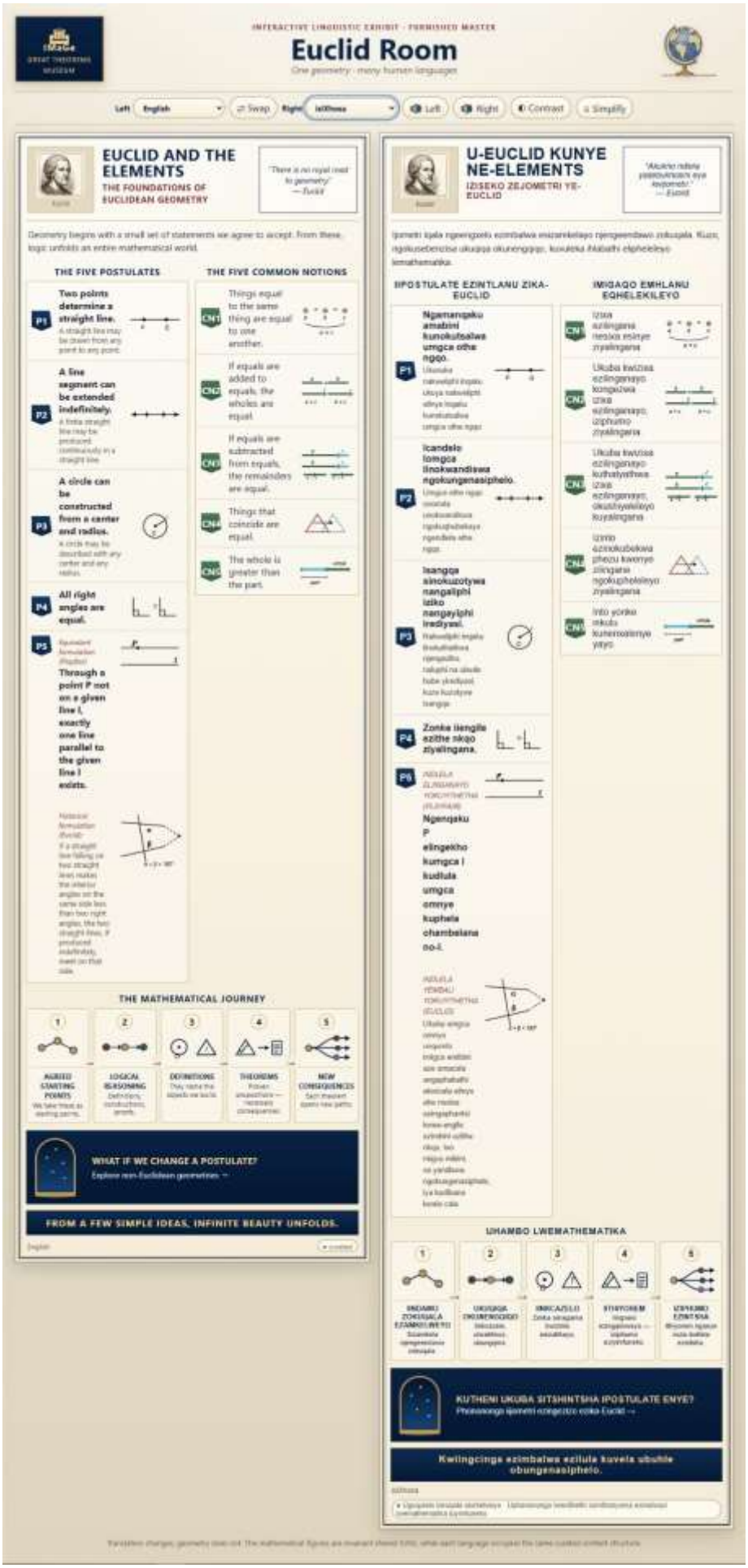


IsiXhosa Annex

An annex is something more than a supplementary translation. It is a curatorial record of how a language entered the IMaGe Great Theorems Museum, including decisions, experiments, difficulties, corrections, and human observations. It is an independently valuable scholarly document.

This annex presents selected exchanges documenting significant translation and design decisions; it is not intended as a complete transcript of the development process.

