

語言工程實驗室

Language Engineering Laboratory



LANGUAGE, *EVOLUTION* and the *BRAIN*

Nanyang Technological University
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	19th century	20th century (first half)	20th century (second half)	21st century
<u>Evolution</u>	Darwin, Mendel	Synthetic theory of evolution	Watson-Crick (1962)	Decoding human genome
<u>Neuro-science</u>	Broca, Wernicke	Cajal (1906) Sherrington (1932)	Sperry (1981) Hebb Penfield	Brain imaging
<u>Linguistics</u>	Schleicher Schmidt	Saussure Sapir Jakobson Greenberg	Generative grammar (MIT) Construction grammar (Berkeley)	Evolutionary linguistics

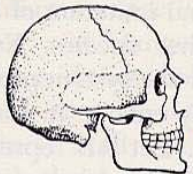
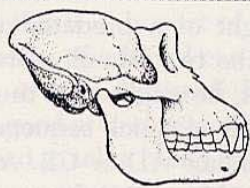
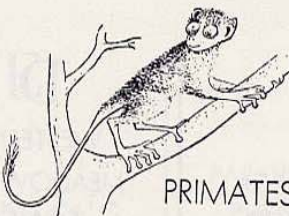
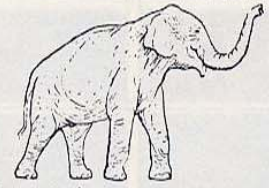
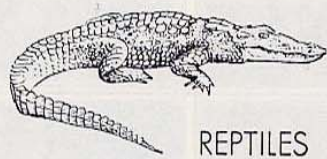
[www.ee.cuhk.edu.hk/~lel/public/
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Comments would be appreciated!

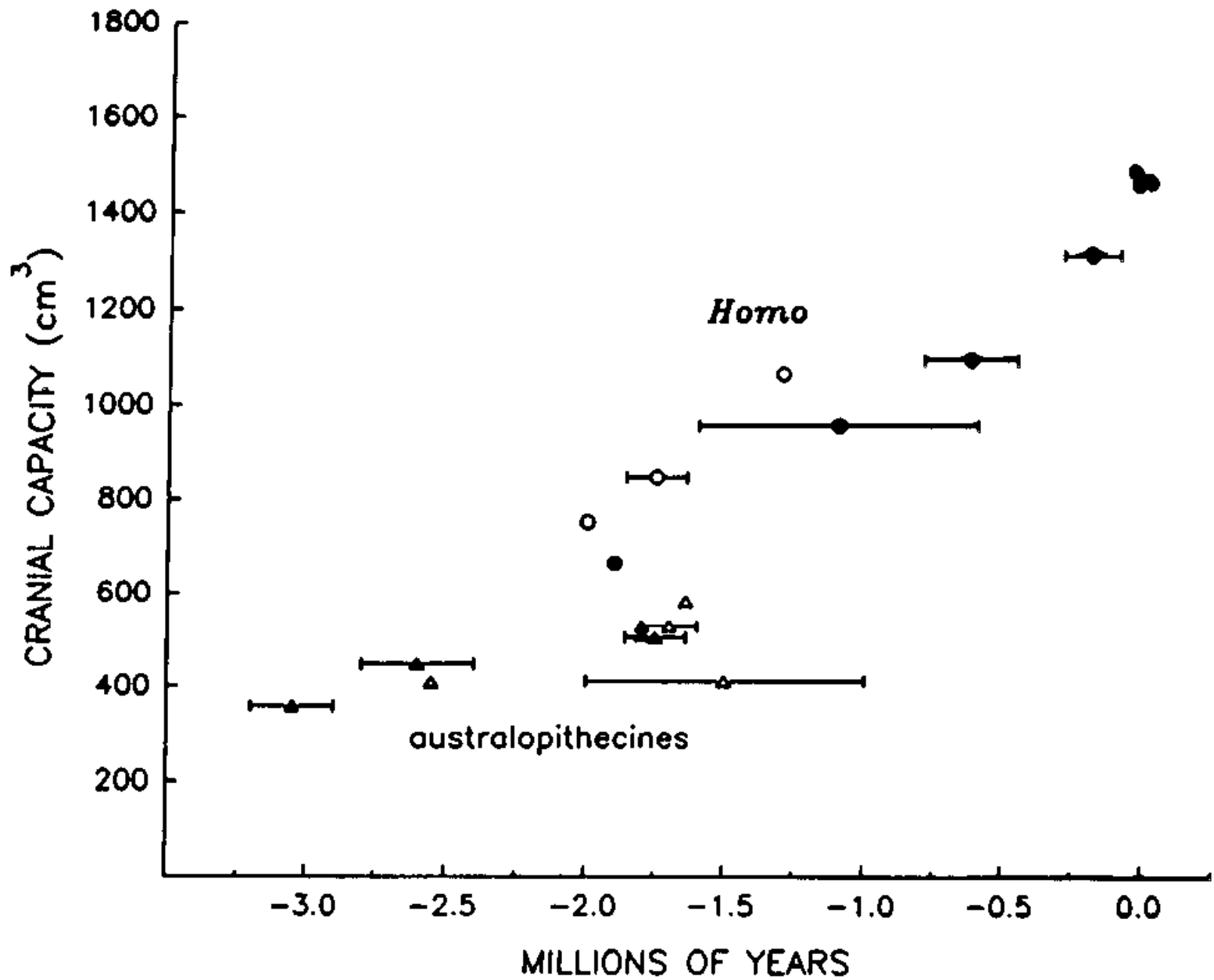
Human Communication. Language and its Psychobiological Bases. W.S-Y. Wang, ed. p.9.

 <p>MAN</p>	<p>DISPLACEMENT PRODUCTIVITY DUALITY OF PATTERNING</p>	<p>TOOL-MAKING AND CARRYING LARYNX AND SOFT PALATE SEPARATED HUMOR VOWEL COLOR MUSIC</p>
 <p>HOMINOIDS</p>	<p>DISCRETENESS TRADITIONAL TRANSMISSION</p>	<p>BIPEDAL LOCOMOTION, NOT UPRIGHT OCCASIONAL TOOL USING</p>
 <p>PRIMATES</p>	<p>SPECIALIZATION SEMANTICITY ARBITRARINESS</p>	<p>HANDS HAND-EYE COORDINATION BINOCULAR VISION MOBILE FACIAL MUSCLES OMNIVOROUS?</p>
 <p>(LAND) MAMMALS</p>	<p>BROADCAST TRANSMISSION AND DIRECTIONAL RECEPTION INTERCHANGEABILITY RAPID FADING TOTAL FEEDBACK VOCAL-AUDITORY CHANNEL</p>	<p>SOCIAL BEHAVIOR "PLAY" WARM BLOODEDNESS</p>
 <p>REPTILES</p>		<p>LAND EGG BREATHING WITH THORACIC MUSCLES</p>

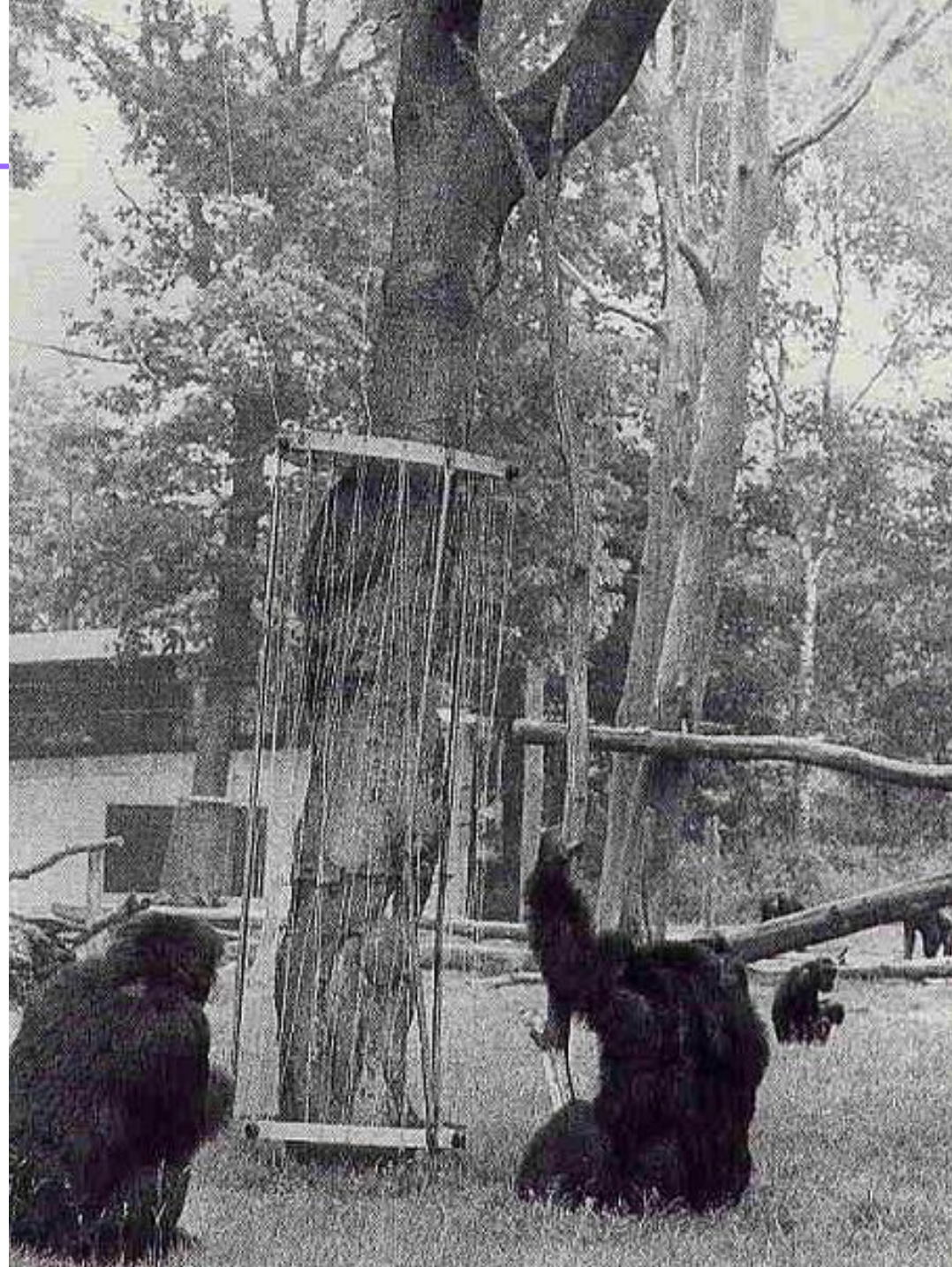
Hockett, C.F. 1960. The origin of speech.
Scientific American 203.88-96.

Hockett, Charles F. & Stuart A. Altmann.
1968. A note on design features. Animal
Communication, ed. by T.A. Sebeok, 61-
72. Bloomington: Indiana University Press.

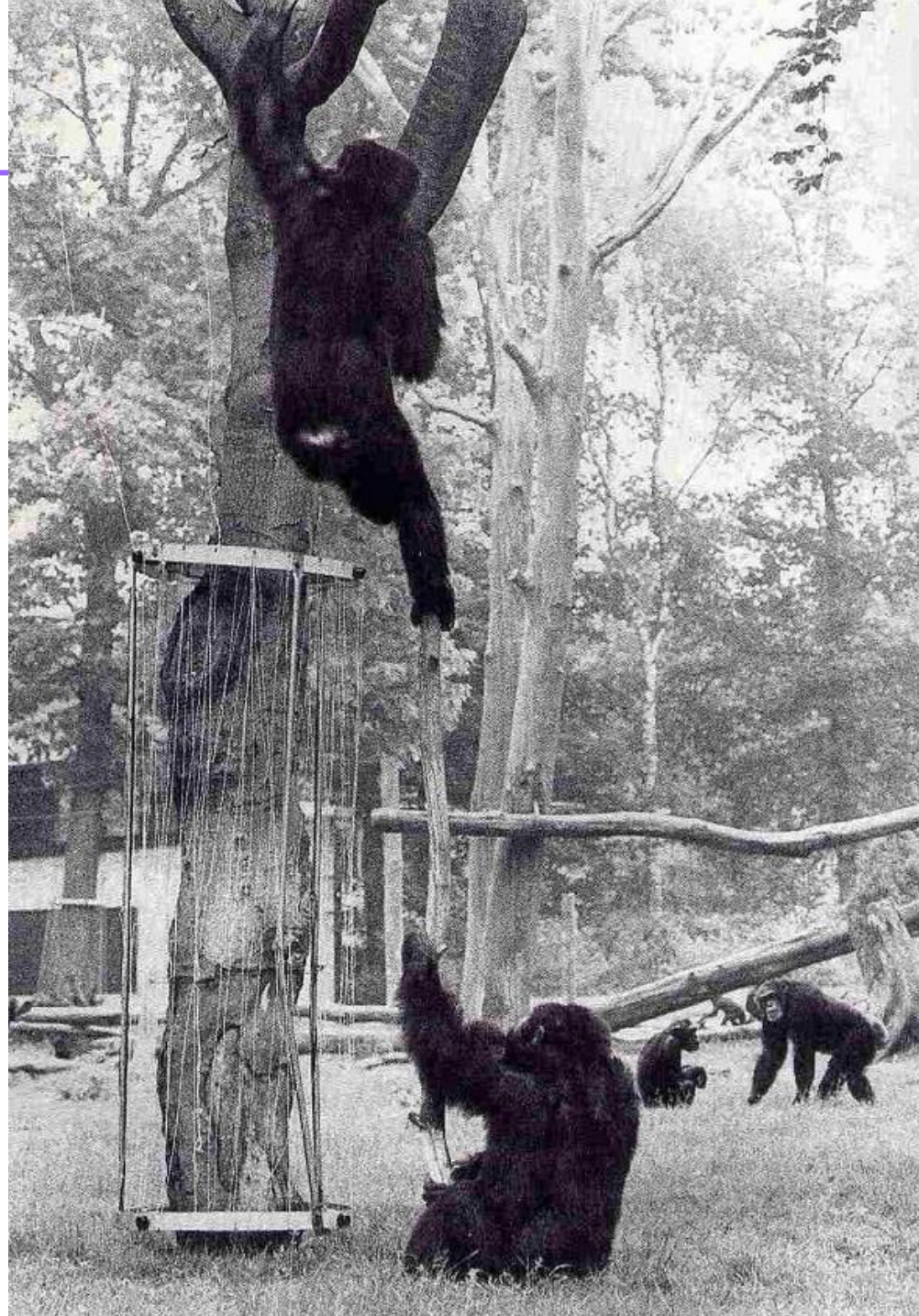
Hockett, C.F. 1978. In search of Jove's brow.
American Speech 53.243-313.

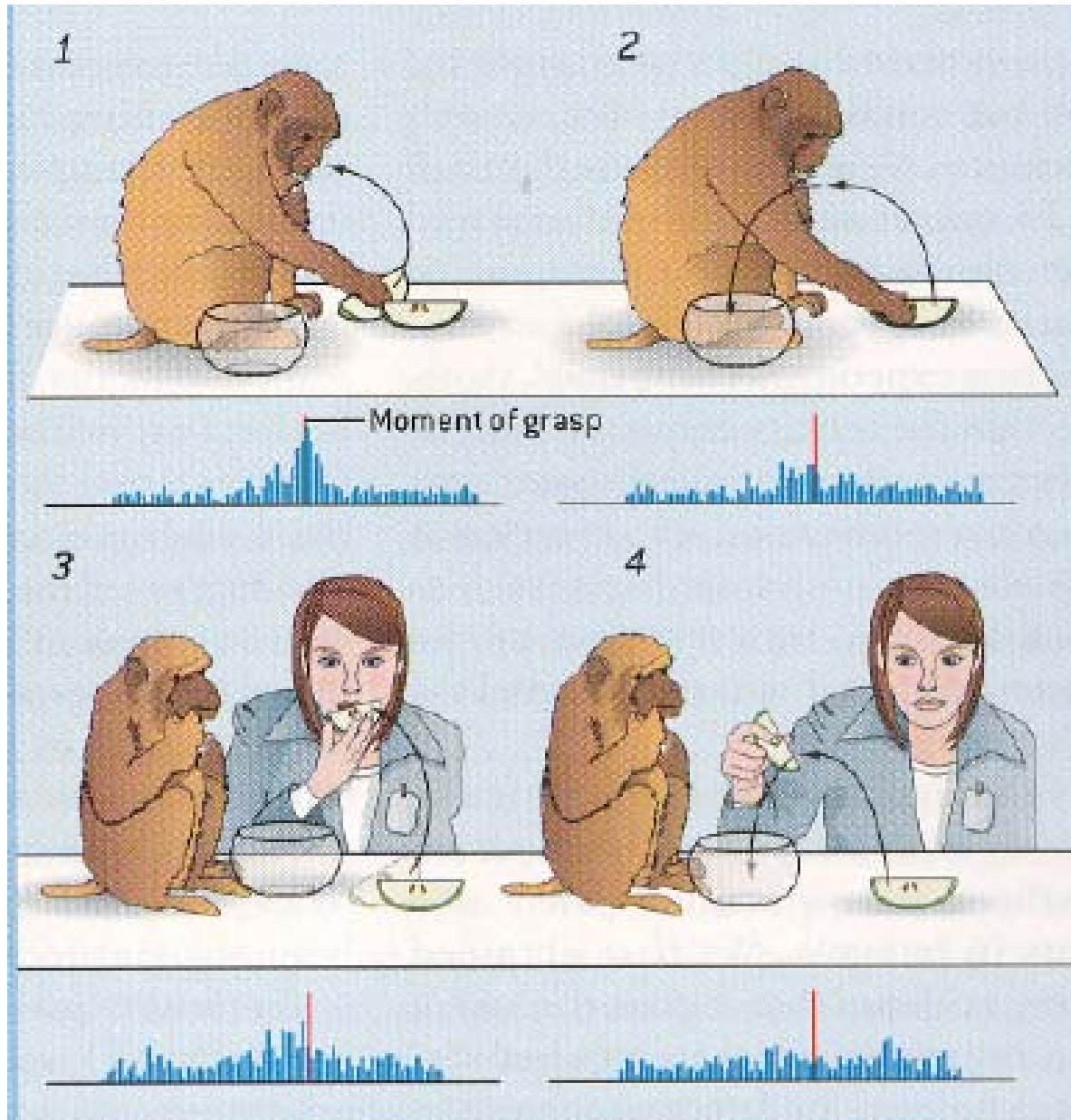


Frans de Waal
Chimpanzee Politics
1998:193.



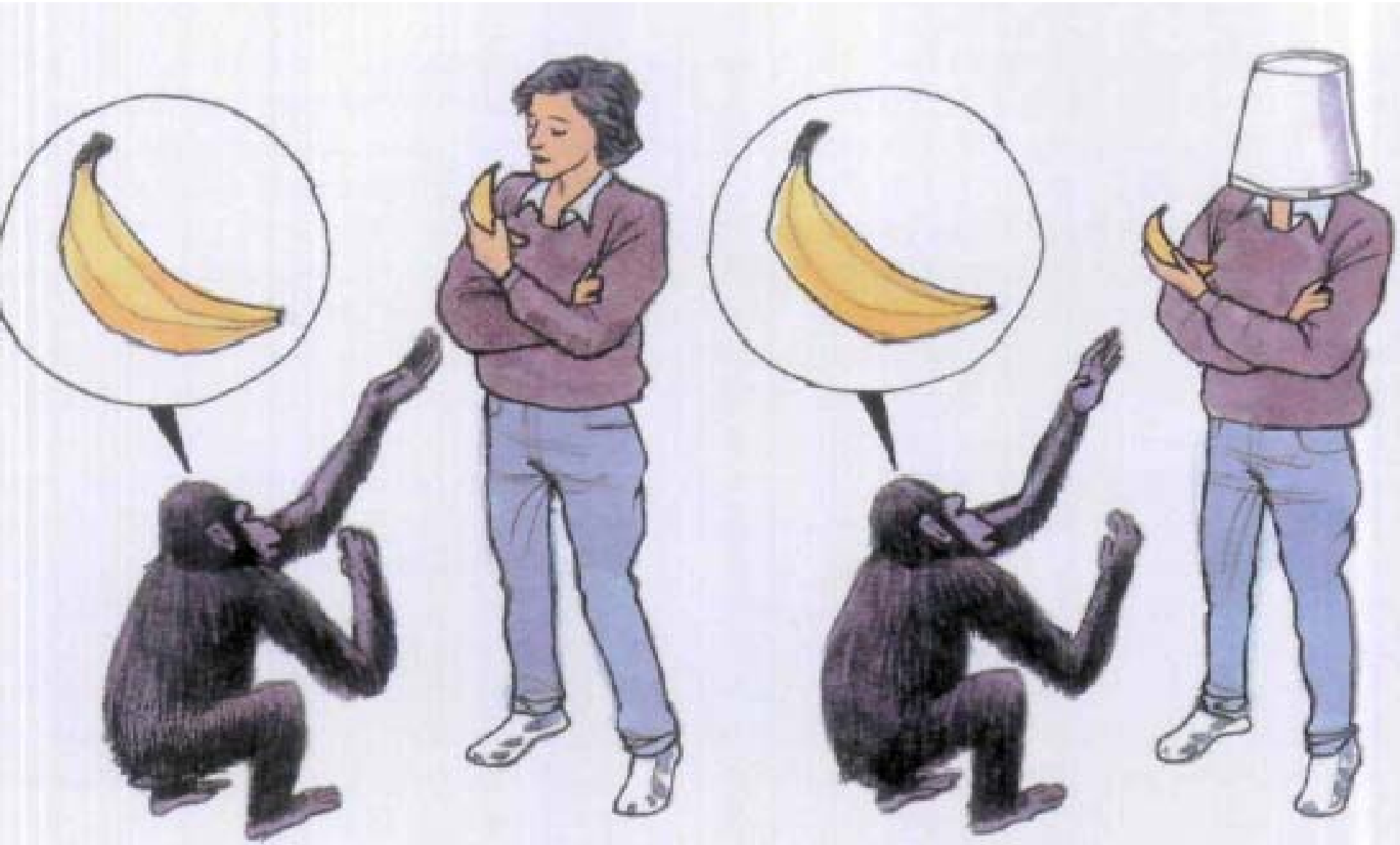
Frans de Waal
Chimpanzee Politics
1998:194





Corballis, Michael C. 2007.

