 + 13                  | invented                         |
| Meroitic       | c. 300 BC – 600 AD               | alphasyllabary                   | 23                                     | Egyptian                         |
| Ge'ez          | c. 1st c. AD; vowels             | abugida                          | 182 + 20                               | Ancient South                    |
| Libyco-Berber  | probably 6th c. BC on            | abjad                            | 24 (22 read)                           | Phoenician model                 |
| Neo-Tifinagh   | adopted 2003                     | alphabet                         | 33                                     | Libyco-Berber                    |
| Nsibidi        | "c. 400 AD" (one<br>source)      | pictographic and<br>ideographic  | several hundred                        | independent                      |
| Adinkra        | by 1817                          | symbols, not                     | 53–98                                  | —                                |

## References for Part V

**DeFrancis, J. (1984). The Chinese Language: Fact and Fantasy. University of Hawaii Press. Chapter "The Ideographic Myth": [https://pinyin.info/readings/texts/ideographic\\_myth.html](https://pinyin.info/readings/texts/ideographic_myth.html)** *Why read?* The plainest statement that Chinese characters write sound and morpheme, not ideas. It gives the two-thirds figure for useful phonetic parts and the origin of the word "ideographic" in 1822. *Reading advice:* The chapter "The Ideographic Myth" was read for this book; the book data and the six myths are as reported in Wikipedia, "The Chinese Language: Fact and Fantasy".

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**Farmer, S., Sproat, R., & Witzel, M. (2004). The Collapse of the Indus-Script Thesis: The Myth of a Literate Harappan Civilization. Electronic Journal of Vedic Studies 11(2): 19–57. <http://www.safarmer.com/fsw2.pdf>** *Why read?* The case that the Indus signs are not writing, with Mahadevan's totals: 2,905 objects, 417 signs, 13,372 occurrences, 4.6 signs on average, 17 at most.

*Reading advice:* Read the sections on inscription length and sign repetition first; then read Rao et al. 2009 against it.

**Ferrara, S., Tassoni, L., Kromer, B., Wacker, L., Friedrich, M., Tonini, F., Lastilla, L., Ravanelli, R., & Talamo, S. (2024). The invention of writing on Rapa Nui (Easter Island). New radiocarbon dates on the Rongorongo script. *Scientific Reports* 14, 2794. <https://www.nature.com/articles/s41598-024-53063-7> *Why read?* The four radiocarbon dates of the Rome tablets, including tablet D at 1493–1509. *Reading advice:* Keep the authors' own limit in view: the date is of the wood, and the wood is not native to the island.**

**Hyland, S. (2017). Writing with Twisted Cords: The Inscriptive Capacity of Andean Khipus. *Current Anthropology* 58(3): 412–419. <https://www.journals.uchicago.edu/doi/full/10.1086/691682> *Why read?* The strongest case that khipus could record sound: two khipus from Collata with 95 symbols. *Reading advice:* Only the abstract was read for this book. The 14 colours, the six animal fibres and the two lineage names come from the publisher's release: <https://www.journals.uchicago.edu/journals/ca/pr/170419>**

**Kelly, P., Winters, J., Miton, H., & Morin, O. (2021). The Predictable Evolution of Letter Shapes: An Emergent Script of West Africa Recapitulates Historical Change in Writing Systems. *Current Anthropology* 62(6): 669–691. <https://www.journals.uchicago.edu/doi/10.1086/717779> *Why read?* A measured history of one script from its first year: Vai letters grew simpler for 171 years. *Reading advice:* Only the abstract page was read. The details "eight illiterate men" and "200 syllabic letters" come from the University of New England release of 11 January 2022: <https://www.une.edu.au/connect/news/2022/01/african-script-holds-clues-to-writings-origins>. The issue is dated December 2021 and appeared online in January 2022.**

**Kettunen, H., & Helmke, C. (2011). Introduction to Maya Hieroglyphs. Wayeb. <https://www.wayeb.org/download/resources/wh2011english.pdf> *Why read?* It gives the sign counts used here: more than 1,000 with variants, Coe's 800, about 200 syllabic signs for about 80 syllables. *Reading advice:* Read the chapter on the writing system and study the syllable grid.**

**Konstapel, J. (2026m). The Standard Reference of the Maze: From the First Distinction to E8, with the Occupants of Every Ring. Constable Research. <https://constable.blog/2026/10/05/the-maze-bottum-up/> *Why read?* Lists what is placed on each ring: 27 nakshatras on ring 3, 16 Ifá meji on ring 4, 64 hexagrams on ring 6, 256 odù on ring 8. It also gives the count of zero-free rooms per ring. *Reading advice:* Read the table of zero-free rooms together with the list of occupants. The maps from hexagram and odù to trit strings are stated there as open.**

