

A Study on Special Sounds in Bunun, Taiwan and  
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Contribution of Bunun's "Glottal Affricates"  
research to human evolutionary studies

メタデータ	言語: English 出版者: 静岡大学言語学研究会 公開日: 2024-03-28 キーワード (Ja): キーワード (En): Glottal Affricate, Bunun, Non-pulmonic airflow pronunciation, Starchy food eating, Tongue evolution 作成者: 森口, 恒一 メールアドレス: 所属:
URL	<a href="https://doi.org/10.14945/0002000500">https://doi.org/10.14945/0002000500</a>

# A Study on Special Sounds in Bunun, Taiwan and a Hypothesis of Human Language Development

— Contribution of Bunun’s “Glottal Affricates” research  
to human evolutionary studies —

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**Keywords :** Glottal Affricate, Bunun, Non-pulmonic airflow pronunciation,  
Starchy food eating, Tongue evolution

This paper focuses on the characteristic sounds of the Bunun language in Taiwan: “Glottal (Plosive/Stop) Affricates” discussed in [Moriguchi(2022a)], assuming that the sounds in Bunun are holdovers of the pronunciations of the ancient human beings, and examines its position in the process of human language acquisition from an evolutionary anthropological perspective.

## Introduction

In linguistics, there are two perspectives: relative elements (characteristics of individual languages) and universal elements (or linguistic abilities common to all human beings). Currently, the meta-substratum behind individual linguistic phenomena and the pursuit of universality are the main trends. As a method, although it pursues universal rules, it is the description and analysis of individual linguistic phenomena that play an important role.

The first feature, which is vocabulary, is completely based on linguistic relativity. It is a combination/signification of meaning and sounds and what is considered universal is simply “coincidence” or “symbolization”.

Next, regarding grammatical aspect, if we pay attention to its regularity, the clear universal regularity appears. That is “typology”. And [Moriguchi (2022b)]

revealed that typological (grammatical) differences are based on occupational rules backed by livelihoods.<sup>1</sup>

The third characteristic is the speech sounds. As [Trubetzkoy(1939)] and his successors write, the universality of speech sound can be analyzed in the form of a “bundle” of multiple elements of human articulatory organs and sound features and its universality is only one choice of infinite combinations of certain limited elements and its realization in each language.

Although the analysis in [Trubetzkoy(1939)] and by his successors had achieved the goal of pursuing the universality of speech sounds, there are some speech sounds that were neither mentioned there nor analyzed in [Ladefoged (1993)]. It is the consonants that have been clarified in a recent study of the Bunun language, a Taiwan’s aboriginal vernacular. [Moriguchi (2022a)].

## 1. A Study of the sounds in an Indigenous people in Taiwan: Bunun Consonants

### 1.1 “Glottal (Plosive/Stop) Affricates” in Bunun

It can be stressed that the research on Taiwan’s aborigines began during the

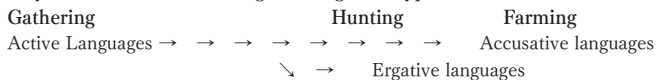
<sup>1</sup> [Moriguchi (2022b)] discusses on the universality of grammar and the basics of its regularity. The paper considers the emergence and its historical changes from three points of linguistic typological view; “Active vs. Inactive”, “Complete vs. Incomplete” and “Subject, Focus/Topic”. And the paper assumes that the grammar changes according to daily human occupations.

At present, the characteristic “types” of the world’s languages are;

- ① Active Language; inactivity/ state vs. activity
- ② Ergative Language: imperfective vs. perfectiveness
- ③ Accusative Language: focus/topic, subject, causative/transitivity.

The grammars seem to have developed after Homo sapiens was established. The author of the paper noticed that it is the view point on behavioral forms of their means of subsistence (gathering, hunting, farming) that created the typological differences in grammars. In other words, the difference in the way of living influenced the grammars and the grammatical “types”. The grammars follow the changes along with the human occupational development. It turns out that Accusative Language, which is common in modern languages, even retains old rule of Active Language, “Activity vs. Inactivity”, along with the rule of “Subject” and “Focus /Topic”. Following is the flow:

[History of livelihoods and changes in linguistic types]



In Slavic languages, for example. the remains of “active vs. inactive” are still observed.

Japanese colonial period, especially by Ogawa and Asai of the Linguistics Department, and Utsushikawa (Utsurikawa) and Mabuchi of the Anthropology Department (Vernacular Studies Course), at Taipei Imperial University. After World War II, Tsuchida, Li and others are conducting research. In their research reports on Bunun there are sounds indicating description with [ʔd] and [ʔb]. But Mabuchi reported [ʔd] sounded like [l] and even Taiwanese anthropologists have reported that it sounds like [l]. In the author’s research, the sound corresponding to /ʔd/(=[ʔd]) could be identified as neither [ʔd], the successive phones of [ʔ] and [d], nor successive ones of [ʔ] and [l]. It is also different from [ʔl] in Bunun [liʔliʔ] “bracken”. It is, on the other hand, totally different from the “Implosive” and “Ejective” described in [Ladefoged (1993)]. And an outstanding problem remained.