The Uniqueness of Human Recursive Thinking. American Scientist 95.240-48.



Theory of Mind studies

Premack, D. & G. Woodruff. 1978. Does the chimpanzee have a theory of mind? *Behav. Brain Sci.* 1.515-26.

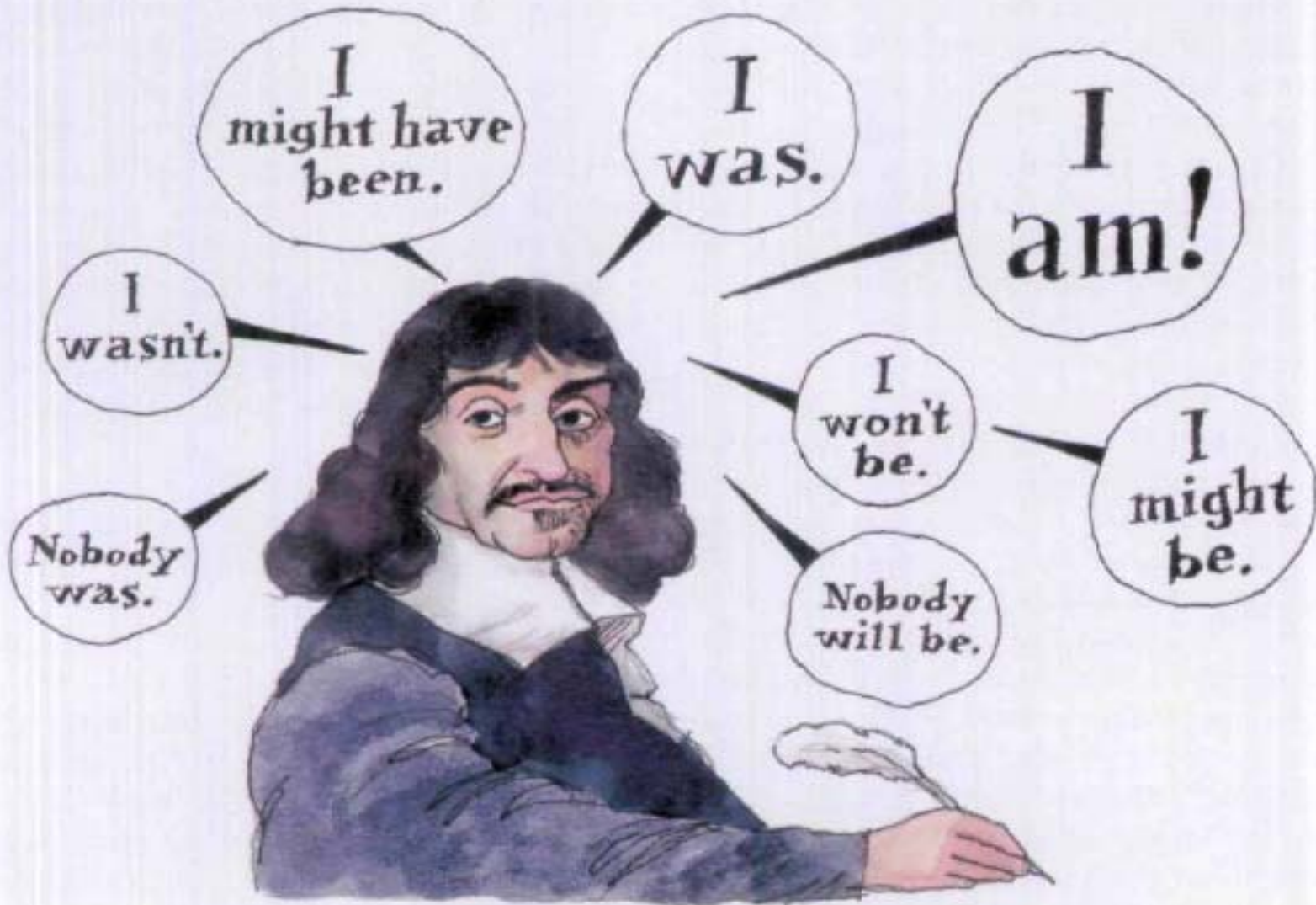
Call, Josep & Michael Tomasello. 2008. Does the chimpanzee have a theory of mind? 30 years later. *Trends in Cognitive Sciences* 12.187-92.

Call, J. & M. Tomasello. 2008. Does the chimpanzee have a theory of mind? 30 years later. *Trends in Cognitive Sciences* 12.187-92.

“In a broad construal of the phrase ‘theory of mind’, then, the answer to Premack and Woodruff’s pregnant question of 30 years ago is a definite **yes**, chimpanzees do have a theory of mind. But chimpanzees probably do not understand others in terms of a fully human-like belief–desire psychology in which they appreciate that others have mental representations of the world that drive their actions even when those do not correspond to reality. And so in a more narrow definition of theory of mind as an understanding of **false beliefs**, the answer to Premack and Woodruff’s question might be **no**, they do not. Why chimpanzees do not seem to understand false beliefs in particular – or if there might be some situations in which they do understand false beliefs – are topics of ongoing research.” *p.191.*



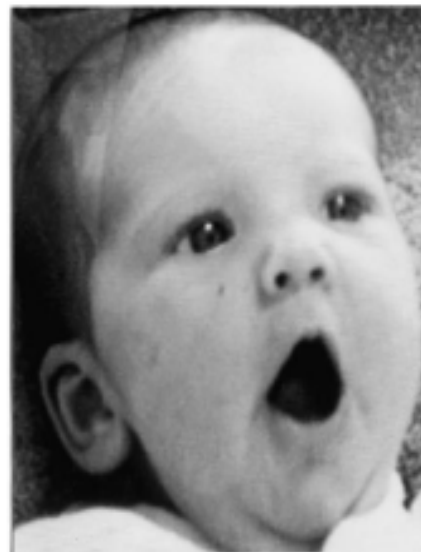
Corballis, Michael C. 2007. The Uniqueness
of Human Recursive Thinking. *American Scientist* 95.240-48.

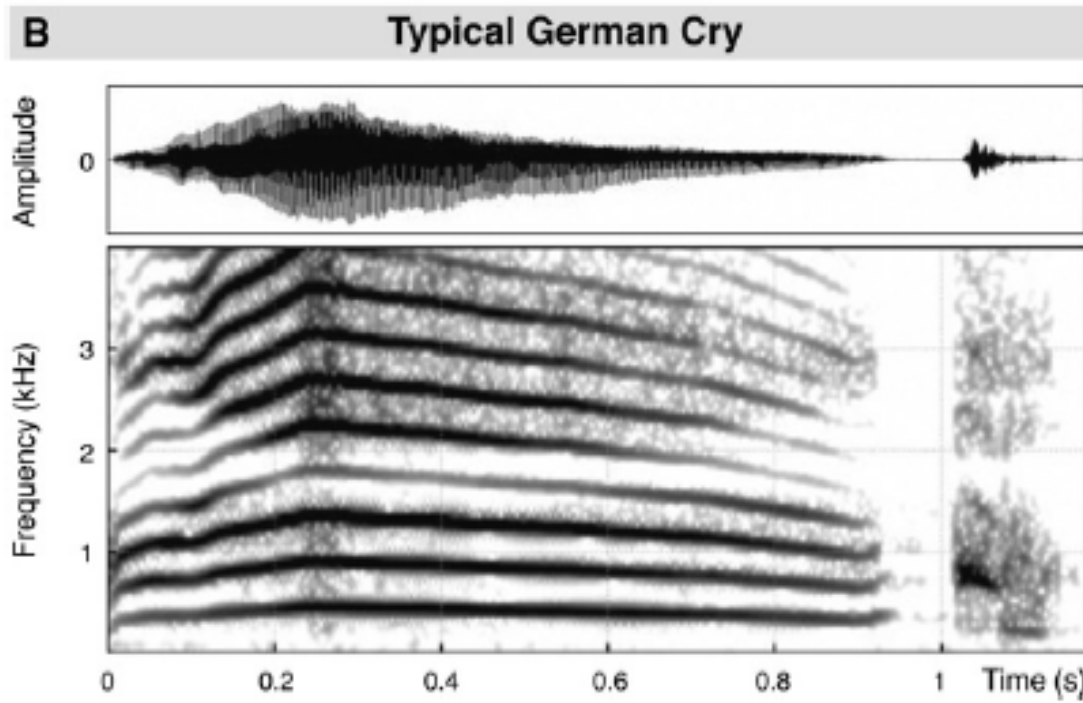
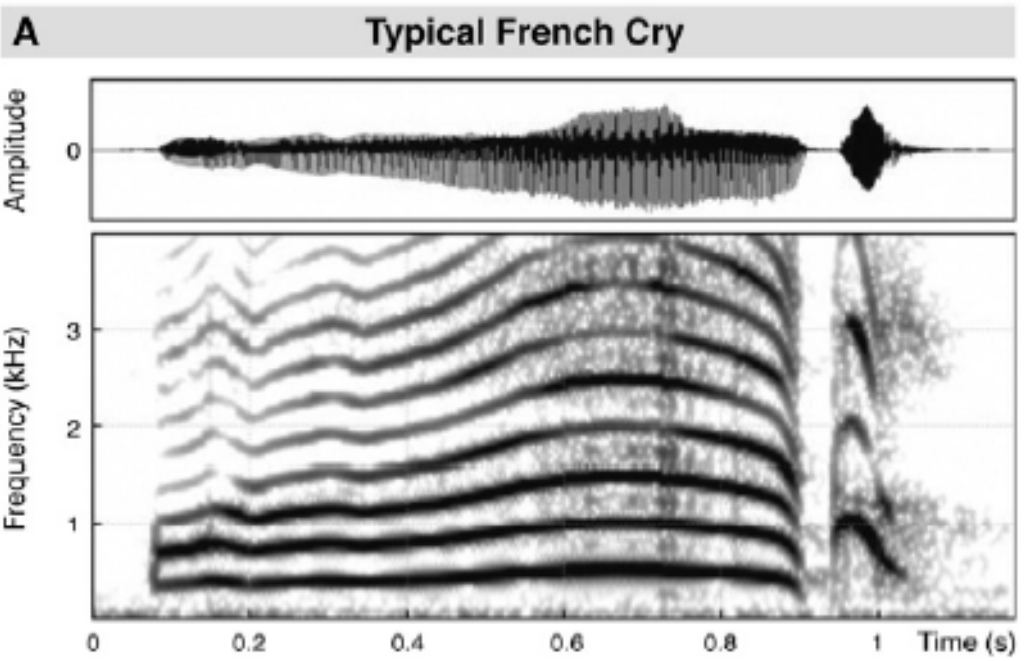


René Descartes as a mental time traveler.

Meltzoff, A. N. & M. K. Moore. 1977.

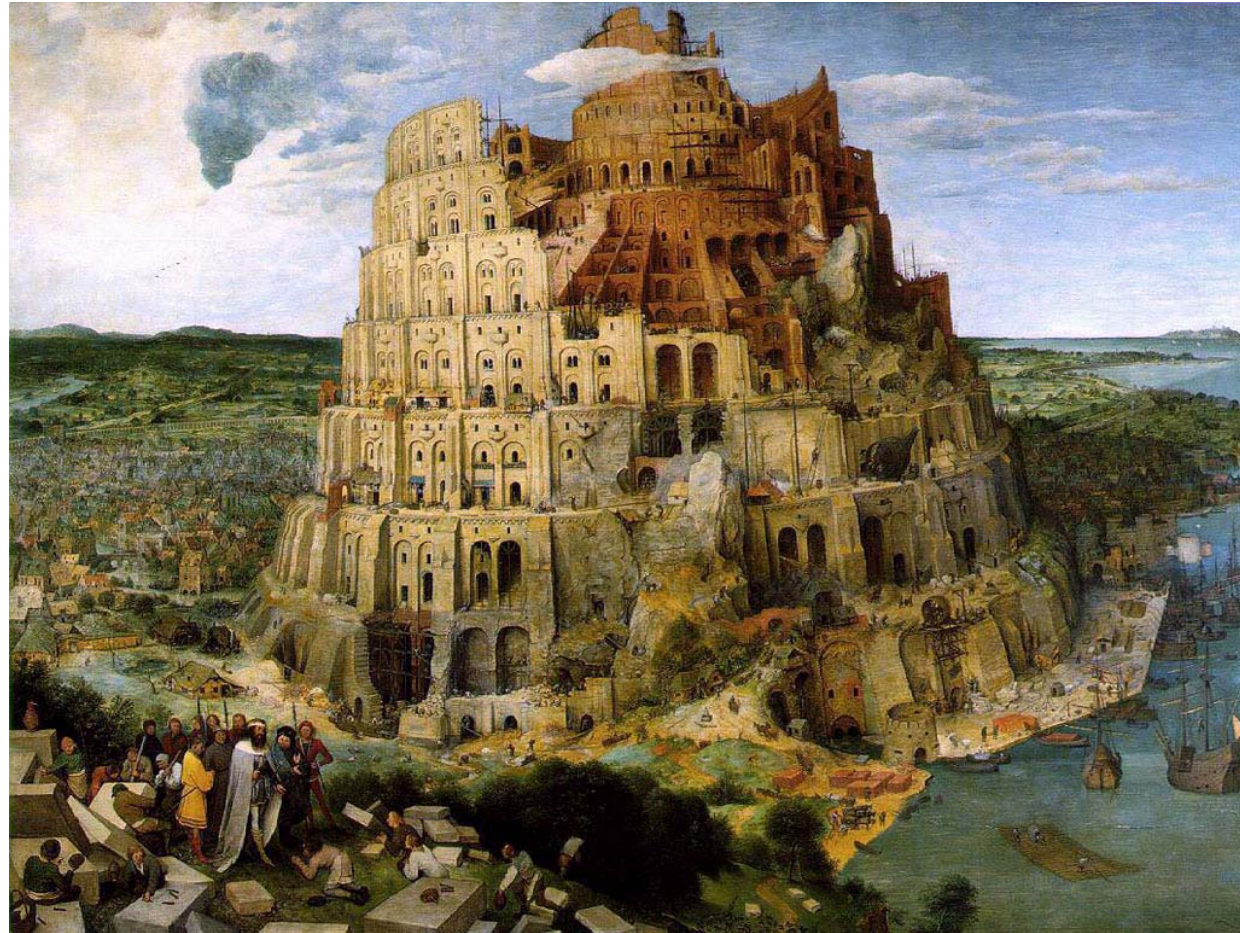
Imitation of facial and manual gestures by human neonates. *Science* 198.75-78.





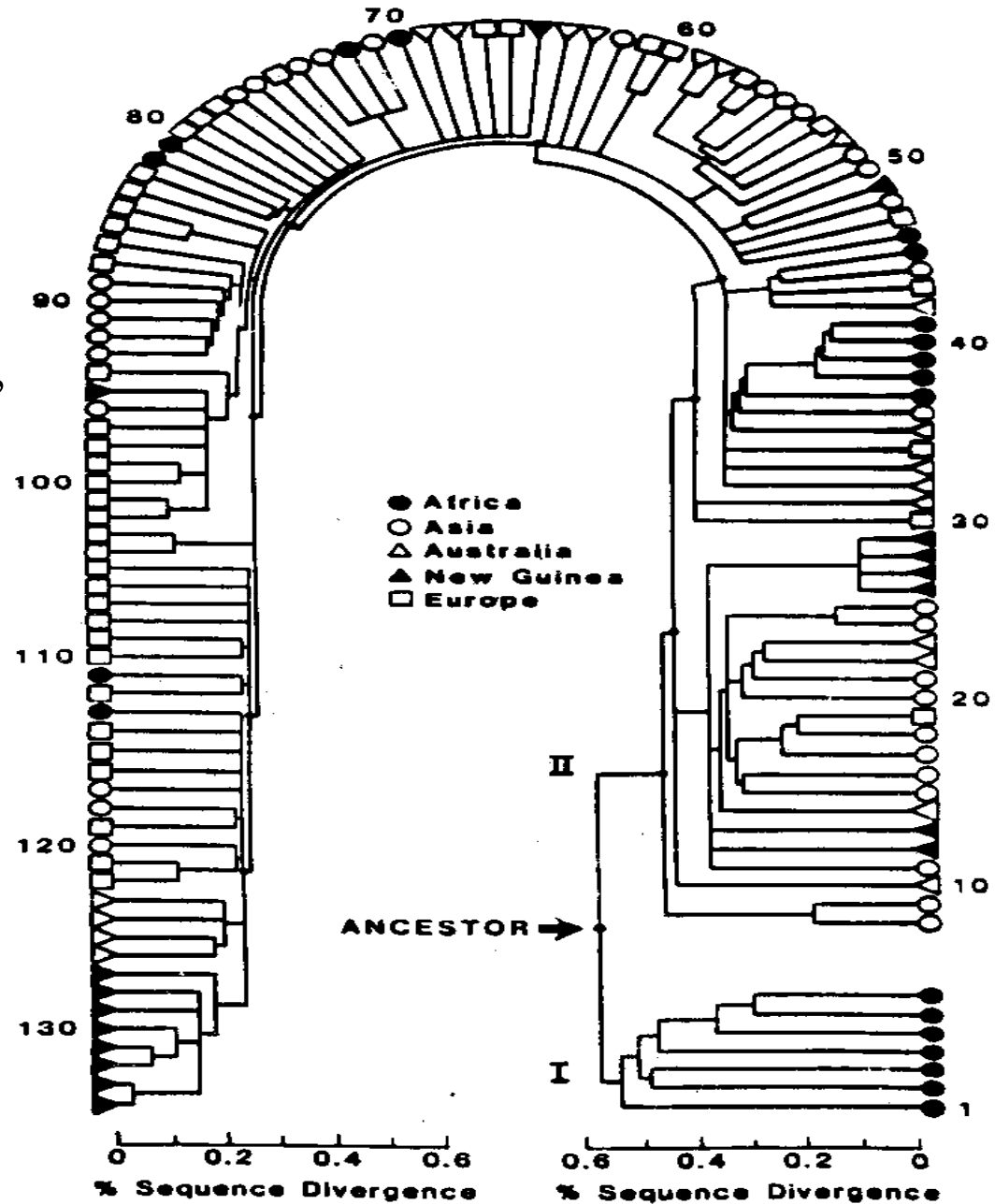
Mampe, Birgit, et al. 2009.
Newborns' Cry Melody Is Shaped
by Their Native Language
Current Biology 19.1994-7.