**Konstapel, J. (2026o). The House of Twenty-Seven Rooms: Tai Chi, the Chinese Count of Three and the Vacuum.Net. Constable Research. <https://constable.blog/2026/10/08/the-house-of-twenty-seven-roomstai-chi-the-chinese-count-of-three-and-the-vacuum-net/> *Why read?* Sets the I Ching's count in twos beside Yang Xiong's *Taixuanjing*, which counts in threes: four lines, 81 figures.**

**Konstapel, J. (2026a). The Ancient Story Engine of Ifá, I Ching, Torah and the Universal Architecture of Change. Constable Research. <https://constable.blog/2026/03/23/the-ancient-story-engineifai-ching-torah-and-the-universalarchitecture-of-change/> *Why read?* On the oral origin of the great registers: odù that are recited and not read, Vedic mantras that carry meaning in tone.**

**Konstapel, J. (2026i). The Root of Language and the MAZE Intake. Constable Research. <https://constable.blog/wp-content/uploads/The-Root-of-Language-and-the-MAZE-Intake.pdf> *Why read?* The source of the click reading used throughout this book, and of the figures on Pāṇini**

cited in Chapter 23. *Reading advice*: Read the section on Sanskrit as the top rung beside the section on the click layer.

**Konstapel, J. (2026d). Understanding Language and Evolution Through the Sphenoid. Constable Research. <https://constable.blog/2026/05/23/understanding-language-and-evolution-through-the-sphenoid/> Why read?** Cited here for the burning of the Maya books in 1562, within a list of knowledge traditions that were suppressed.

**Konstapel, J. (2026b). 65,000 Jaar Wetenschapsgeschiedenis (Coherence Intelligence Across 65,000 Years). Constable Research. <https://constable.blog/2026/05/16/coherence-intelligence-across-65000-years/> Why read?** Gives the size of the Ifá corpus, more than 65,000 text units, among eleven knowledge traditions.

**Omniglot (n.d.). Writing systems statistics. <https://www.omniglot.com/writing/stats.htm> Why read?** The only source found that reports figures for written and unwritten languages: 3,661 written, 719 unwritten, 2,586 uncertain (ScriptSource) and 3,909 written (an older Ethnologue). *Reading advice*: A secondary source. Its figure of 34 scripts in active use has no stated basis.

**Rao, R. P. N., Yadav, N., Vahia, M. N., Joglekar, H., Adhikari, R., & Mahadevan, I. (2009). Entropic Evidence for Linguistic Structure in the Indus Script. Science 324: 1165. <https://homes.cs.washington.edu/~rao/ScienceIndus.pdf> Why read?** The case that Indus sign sequences are ordered as language is. *Reading advice*: The authors' copy was read. Read it after Farmer, Sproat & Witzel 2004; Sproat's replies are reported in Wikipedia, "Indus script".

**SIL International (2026). Scripts index. <https://writingsystems.info/scrlang/scripts-index> Why read?** The successor of ScriptSource and the fullest open list of scripts. The count of 324 was made by hand for this book, with a margin of two.

**Unicode Consortium (2026a). Unicode 18.0.0. <http://www.unicode.org/versions/Unicode18.0.0/> Why read?** The current count of characters, 172,808, and the three new scripts: Proto-Cuneiform, Jurchen and Seal. *Reading advice*: The page was still labelled a preliminary draft for beta review when it was read.

**Unicode Consortium (2026b). Supported Scripts. <https://www.unicode.org/standard/supported.html> Why read?** The list of the 175 scripts in Unicode 18.0.

**Wikipedia, English edition (opened 8 October 2026). Articles used:** "Abugida"; "Adinkra symbols"; "Aztec script"; "Bamum script"; "Brahmi script"; "Brahmic scripts"; "Canadian Aboriginal syllabics"; "Cascajal Block"; "Cherokee syllabary"; "Chinese bronze inscriptions"; "Chinese character classification"; "Chinese characters"; "Chinese script styles"; "Chữ Nôm"; "Devanagari"; "Ethnologue"; "Featural writing system"; "Ge'ez script"; "Hangul"; "History of writing"; "Hunminjeongeum Haerye"; "Idu script"; "Ignace Gelb"; "Indus script"; "Isthmian script"; "Japanese writing system"; "Javanese script"; "Jiahu symbols"; "Jurchen script"; "Kana"; "Kangxi Dictionary"; "Kharosthi"; "Khitan scripts"; "Khmer script"; "List of Commonly Used Characters in Modern Chinese"; "Maya script"; "Meroitic script"; "Mesoamerican writing systems"; "Mixtec writing"; "Mon-Burmese script"; "N'Ko script"; "Neolithic signs in China"; "Nsibidi"; "Nüshu"; "Oracle bone script"; "Origin of Hangul"; "Pahawh Hmong"; "Peter T. Daniels"; "Quipu"; "Rongorongo"; "Sequoyah"; "Shuowen Jiezi"; "Simplified Chinese characters"; "Small seal script"; "Standard Chinese phonology"; "Table of General Standard Chinese Characters"; "Tamil script"; "Tangut script"; "Thai script"; "The Chinese Language: Fact and Fantasy"; "The World's Writing Systems"; "Tibetan script"; "Tifinagh"; "Unicode"; "Vai syllabary"; "Vietnamese alphabet"; "Writing system"; "Written Chinese"; "Yi script"; "Yuri

**Knorozov"; "Zapotec script". [https://en.wikipedia.org/wiki/ Why read?](https://en.wikipedia.org/wiki/Why_read?)** Most dates and counts in this Part were seen only here. Each article names the specialist literature behind its figures.  
**Reading advice:** Use the articles as a way in. Several of them contradict each other; the Status lists name the places.