To enlarge the images and improve their legibility, please use your document viewer's zoom controls.

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SPECIAL ISSUE: HUMAN/MACHINE COLLABORATION
IsiXhosa Annex
To
IMaGe Great Theorems Museum
Sandra Lach Arlinghaus
With Collaborator and Assistant Curator IMaGe Great Theorems, Vector

Persistent University of Michigan Deep Blue Research Collection Archive, Institute of Mathematical Geography.

URL: **http://deepblue.lib.umich.edu/handle/2027.42/58219**

Cite articles as: Author name(s), Year. Title of article, *Solstice: An Electronic Journal of Geography and Mathematics*, Vol. YY, No. ZZ. Ann Arbor: Institute of Mathematical Geography.

Arlinghaus/Vector collaboration. The material in this Annex was largely composed, at Arlinghaus's direction, by Vector. Any added comments from Arlinghaus are shown with a light green background behind the text. The responsibility here, as with all other elements of this Human/Machine Collaboration, rests with the human.

Color serves as a guide to the reader. Material between lavender bars was created primarily by Vector with oversight by Arlinghaus. Material in black and white, outside those bars was created primarily by Arlinghaus. Comments by Arlinghaus within those bars has a green background.

Principal Contextual Concepts: Translation Decisions; Mathematical Content; Interface Adaptation; Testing and Corrections; Final Status.

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IsiXhosa

IsiXhosa: Mathematical Terminology and Experimental Speech

For **isiXhosa**, I want to be more conservative than with any language so far. I checked South Africa's Department of Basic Education mathematics resources first; they publish an official isiXhosa mathematics terminology list, and it confirms useful school-math vocabulary such as **umgca** for line, **isangqa** for circle, and **iengile** for angle. It also shows something important: contemporary isiXhosa mathematical language freely mixes inherited vocabulary with adapted technical borrowings, so we should not try to "purify" the language artificially.

For this version I would label the status more strongly than "review welcome":

isiXhosa · provisional curated translation · native-speaker mathematical review essential

That is the right scholarly posture.

For the entrance, I propose:

U-EUCLID KUNYE NE-ELEMENTS

IZISEKO ZEJOMETRI YE-EUCLID

And for the introduction, cautiously:

Ijometri iqala ngeengxelo ezimbalwa esizamkelayo njengeendawo zokuqala. Kuzo, ngokusebenzisa ukuqiqa okunengqiqo, kuvuleka ihlabathi elipheleleyo lemathematika.

The sense is our familiar one: geometry begins with a few statements accepted as starting points; through logical reasoning, a whole mathematical world opens.

I would mark that as **provisional**, not hard-freeze it yet.

The Five Postulates

For the postulates, I think we can be reasonably direct.

P1

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Ngamanqaku amabini kunokutsalwa umgca othe ngqo.

Historical:

Ukusuka nakweliphi inqaku ukuya nakweliphi elinye inqaku kunokutsalwa umgca othe ngqo.

P2

Icandelo lomgca linokwandiswa ngokungenasiphelo.

Historical:

Umgca othe ngqo onomda unokwandiswa ngokuqhubekayo ngendlela ethe ngqo.

P3

Isangqa sinokuzotywa nangaliphi iziko nangayiphi irediyasi.

I am deliberately allowing **irediyasi** here as a technical borrowing rather than inventing a more "native-looking" term without confidence.

Historical:

Nakweliphi inqaku linokuthathwa njengeziko, naluphi na ubude bube yirediyasi, kuze kuzotywe isangqa.

P4

Zonke iiengile ezithe nkqo ziyalingana.

Here I want native-speaker review especially, because "right angle" terminology is exactly the sort of place where school-mathematics convention matters more than literal translation.

P5 — Playfair

Label:

Indlela elinganayo yokuyithetha (Playfair)

Statement:

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Ngenqaku P elingekho kumgca l kudlula umgca omnye kuphela ohambelana no-l.

The key phrase is **omnye kuphela** — one only.