Language Diversity:



“Go to, let us go down, and there confound their language, that they may not understand one another's speech” (Genesis 11:7)

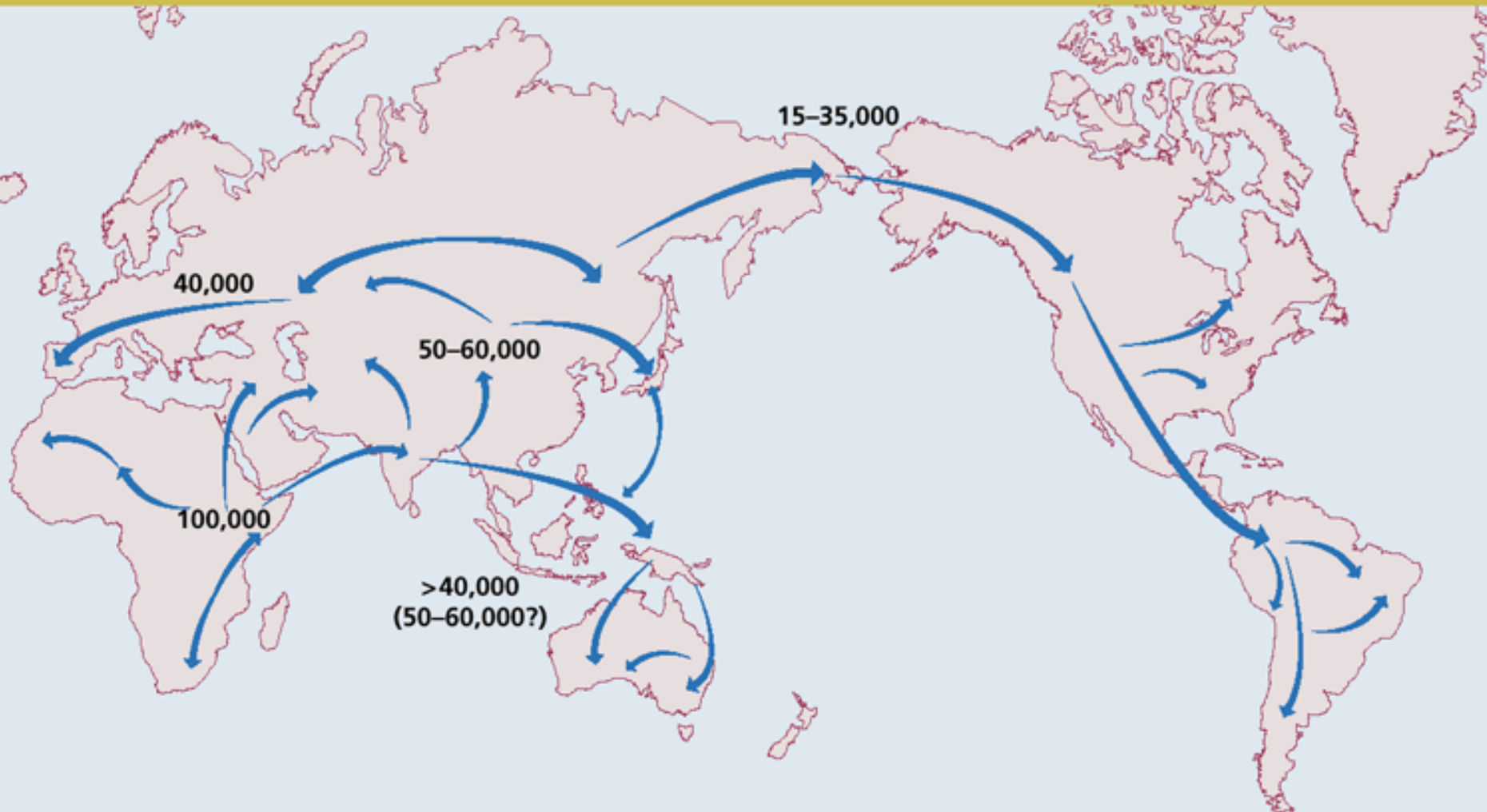
Cann, R., M. Stoneking, and A. Wilson. (1987).
Mitochondrial DNA
and human evolution.
Nature 325:31-36.

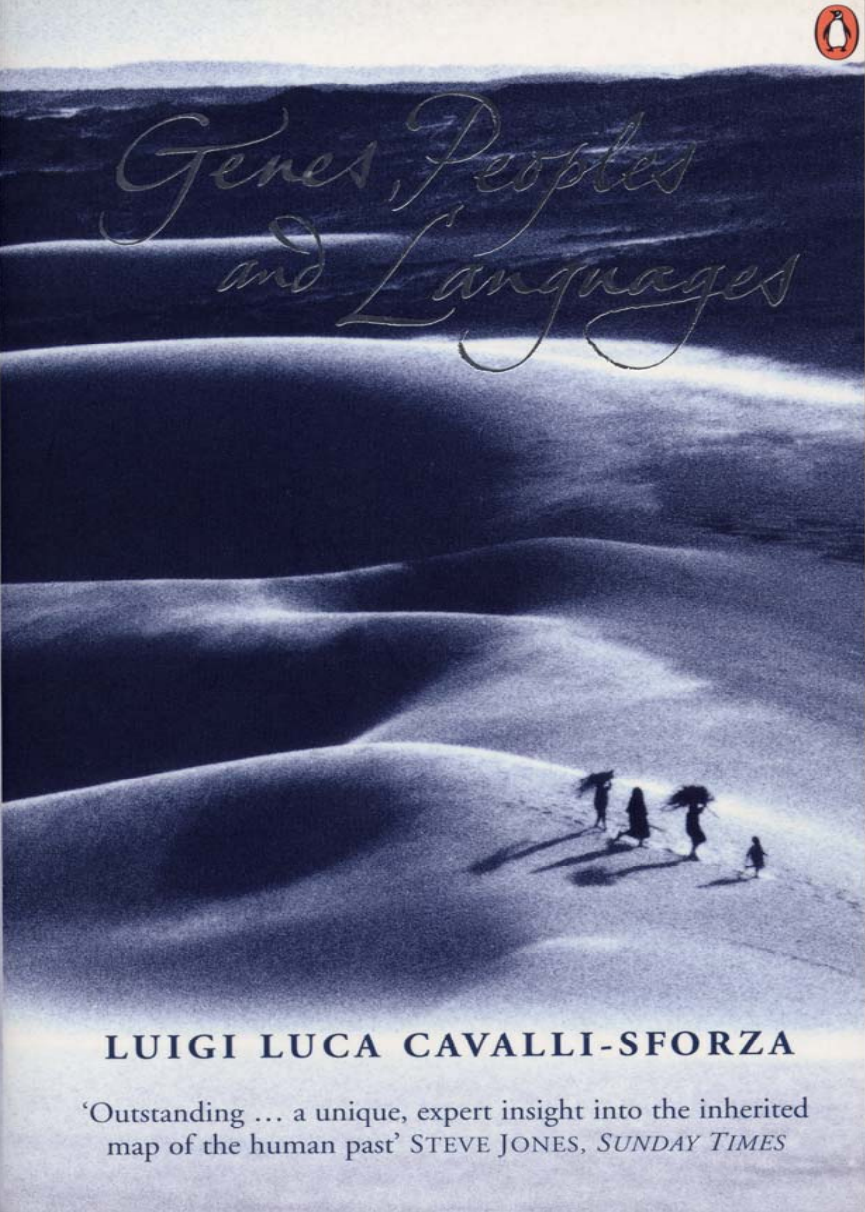


L.L.Cavalli-Sforza & M.W.Feldman.

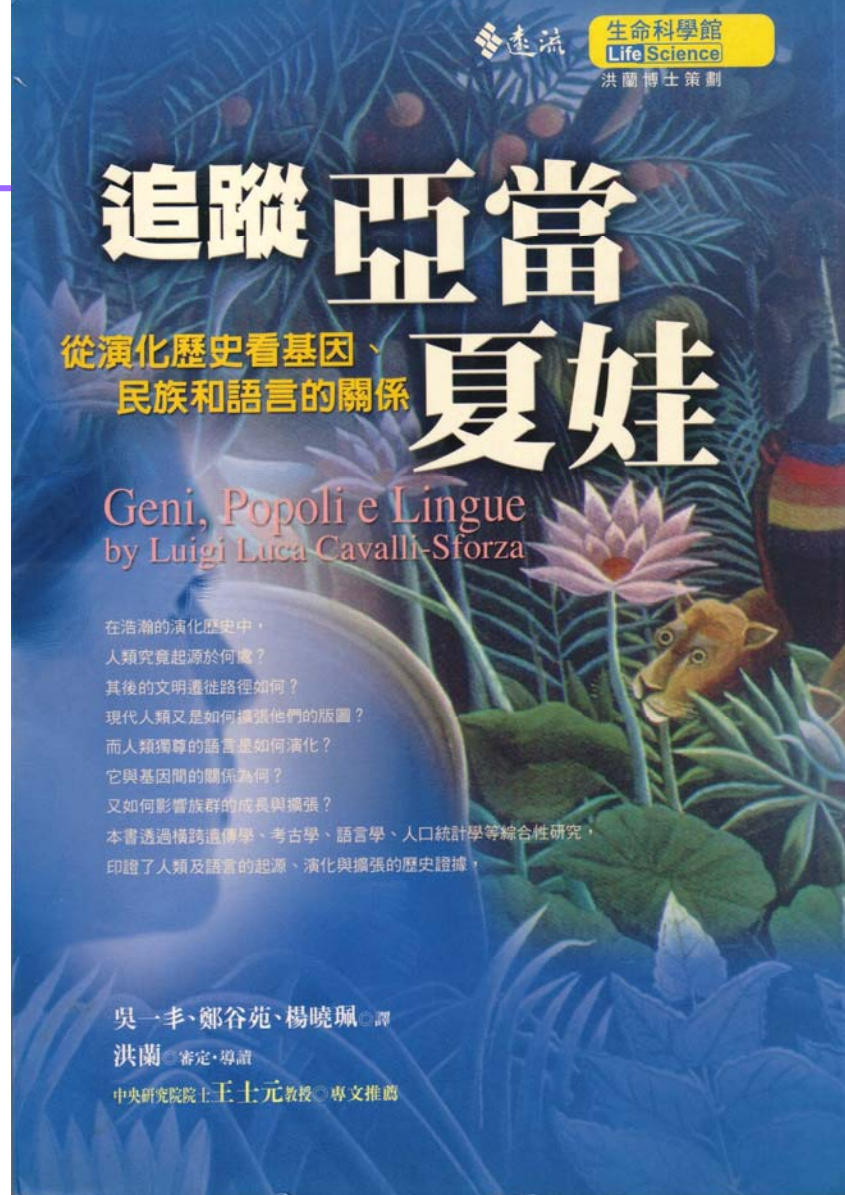
The application of molecular genetic approaches to the study of human evolution.

Nature Genetics Suppl. 33.266-75. March 2003.





Luigi Luca Cavalli-Sforza. 2000. *Genes, Peoples, and Languages*. New York: North Point Press.



2003. 卡瓦利斯基札著. 追蹤亞當夏娃. 台北遠流出版公司.

Freedman, D.A. & W.S-Y. Wang. 1996.

Language polygenesis: a probabilistic model. *Anthropological Science* 104.2.131-8.

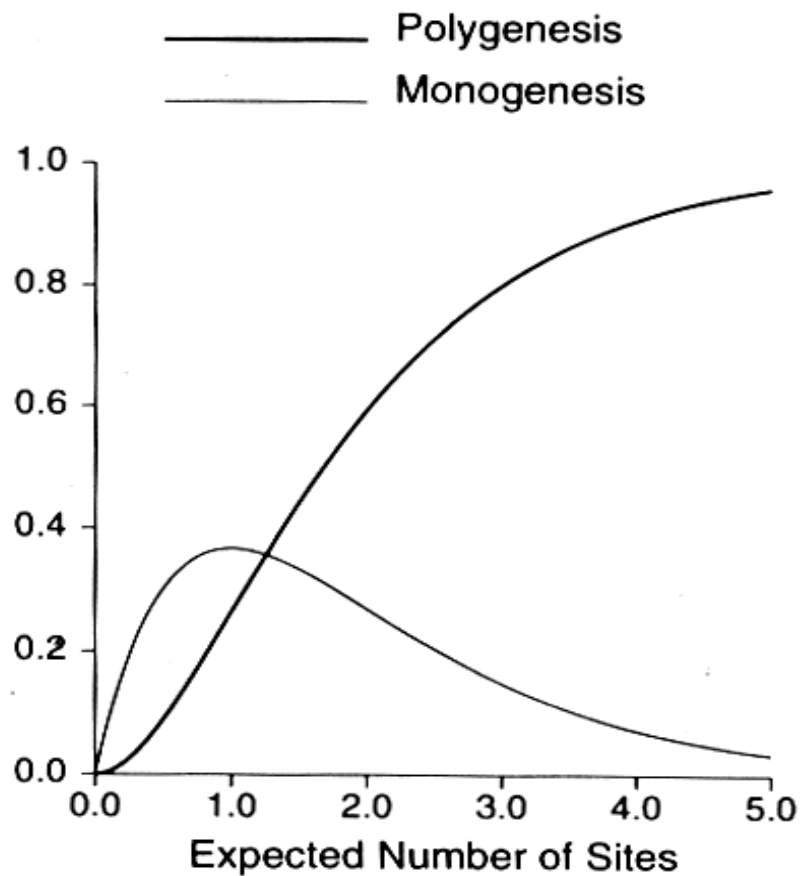


Fig. 1. Poisson model for language emergence. The heavier curve shows the probability of polygenesis; the lighter curve, monogenesis. Probability is a function of the expected number of sites at which language emergence (horizontal axis).

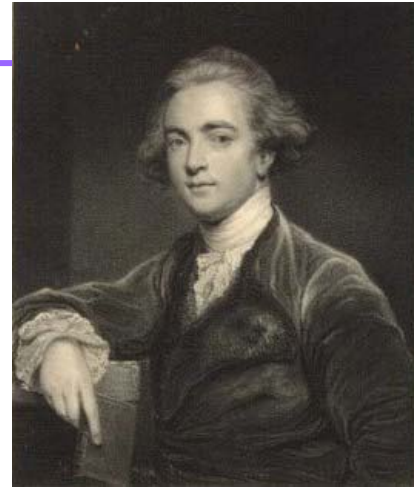
“Linguistics may be said

to have begun its scientific career with the comparative study and reconstruction of the Indo-European languages. In the course of their detailed researches Indo-European linguists have gradually developed a technique which is probably more nearly perfect than that of any other science dealing with man's institutions.”



Edward Sapir 1884-1939

“*The Sanscrit language, Whatever be its antiquity, is of a wonderful structure; more perfect than the*



*Greek, more copious than the Latin, and more exquisitely refined than either, yet bearing to both of them **a stronger affinity ... than could possibly have been produced by accident**; so strong indeed, that no philologer could examine them all three, without believing them to have **sprung from some common source, which, perhaps, no longer exists.**” (1786)*

Theorists of language change: Trees and Waves



August Schleicher
1821 – 1868

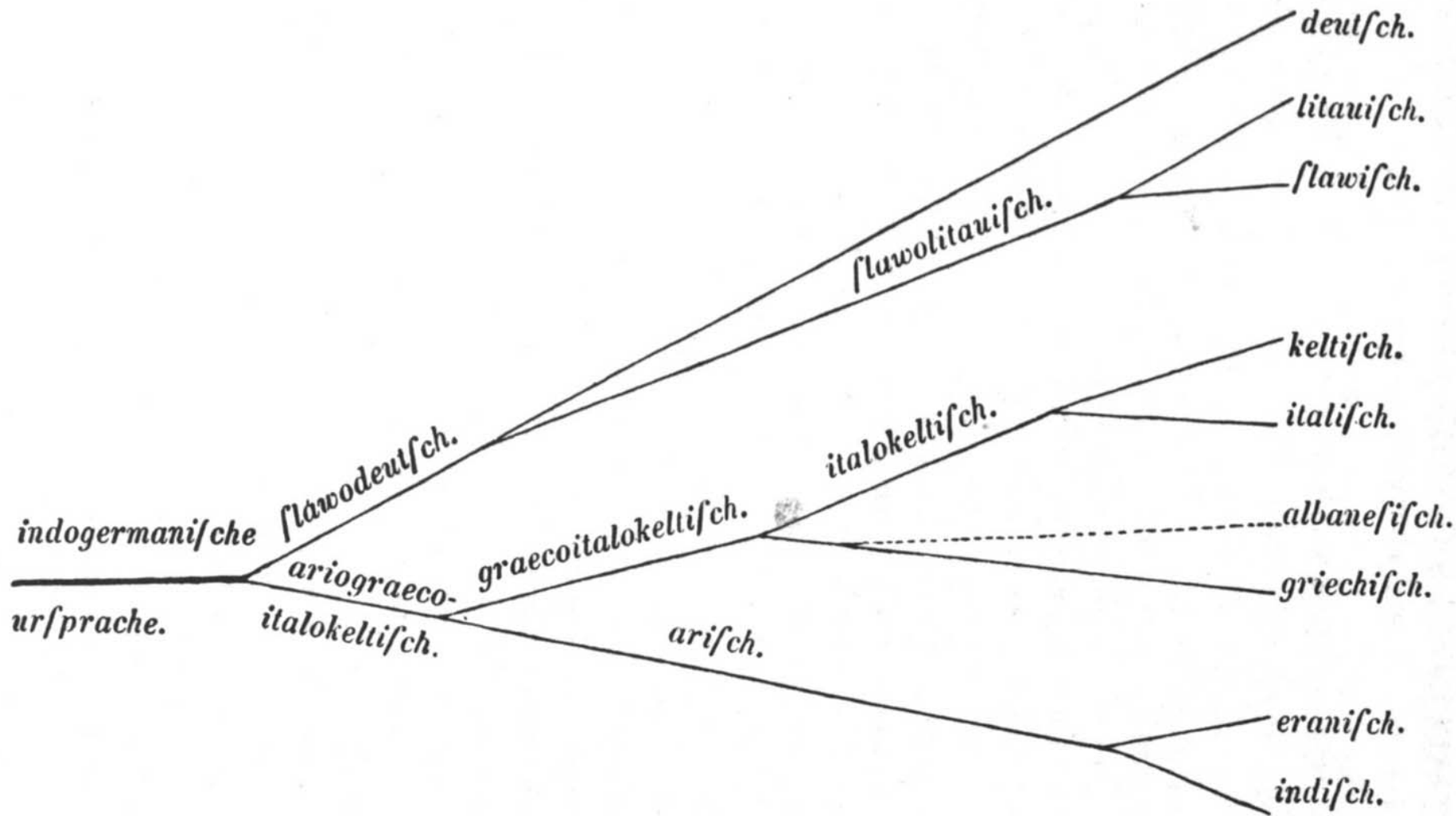
Johannes Schmidt
1843–1901



Wang, W.S-Y. & J.W. Minett. 2005.

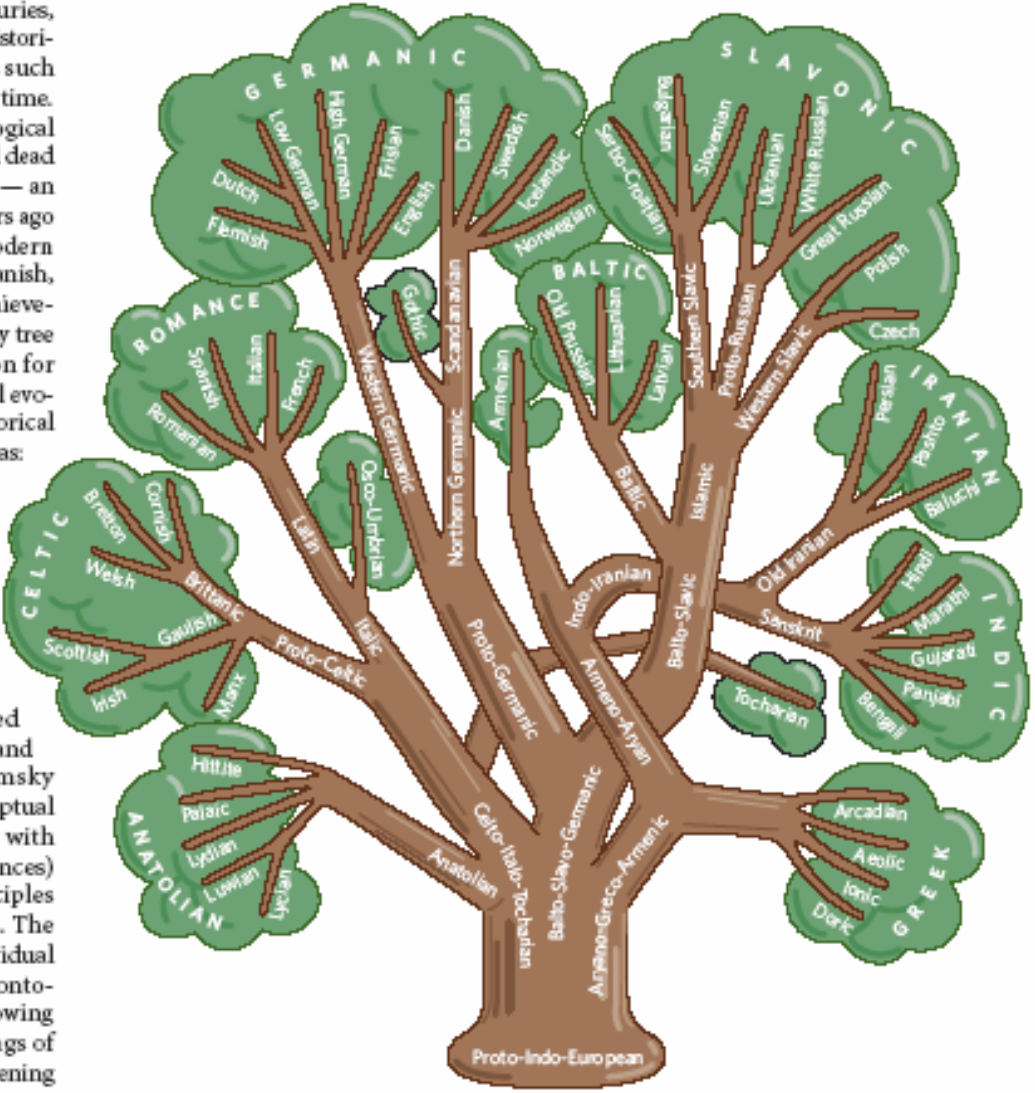
**Vertical and horizontal transmission
in language evolution.**

Transactions of the Philological Society 103.2.121-46.