As the result of author’s investigation, it was identified that the phenomenon was not two successive phones of glottal stop [ʔ] and stop [d] or lateral fricative [l], but double articulation of vocal cord’s emission of the air (glottal plosive/stop) from lungs and lateral fricative. Therefore, [Moriguchi (2022a)] proposed the term “Glottal (Plosive/Stop) Affricates” = [ʔ̠], which has not been reported in linguistic or phonetic fields until now.

## 1.2 Takitudu consonants

The “Glottal (Plosive/Stop) Affricates” in Northern Bunun dialect (Takitudu) will be briefly shown as follows;

### Takitudu Bunun “Glottal (Plosive/Stop) Affricates”

- |  |                            |            |
|--|----------------------------|------------|
| ① /d/ : /d/ = [ʔ̠]                       | [quuʔ# ~ quuʔ̠-]           | “to drink” |
| ② /b/ : /b/ = [ʔ̠b] ~ (*)[ʔ̠v]           | [laqaiʔ# ~ laqaiʔ̠b]       | “to pass”  |
| ③ /c/ : [ts] (: /s/ = [ʂ]/[ʃ]) : * [ʔ̠s] | [tsutsu]                   |            |
|  | (Southern dial.: [susu])   | “milk”     |
| ④ /z/ = [ð] : * [ʔ̠ʒ]                    | [paað]                     | “rice”     |
| ⑤ /k/ : * [ʔ̠x]                          | [kaun ~ aun]               | “to eat”   |
| ⑥ /h/ : * [ʔ̠h]                          | [qumah]                    | “field”    |
| ⑦ /q/ ~ /x/ : * [ʔ̠χ]                    | [qanituʔ]                  |            |
|  | (Southern dial. [xanituʔ]) | “spirit”   |

⑧ Disappeared : \* $[\hat{r}_Y]$  None<sup>2</sup>

## 2. Bunun phonetic research result and its contribution to comparative linguistics of the Philippine and Formosan aboriginal languages.

If we compare cognates or words with the same origin that are related to “Glottal (plosive) affricates” observed in Bunun, we find that they changed into stop or fricative or affricate.

	<u>Formosan</u>	<u>Philippines</u>	
①	* $[\hat{r}]$ tsatsan (Ba), razan(Kv), daran(Pz), djalan(Pw)	chalan~shalan(Ib), raxan(It), dalan(If), dahan(Tg), chalan(Ch)	“road”
②	* $[\hat{r}_b]$ ~* $[\hat{r}_v]$ qaruf(Th), qa’a( $\hat{r}_b$ )(NB)	aib(Mn) <sup>a</sup> wala~ <sup>b</sup> wala(Iba, (Kr), gwaha (Ch)	“knee” “none”
③	* $[\hat{r}_s]$ *aθo(Pr-R), ahu(Th), atu(Ho) atsu?(NB), asu?(SB)	aso(Tg), ato(Is), oho(Tb), aho(Ag)	“dog”
④	* $[\hat{r}_j]$ panay(Ba), pazay(Th etc) pagay(At), payay(Sd), paday(Pw), paað(BN)	paray(It), pagay(Il), page(If), paey(Ak), palay(Tg)	“rice”
⑤	* $[\hat{r}_x]$ kaun (except Bunun), kaun ~ aun(NB)	kain(Tg), kan(Iv), an, a-ʔan(If)	“to eat”
⑥	* $[\hat{r}_h]$ ʔomæh(Ss), qumah(At) qumah (NB), χuma?(SB)	kuma(Tb). uma(Il), uma(h)(Kl)	“field”
⑦	* $[\hat{r}_Y]$ nangan (Kv), ngangan (Am), ngadan (Pw), ngaan (Bn)	nangan(Il), ngagan(Ib), nahan(Itw), ngalan(Kl), ngagan(Ml)	“name”
⑧	* $[\hat{r}_\chi]$ HalTu (Py), littu(Sr) qanitu?(NB), χanitu?(SB)	anitu(It, Iv, Tg), kanitu(Kl)	“spirit”

(Blust & Trussel(2020))

<sup>2</sup> \* [ ] : Presumed proto-language form. It changes to different sounds in proto-language in Bunun. Only  $[\hat{r}]$  and  $[\hat{r}_b]$ ( $[\hat{r}_v]$ ) remain in the contemporary Bunun language.  $[\hat{r}_v]$  (→ (\* $\hat{r}_v$ ), which is an old form of  $[\hat{r}_b]$ , seems to have been still existing during Mabuchi’s investigation (about 150 years ago).