P5 — Euclid

Label:

Indlela yembali yokuyithetha (Euclid)

Provisional wording:

Ukuba umgca omnye unqumla imigca emibini aze amacala angaphakathi akwicala elinye abe nesixa esingaphantsi kwee-engile ezimbini ezithe nkqo, loo migca mibini, xa yandiswa ngokungenasiphelo, iya kudibana kwelo cala.

This is exactly the kind of sentence I would want an educated native isiXhosa speaker with mathematical background to inspect carefully before we call it polished.

For the Common Notions, I would tentatively use:
IMIGAQO EMHLANU EQHELEKILEYO
“Five general/common principles.”
Then:

CN1 — Izixa ezilingana nesixa esinye ziyalingana.
CN2 — Ukuba kwizixa ezilinganayo kongezwa izixa ezilinganayo, iziphumo ziyalingana.
CN3 — Ukuba kwizixa ezilinganayo kuthatyathwa izixa ezilinganayo, okushiyekileyo kuyalingana.
CN4 — Izinto ezinokubekwa phezu kwenye zilingane ngokupheleleyo ziyalingana.
CN5 — Into yonke inkulu kunenxalenye yayo.

CN5 in particular feels quite natural to me. CN4 should be native-reviewed.

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The Mathematical Journey

For the Journey, I would use:

UHAMBO LWEMATHEMATIKA

This is intentionally more literal than in some languages; in isiXhosa the metaphor feels usable, but again I would not insist on it if a native reviewer prefers something like “course/development.”

Then:

IINDAWO ZOKUQALA EZAMKELWEYO

Sizamkela njengeendawo zokuqala.

UKUQIQA OKUNENGQIQO

Iinkcazelo, ulwakhiwo, ubungqina.

IINKCAZELO

Zinika amagama kwizinto esizakhayo.

IITHIYOREM

Iingxelo ezingqiniweyo — iziphumo eziyimfuneko.

IZIPHUMO EZINTSHA

Ithiyorem nganye ivula iindlela ezintsha.

I am deliberately allowing **ithiyorem** as a technical borrowing rather than forcing a dubious coinage.

The doorway

For the doorway:

KUTHENI UKUBA SITSHINTSHA IPOSTULATE ENYE?

and:

Phonononga iijometri ezingezizo ezika-Euclid →

Again, strongly provisional.

Closing inscription

For the closing inscription:

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Kwiingcinga ezimbalwa ezilula kuvela ubuhle obungenasiphelo.

That one I like: “From a few simple ideas emerges infinite beauty.”

Status

So my recommendation is **not yet to deep-freeze the isiXhosa wording as final**. I would put it in the **refrigerator section marked PROVISIONAL**, install it into a test copy, and immediately turn to the voice experiment. The South African government’s terminology resources give us enough grounding to make the test intellectually respectable, but native-speaker mathematical review should be considered essential before publication.

Speech Synthesis, Click Consonants, and Browser Fallback

And now comes the fun part: if the browser gives us an isiXhosa voice, the letters **c, q, x** are where we listen very carefully. If it merely reads them as English consonants, we will have found another technological frontier.

I am ready to install the provisional version and see what the voice generator does.

I kept isiXhosa conspicuously marked as requiring native-speaker mathematical review. South Africa's Department of Basic Education does maintain and actively refine isiXhosa mathematics terminology, so we have a real terminological foundation rather than guesswork; its published list, for example, explicitly defines **umgca** as “line.”

Now comes our experiment. I set the speech locale to **xh-ZA**. Chrome/iPhone may have a genuine isiXhosa-capable voice, may fall back to another South African/English voice, or may do something altogether peculiar.

The especially revealing things to listen for are words containing **c, q, and x**. In isiXhosa those letters can represent click consonants; an English fallback would almost certainly expose itself there.

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To have an idea of what clicks sound like, I have asked Bill, who has limited experience with Zulu and with a few native speakers, to make the click sounds he learned from those individuals as well as in the phonology classroom in his studies as a linguistics major—as illustrative pronunciations. The following audio files illustrate three click consonants inside Zulu words:

Dental click inside Zulu word for 'earring'

Alveolar click inside Zulu word for 'chat'

Lateral click inside Zulu word for 'hat'.