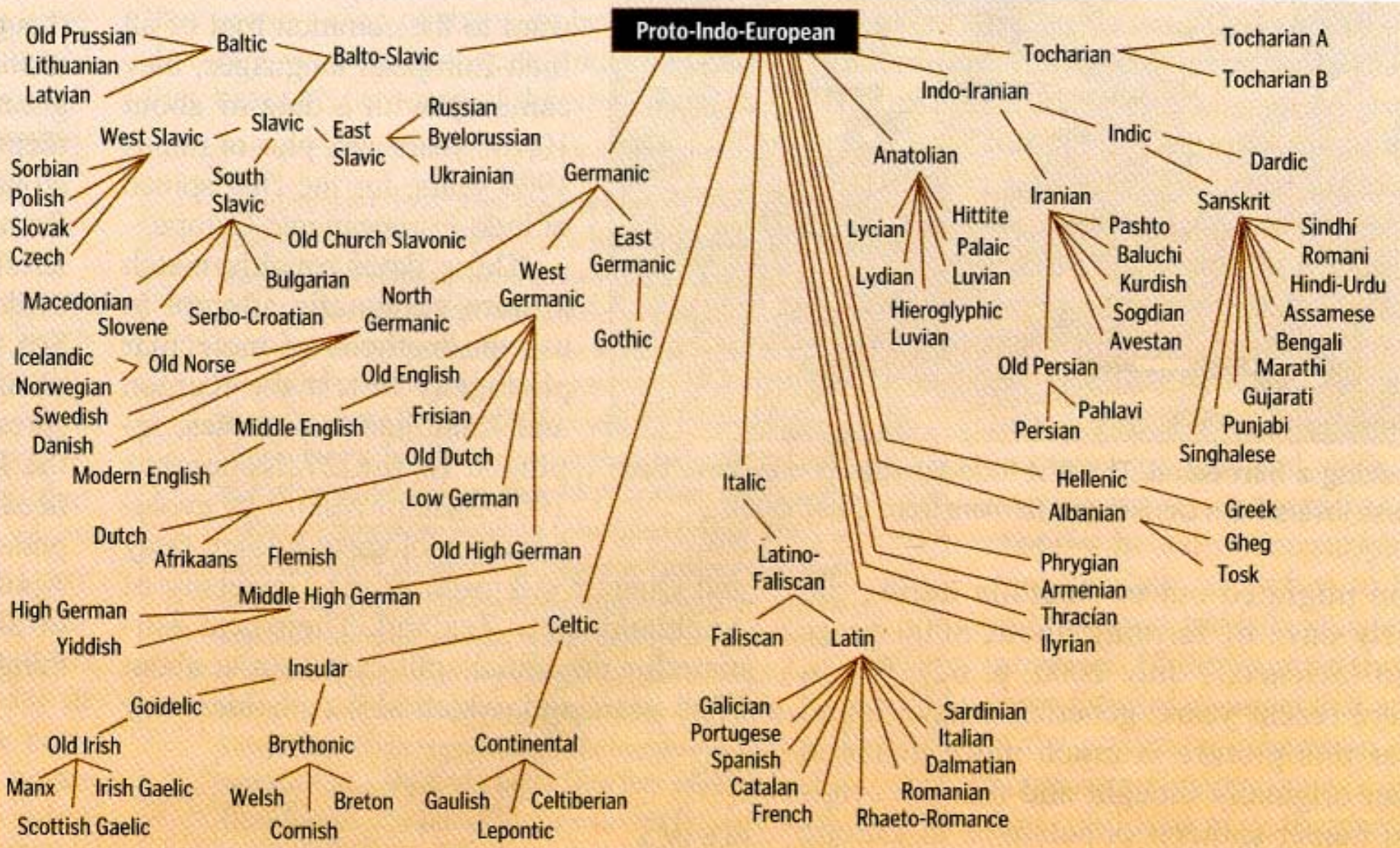
SCHLEICHER'S INDO-EUROPEAN FAMILY TREE
 [After Schleicher's *Compendium*]

centuries, only historically such rough time. etymological selected dead years ago of modern Spanish, a family tree for logical evolutionary ideas: the author argued that the individual age (ontology, allowing meanings of language gene). But the individual age (ontology, allowing meanings of language gene). But the individual age (ontology, allowing meanings of language gene).

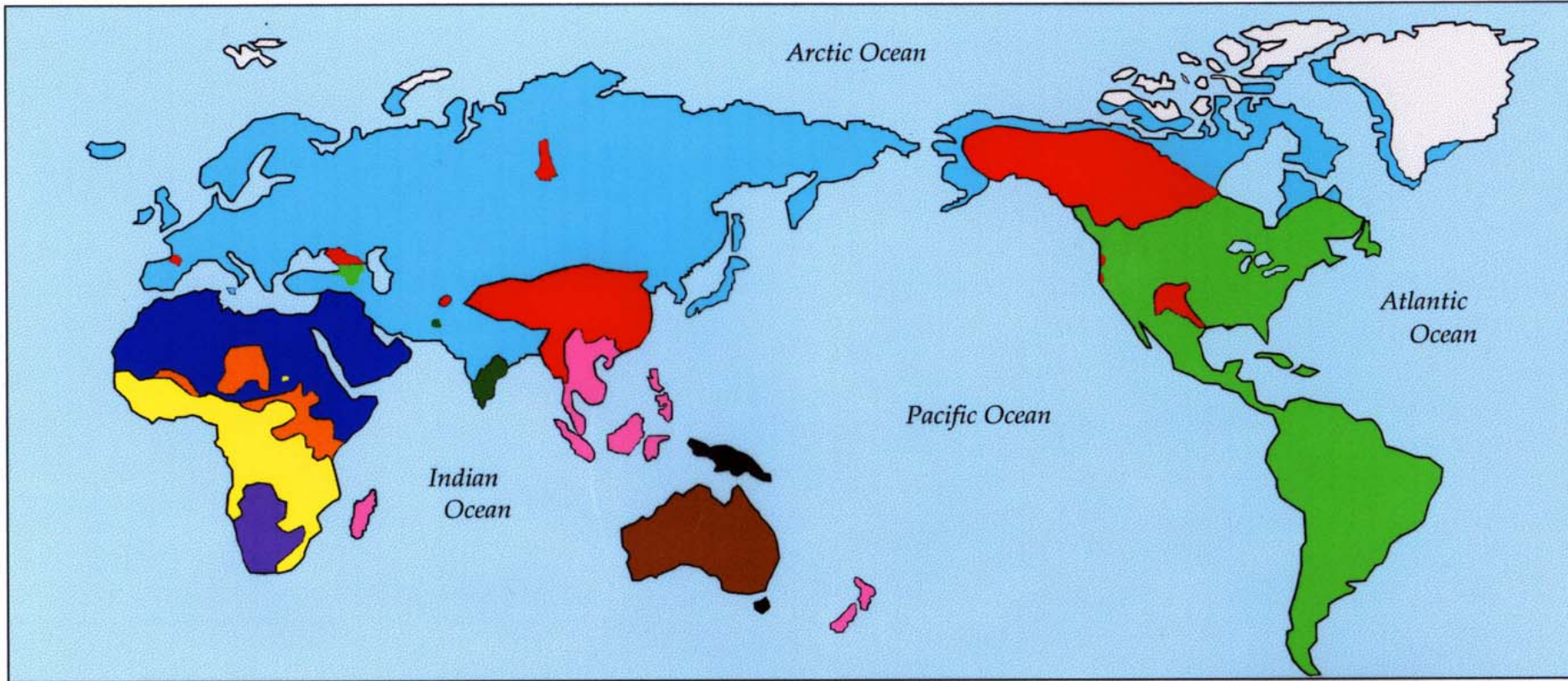














W.T.Fitch. Nature
October 11,
2007.p.665.

Figure 1 | The glossogenetic tree of Indo-European language. The words of language are not inherited biologically, but are passed on culturally through learning. This process of ‘cultural evolution’ generates a hierarchical tree of relationships among languages, here illustrated by the Indo-European family. Just as descent with modification in biological evolution (phylogeny) leads to phylogenetic trees, so the analogous process in language change (glossogeny) can lead to glossogenetic trees.



Say it in Indo-European. The 144 languages of this family descend from one ancient mother tongue.



- | | | |
|---|--|--|
|  Khoisan |  Dravidian |  Austric |
|  Niger-Kordofanian |  Kartvelian |  Indo-Pacific |
|  Nilo-Saharan |  Eurasian |  Australian |
|  Afro-Asiatic |  Dene-Caucasian |  Amerind |



Language Families of the World (after Greenberg)

Charles Darwin

*“If we possessed a perfect pedigree of mankind, **a genealogical arrangement of the races of man would afford the best classification of the various languages** now spoken throughout the world*

...

*The various degrees of difference between the languages of the same stock, would have to be expressed by **groups subordinate to groups**”*

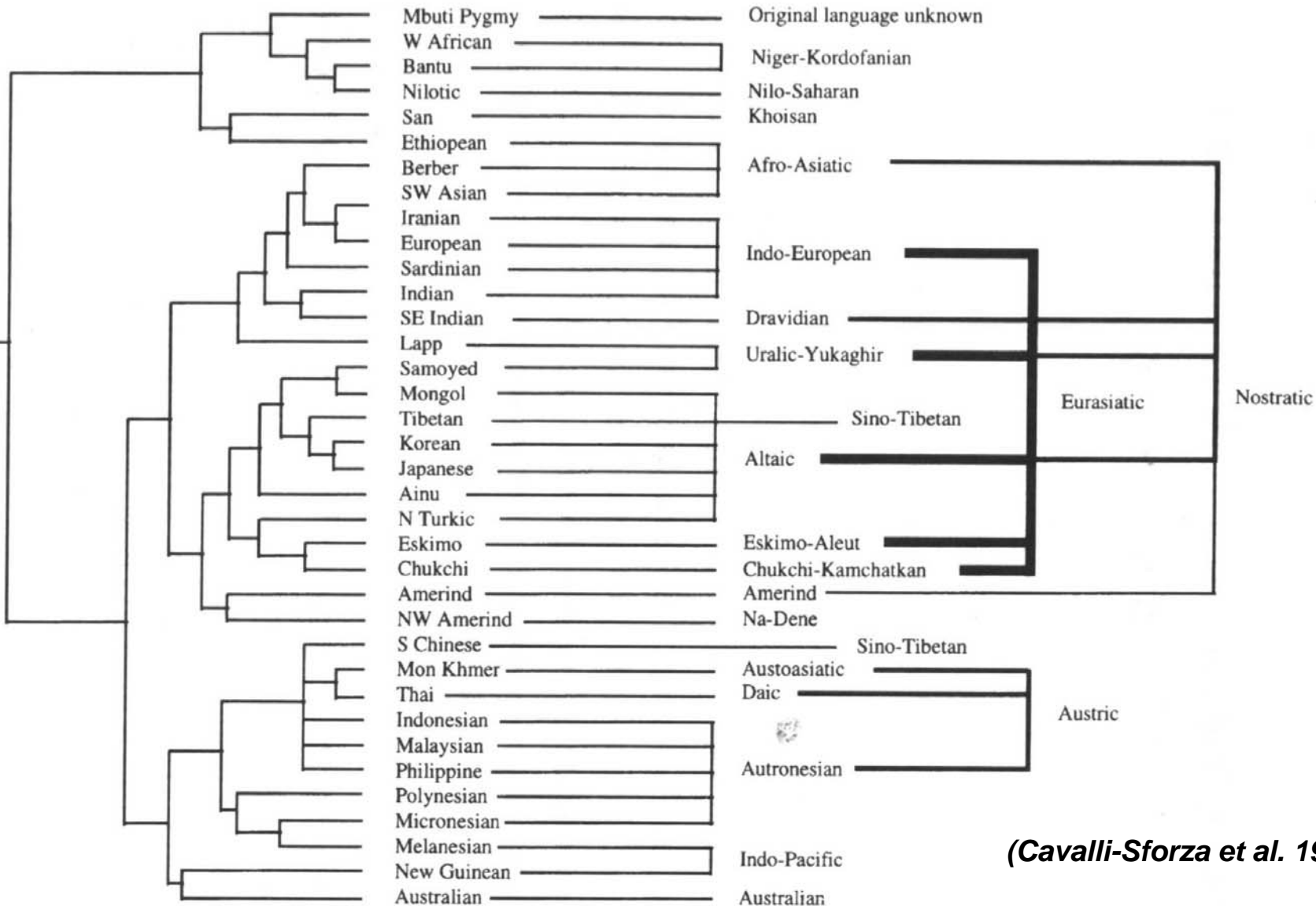
(Darwin, 1859)