**Works known to this Part only through Wikipedia.** The following are named in the text and were not opened: Daniels, P. T. (1990), "Fundamentals of Grammatology", *Journal of the American Oriental Society* 110(4): 727–731; Daniels, P. T., & Bright, W. (1996), *The World's Writing Systems*, Oxford University Press; Gelb, I. J. (1952, rev. 1963), *A Study of Writing*, University of Chicago Press; Knorozov, Y. (1952), "Drevnyaya pis'mennost' Tsentral'noy Ameriki", *Sovetskaya Etnografiya* 3(2): 100–118; Li, X., Harbottle, G., Zhang, J., & Wang, C. (2003), "The earliest writing? Sign use in the seventh millennium BC at Jiahu", *Antiquity* 77(295): 31–44; Locke, L. L. (1912, 1923), on the khipu knots; Rodríguez Martínez et al. (2006), "Oldest Writing in the New World", *Science*; Sampson, G. (1985), *Writing Systems*; Urton, G. (2003), *Signs of the Inka Khipu*; Boltz, W. G. (1994), *The Origin and Early Development of the Chinese Writing System*, American Oriental Society. **Why read?** These are the primary works behind the secondary reports used here.  
**Reading advice:** A reader who wants to check a figure in this Part should go to these before relying on the encyclopaedia article.

## Part VI. The Whole

The first five parts took the rungs one at a time. This part sets them side by side. Chapter 27 draws the tree from the animal call to the scripts of today. Chapter 28 follows the people along the same road and names what each rung left behind. A ledger for the whole book closes the part.

### Chapter 27. The Tree

The development of language is a sequence up to the rung of image and sound. From there it is a tree. This chapter gives the sequence, then the branches, then the four things that hold from the first rung to the last.

#### 27.1 The sequence

**Table 27.1 The rungs from the animal call to image-sound writing**

| Rung     | What is added               | Carrier                     | Count                                                           | Chap |
|----------|-----------------------------|-----------------------------|-----------------------------------------------------------------|------|
| 1. State | The body is the sign        | nearly all animals          | no separate signs                                               | 2    |
| 2. Call  | One sound for one           | vervet monkey               | 3 alarm calls tested                                            | 2    |
| 3. Call  | An affix changes the call   | Campbell's                  | krak, krak-oo; hok, hok-oo                                      | 2    |
| 4. Order | The same parts in another   | Japanese tit                | ABC-D answered, D-ABC not                                       | 2    |
| 5. Grid  | Independent choices at once | sperm whale                 | $18 \times 5 \times 3 \times 2 = 540$ cells; at least 143 found | 3    |
| 6. Name  | A sound for one individual  | dolphin, elephant, marmoset | one per animal                                                  | 3    |
| 7. Song  | Learned, layered,           | humpback,                   | units, phrases, themes, songs                                   | 3    |
| 8. Map   | A movement that shows a     | honeybee                    | angle is direction, duration is                                 | 4    |

|                 |                                        |                           |                                      |            |
|-----------------|----------------------------------------|---------------------------|--------------------------------------|------------|
| 9. Click        | The full grid in the mouth             | San hunters               | !Xóõ 83 clicks in 161 sounds         | 5–9        |
| 10. Speech      | Sounds one after another               | all peoples               | median 33 sounds                     | 10–11      |
| 11. Tone        | A level laid over the sound            | 636 inventories           | three tones most frequent            | 12         |
| 12. One         | Speech reduced to pitch or             | whistlers,                | Bora: rhythm carries most            | 13         |
| 13. Mark        | The sign stays when the speaker leaves | cave painters, counters   | sequences of up to 13 marks          | 15         |
| 14. Tablet      | The mark stands for a                  | Sumer                     | 705 to about 2,000 signs by          | 16         |
| 15. Image-sound | The image stands for its sound         | Egypt, Sumer, China, Maya | image, sound and class sign together | 17, 21, 24 |

Rungs 2 to 8 lie among the animals. They are not one line of descent. Each animal stands on its own rung. Rung 9 is the first on which the whole grid sits in one mouth.

## 27.2 The branches

At rung 15 a script holds three parts in one written word: an image, a sound, and a sign for the class of thing. Each later script is a choice of what to keep.