Formosan: Ba(Basay), Bn(Bunun), Ho(Hoanya), Kv(Kavalan), NB(Northern Bunun), Pr-R(Proto-Rukai), Th(Thao), Pw(Paiwan), Pz(Pazeh), SB(Southern Bunun), Sd(Seedeq), Sr(Siraya), Ss(Saisiyat)

Philippines: Ag(Agutaynen), Ak(Aklanon), Ch(Chamorro), Kl(Kalamian), Kr(Karao), Ibl(Ibaloy), Ibn(Ibanag), If(Ifugao), Il(Ilocano), Is(Isneg), Itb(Itbayat), Itw(Itawis), Iv(Ivatan), Ml(Malaweg), Mn(Manobo), Tb(Tboli), Tg(Tagalog)

From “comparative linguistics” perspective the reconstructed forms are presumed to have developed from plosives or fricatives or their double articulated (affricated) sounds. No evidence for the existence of the progenitor type has been recognized, but the existence of “Glottal affricates” in Bunun suggests that the sounds in proto-forms assumed in “Comparative linguistics” are surviving, to which is considered the sounds provide the “Historical linguistics’ evidence”.<sup>3</sup>

### 3. “Glottal (Plosive/Stop) Affricates” in Bunun

#### 3.1 “Glottal (Plosive/Stop) Affricates” and non-pulmonic airflow pronunciations

“Implosives, Ejectives, Clicks, etc.” are treated neither in [Trubetzkoy (1939)] nor in general phonetics focusing on modern languages. But in [Ladefoged(1993)] they are treated as special or non-pulmonic airflow pronunciations. In a sense, they are the sounds often found in indigenous languages, the languages of peoples who have not yet modernized.

The former two are the pronunciations related to the glottis (glottalic airstream) and the click is related to the tongue. The first two pronunciations are considered double articulations of “glottal operation” and oral “fricatives” or “plosives”. If this is the case, it is highly probable that Bunun’s /ʔd/[ʔl], /ʔb~ʔv/[ʔb~ʔv], etc. are double articulations of a “glottal (plosive/stop)” and a “fricative”.

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<sup>3</sup> Historical linguistics = historical research of language using only actual materials; Comparative linguistics = historical research of language based on existing materials to establish a logically presumed proto-form that can explain the history.

## 4. Linguistic Changes

The first of the above two pronunciation methods exists in the Bunun language and the second group exists in the Hunting-gathering peoples. In addition to these, a third pronunciation method is the pronunciation mainly using the oral cavity, which is widely used in modern languages. There are many languages that still contain combinations of these three or two. However, it is difficult to imagine that they occurred sporadically in specific regions and different ages. Conversely, it is possible to hypothesize that it is the result of the evolution of pronunciation that occurred during the process of human physical evolution. Although it is impossible to determine the exact period from linguistics, it is worthwhile to take the history of the movement possibilities in oral organs related to these pronunciations into consideration, that is, the history of changes from animals to humans, especially the abilities of the “tongue” and vocal cords. The changes in function make it possible to estimate the periods in which they occurred.

As a result of linguistic analysis on the special sounds of the Bunun language, it is presumed that the human beings could articulate the sounds with methods that solely relied on the closing and opening of the lips and glottis as an animal at first, then gradually became possible to pronounce clear fricatives and plosive in oral cavity manipulated with “glottis” and finally plosives by controlling airflow with narrowing or stopping with the downsized “tongue” in oral cavity. This evolution can be assumed in the language acquisition from animal to human beings.

Therefore, it is necessary to consider when the Bunun’s “Glottal (plosive/closed) affricates” occurred in the process discussed above. Since it is a double articulation of the constriction (fricative) caused only by exhalation from lungs due to the release of the vocal cords and fricative sound with “tongue” in the oral cavity, this pronunciation is possible even for animals. It is also estimated that this was the pronunciation before the time when “Implosives” and “Ejectives” and their changes to plosives by the developed “tongue” in oral cavity occurred. This pronunciation method is the one used by humans in the earliest era.

As the result, at least the following three evolutionary stages can be assumed.

- Animals:** ① Opening and closing of both lips and glottis  
 (Sounds like vowels, shouts)  
 ↓
- 1<sup>st</sup> Stage:** ② Glottal stop + Constricted fricative (with “tongue” or lips)  
 “Glottal affricates”  
 (Development of vowels)  
 ↓
- 2<sup>nd</sup> Stage:** ③ Glottal manipulation + plosive/fricative (with “tongue” or lips)  
 “Glottal plosives (“Ejectives” and “Implosives”) and “Click”  
 (Development of glottalized consonants,  
 farther development of vowels)  
 ↓
- 3<sup>rd</sup> Stage:** ④ “Tongue”(small and foliated) + oral cavity:  
 plosive + fricative + affricate  
 (Gradual loss of glottal function and development of oral  
 consonants and vowels.)

What does this phonetic trend mean?

Why can such a trend be assumed?

What comes into play here is the relationship between the contraction of teeth and “tongue” in the oral cavity, that is, foliated and flexible latter and the resulting expansion of the oral cavity, and the functional change of “Glottis”.