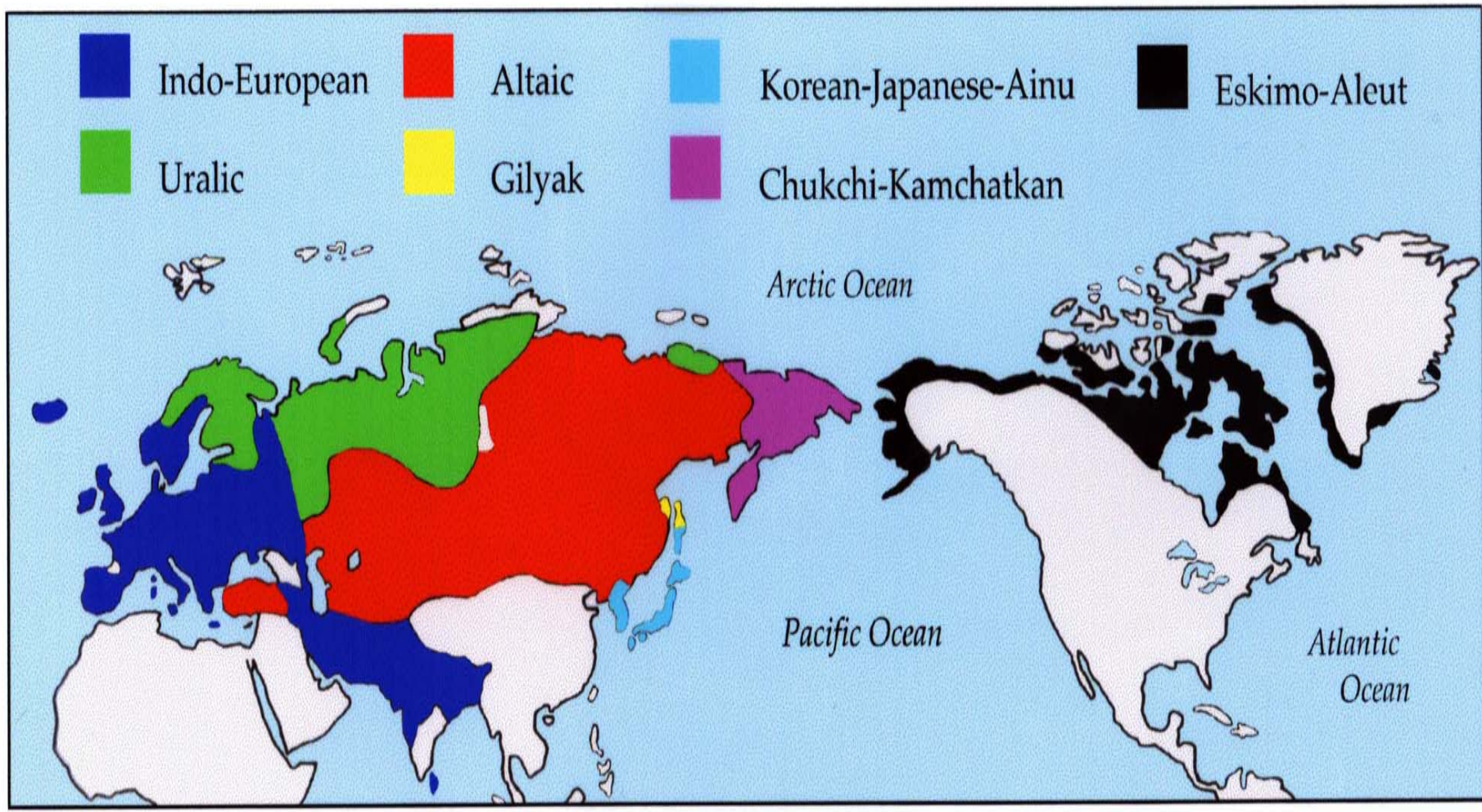
GENETIC TREE

POPULATIONS

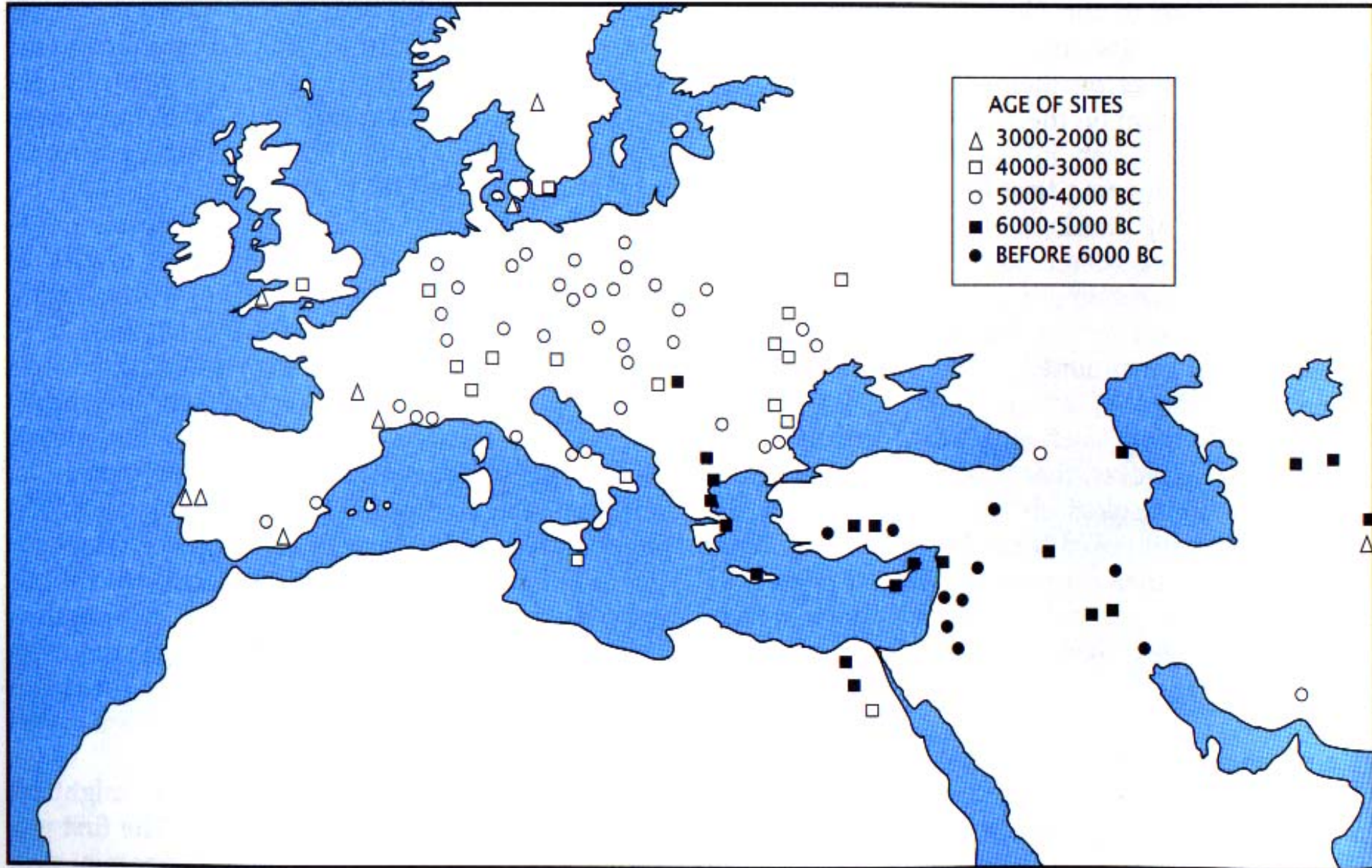
LINGUISTIC FAMILIES

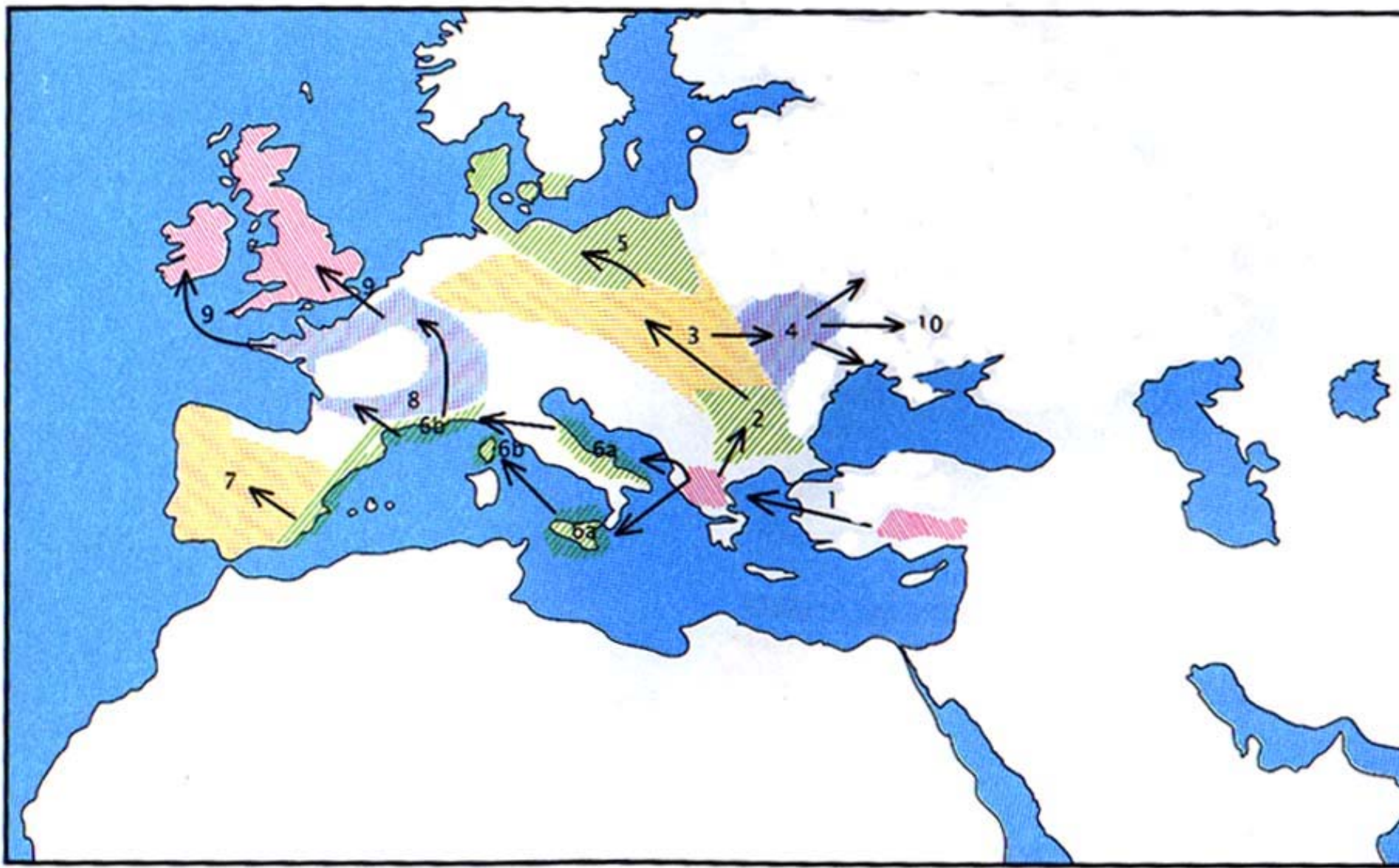


(Cavalli-Sforza et al. 1988)



The Eurasiatic Family





Words for integers in some Indo-European languages.
from C.Renfrew 1989.

ENGLISH	GOTHIC	LATIN	GREEK	SANSKRIT	JAPANESE
ONE	AJNS	UNUS	HEIS	EKAS	HITOTSU
TWO	TWAI	DUO	DUŌ	DVĀ	FUTATSU
THREE	THREIS	TRS	TREIS	TRAYAS	MITTSU
FOUR	FIDWOR	QUATTUOR	TETTARES	CATVĀRAS	YOTTSU
FIVE	FIMF	QUINQUE	PENTE	PANCA	ITSUTSU
SIX	SAIHS	SEX	HEKS	ṢAṬ	MUTTSU
SEVEN	SIBUN	SEPTEM	HEPTA	SAPTA	NANATSU
EIGHT	AHTAU	OCTO	OKTŌ	AṢṬĀ	YATSU
NINE	NIUN	NOVEM	ENNEA	NAVA	KOKONOTSU
TEN	TAIHUN	DECEM	DEKA	DAŚA	TO

<i>Integer</i>	<i>English</i>	<i>Gothic</i>	<i>Latin</i>	<i>Greek</i>	<i>Sanskrit</i>
two, ten	t-	t-	d-	d-	d-
three	th-	th-	t-	t-	t-
eight, ten	‘gh’	-h-	-k-	-k-	-s-
six, seven	s-	s-	s-	h-	s-

Some Indo-European Correspondences in Integers

Grimm's Law: PIE > Germanic

bh > b

b > p

p > f

dh > d

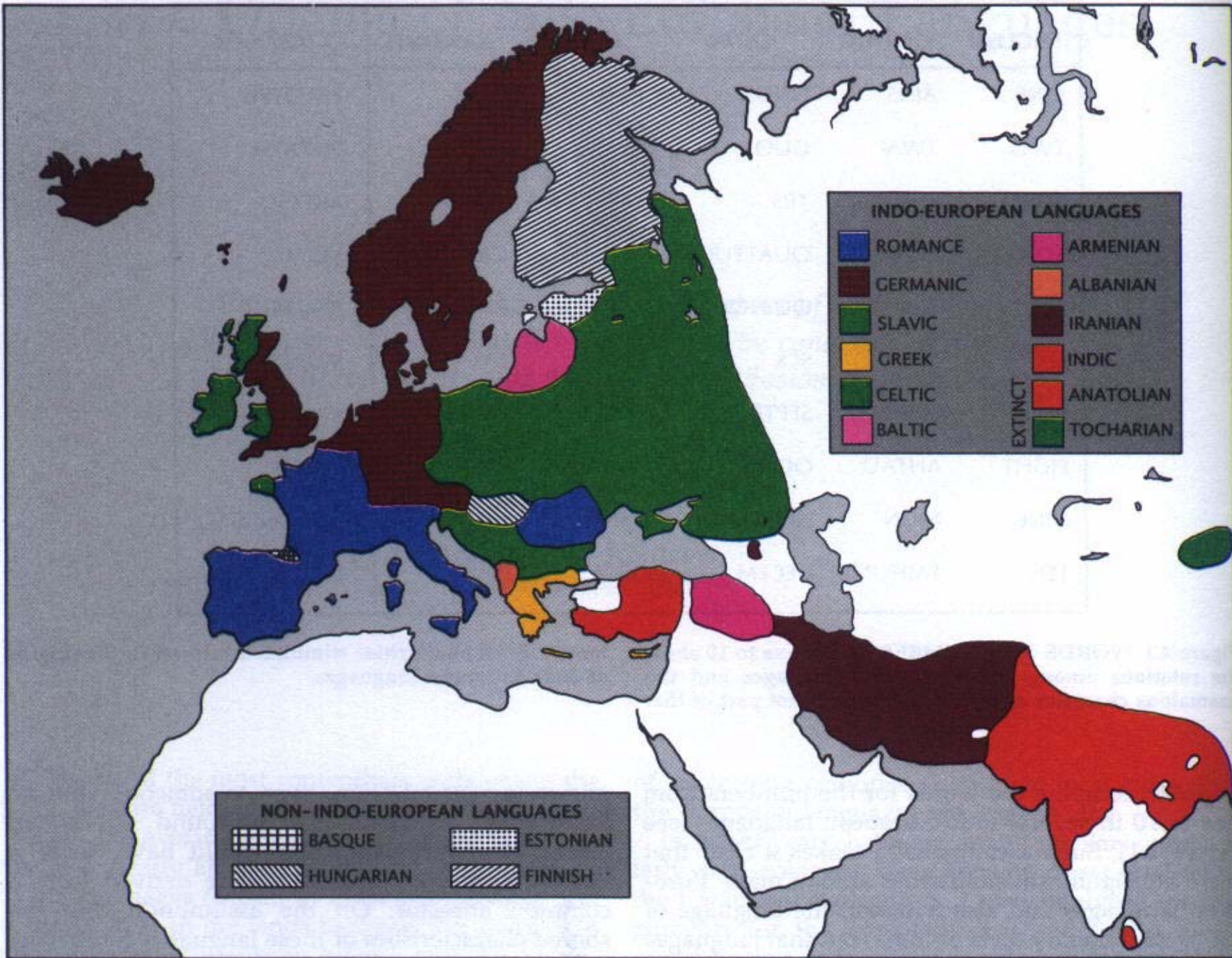
d > t

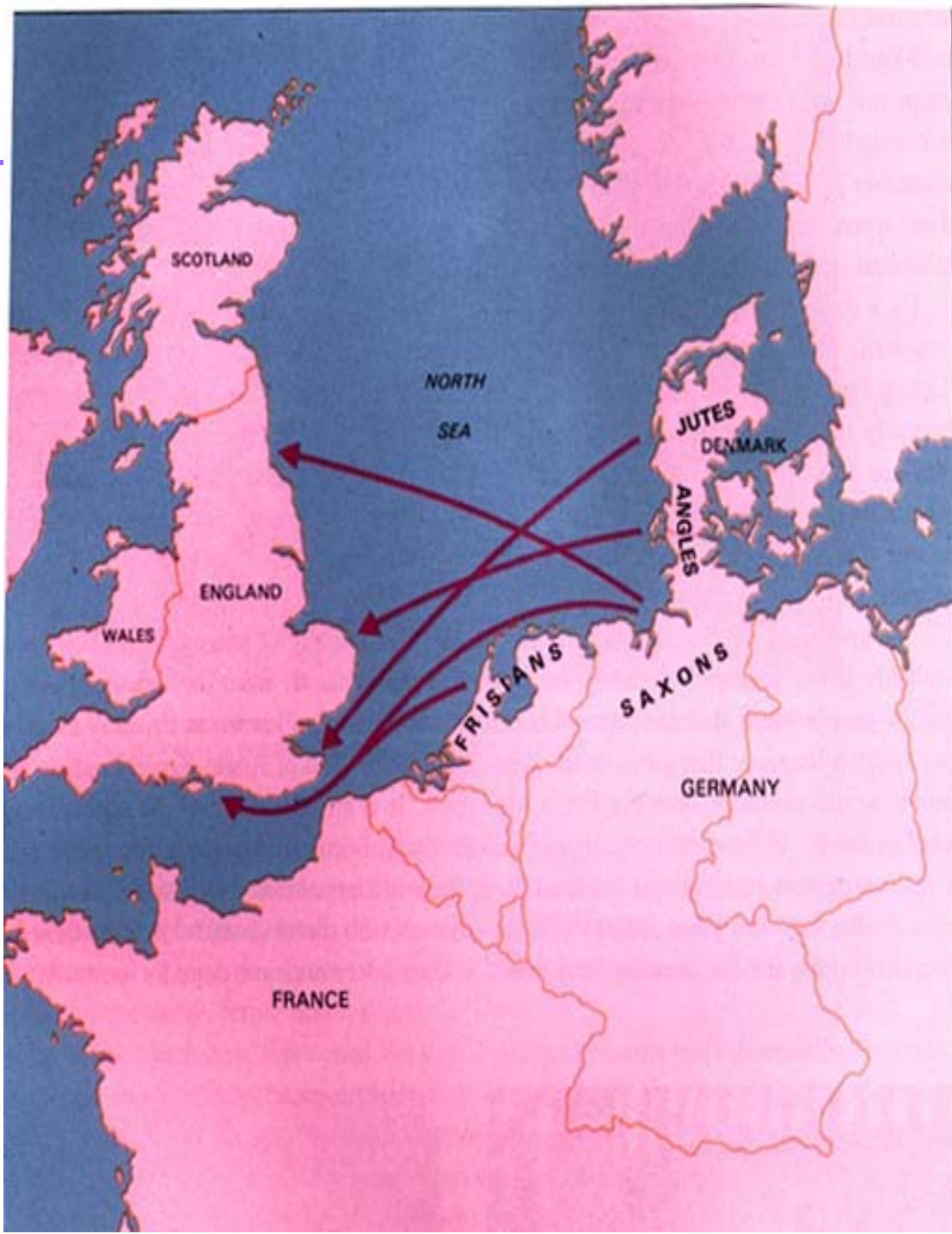
t > th

gh > g

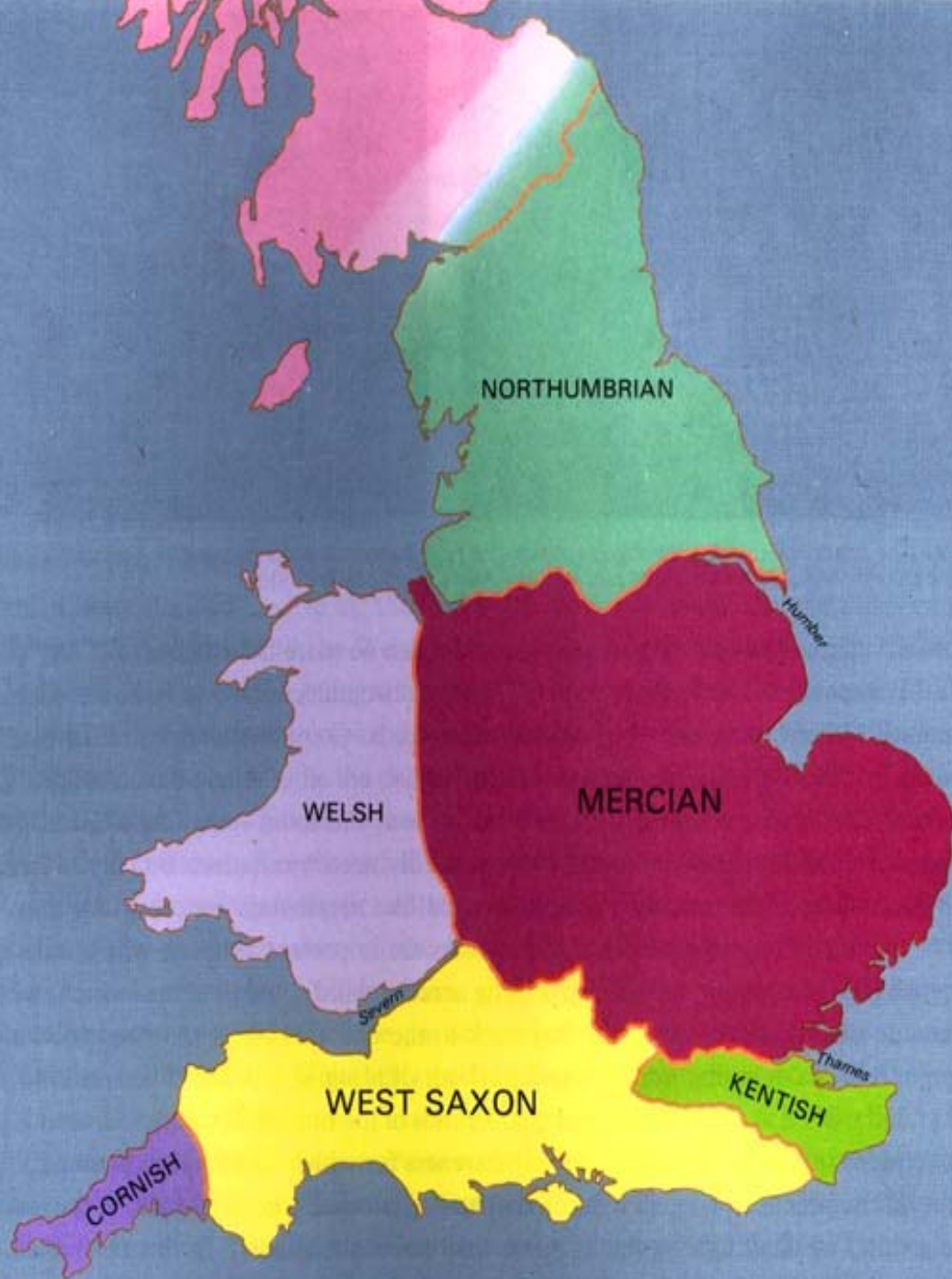
g > k

k > h





Settlement of Britain by Germanic tribes

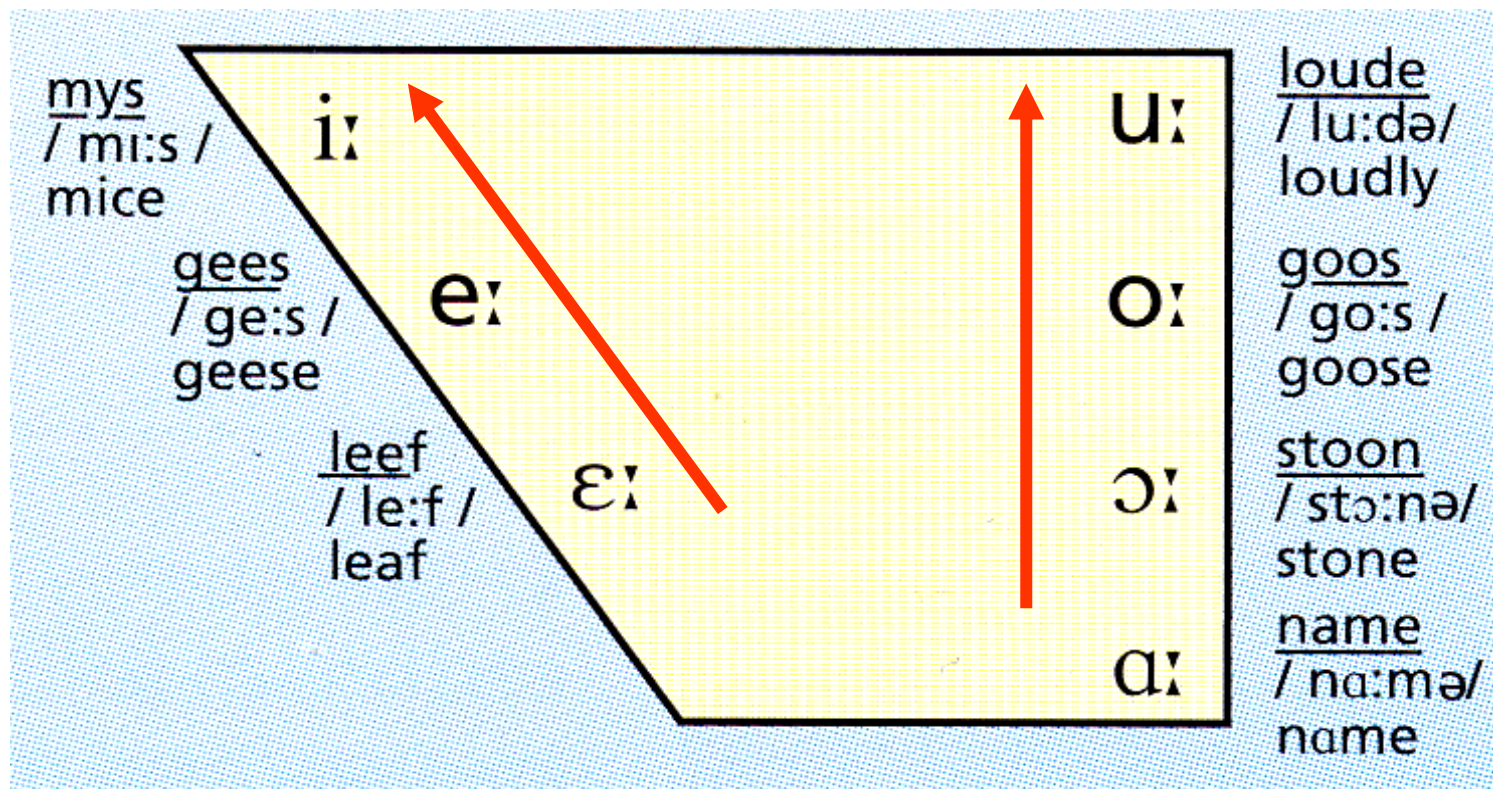


Varieties of Old English (Anglo-Saxon)

Language Change

Fæder ure, þu þe eart on heofonum, si þin nama gehalgod. To becume þin rice. Gewurpe ðin willa on eorðan swa swa on heofonum. Urne gedæghwamlican hlaf syle us to dæg. And forgyf us ure gyltas, swa swa we forgyfað urum gyltendum. And ne gelæd þu us costnunge, ac alys us of yfele.

Sound Change: The Great Vowel Shift



15th to 18th Century English, i.e., Middle English to Modern English

Vowel alternations in English

a > e

e > i

i > ai

sanity > sane

shepherd > sheep

hid > hide

gratitude > grateful

kept > keep

Christmas > Christ

opacity > opaque

serenity > serene

divinity > divine

tabular > table

obscenity > obscene

linear > line

chastity > chaste

leapt > leap

fifth > five

Wang, W.S-Y. 1968. Vowel features, paired variables and the English vowel shift.