**Table 27.2 The branches from image-sound writing**

| Branch          | The sign stands for            | Kept                     | Dropped         | Examples               | Signs                                      | Chapter |
|-----------------|--------------------------------|--------------------------|-----------------|------------------------|--------------------------------------------|---------|
| Deepened image- | word or word part              | image and sound          | nothing         | Chinese                | 9,353 in 100 CE; 82% built of meaning plus | 21      |
| Syllable        | consonant with vowel as one    | sound                    | image           | Linear B, kana,        | 46 to about 87                             | 20, 22, |
| Consonants only | the frame of the word          | consonant                | image, vowel    | Phoenician, Hebrew,    | 22 to 28                                   | 19      |
| Built syllable  | consonant with a vowel mark on | sound, with the build    | image           | Brahmi and its         | consonants times vowel marks               | 23      |
| Single sound    | one sound                      | sound                    | everything else | Greek, Latin, Cyrillic | 24 to 33                                   | 19      |
| The movement    | the position of tongue and lip | the turn, drawn          | image of the    | Hangul                 | 24 letters; 11,172 possible blocks         | 22      |
| Knots           | a count, perhaps a name        | the strand and its turns | image and       | kipu                   | decimal knots                              | 24      |

Writing began more than once. Sumer, China and Mesoamerica are accepted as separate beginnings (Chapter 26). Each of the three began on the same rung: image and sound together.

## 27.3 The parent rule along the tree

The rule of Chapter 1 says that a form stands on its parent and adds one turn. It was counted in Chapter 7. It returns as a reading on every rung.

**Table 27.3 Where the parent stands beside the child**

| Rung           | Child                                  | Parent                                             | Count or source                     |
|----------------|----------------------------------------|----------------------------------------------------|-------------------------------------|
| Animal call    | krak-oo, hok-oo                        | krak, hok                                          | Ouattara et al. 2009                |
| Click          | series with two or more accompaniments | the series with one fewer                          | 77 of 77 (Appendix A6)              |
| Sounds without | sound with two modifier signs          | the sound with one                                 | 68.7% at home, 18.5% elsewhere (A7) |
| Speech of      | the Tortoise's, the Moon's             | !Xam with one change on the                        | Bleek 1875                          |
| First alphabet | the letter                             | the one-consonant sign inside hieroglyphic writing | Chapter 17, 18                      |
| Vowel letters  | Greek vowel signs                      | Phoenician consonant letters                       | Chapter 19                          |
| Latin row      | W, U, J                                | V, V, I                                            | Chapter 19                          |
| Built syllable | consonant with vowel                   | the bare consonant sign                            | Chapter 23                          |

One case goes the other way. The call wak-oo of Campbell's monkey has no bare parent wak in the source (Chapter 2). The parent stands only inside the child there.

## 27.4 The grid along the tree

A grid is a set of independent choices in which nearly every combination is inhabited. It returns at every depth.

**Table 27.4 Grids**

| Where                   | The choices                        | Size | Inhabited             |
|-------------------------|------------------------------------|------|-----------------------|
| Sperm whale coda        | rhythm × tempo × rubato × ornament | 540  | at least 143          |
| !Xóõ clicks             | 5 places × 17 accompaniments       | 85   | 83                    |
| Sandawe clicks          | 3 places × 5 accompaniments        | 15   | 15                    |
| Jul'hoan accompaniments | five marks, each present or absent | 32   | 12                    |
| Sanskrit stops          | 5 places × 5 manners               | 25   | 25                    |
| Kana                    | consonant rows × vowel columns     | —    | 46 basic signs        |
| Hangul block            | initial × vowel × optional final   | —    | built from 24 letters |

The click grid and the Sanskrit sound table have the same form: place of closure times what is done with it. The hunters inhabit the grid. The grammarians wrote it down as a table (Chapter 14).

## 27.5 From at-once to one-after-another

A click holds several things in one sound: a front closure, a back closure, and its accompaniments. A click row in the sound database has 4.2 zeros among 38 features. Another consonant has 7.8. A vowel has 9.4 (Appendix A4).

Tone holds a level over the sound at the same moment. An image-sound sign holds image, sound and class at once.

The letter holds one thing. An alphabetic text sets its signs one after another. Along the tree the at-once is laid out in a row.

## 27.6 From full to thin

**Table 27.5 How many units**

| Form                         | Units          |
|------------------------------|----------------|
| !Xóõ, all sounds (PHOIBLE)   | 161            |
| World median, all sounds     | 33             |
| Ugaritic letters             | 27 and 3 added |
| Greek letters                | 24             |
| Phoenician letters           | 22             |
| Xu Shen's characters, 100 CE | 9,353          |

The alphabet lands on ring 3: 27 rooms, three trits per sign. The median spoken inventory of 33 sounds needs ring 4. The alphabet writes fewer distinctions than the mouth makes. Tone and click are not written by it at all.