This explains that there were development and disappearance of pronunciations (Implosive, Ejections, Clicks, etc.) based on the operation of the non-pulmonic airflow mechanisms with “glottis” and “tongue” after the 1<sup>st</sup> stage, which hardly remain in modern languages. This trend is clarified by the fact that when the ability of “tongue” was still immature as a pronunciation organ, i.e., evolutions of “teeth”, “tongue” and oral cavity, had not reached at the level of operational ability to utilize well as an instrument, they tried to take different direction of the use of “glottis” for new linguistic manipulation which had started functioning ahead of “tongue”.

As compared with apes, human being has smaller mouth and jaw and the



size of teeth and “tongue” also appears to vary in accordance with the functions of “tongue” in oral cavity. The changes are certainly related to the type of food and the method of cooking, which play an important role in the human evolution. In the past, the “tongue’s” main function was only for eating. But its role has been weakened and new vocal operations and articulations have been invented. Eventually, it evolved into an important organ for spoken language we use today.

## **5. The relationship between human evolution and special pronunciations in Bunun and its significance**

It is admitted that the evolution of primates was made possible by “Bipedalism”. The following evolutions can be considered due to the human linguistic characteristics by the upright walking on two legs.

- ① As the result of expansion of throat and oral cavity, the air and food passageways were separated and nasal and oral sounds developed and vowels were acquired.
- ② The brain developed due to the increase of brain capacity.
- ③ Vowels were developed by the movement of “tongue” due to the expansion of the oral cavity and fricative consonants were done by the opening and closing of airflow through space between “tongue” and palate.

It is true that consonants are manipulated by the opening and closing or narrowing with “tongue” and its position, but this does not seem to be the result of bipedal locomotion. Vowels are thought to be generated by the expansion of the oral cavity caused by the consequent enlargement of the movable range of “tongue” and its movement. But this cannot perfectly explain the generation of consonant articulations, which are characterized by explosion or friction with “tongue”. The development of consonants, which are important sounds and are not explained by “Bipedalism”, is still unclear. So, let us take a closer look at the pronunciation of consonants.

From an animalistic point of view, teeth are responsible for cutting food and the functions of “tongue” are to masticate, stir and swallow food. “Tongue” does

not stop food or narrow the mouth. Lips, on the other hand, play an important role in opening and closing. The important function of the lips is to open and close for taking food in and the important role of the vocal cords and glottis is to open and close for vocalization and breath control.

Therefore, it is necessary to consider the ability of organs related to language from the human development's point of view.

(Apes, Bonobo)→(Austropitecus)→(Homoerectus)→(Homoneandeltalensis)→Extinct  
 (Panpaniscus) ↘ (Homoheiderbergensis)→ (Homosapiens)

(Common to animals and humans) [A]

	[Austro]	[Erectus]	[[Heider]	[Sapiens]
1. Vocal cord vibration, opening and closing	o	o	o	o
2. Manipulation ability of "Glottis"	x	x(o)	o	x
3. Opening and closing of lips	o	o	o	o
4. "Tongue" movement	o	o	o	o
5. "Tongue" and tooth size	(large)	(large, medium)	(medium, small)	(small)

(Human only) [B]

1. "Tongue" closure and narrowing	x	x	x/o	o
2. Pronunciation of distinct vowels	x	x	x(o)	o
3. Nasal vs. oral sounds	x	x	x(o)	o

(o = possible, x = impossible)

Vocal cord vibration and its opening and closing	A-1
Bilabial	A-2
Nasal	(B-3)
Glottal Affricate (Glottal stop and fricative)	A-1, (2)+B-1.(2)

Click, Implosive, Ejective

A-1,2+B-1,2

Bilabial, Fricative, Glottal stop, Voiced vs. Unvoiced

B-1,2,3

If a detailed examination of the documentary film of an experiment in the U.S. in which a Bonobo mimics human speech reveals that it can imitate the pitch and length of the sounds, but there are no vowel elements and it seems that consonants cannot be pronounced clearly. Being able to understand human utterances, on the other hand, means that it already has the language ability and can understand the content of the speech. In other words, the ability of hearing and understanding of the import of the speech is already provided, but it is still animalistic in terms of pronunciation as it does not yet have a wide mouth cavity and a flexible and foliated delicate “tongue” for linguistic activity. Especially it is difficult for a Bonobo to pronounce stop consonants and clear vowels.

## **6 . How did humans acquire the ability of pronouncing oral plosives?**

### **--- “Tongue” development due to the changes in eating habits.**

It is obvious that the linguistic perspective alone does not constitute historical evidence. However, it seems possible to track changes in pronunciation by considering the evolution of “tongue”, which plays an important role in pronouncing these sounds, from an anthropological and archaeological perspective.

The roles of “tongue” would be food crushing, stirring, swallowing and speech articulation. From an animalistic point of view, the former three are the main functions. But humans obtained the ways of modulation of speech sounds.

Based on Wrangham (2009), the relationship between diet and livelihoods among primates is considered as follows ;

- ① In the case of gathering life, they eat raw or fallen and fermented food and masticate (chew with strong / large teeth and “tongue”, mix with saliva) and swallow. They also lick food with “tongue” and suck food in with breath.
- ② In the case of hunting life, on the other hand, prey is killed, its meat is cut, bitten off, chewed raw and mixed with saliva and swallowed the pieces in. But,

when humans began to use fire, they started to eat meat by grilling it and the role of “tongue” was not to crush it by pressing down, but to stir it and mix the grilled part and the raw part to taste it. No thick tough bulky “tongue” is needed any more.