In IsiXhosa: C: dental click, Q: alveolar click, X: lateral click. The voiced examples above are illustrative only, in one language that uses clicks. Archival page in Deep Blue, persistent online archive at The University of Michigan.

So this time I would listen before freezing anything. The visual exhibit is the first test; **the clicks are the second.** 🐵🌍

Visual seems to have carried through. The voice is clearly reading the test as American English.

Aha. Then we've found the edge very clearly.

The **visual architecture passes**: isiXhosa fits into the same diptych without difficulty. But the Chrome/iPhone speech layer apparently does **not** have a usable isiXhosa voice and is falling back to American English—essentially the same category of failure we observed with Latin.

And with isiXhosa that failure is particularly revealing. An English voice cannot merely give the language a "foreign accent"; it changes the phonological system. In particular, the orthographic **c, q, x** cannot be treated with ordinary American-English letter values and still represent isiXhosa. So the synthesized result should be documented as **unsupported/fallback speech**, not "poor isiXhosa pronunciation."

That gives our Museum a surprisingly interesting little taxonomy already:

Fully useful speech: French, German, Italian, Spanish, Mandarin, Japanese, Arabic, Hungarian, Hindi, etc.

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Modern-language proxy: Ancient Greek apparently rendered through a Modern Greek voice.

Unsupported fallback: Latin and isiXhosa rendered as though their written forms were American English.

And I would keep all three phenomena visible.

In fact, isiXhosa makes the technological limitation more pedagogically obvious than Latin does. A visitor who knows the language could immediately hear that something fundamental is missing. Later, if browser speech support improves and those clicks suddenly appear correctly, the *same exhibit* becomes evidence that the technology has advanced.

I therefore would **freeze the visual/technical v11 experiment**, but **not promote the isiXhosa translation itself from provisional status**. Its two caveats should travel with it:

Translation: provisional; native-speaker mathematical review essential.
Audio: experimental; on our tested Chrome/iPhone configuration, isiXhosa is rendered through an American-English fallback voice and does not reproduce isiXhosa phonology reliably.

That distinction is important: the translation and the speech synthesis are two independent uncertainties.

As with Hungarian, Chinese, and Hindi, please note that v11 refers to an earlier developmental stage, not necessarily the current Museum version.

Indeed, for the two things being frozen:

- The experimental implementation was frozen as a historical artifact.
- The isiXhosa translation remained provisional, pending native-speaker mathematical review.

And we've accomplished exactly what we wanted by choosing a click language: we pushed the voice system until it said, in effect, **“I don't know how to do this yet.”**

That's useful knowledge.

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I think v11 belongs in the freezer—but perhaps on the shelf labeled **Experimental Cultures: Do Not Mistake Limitations for Features.**

When listening to the voice rendering the fallback becomes immediately transparent, on the C in Euclid, himself. That is satisfying in a certain way—Euclid not only reveals geometric structure but in this case linguistic structure—by his name! Agree with you. Please freeze as you say!

Yes! That is wonderfully satisfying: **Euclid's own name becomes a diagnostic instrument.** The voice reaches the **c** in *Euclid*, applies its American-English machinery, and immediately reveals that the speech system has failed to enter isiXhosa phonology at all. The mathematics, the language, and the technology expose one another.

However, the letter c in the Latin-script spelling Euclid is not automatically evidence of how the corresponding sound should be pronounced in isiXhosa. A borrowed proper name may follow conventions different from ordinary isiXhosa vocabulary. It is an immediate indication of English-language fallback rather than a definitive test of an isiXhosa click consonant.

The more rigorous phonological test would involve actual isiXhosa words containing the relevant click consonants, ideally reviewed by a competent speaker, strengthening the scientific interpretation.

I've frozen v11 exactly in the form we agreed upon: **the implementation is frozen; the isiXhosa translation remains explicitly provisional.**

Syntax checked and safely stored.

That observation about the **c in Euclid** belongs in our eventual audio/curatorial notes. It's almost too perfect: before the visitor even reaches specialized mathematical vocabulary or a deliberately click-rich word, **Euclid announces the limitation himself**.