Chinese went the other way. It kept the image-sound rung and took in thousands of signs.

## 27.7 Two layers along the tree

The click has a frozen layer of few places and a moving layer of accompaniments that are present or absent. The consonant script has the same split. The consonants carry the frame of the word. The vowels move within it and were long left unwritten (Chapter 19).

In both cases the frozen layer is the one that is kept when something is dropped.

## 27.8 Status

- Counted: the click grids, the parent test, the feature zeros, the tone counts, the inventory sizes (Appendix A).
- Read in source: the whale grid, the Campbell's affix, the tit's order, Bleek's passage, the share of meaning-plus-sound characters.
- From secondary source: most sign counts and dates of the scripts in Table 27.2.
- Open: the parent rule is counted for sounds only. For scripts it is a reading. A count over the sign lists of the scripts has not been made.
- Open: no dated evidence marks the step from rung 9 to rung 10.

# Chapter 28. What Each Rung Left Behind

Every rung of the tree was made by people, and every rung dropped something that the people of the rung before still held. This chapter follows that loss.

## 28.1 The animal

The !Xam narrators spoke of a time when the animals were people. They gave each animal its own way of speaking the human language. The Tortoise turned the clicks into lip sounds. The Moon put one click in place of all others but the lip click (Bleek 1875). To know the animal's speech was to know its one change.

In the same record a man feels a tapping in his body and knows what game is near. The narrator Ilkabbo called these "the Bushmen's letters". They "are in their bodies" (Chapter 8).

On the Mozambican honey grounds a hunter's call to the honeyguide raised the finding of a nest from 17% to 54% (Chapter 4). That exchange is alive.

Speech without clicks kept none of this. The first thing to leave the picture was the animal.

## **28.2 The body**

The hunter's speech sits in the whole mouth. The click is made without the breath and can sound together with voice and nose. Tone, whistle and drum carry pitch and rhythm across a valley.

The mark stays when the speaker has left. With it the voice, the face and the hand left the message. The second thing to leave the picture was the body.

## **28.3 The thing**

The first tablets of Sumer record things counted: rations, grain, fish, animals, textiles, land and labour. The sign stood for the thing.

The rebus turned the sign from the thing to the sound of its name. From then on a picture of an eye could stand for a word that only sounds like "eye". The third thing to leave the picture was the thing.

## **28.4 The image**

In Egypt about 1% of the people could read in the third millennium BC (Baines, in Zinn 2013). The large script belonged to them.

The first alphabet was made at the mines and desert roads. Its makers were among the Semitic speakers on Egyptian expeditions: soldiers, sailors, donkey drivers, miners. They left about 50 short texts (Chapter 18). They took the one-consonant principle and left the rest. The ox head became a letter.

The fourth thing to leave the picture was the image. A reader of an alphabet needs none of the four.

## **28.5 The ones who kept more**

Not every people went the whole road.

The speakers of Jul'hoan, about 4,000 in 2003, and of Taa, about 2,500 in 2011, still speak the full grid (Chapter 7). !Xam is gone. Its last known speakers died in the 1910s. For Nluu one first-language speaker was reported in October 2025, aged 92. She runs a school for the language with her granddaughter (AFP 2025).

China kept image and sound in one sign. Korea drew the movement of the mouth. The Andes wrote in knots. India kept the build of the syllable visible.

Sequoyah made a script for Cherokee in 1821 without being able to read any other. He reached for the syllable (Chapter 25).

## **28.6 The count today**

The Unicode standard lists 172 scripts in version 17.0 and 175 in the draft of version 18.0 (Chapter 26). Three accepted beginnings of writing stand behind them.

## **28.7 In the net**

The road from the animal to the alphabet is a road of dropping. At each rung one layer is let go and the frozen layer under it is kept.

The parent rule runs the other way along the same road. Each form holds its parent inside it. The alphabet holds the one-consonant signs. Those hold the image-sound script. That script holds the mark, and the mark holds the spoken word.

Followed back turn by turn, the row of letters leads to the mesh in the mouth, and behind it to the call. The address of a form is the record of its walk. The history of language can be read from any letter backwards.

What the lXam narrators called understanding the animal has the same form. It is the step back by one turn.

## **28.8 Status**

- Read in source: Bleek 1875; the honeyguide rates; the AFP report on Nluu; Goldwasser on the makers of the alphabet.
- From secondary source: speaker numbers; the literacy figure; the Unicode count of version 17.0.
- Open: no testimony was found of San hunters calling or answering animals in the hunt. The record has the stories and the presentiments.