- ③ After ②, because of the agricultural cultivation, root crops and grains that are mainly starchy are boiled, softened, chewed, crushed, mixed with saliva, stirred, mashed, tasted and swallowed. As a result, it is envisioned that the size of the teeth became smaller and “tongue” thinner and more foliated, which enabled the development of finely-moving “tongue” and the enlargement of the oral cavity.

As an animal, human could also close their lips and “glottis”. Although there may have been constriction with “tongue”, it is doubtful that the delicate manipulation could be achieved with a thick tough bulky “tongue” as observed in Bonobos. The function of teeth and “tongue” of olden times requires strength capable of chewing and crushing rather than fine movements. If you estimate when the function of “tongue” developed, it would be after cooking with fire that occurred in the era of hunting, especially when it became possible to taste meat by cooking and stirring with “tongue”. It is presumed that the development of food cookery and the starchy dishes of plants gradually enhanced further improvement of “tongue”. As a result, the size of “tongue” became smaller and thinner/more foliated, with which result the oral cavity became larger. The following changes are presumed:

Food: Fruits/Plants → Marrow → Carnivorous → Grains, Crops → Cultivated plants

(hunting) (from raw to cooking) (cooking starch)

Teeth, Tongue : *Getting smaller and thinner/more foliated*

## 7. Why did Homo neanderthalensis lack language ability and Homo sapiens could own?

It is true that the use of fire caused the ability to expand oral cavity and

shrink “tongue”, gaining flexibility, but *Homo neanderthalensis* did not have the kind of flexible “tongue” that modern human possesses. It is necessary to consider why such evolution occurred.

## 7.1 “Tongue” development and Bipedal walking

As the function of “tongue” developed, humans acquired the modern consonants observed today. It is, on the other hand, presumed that the double articulation of “fricative” with animal-like “tongue” and “explosion of the vocal cords”, which is the peculiar pronunciation found in the contemporary Bunun language, was present in the early stages in human history. If that’s the case, a question arises: “Why did our “tongue” start to move so actively?”

Human beings have expanded their oral cavity by walking on two legs. It is partly true linguistically as it was possible for them to pronounce “vowels”. But as mentioned above, the occurrence of “consonants”, especially, plosives cannot be explained by this upright walking only and it is not believed that all kinds of “consonants” have been possessed by humans since the time when they were animals.

Regarding grammar, on the other hand, the cause of its occurrence was discussed in [Note 1]. [Moriguchi (2022b)] proposed the hypothesis that it may have arisen from typological considerations based on the human occupations. In other words, the author thought that “gathering” gave rise to “Active language”, “hunting” gave rise to “Ergative language” and “cultivation/ agricultural and livestock farming” gave rise to “Accusative language”. It is, therefore, hypothesized that the development of the oral cavity and “tongue” may also be due to the subsistence occupations and related eating or cooking methods.

## 7.2 Development of “Tongue”

When *Homo neanderthalensis* and *Homo heidelbergensis*, latter of which is the ancestor of *Homo sapiens*, were both maintaining their existence, there was little difference in their physical ability. The physical difference of *Homo sapiens* from *Homo neanderthalensis* is the expansion of the oral cavity and the flexibility of “tongue” due to the downsizing of the teeth and acquisition of the flexible

foliated “tongue”. Therefore, it is hypothesized that what made it possible for modern humans to evolve “tongue” that they can use freely, is the result of changes in human diet, the development of “fire-and-water” based cookery” and changes in “subsistence”. The mashed food brought a talent of the “tongue” out.

### 7.3 “Tongue” and cooking methods

[Wrangham (2009)] hypothesizes that the brain expanded in accordance with the saccharification of starch. This is a question of nutritional value, but let us consider changes in the function of “tongue”.

Perhaps, in the case of animals, the function of “tongue” was to take food into body. But it is not clear whether it had the function of controlling breath or not. When humans started using “fire” to soften meat and plants, the ability of “tongue” was accelerated and they could taste food. As a result, “tongue” became active and could conduct sensitive behavior. Stirring with “tongue” is especially important for cooked root crops and grains.

The issue here is the difference between *Homo sapiens* and *Homo neanderthalensis*. The former had excellent speech abilities and the latter was unable to make fullest use of their speech abilities. You will notice it is the eating habit that leads to the difference between the two. While the latter mainly ate meat and gathered food, the former was able to increase the production of root crops and grains through “cultivation”. *Homo sapiens* followed the path of cookery with “fire-and-water” and turning meat and plants into mashed soft food. The soft mashed food eating enables “tongue” to carry out delicate movements from the movement by power in eating raw food. Therefore, various movements of “tongue” became possible other than drinking and eating.