Language 44.695-708.

Reprinted in *Essays on the Sound Pattern of English* 377-94.

D.L. Goyvaerts & G.K. Pullum eds. Ghent 1975.

Danish (16) : bark, big, cut, die, dirty, egg, hit, husband, leg, root, rotten, skin, sky, stick, they, wing.

French (12) : animal, because, count, dig, flower, fruit, take, mountain, push, river, turn, vomit.

S. M. Embleton, 1986.

Statistics in Historical Linguistics. Bochum

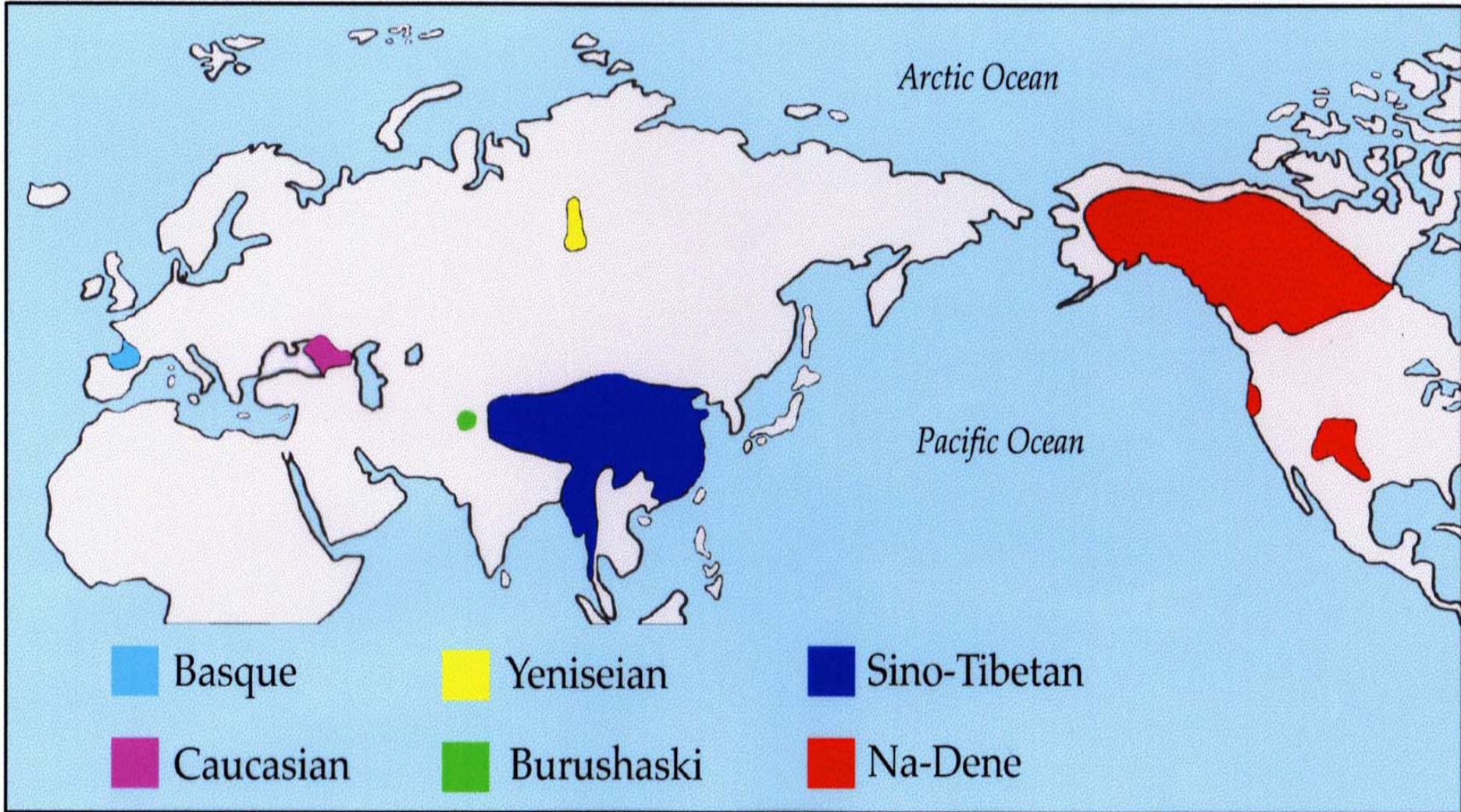


From Rev. Paul Freyburg.
Columbus, Ohio, 1963.

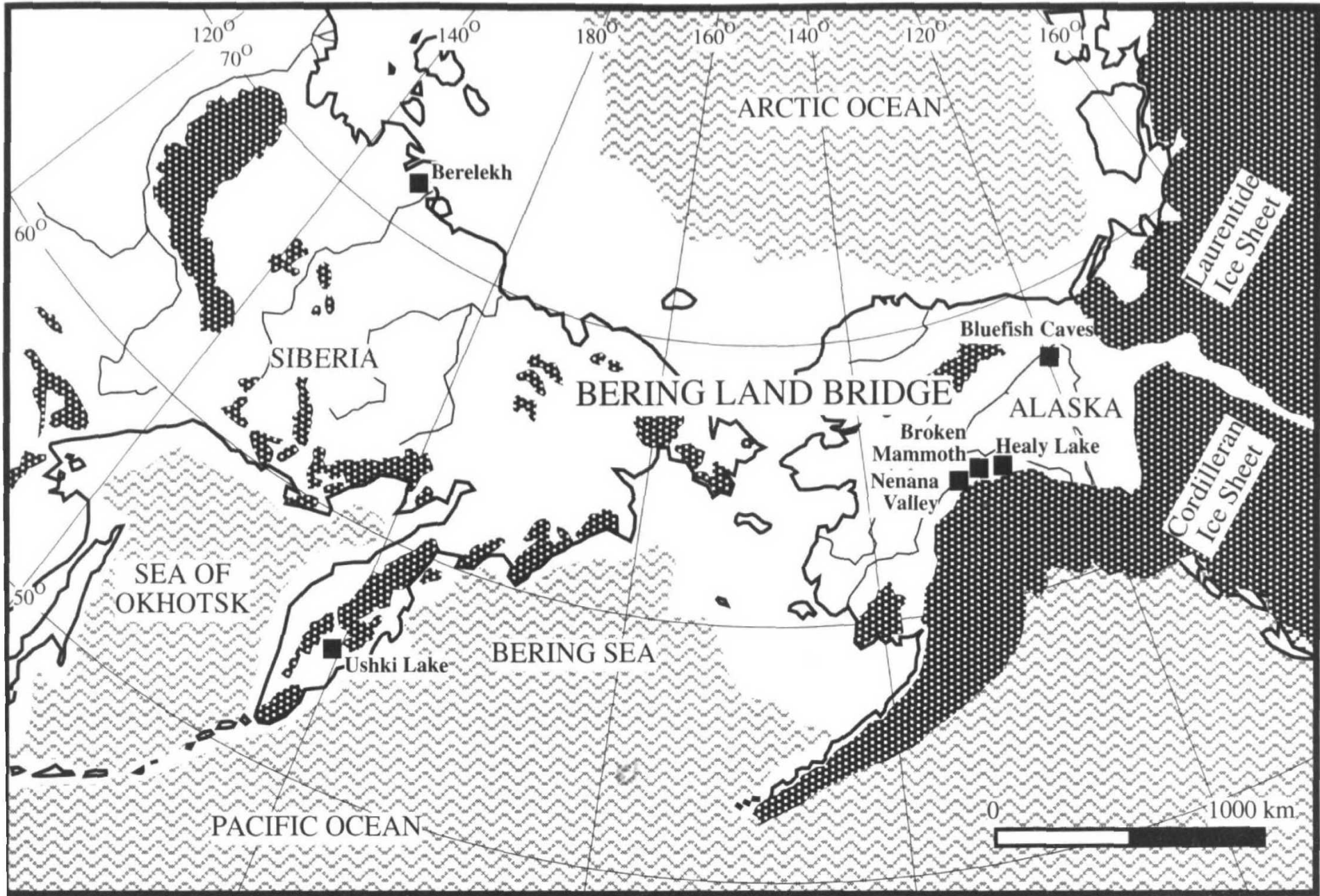
Tripela Liklik Pik

Bipo tru tripela liklik pik i stap. Ol i stap long bus tasol. Ol i no gat haus. Na i gat wanpela weldok tu em i stap long dispela bus. Em i bikpela moa, na em i nogut tru. ...

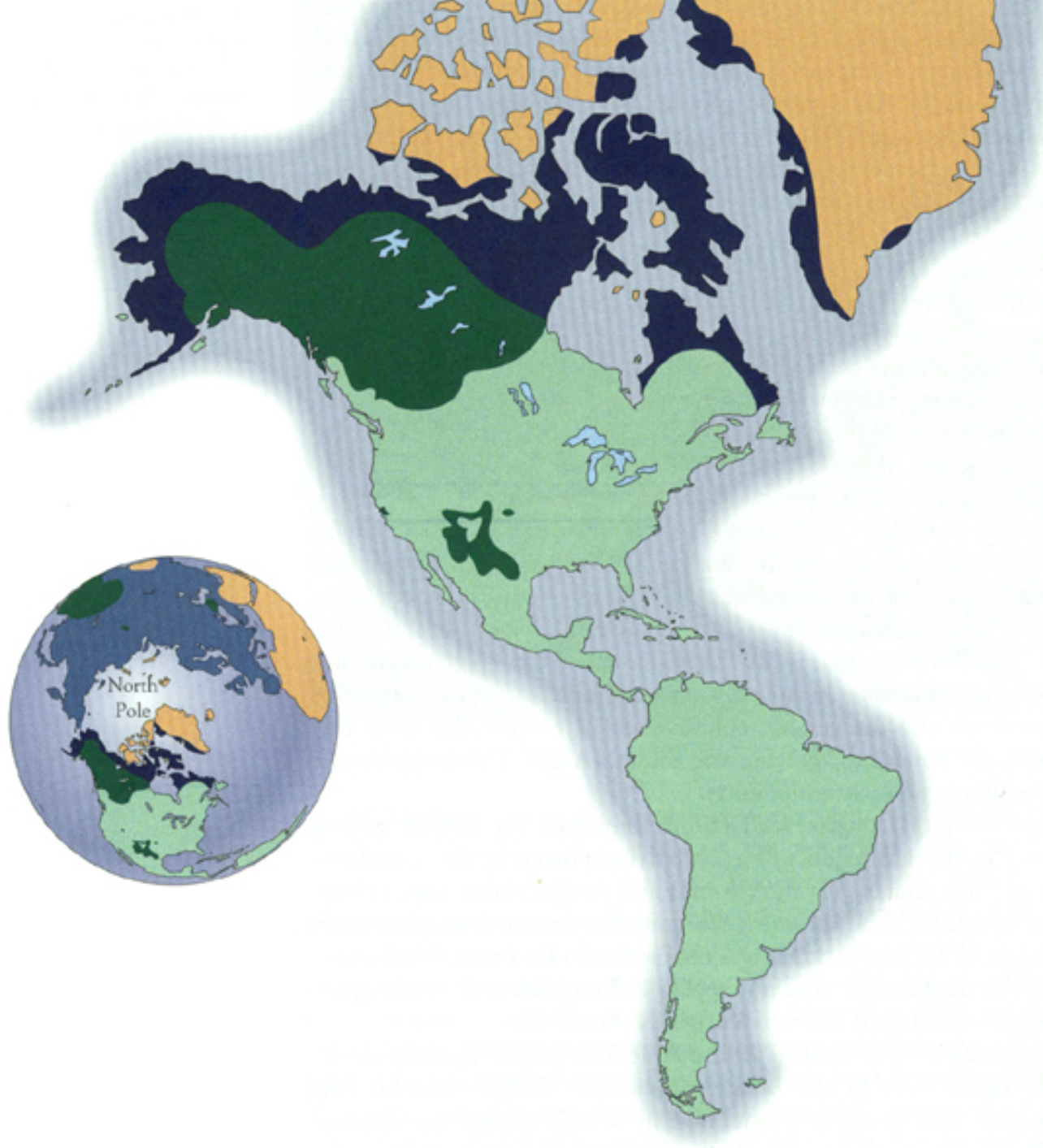
Orait tripela liklik pik ol i laik wokim haus. Ol i go nabaut wan wan na ol i laik painin samting bilong wokim haus. Wanpela em i wokabaut long rot na em i lukim wanpela man i karim kunai i kam. Orait pik i tok, "Pren, ating you ken givim me sampela kunai? Mi laik wokim haus." ...

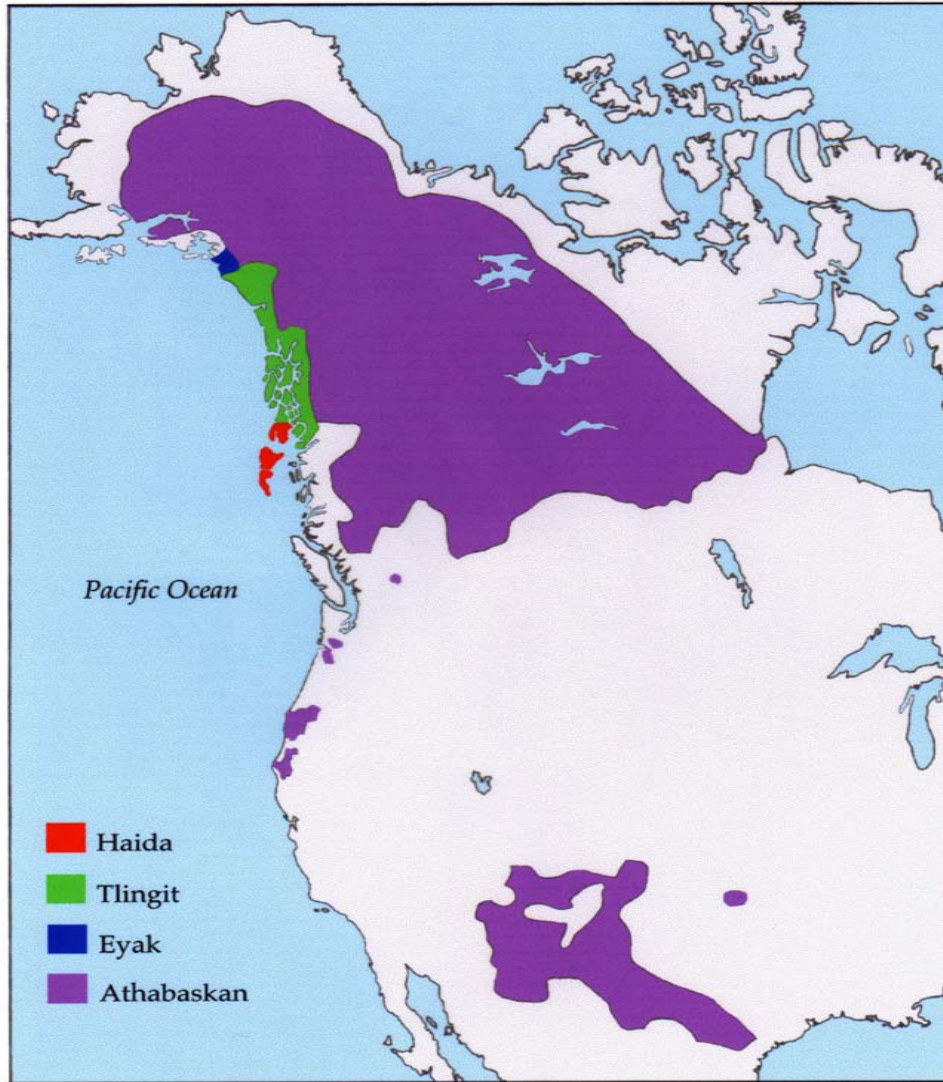


The Dene-Caucasian Family



Richard Klein. The Human Career.





The Na-Dene Family

Ruhlen, Merritt. 1998.

The origin of the Na-Dene. *Proc.Natl.Acad.Sci.USA* 95.13994-13996.

	Ket	Proto- Athabaskan
birch bark	qɨ'y	
birch tree		*q'əy

Postponement of glottal stop also occurs in the words for *stone, utensil, bow, and foot.*

*Wu, Xinzhi
& F.E.Poirier.*

Human Evolution in China.

*Oxford
University Press,
1995.*

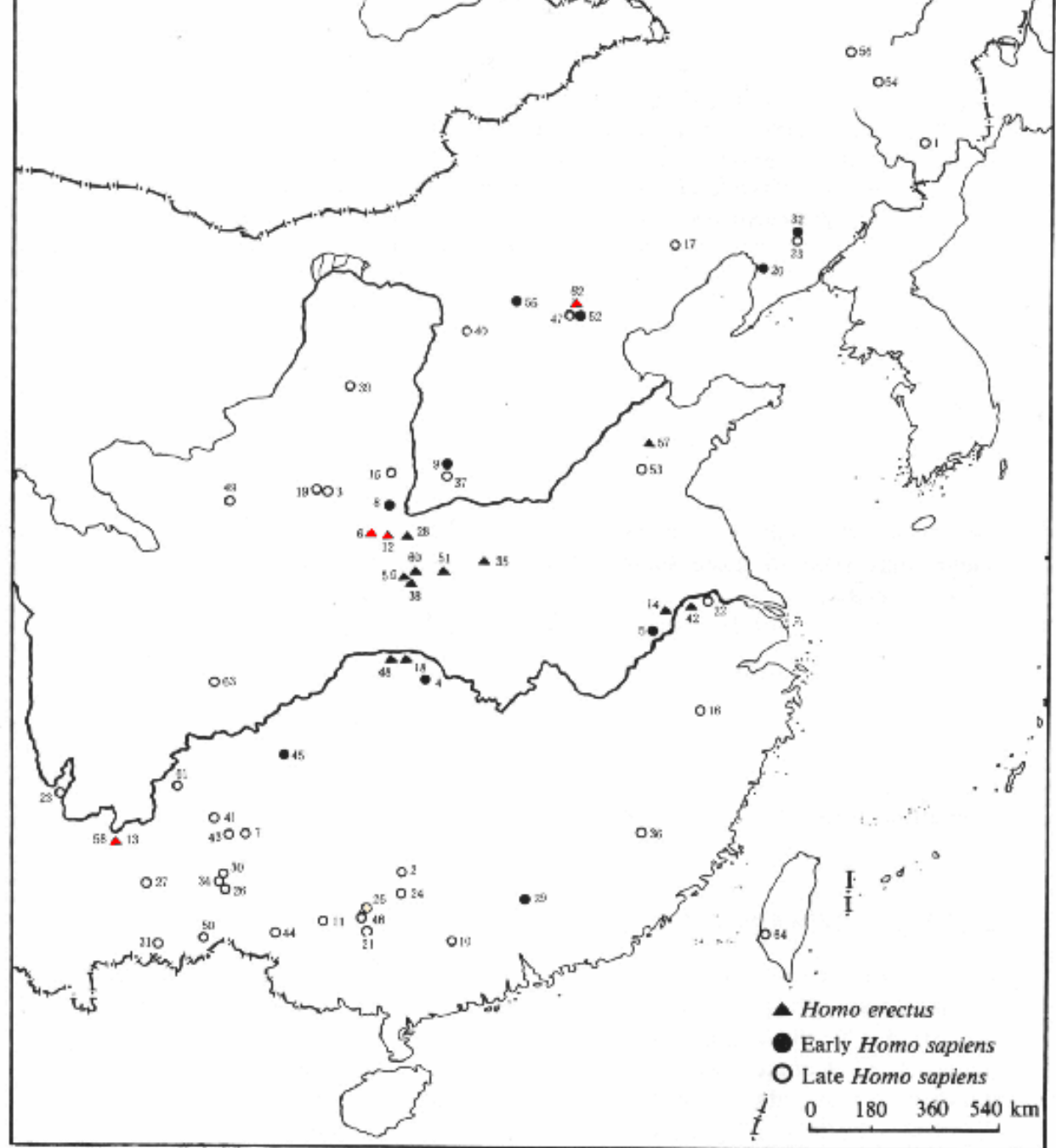
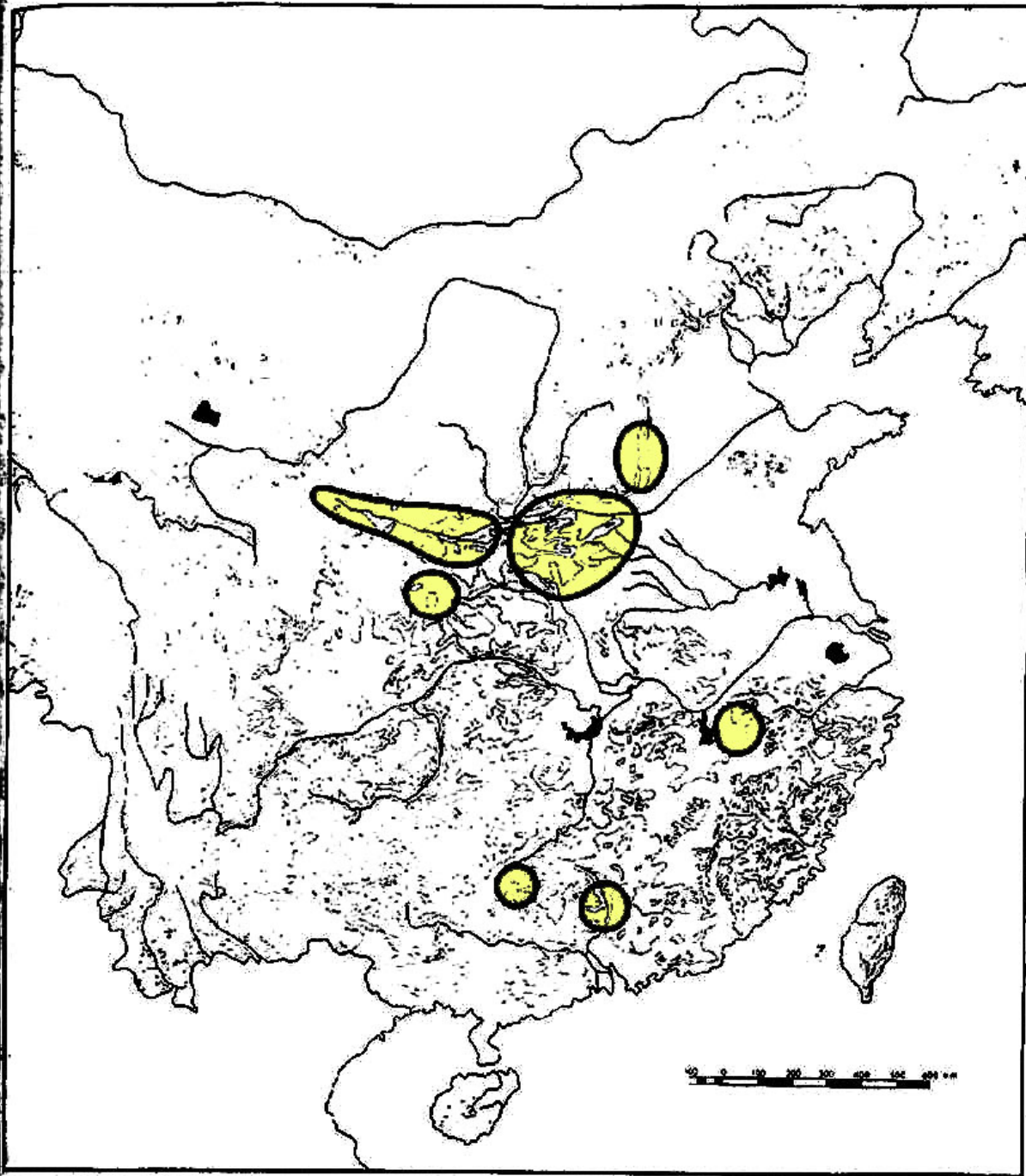