## **The ledger of the whole book**

**Counted for this book** (on PHOIBLE 2.0, 3,020 inventories; Appendix A)

- 21 inventories in 19 languages have click phonemes.
- The click grids are nearly full: 83 of 85, 48 of 52, 18 of 21, 15 of 15.
- Every click series with two or more accompaniments has its parent in the same inventory: 77 of 77, chance 87.9%.
- In 3,001 inventories without clicks the parent is present for 62.0%, 68.7% and 65.7% of sounds with one, two and three or more modifier signs; chance 50.6%, 18.5% and 1.7%.
- A click row has 4.2 zeros among 38 features; a vowel row has 9.4.
- Among 636 inventories with tone, three tones is the most frequent count.

**Read in the source**

- Bleek's 1875 passage on the speech of the animals, with his own conclusion.

- The sperm whale grid, the Campbell's affix, the Japanese tit's order.
- Proto-cuneiform counts, the Lachish finds, the Umm el-Marra reports.
- The Indus sign statistics and the Rongorongo dating.

### Resting on secondary sources

- Most click inventories outside PHOIBLE.
- Most dates and sign counts of the scripts in Parts IV and V.
- Whistled-language counts, the Sanskrit numbers, the bones.

### Open

1. The step from click speech to speech without clicks has three positions and no date.
2. The one third of marked sounds that lack a parent has not been sorted.
3. The four tongue clicks as two two-way distinctions rest on one reading; no phonetic source was opened for it.
4. The parent rule has been counted for sounds, not yet for the sign lists of scripts.
5. The handbooks on clicks (Ladefoged and Maddieson; Traill; Miller) and on scripts (Daniels and Bright) were not opened.
6. Quotations were read through a text extractor. Each needs one check against the page before print.

## References for Part VI

**AFP (2025). Last fluent speaker on a quest to keep ancient San language alive. Agence France-Presse via IOL, 10 October 2025.** *Why read?* The present state of Nluu, told through its last first-language speaker and the school she keeps.

**Bleek, W. H. I. (1875). A Brief Account of Bushman Folk-lore and Other Texts. Second Report concerning Bushman Researches. Cape Town: Juta; London: Trübner; Leipzig: Brockhaus.** [https://archive.org/stream/briefaccountofbu00blee/briefaccountofbu00blee\\_djvu.txt](https://archive.org/stream/briefaccountofbu00blee/briefaccountofbu00blee_djvu.txt) *Why read?* The printed passage on the speech of the animals and the Moon, with Bleek's conclusion on the former number of clicks. *Reading advice:* Read the General Report; the passage is short and gives the notebook numbers.

**Konstapel, J. (2026i). The Root of Language and the MAZE Intake. constable.blog, 11 September 2026.** <https://constable.blog/wp-content/uploads/The-Root-of-Language-and-the-MAZE-Intake.pdf> *Why read?* The click as closure, loading and discharge in the mouth, and the three layers of language from Sanskrit down to the click. *Reading advice:* Read the section on the click layer beside Chapter 5 of this book.

**Moran, S. & McCloy, D. (eds.) (2019). PHOIBLE 2.0.** <https://phoible.org/> ; data file <https://raw.githubusercontent.com/phoible/dev/master/data/phoible.csv> (downloaded 8 October 2026). *Why read?* The database of 3,020 sound inventories on which every count of Appendix A was made. *Reading advice:* Download the single data file; each row is one sound in one language with 38 features.

**Zinn, K. (2013). Literacy, Pharaonic Egypt. *The Encyclopedia of Ancient History*, pp. 4100–4104.** <https://repository.uwtsd.ac.uk/569/1/Literacy%20Pharaonic%20Egypt.pdf> *Why read?* The source through which the estimate of about 1% literacy in early Egypt is reported.

## Appendix A. Click computations on PHOIBLE

Source: PHOIBLE 2.0 development file, <https://raw.githubusercontent.com/phoible/dev/master/data/phoible.csv>, downloaded 8 October 2026. 3,020 inventories, 105,484 segments. All figures below were computed for this book. Status: COMPUTED.

## A1. Inventories with click phonemes (21 inventories, 19 languages)

| Inventory    | Source | Segments | Clicks | Per place                   |
|--------------|--------|----------|--------|-----------------------------|
| !Xóõ         | ph     | 161      | 83     | 17,    17, ‡ 16, ! 17, Ø 16 |
| !XU          | upsid  | 141      | 48     | 12, ‡ 24, ! 12              |
| !Xun         | ph     | 120      | 48     | 13,    10, ! 13, !! 12      |
| Nama         | upsid  | 41       | 20     | 5,    5, ! 10               |
| Xhosa        | ph     | 84       | 18     | 6,    6, ! 6                |
| Sandawe      | upsid  | 54       | 15     | 5,    5, ! 5                |
| Sandawe      | ph     | 64       | 15     | 5,    5, ! 5                |
| Hadza        | upsid  | 62       | 12     | 4,    4, ! 4                |
| Ndebele      | ph     | 68       | 12     | 4,    4, ! 4                |
| Yeyi         | ph     | 90       | 10     | 6, ! 4                      |
| Copi         | ph     | 68       | 5      | ! 5                         |
| Nama         | spa    | 33       | 4      | one per place               |
| San          | ph     | 29       | 4      | one per place               |
| Zulu         | spa    | 43       | 3      | 1,    1, ! 1                |
| Zulu         | upsid  | 37       | 3      | 1, ! 2                      |
| Fwe          | ph     | 60       | 3      | 3                           |
| Dahalo       | upsid  | 59       | 2      | 2                           |
| Shekgalagari | ph     | 53       | 2      | 1, Ø 1                      |
| Masalit      | ph     | 45       | 2      | 1, ! 1                      |
| Sesotho      | ph     | 46       | 1      | ! 1                         |
| Ronga        | ph     | 69       | 1      | ‡ 1                         |