By obtaining large amounts of starchy plants through agricultural cultivation and eating mashed soft food cooked with “fire-and-water”, “tongue” shrunk and oral cavity was widened, which gives the former (*Homo sapiens*) finely moving “tongue”. However, the size of the mouth of *Homo neanderthalensis* suggests that these movements were not possible. Based on the results of [Lieberman (1975)], it is presumed that they could neither pronounce “vowels” clearly and sufficiently, nor produce stop/plosive sounds well because of the size of “tongue” and oral

cavity.

#### 7.4 “Tongue” development and eating habits

As mentioned above, *Homo neanderthalensis* and *Homo heidelbergensis* (progenitor of *Homo sapiens*) are thought to have owned completely same ability until a certain era, but the difference was due to the large amounts of plants containing a lot of starch by cultivation. It is thought that the use of “fire-and-water” to soften and mush plants and acquisition of the large amounts of plants by cultivation contribute to the shrinkage of teeth and “tongue” foliation and lead to the consequent delicate activity of “tongue”.

The changes can be illustrated as follows in relation to the eating habits:

Fruits/nuts/grasses → Marrow → Carnivorous → Cooked grains, crops → Cultivated plants

Meat (hunting)                      Starch      Agricultural cultivation

“Teeth”:      (large) → (large) → (medium) → (small) → (smaller)

“Tongue”: (tough & bulky) → (medium & less bulky) → (small & thin) → (smaller & thinner/foliated)

“Oral cavity”:      (small) → (small) → (medium) → (large) → (larger)

#### 8. Changes in food habits by agricultural farming and the development of oral plosive/stop consonants and vowels.

The production of the “Glottal (plosive) affricates” found in the Bunun language is possible even with animal-like oral cavity without a contracted “tongue” and it is assumed that this was the last era of *Homo neanderthalensis* and *Homo heidelbergensis*. Afterwards, by taking cooked soft starchy food, *Homo sapiens*’ “tongue” and teeth appeared to shrink, allowing for “tongue” foliated. But it is still immature and could neither close tightly nor move delicately. Then, the 2<sup>nd</sup> stage, that is, “(glottal) Ejective sounds” and “(glottal) Implosive sounds” by glottal manipulation followed. Furthermore, as the ability of “tongue” developed,

intraoral plosives became possible and the vocalization of glottal operations was probably no longer necessary.

1 <sup>st</sup> Stage: “Animalistic”	2 <sup>nd</sup> Stage: “Transitional Age”	3 <sup>rd</sup> Stage: “Human”
Glottal (plosive) affricates	Ejectives, Implosives (Pronunciation produced by the glottal airflow mechanism) Clicks Acquisition of the vowels	Oral plosives, etc.

## 9. Glottal and oral plosive/stop consonants’ generation process and their estimated times

By matching findings on “tongue” development in evolutionary anthropology and archaeology with linguistic changes in pronunciation, it is possible to estimate the periods in which these pronunciations occurred.

Consideration on whether the linguistic development of consonants, especially plosives, shown in Chapter 4 can be linked with the development of humankind will be discussed in this chapter.

In the age of *Homo erectus*, when humans generally changed to the age of meat eating / carnivorous, their jaws had already begun to degenerate and conversely their brain volume is estimated to have been approximately the same as that of modern humans. Their brain volume increased from one-half to two-thirds of modern humans. That of *Homo heidelbergensis* is assumed to be approximately the same as that of modern humans.

According to [Wrangham (2009)], the initial contraction of teeth started over time from *Homo habilis* to *Homo erectus* and the change was gradual. The latter’s molar teeth are estimated to have decreased by 21% of those of the former, and the function of the canine teeth also seems to have deteriorated over time. Brain volume appears to have increased during this period. This is presumed to be the era when their diet changed from raw food eating to cooked food eating. In other words, it was the first period when the increase in brain capacity and the



reduction in the size of the teeth, especially molars, began, signifying a modest expansion of the oral cavity. It is, on the other hand, assumed that the establishment of the cooking methods using “fire” seems to be the age of *Homo heidelbergensis*. Remains of furnaces that indicate the development of cooking in the early days of *Homo sapiens* appear to date back to around 180,000 to 100,000 years ago. In this case, it is possible to note that the late Paleolithic period would be the time when the influence of “fire-and-water” based cooking had effect on the human body and caused evolution. Indeed, it is estimated that the use of “fire” began between 250,000 and 300,000 years ago, but the next time when the effect of cooking appeared in reduction of teeth size was 100,000 years ago. [Brace (1995)]

The author does not have any empirical data on the change of “tongue”, but from an evolutionary perspective, it can be estimated that it was the time when a change from a thick and tough muscular “tongue” to a thin and foliated one that is more flexible and can move up and down more delicately than a thick tough muscular “tongue”. But could it have been possible for “tongue” to develop only with meat dishes?