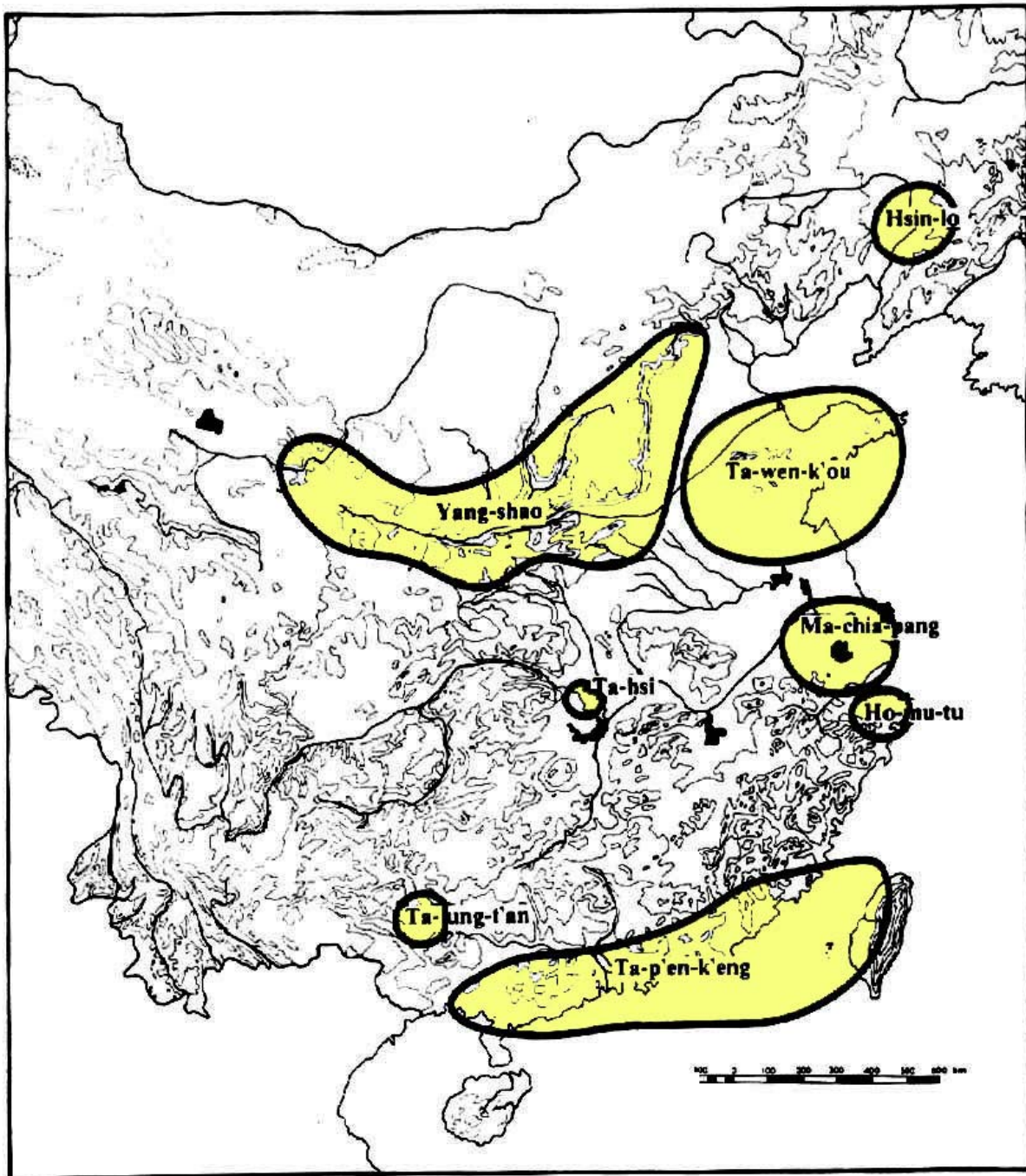
FIG. 1.1 Hominid locations in China.

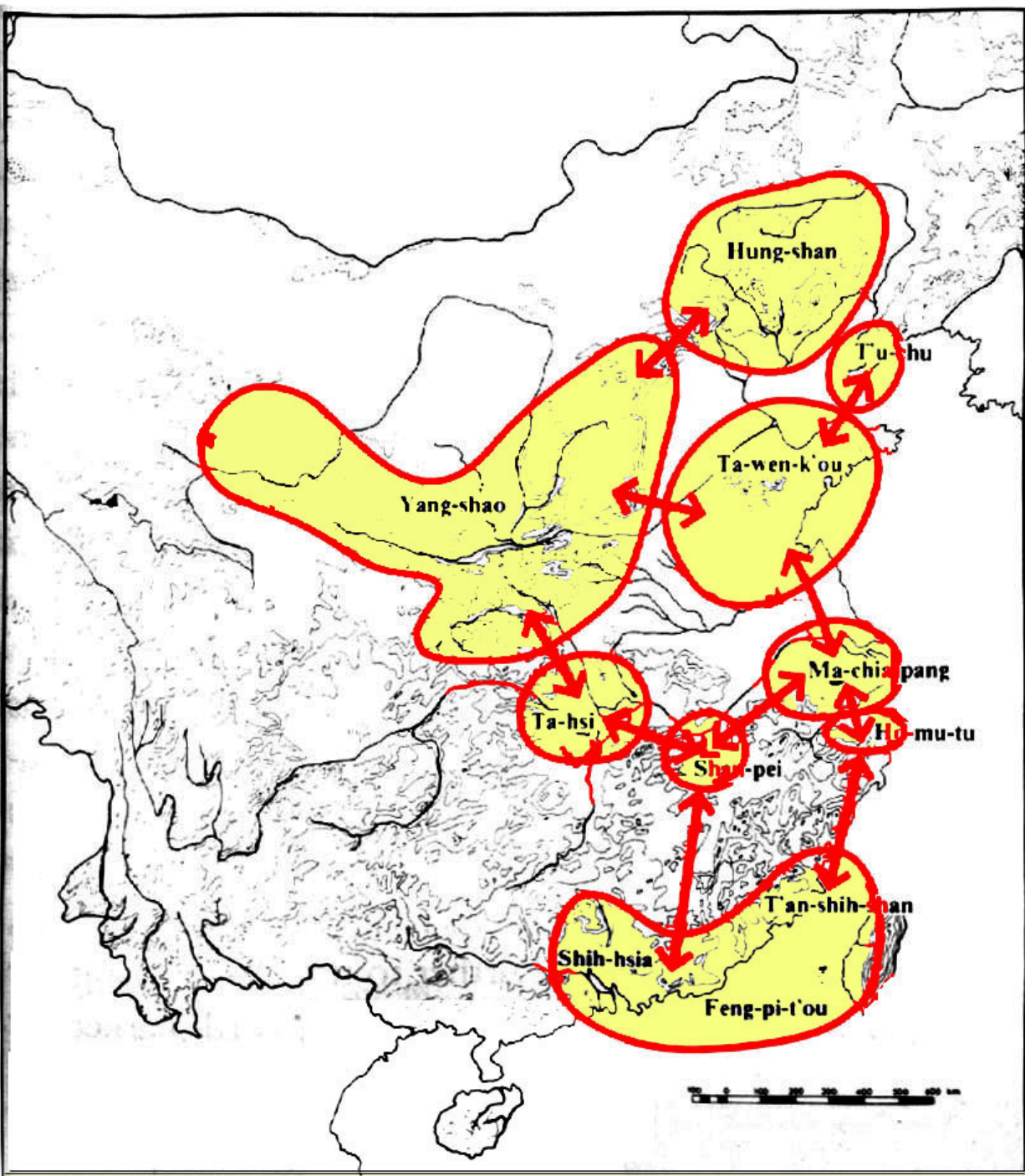


Chang, Kwang-chih. 1986.

The Archeology of Ancient China

Fourth Edition:
Yale University Press.

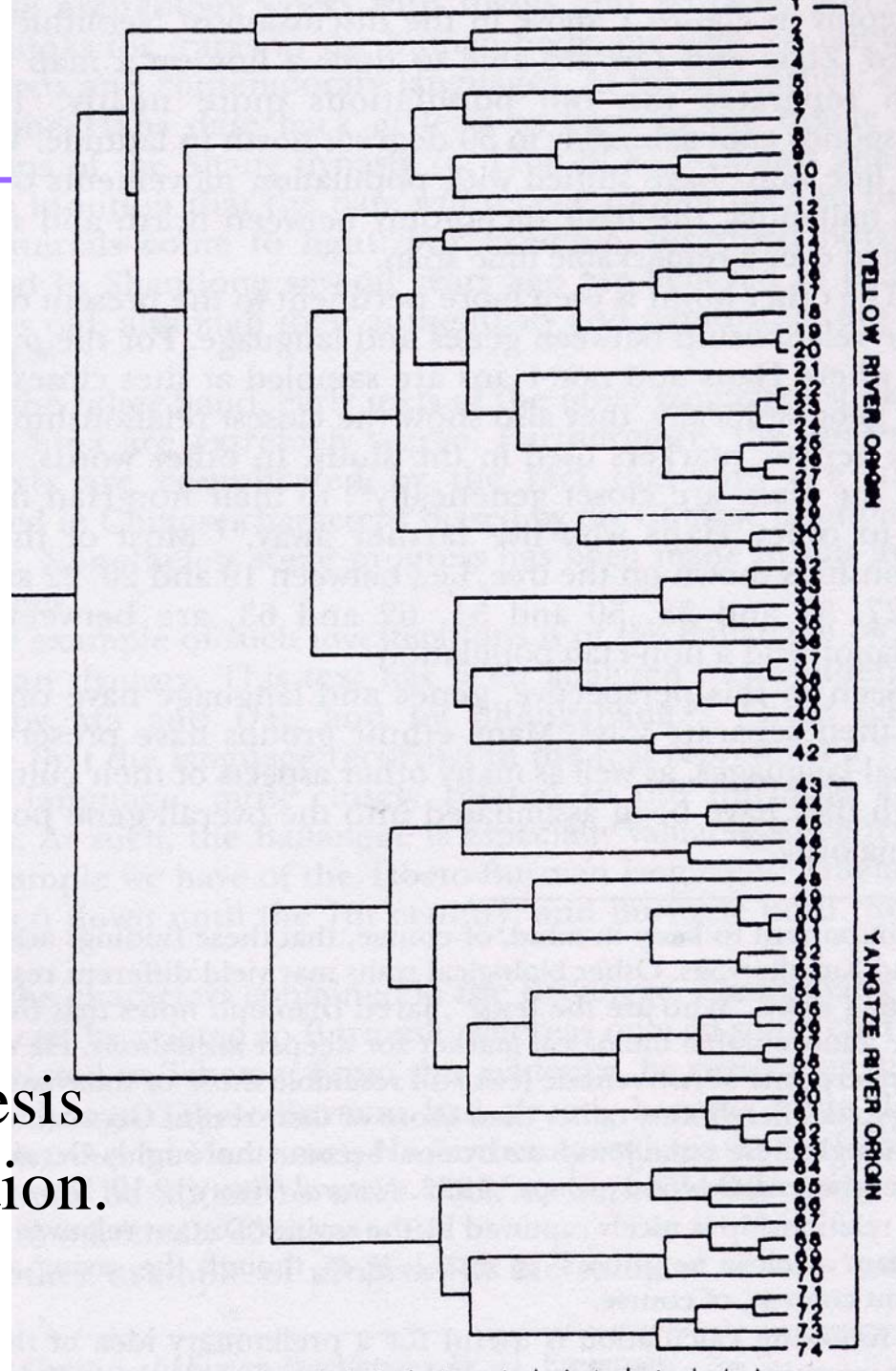


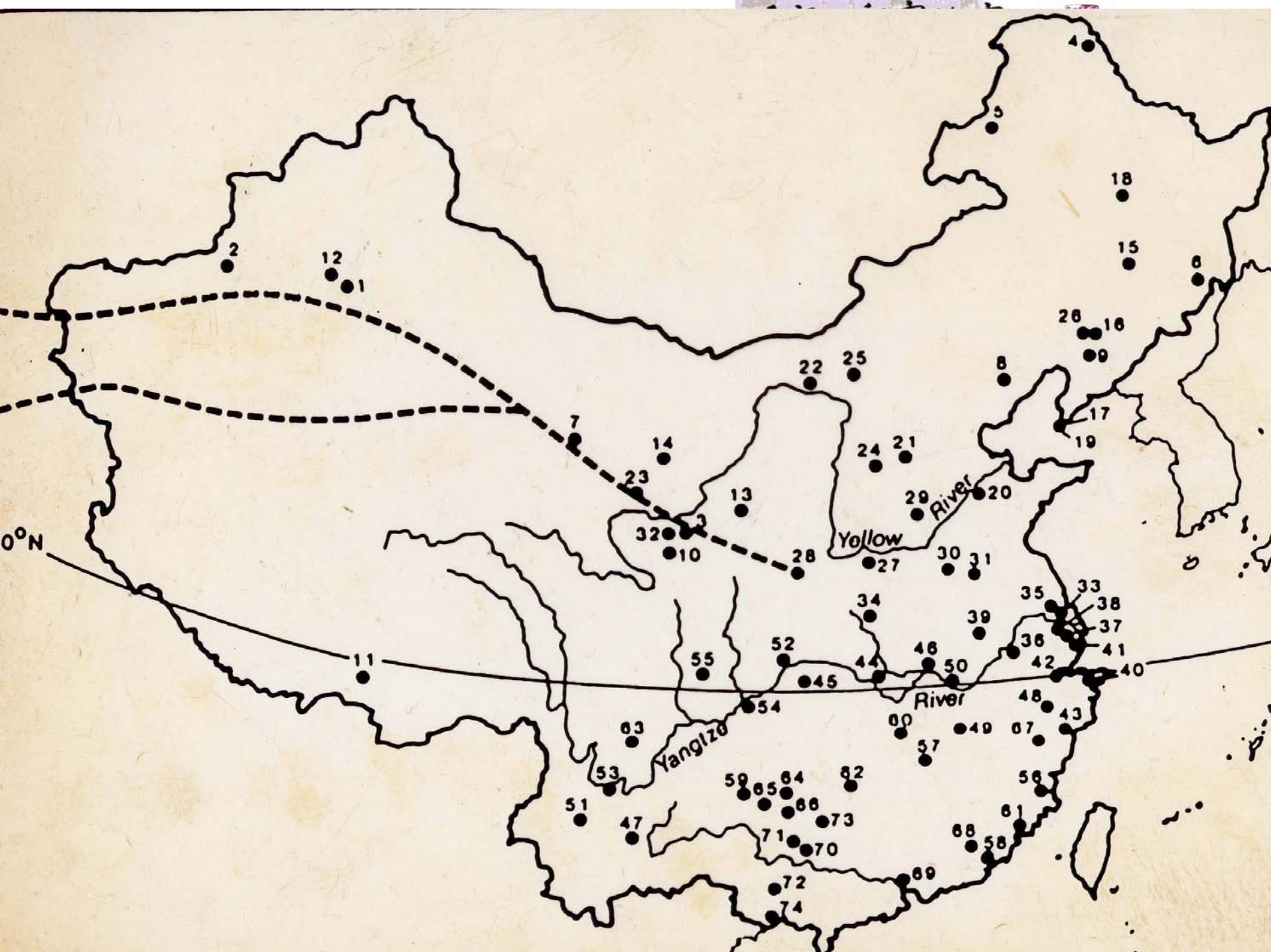


6000 B.P.

“Initial
China”
K.C.Chang

Zhao, T.M. & T.D.Lee. 1989.
Gm and Km allotypes in 74
Chinese populations: a hypothesis
of the origin of the Chinese nation.
Human Genetics 83.101-110.







1	ashes	belly	bird	bite	all	earth
2	bark	<i>blood</i>	claw	burn	big	<i>I</i>
3	cloud	<i>bone</i>	<i>dog</i>	come	black	<i>name</i>
4	<i>fire</i>	breast	feather	<i>die</i>	cold	night
5	leaf	<i>ear</i>	<i>fish</i>	drink	dry	not
6	man	<i>egg</i>	<i>horn</i>	eat	fat	<i>one</i>
7	<i>moon</i>	<i>eye</i>	<i>louse</i>	fly	<i>full</i>	road
8	mountain	foot	<i>tail</i>	<i>give</i>	good	
9	person	hair		hear	green	that
10	rain	<i>hand</i>		kill	long	<i>this</i>
11	root	head		<i>know</i>	many	<i>thou</i>
12	sand	heart		lie	<i>new</i>	<i>two</i>
13	seed	knee		say	red	we
14	smoke	liver		see	round	<i>what</i>
15	star	meat		sit	small	<i>who</i>
16	<i>stone</i>	mouth		sleep	warm	
17	<i>sun</i>	neck		stand	white	
18	tree	<i>nose</i>		swim	yellow	
19	<i>water</i>	skin		walk		
20	woman	<i>tongue</i>				
21		<i>tooth</i>				
	<i>salt</i>					100
	<i>wind</i>				<i>year</i>	
7	9	5	3	2	9	35

Basic meanings

according to

M. Swadesh &

S. Yakhontov.

S. Starostin, 1995.

	OC	PTB	PNC	PY	PIE
Old Chinese					
Proto-Tibeto-Burman	74				
Proto-North-Caucasian	43	51			
Proto-Yenisseian	34	40	57		
Proto-Indo-European	23	14	17	11	
Proto-Austronesian	14	11	11	11	14

Wang, W.S-Y. (ed.) 1995. *The Ancestry of the Chinese Language*
Journal of Chinese Linguistics Monograph No.8.

Chinese translation: 2005. 李葆嘉主譯. 漢語的祖先. 681 pages. 北京: 中華書局.