The UPSID rows use an older notation; place counts there are affected by encoding (for example ‡ 24 in !XU).

## A2. The grid: places × accompaniments

| Language | Places | Accompaniment series | Cells filled |
|----------|--------|----------------------|--------------|
| !Xóõ     | 5      | 17                   | 83 of 85     |

|         |   |    |          |
|---------|---|----|----------|
| !Xun    | 4 | 13 | 48 of 52 |
| Xhosa   | 3 | 7  | 18 of 21 |
| Sandawe | 3 | 5  | 15 of 15 |

!Xóǝ series as written in the file: k\_, k\_h, k\_kx', k\_x, k\_ʔ, k\_h, q\_, q\_', ɲ\_, ɲ\_, g\_, g\_kx', g\_kh, g\_x, g\_, g\_qh, ʔɲ\_ (the underscore stands for the click).

### A3. Inventory sizes, all 3,020 inventories

Median 33 segments, mean 34.9, minimum 11, maximum 161. Median consonants 22.

| Size band | Inventories |
|-----------|-------------|
| 1–13      | 5           |
| 14–27     | 1,034       |
| 28–40     | 1,150       |
| 41–81     | 810         |
| 82–121    | 17          |
| 122–243   | 4           |

### A4. The feature register (38 features, values +, –, 0)

Share of all values: – 59.4%, 0 23.5%, + 17.1%; 10,235 double values such as "–,+".

| Class                 | Segments | Mean + | Mean – | Mean 0 | With a double value | Trit sum $\equiv 0 \pmod{3}$ |
|-----------------------|----------|--------|--------|--------|---------------------|------------------------------|
| Vowel                 | 31,052   | 8.99   | 19.39  | 9.42   | 6.2%                | 25.3%                        |
| Consonant (non-click) | 71,971   | 5.53   | 24.46  | 7.84   | 9.4%                | 36.8%                        |
| Click                 | 311      | 7.25   | 25.37  | 4.21   | 24.1%               | 40.7% (236 rows)             |

### A5. Features needed to tell all segments apart (greedy choice, not a proven minimum)

| Inventory    | Segments | Features needed | $\log_3 N$ | Ratio |
|--------------|----------|-----------------|------------|-------|
| World median | 33       | 10              | 3.2        | 3.05  |
| Sandawe      | 60       | 12              | 3.73       | 3.22  |
| Xhosa        | 83       | 12              | 4.02       | 2.98  |
| !Xun         | 114      | 14              | 4.31       | 3.25  |
| !Xóǝ         | 157      | 15              | 4.60       | 3.26  |

## A6. The parent test on click series

Coding from the notation, one table for all languages: voice (g, ɠ), nasal (ŋ, ɳ), uvular (q, ɢ, ɴ), voiceless (ring diacritic), breath (<sup>h</sup>, h), friction (x, χ), glottal (ʔ, ʕ, ʕ̰). A series has a parent when removing one of its marks gives a series present at the same place.

| Inventory            | Series with accompaniment | Parent present | Chance level |
|----------------------|---------------------------|----------------|--------------|
| !Xóõ (ph)            | 73                        | 73             | 91%          |
| !Xun (ph)            | 44                        | 44             | 96%          |
| Xhosa (ph)           | 15                        | 15             | 87%          |
| Sandawe (ph)         | 12                        | 12             | 100%         |
| Ndebele (ph)         | 9                         | 9              | 100%         |
| Yeyi, Copi, Fwe (ph) | 10                        | 10             | 92–100%      |
| !XU (upsid)          | 29                        | 27             | 78%          |
| Nama (upsid)         | 13                        | 7              | 48%          |
| Hadza (upsid)        | 9                         | 6              | 65%          |
| Sandawe (upsid)      | 12                        | 12             | 100%         |

Series with two or more marks, non-UPSID inventories: 77 of 77 with a parent; chance 87.9%. The same series is counted once per place, so the 77 are not independent. With the 38 database features used as marks instead: !Xóõ 53 of 78, !Xun 34 of 44, Sandawe 12 of 12, Xhosa 10 of 15.