*Homo sapiens* ended up eating a lot of “starchy” food cooked with “fire-and-water”. As the result they did not need to apply force on food with “tongue” and could provide “tongue” with delicate movements. That is, it becomes necessary to obtain a large harvesting of “starchy” plants for “tongue” to become smaller and more foliated and obtain the delicate movements. *Homo sapiens* experienced and enjoyed warmer climate after the end of the “4<sup>th</sup> Ice Age” and agriculture developed, making it possible to harvest many grains and root crops. During this period, teeth became even smaller and “tongue” was more foliated, making its delicate movements possible.

It is also presumed that due to the shrinking of teeth and “tongue” and the expansion of the oral cavity, the number of vowels became diverse, such as 2 vowels, 3 vowels, 4 vowels and so on. On the other hand, the consonants, especially plosives/stops, which were relied on the implosion or ejection of the glottis with the movement of “tongue” in oral cavity at the beginning of *Homo sapiens* age, were shifted to the ones pronounced only with “tongue” in the oral cavity and breath from lungs.

Then, the phases discussed in Chapter 4 are incorporated into those of humankind as follows;

- ① **Animals:** Opening and closing of both lips and opening and closing of the glottis (Sounds like vowels, shouts) (fricative)  
↓
- ② **Mid-late Homo heidelbergensis:** Glottal plosive + constricted fricative (due to tongue and lips) “Glottal affricate” (limited vowel development) (glottal plosive + fricative)  
↓
- ③ **After Homo sapiens:** Glottal manipulation + (tongue, lip) plosives/stop (100,000 years ago?) “Glottal plosives (Implosives, Ejectives, etc.)” (glottal stop/plosive + fricative, oral stop)  
↓
- ④ **(23,000~)14,000 years ago:** Fricative + Plosive/stop + Affricate (After start of agricultural Farming) (Enlargement of oral cavity and foliation of “tongue”; Gradual loss of function of the glottis; Shift to the oral cavity and increase of the number of vowels)

## 10. Vicissitudes of “Tongue” and “Glottis” functional evolutions

As discussed above, the contraction of “tongue” and waxing and waning of the functions of “glottis” contributed to the development of language acquisition, which flow is observed in the following figure:

- ① **Stage 1 (or before)**
  - a) Separation of air and food passageways and expansion of the oral cavity due to the upright bipedal walking.
  - b) Holding and bursting of the breath from lungs with “glottis”.

② Stage 2

- a) Shrinkage of teeth and “tongue” due to changes in diet.
- b) Acquisition of linguistically useful operational abilities of implosion and ejection by “glottis” and increased its manipulation ability.

③ Stage 3

- a) Further contraction of “tongue” due to the dietary changes and the replacement of functions of holding and bursting breath from “glottis” to oral cavity.
- b) Deterioration of “glottal” functions due to the development of the consonants with “tongue” in the oral cavity.

The flow above can be diagrammed as shown below:

	Stage 1	Stage 2	Stage 3
Shrinkage of the “tongue”	+	+++	++++++
Expansion of the “oral cavity”	+	++++	+++++
“Glottis” manipulation	++	+++++	∅

• Rise and Fall of Linguistic Functions:

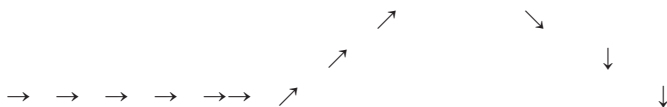
“Tongue”

Mixing, Crashing → Preparation → Functioning



“Glottis”

Opening/closing → Manipulation → Loss of linguistic function



The figures above show that as an animal the humans first made fricative sounds through the space between inactive tough bulky “tongue” and palate with the breath from lungs controlled by “glottis”. Later, the acquisition of the precise control of “glottis” functions enabled the further development and led to the production of the sounds; “Implosive” and “Ejectives” etc.

Eventually, the result of the changes in diet or starting of the “mushy soft meal” and the effects of the production of large amounts of starchy plants due to a milder climate made it possible for the humans to control opening/closing and friction with “tongue” in oral cavity.

Consequently, the need for “glottal” operation in old pronunciation style disappeared and its function was gradually lost and the function of “glottis” was replaced by “tongue” in the oral cavity. This function has been carried over to our modern languages.

## **11. Conclusions**

It has been proven that the “Glottal (plosive/closed) affricates” found in the Bunun language inherit the animal-like pronunciations in the early stage of Homo sapiens and have been preserved to this day. And the consideration on the history from the old type of the special pronunciations to the oral based pronunciations in contemporary languages revealed that the change of articulatory methods was created by the dietary changes.

If Homo sapiens was not the only “species” that acquired the ability to speak, but had acquired it due to this difference in dietary habits, then Homo neanderthalensis might also follow the path of Homo sapiens due to the changes in diet or the change to mashed soft food. It might have been possible. In Europe and elsewhere, it is said that Homo neanderthalensis and Homo sapiens were able to interbreed and many humans have now been confirmed as the result of interbreeding between the two. The ability of new humans to acquire language was ultimately made possible by the differences in “dietary habits”, confirming that language arose from a cause different from that of the “Species.” But before that, Homo neanderthalensis was overthrown by Homo sapiens. Homo neanderthalensis might have acquired language if they had eaten a lot of mashed

soft starchy food. The fact that these new interbred humans were able to acquire language explains that some of the language abilities were created due to the changes in their dietary habits, which supports the premise that languages evolved and became established for the reasons other than “Species”. However, before that, *Homo neanderthalensis* was wiped out by *Homo sapiens*. *Homo neanderthalensis* might have acquired language if they had eaten lots of “fire-and-water” mushed soft starchy food earlier.