	GZ	BJ	SH	XM	Japanese
1	jat ^{IVu}	yi ^{Iu}	yi? ^{IVu}	tsit ^{IVv}	ichi
2	ji ^{IIIv}	er ^{III}	ni ^{IIIv}	li ^{IIIv}	ni
3	saam ^{Iu}	san ^{Iu}	se ^{Iu}	sã ^{Iu}	san
4	sei ^{IIIu}	si ^{III}	si ^{IIIu}	si ^{IIIu}	shi
5	ng > m ^{IIv}	wu ^{II}	ng ^{IIv}	go ^{IIIv}	go
6	luk ^{IVv}	liu ^{III}	lu? ^{IVv}	lak ^{IVv}	roku
10	sap ^{IVv}	shi ^{Iv}	ze? ^{IVv}	tsap ^{IVv}	ju

Cognate percentages for basic words.

based on Xu, 1991.

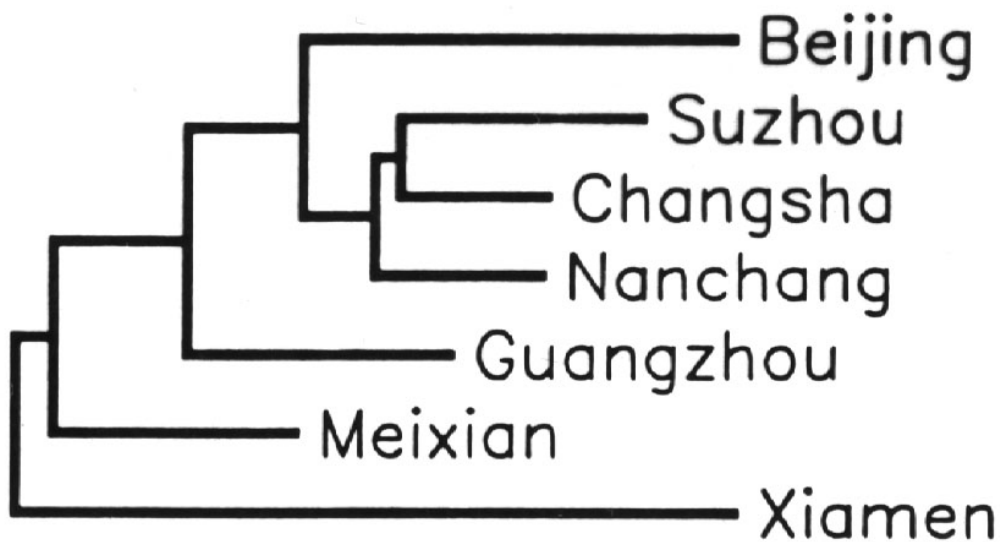
	BJ	SZ	CS	NC	MX	GZ
Suzhou	73					
Changsha	79	86				
Nanchang	76	84	88			
Meixian	69	73	72	77		
Guangzhou	74	77	76	78	79	
Xiamen	56	59	61	64	68	63

Cognate percentages for basic words.

based on Dyen, Kruskal and Black 1992.

	E	G	Sw	Fr	Sp	It
German	58					
Swedish	59	70				
French	24	24	24			
Spanish	24	25	25	73		
Italian	25	27	26	80	79	
Russian	24	25	25	22	23	24

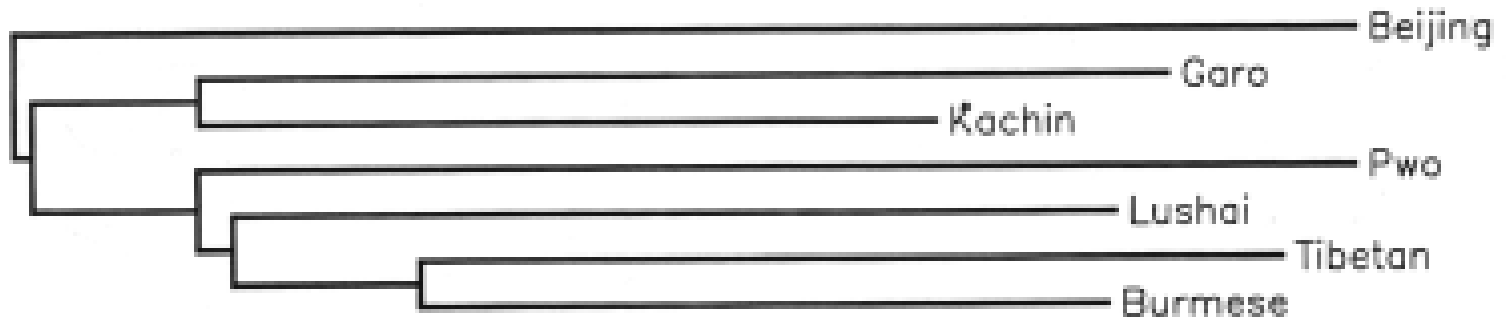
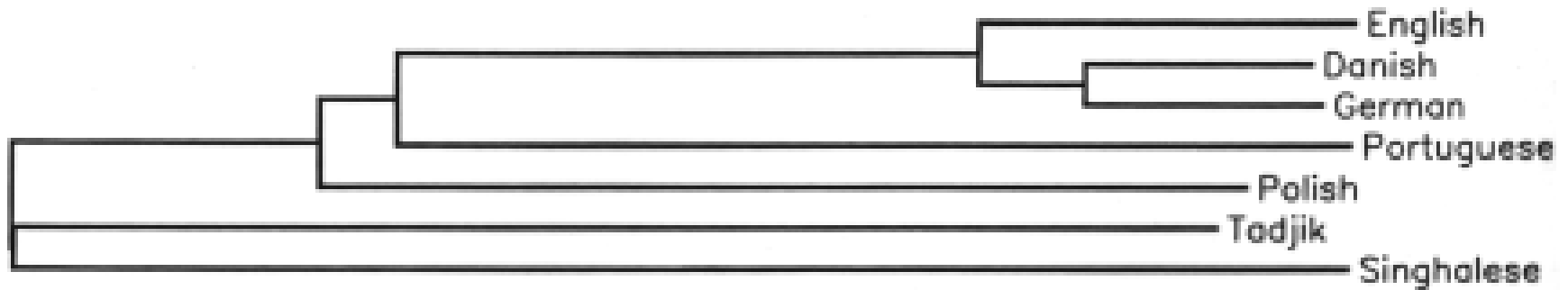
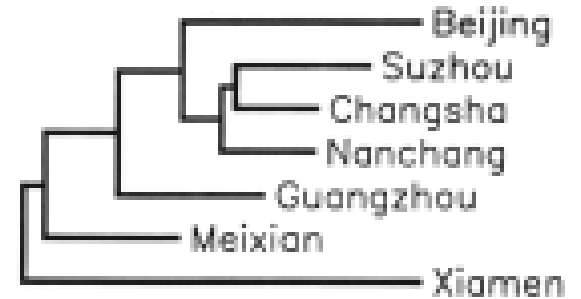
*Wang, William S-Y. 1998. Three windows on the past.
p.530 in The Bronze Age and Early Iron Age Peoples of
Eastern Central Asia. U.Pennsylvania Museum Publications.*



Wang, W.S-Y. 1998.

Three windows on the past.

Pp.508-534 in V.H.Mair, ed.



錢大昕 1728-1804.

“如伏羲即庖羲 ...凡今人所謂輕唇者，漢魏以前，皆讀重唇，知輕唇之非古矣。”

f	b/p
方	旁, 滂
分	貧, 盼
非	排, 悲
反	板, 扳

	普通話	閩語
房	fang	pang
分	fen	pun
痲	fei	pui
飯	fan	png

Cl-cluster in Old Chinese

kl-	pl-
京：涼	龐：龍
見：覽	剝：祿
柬：蘭	變：戀
儉：臉	sl-
監：藍	灑：麗
各：路	數：摟

Chinese Japanese

Vng=o:

wang	王	o:	hu	壺	ko	h :: k
yang	陽	yo:	he	鶴	kaku	
lang	浪	ro:	hei	黑	koku	
mang	盲	mo:	hai	海	kai	
fang	方	ho:	hua	花	ka	
kong	孔	ko:	hua	滑	kotsu	
dong	東	to:	huo	活	katsu	
song	宋	so:	han	漢	kan	
nong	農	no:	hun	婚	kon	
ding	丁	cho:	huang	黃	ko:	
qing	情	jo:	xi	喜	ki	h > x
xing	星	sho:	xi	系	kei	
ming	命	myo:	xiu	休	kyu:	
ling	嶺	ryo:	xin	欣	kin	
bing	冰	hyo:	xian	險	ken	
bing	病	byo:	xiang	向	ko:	

目加田 誠・唐詩散策 1979:102.

<p>千山鳥飛絶</p> <p>sen zan chou hi zetsu</p>	<p>千山 鳥飛ぶこと絶え</p> <p>sen zan tori tobu koto tae</p>
<p>萬徑人蹤滅</p> <p>ban kei jin shou metsu</p>	<p>万径 人蹤滅す</p> <p>ban kei jin shou messu</p>
<p>孤舟蓑笠翁</p> <p>ko shuu sa ryuu ou</p>	<p>孤舟 蓑笠の翁</p> <p>ko shuu sa ryuu no ou</p>
<p>獨釣寒江雪</p> <p>doku chou kan kou setsu</p>	<p>独り寒江の雪に釣る</p> <p>hitori kankou no yukini tsuru</p>

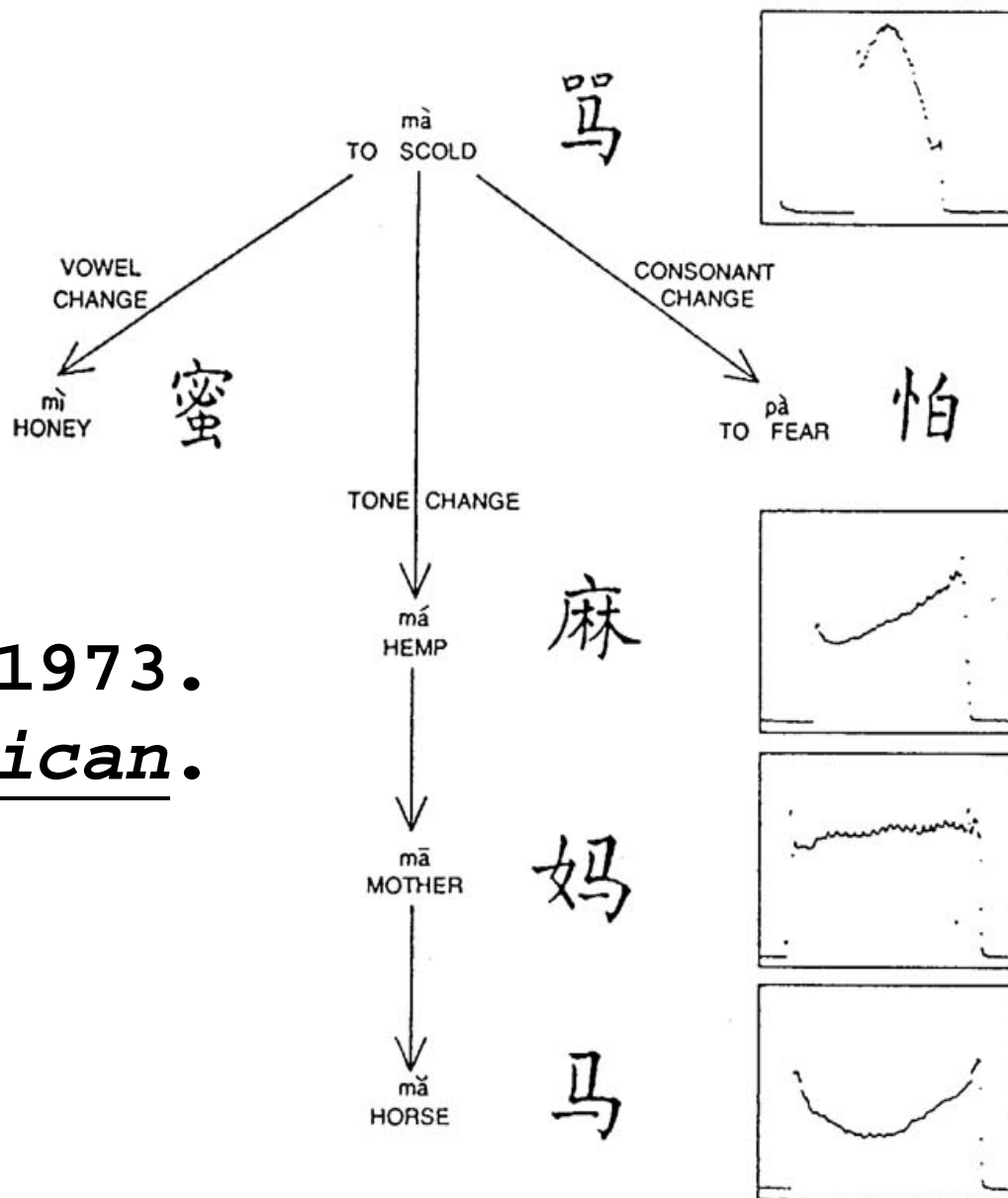
Lexical strata in Japanese

based on Shibatani 1987:133.

Meaning :	cancellation	detour	idea	acrobatics

wago : 和語	torikeshi	mawarimichi	omoitsuki	karuwaza
kango : 漢語	kaiyaku 解 約	ukairo 迂回路	chakusô 著 想	kyokugei 曲 藝
gairaigo : 外來語	kyanseru	baipasu	aidea	akurobatto

Chinese tones



W.S-Y.Wang.Feb.1973.
Scientific American.

	平	上	去	入
陰	詩 55	史 35	試 33	識 5 錫 3
陽	時 21	市 23	是 22	食 2

赵元任，语言问题。1980：149

施氏食狮史

石室诗士施氏，嗜狮，誓食十狮。氏时时
 适市视狮。十时，适十狮适市。是时，适
 施氏适市。氏视是十狮，恃矢势，使是十
 狮逝世。氏拾是十狮尸，适石室。石室
 湿，氏使侍拭石室。石室拭，氏始试食十
 狮尸。食时，始识是十狮尸，实十石狮尸。
 试释是事。

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 试释是事。

Language endangerment

Dao Hua (倒话)

- A creole language in Southwest Sichuan Prov., between the Tibetan area and Han area.
- Emerged 300 years ago during the invasion of Qing troops into Tibetan to suppress the minority riot.
- Influenced a lot by Southwest Mandarin (e.g., Lexicons) and Tibetan (e.g., Grammar).
- Now documented and studied by Endangered Languages Documentation and Preservation (ELDP).



Mixture of Mandarin and Tibetan in Dao Hua

- 马 骑 人 一 个 来了。
- **Horse ride man one MW come**
- 一 个 骑 马 的 人 来了。
- **one MW ride horse Pt man come Pt.**

- 他 -ki 茶 喝 -tsv⁴ - tsu⁴ - di- jiu³- li。
- **he (subject) tea drink (when is going to and not begin yet)**
- (他正要喝茶 (还没喝) 的时候)

Mixture in Linguistic components in Dao Hua

L: Language; **T:** Tibetan; **M:** Mandarin; **Z:** Dao hua

V: Vocabulary; **S:** Semantics;

Gc: Grammar (content); **Gf:** Grammar (form);

Ps: Phonology (Phonotactics); **Pe:** Phonology (Phonemes);

$$L(Z) = \{V(M), \{Gc(T), Gf(T\&M)\}, \{Ps(M), Pe(T)\}, S(T\&M)\}$$

Wang, W.S-Y. & C.F. Lien. 1993.

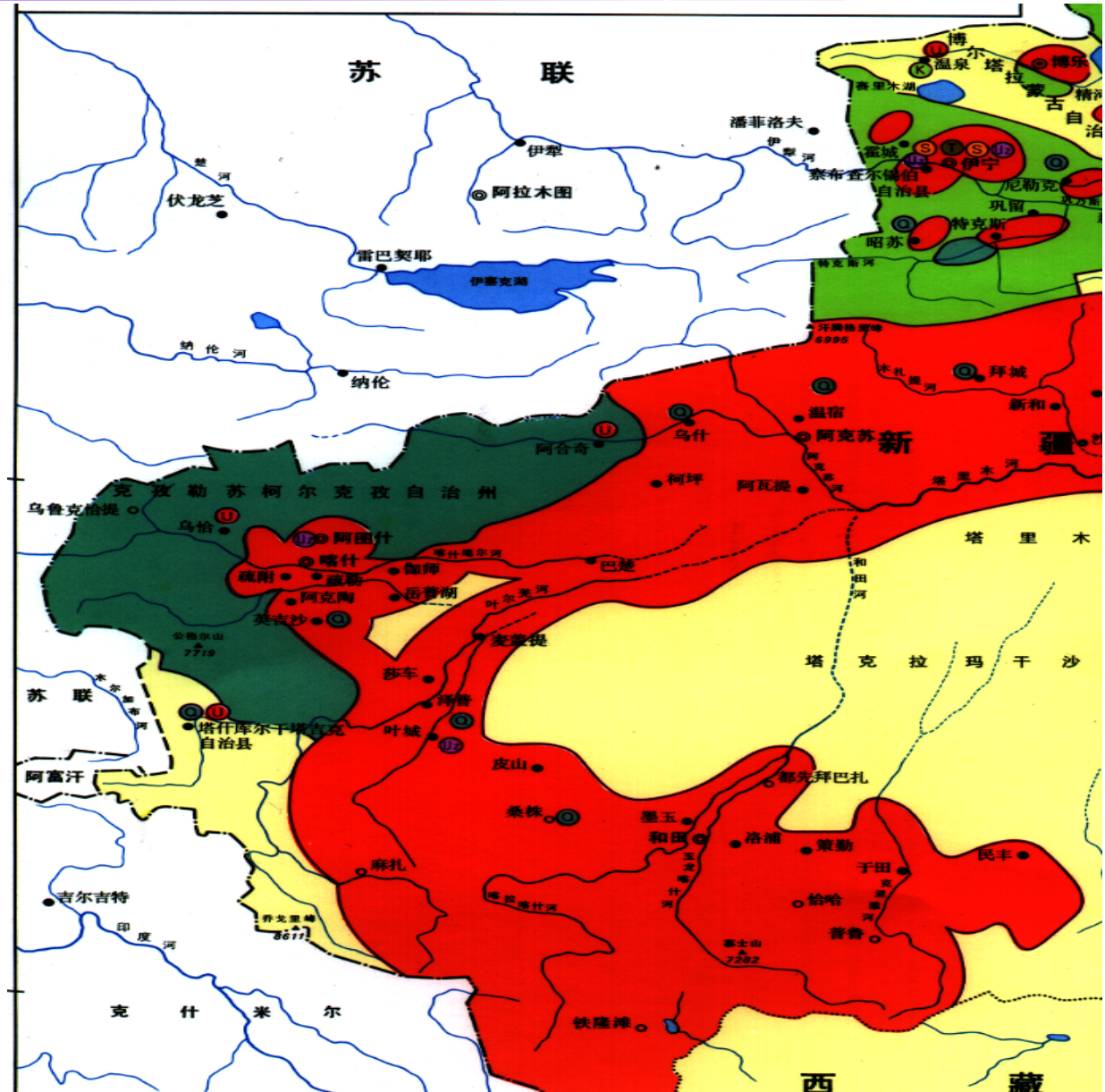
Bidirectional diffusion in sound change.

Historical Linguistics: Problems and Perspectives, ed. by C. Jones, 345-400.

	Initial	Final	Tone	Example
1	L	L	L	飼 su 2b 'to feed'
2	C	C	C	誓 tsua 3b 'oath'
3	C	L	L	鬧 nãu 2b 'noisy'
4	L	C	C	露 lou 3b 'dew'
5	L	C	L	露 lou 2b 'dew'
6	C	L	C	謝 tsia 3b 'thank'
7	C	C	L	量 niõ 2b 'quantity'
8	L	L	C	誓 si 3b 'oath'



Husmann, L.E. & W.S-Y. Wang. 1991.
Ethnolinguistic notes on the Dungan. Sino-Platonic Papers 27.71-84.



М. Х. ИМАЗОВ

ХУЭЙЗҮ
ЙҮЯН

4

东干语课本

Husmann, L.E. & W.S-Y. Wang. 1991.
Ethnolinguistic notes on the Dungan.
Sino-Platonic Papers 27.71-84.

Лёнгэ ляншу.

Лёнгэ ляншу зэ фулинни зудилэ. Мынмынди чўлэ-лигэ щүн. Йигэ подичи шонли фу, чёнхали. Ди эргэ мэ дунтан. Мэ форли, та пахали, жуончын сыжынли.

Щүн до гынчян вынтуэ, та чи ду бу чўли. Щүн ба тади лян вынлихар, дончын сыдёли, зугуэли.

Щүн зудё, нэгэ да фушон халэ, щётуэли: «Щүн ги ни зэ эрдуэшон чёчёр фэ сали?» Ди эргэ хуэйдади: «Щүн фэсы, ю бу хо жыни, таму до зуэнанчўр, ба ляншуму лёха, пони».

(Л. Н. Толстой).



Нян жян, эр лён.

Сангэ южуанжя зудо савэнили. Жужу-виви мэю фужы-цомё. Ячё-ловади йинщён ду бу жян. Гуонсы