## A7. The parent test on languages without clicks

A parent is the same segment with one modifier sign removed (Unicode classes Lm, Mn, Sk). 3,001 inventories.

| Modifier signs | Segments | Parent in own inventory | Parent in a random other inventory |
|----------------|----------|-------------------------|------------------------------------|
| 1              | 27,896   | 62.0%                   | 50.6%                              |
| 2              | 4,428    | 68.7%                   | 18.5%                              |
| 3 or more      | 361      | 65.7%                   | 1.7%                               |

Voicing is a letter change (k to g), not a modifier, so this test does not see it.

## A8. Tone

636 of 3,020 inventories list tones. Median 3. Distribution: 3 tones 217, 2 tones 181, 4 tones 124, 5 tones 60, 6 tones 25, 8 tones 10, 7 tones 7, 1 tone 6. Mandarin 4, Cantonese 5, Vietnamese 6 or 8 by source, !Xun 4, Sandawe 5, Xhosa 2. Many sources in the file do not record tone, so 636 is a lower bound.

# A9. Earlier hand calibration (not recomputed)

Jul’hoan: 4 places × 12 series = 48; series by number of turns 1, 4, 5, 2; parent present 12 of 12.  
!Xóõ: 17 series × 5 places – 2 = 83; parent present 16 of 17. Jul’hoan is not in PHOIBLE under that name.

# Appendix B. The state of the sources

The facts of this book were collected in a source file of six parts. Each row of that file carries a status. READ: the source was opened and the figure was seen there. SECONDARY: seen only in a secondary source, which is named. MEMORY and NOT FOUND rows were not used as facts in the book.

| Part                                                              | READ          | SECONDARY | MEMORY | NOT FOUND |
|-------------------------------------------------------------------|---------------|-----------|--------|-----------|
| 1. Animals                                                        | 82            | 36        | 16     | 7         |
| 2. The San and the click languages                                | 74            | 54        | 0      | 5         |
| 3. Speech, tone, language without the mouth                       | 52            | 113       | 7      | 12        |
| 4. First marks to the alphabet                                    | 99            | 147       | 12     | 6         |
| 5. Scripts outside the Near Eastern–European line                 | 30            | 127       | 2      | 11        |
| 6. Texts on the theory at constable.blog (53 posts, 14 PDFs read) | 38 entries    | 0         | 0      | 0         |
| Appendix A. Click computations on PHOIBLE                         | computed here |           |        |           |

# Figures that changed when the source was opened

| Commonly quoted                     | What the source gives                                                                                                             |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Sperm whale: 156                    | The article says "at least 143 combinations frequently realised". The grid is 18 × 5 × 2 × 2 = 540 cells.                         |
| Bee dance: about 1                  | Measured 0.41 s at 100 m and 2.20 s at 1.7 km; not linear.                                                                        |
| Honeyguide: 17%                     | Science abstract: 17% to 54%. Cambridge press release: 16%.                                                                       |
| Lion and Hyena in Bleek 1875        | Not in the printed 1875 passage (seven speakers). They come from a notebook page of 15 October 1873, seen only through Wikipedia. |
| Clicks used in hunting              | Rests on Hadza testimony reported by Pennisi 2004. Güldemann rejects the hunting advantage: clicks are the loudest consonants.    |
| !Xóõ: 161 sounds, 83 clicks         | That is one analysis (PHOIBLE). Others give 20 to 111 clicks and 58 to 164 consonants.                                            |
| First alphabet c. 1850 BC, 22 signs | Dates run from the 19th to the 13th century BC; sign count 22 or at least 27.                                                     |
| Egyptian: about 700                 | Middle Kingdom 750 or 900; Ptolemaic 5,000 to 8,000.                                                                              |
| Tone: most                          | WALS measures 41.8% tonal and calls this too low.                                                                                 |
| Drums carry tone                    | In Bora drumming rhythm carries more than tone (Seifart 2018).                                                                    |
| Pāṇini: 5th century BC              | Majority date now about 350 BCE; sūtra count 3,959, 3,983 or 3,996.                                                               |

## Not opened

1. Paywalled primaries read as abstract only: Seyfarth 1980, Spottiswoode 2016, Berthet 2025, Garland 2011, Knight 2003, Schlebusch 2017, Senghas 2004, Hyland 2017.
2. Not opened at all: Ladefoged & Maddieson 1996, Miller 2011, Traill 1985, Sands & Güldemann 2009, Dreyer 1998, Darnell 2005, Goldwasser 2006, Sass, Hamilton 2006, Daniels & Bright 1996, Meyer 2015 (book), Carrington 1949.
3. Click inventories other than PHOIBLE are SECONDARY throughout.
4. Parts 4 (items 7–13) and 5 rest largely on Wikipedia and need a handbook check.
5. From constable.blog nothing before August 2007 was reached.
6. No source was found for hunters imitating animal calls among the San.
7. The step from click speech to speech without clicks has positions (ancient, contact, innovation) but no dated evidence.