Furthermore, as stated in [Lieberman (1975)], *Homo neanderthalensis* is incapable of producing complete vowel sounds. The author can emphasize that the acquisition of many complex vowels and consonants was due to the discovery of “fire-and-water” based cooking and the active cultivation of starchy plants, which led to the contraction of teeth and “tongue”, allowing humans latter’s delicate movements and further enlargement of oral cavity.

Indeed, Primates were able to walk on two legs and expanded their oral cavity and brain capacity. This happened with both *Homo neanderthalensis* and *Homo heidelbergensis* (*Homo sapiens*). But this cannot explain the lower possibility of the former in acquiring language ability. “Bipedal” locomotion alone cannot promote language development.

As a result of the change from raw food eating to “fire” cooked food eating which is observed in the progress from *Homo habilis* to *Homo erectus*, the oral cavity slowly expanded due to the reduction of the teeth size and foliation of “tongue”. The expansion of mushy “starchy” cuisine that developed surprisingly at the turn of the age of *Homo sapiens* and the increased yield of the plant afterwards because of the change to a warmer climate (= “end of the 4<sup>th</sup> Ice Age”) remarkably promoted the human’s linguistic ability. It is because of these happenings that humankind was able to acquire perfect language. The ensuing expansion of the oral cavity due to the astonishing reduction of teeth size and foliation of “tongue” and the ability to make delicate movements of “tongue” made it possible to produce distinct vowels and consonants, resulting in our language of *Homo sapiens* from animalistic language.

The results of the discussion above show that “Species” is not the only factor that determines language acquisition, but also the “livelihood” or “daily life pattern” plays a major role.

The language acquisition through culinary history and farming may have determined our different fate from *Homo neanderthalensis*, which is clarified through the historical analysis of the peculiar sounds in the Bunun language.

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(要旨)

# 台湾・ブヌン語の特殊発音研究と 人類の言語発達に関する一試論

— ブヌン語の「声門破擦音」研究の人類進化探求への寄与 —

森 口 恒 一

本論は、『静言論叢』第5号で論じた台湾・ブヌン語における特殊な発音である「声門破擦音」と声門と関係する「内破音、放出音」、現代人の子音（破裂音）の3者の関係を考察し、その歴史的变化を人類進化の流れの中で探求する。

①「声門破擦音」、②「内破音、放出音」、③「現代の口腔のみに行う発音」の3種の異なる発音方法の歴史的關係は、「舌」の可動可能性を動物から人類が獲得した形状への進化から考察すると、①→②→③の流れが妥当だと考えられる。しかし、言語学からだけの視点ではその時代を明白にすることは出来ない。そこで、この変化で重要な役をなす「舌」を進化人類学的に見て、年代を推定した。

Wrangham(2009)は、食事法の変化、特に、火の使用とでんぷんを多量に含む植物の栽培による「舌」、口腔の進化が起こったとしている。そこで本論は、「舌」の進化が言語発達に寄与し、現代人の発音方法への進化を促したと仮定した。

①→②→③の流れは、口腔の広がり、「舌」の機能の変化と可動可能性の進化に起因すると思われる。Wranghamは、食事法の変化により「舌」の収縮が起こり、柔軟性、可動性が増したと仮定し、考古学的にその年代を推定できるとした。そこで「舌」の変化の流れと3者の発音方法を対照すると以下のようになる。

1. 動物：①両唇の開閉と声門の開閉（母音らしき音、叫び声）（摩擦音）  
↓
2. Homo heidelbergensis 中後期：②声門破裂+（「舌」、唇による）狭め・摩擦音  
（500,000年?） ↓ → 「声門破擦音」
3. Homo sapiens 初期前後：③声門操作+（「舌」、唇による）破裂音  
（100,000年前?） ↓ → 「内破音、放出音」
4. 農耕以降（14,000年前）：④「舌」による口腔・破裂音+摩擦音+破擦音

上記の議論から②のような発音法は、動物的な口腔と「舌」でも可能であると思われる。一方、③は、Neanderthalensis, Heidelbergensis時代にはあったかもしれないが、Liberman(1975)の研究によるとその可能性は非常に低く、主にSapiensに入ってからのことのようである。また、現代的な口腔と「舌」による調音が可能になったのは、明らかに薄い柔軟な「舌」の獲得以降であり、それはでんぶん質の食事の発達と第4氷河期の終了に伴う栽培農業の発達以降のことであるとした。

本論は、食事法と栽培農業の発達が、人類の言語進化に影響を与えたと結論付けた。そして、この文化的違いが、両人類の運命の違いを導き出したとも考えた。