PHONOGRAPHIC AND PHONOSTENOGRAPHIC MICHELA SYMBOLS

Giulia Torregrossa

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1. Introduction: a universal phonetic communication to bring people together

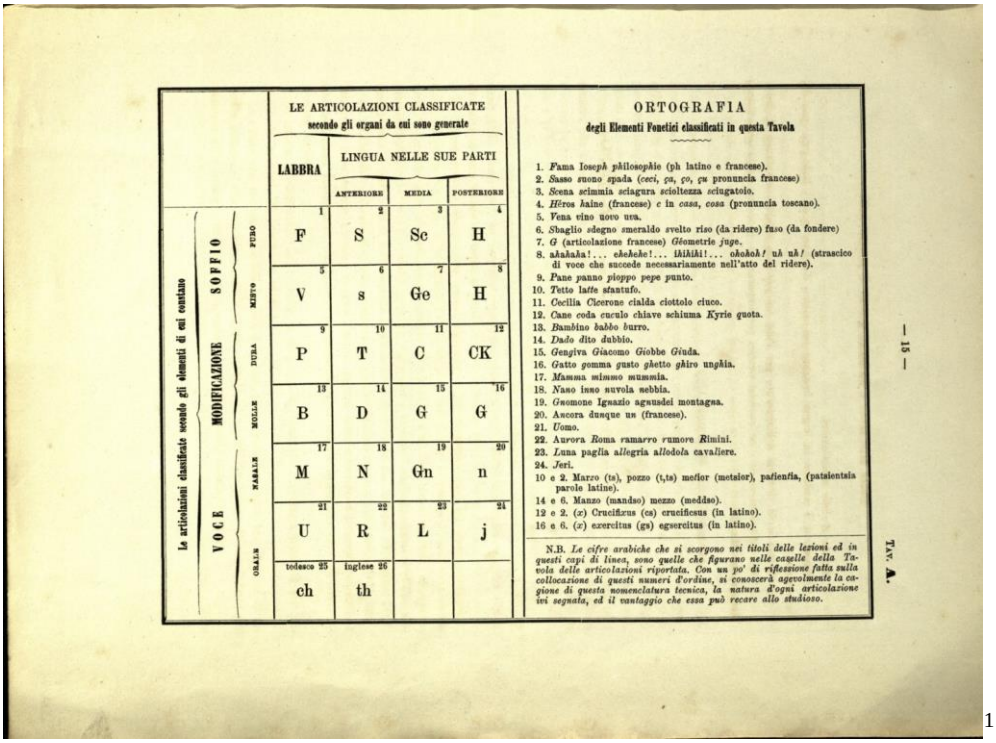
The name of Professor Antonio Michela Zucco is mainly related to the invention of one of the first stenotyping machines, the Michela keyboard, which precisely took its name from him. The keyboard, however, in reality was the natural material landing and the practical application of the long course of his studies, which started from the interest in the human vocal apparatus and all the sounds pronounced by it, up to the word, the more powerful means of communication that man uses.

The first result of such research was the scrupulous classification of all the phonemes pronounced by the human organs in any spoken language (phonography); the first practical application of this study was then the elaboration of a system of handwriting and rereading the sounds that could be common to every language (a sort of universal phonetic alphabet that aimed to bring together all the men of the planet in the era of progress, before the international phonetic alphabet - IPA - was invented); the second practical application of these studies was the invention of a stenophonographic (stenotypic) machine aimed at quickly transcribing in syllables and at rereading all the pronounceable sounds, to facilitate the visually-impaired, and of some of its derivatives, such as the stenotelegraph. These two practical applications were not chronologically consequent, but their improvement went on throughout the life of their inventor.

2. The articulations panel, ancestor of the universal phonetic alphabet

According to Professor Michela, the phonic elements emanating from the human lips are articulated sounds exhaled by the larynx, which give different modulations to the voice through the organs that emanate it (mouth, lips, teeth, tongue and oral and nasal cavities). The phonic elements in the various languages correspond to graphs, which are the conventional signs used by the various alphabets to allow the writing and reading of the different languages (so if writing is the graphic

synthesis of an acoustic analysis, the reading vice versa is the phonic synthesis of a graphic analysis). Professor Michela classified the various phonic elements that can compose every syllable that can be produced by the organs of the human word. To obviate the orthographic «oddness» of some alphabets, far from the real pronunciation (and therefore the difficulties deriving from the languages we now call opaque, because a graphic sign does not always correspond to the same pronunciation, as in French or partly in Italian, in which there are different pronunciations assigned to the same spelling, as happens for c, depending on the following vowel), he ordered in a table, which he wanted to call phonographic palette, all the graphic signs necessary to represent these phonic elements and established a mandatory correspondence of each sign to a sound. According to the same scheme, he finally created a table of phonostenographic symbols that he elaborated to transcribe and unequivocally reread the aforementioned sounds.



LE ARTICOLAZIONI CLASSIFICATE
secondo gli organi da cui sono generate

Le articolazioni classificate secondo gli elementi di cui constano			LABBRA	LINGUA NELLE SUE PARTI: ANTERIORE	MEDIA	POSTERIORE
VOCE	MODIFICAZIONE	SOFFIO PURO	1 F	2 S	3 Sc	4 H
		SOFFIO MISTO	5 V	6 s	7 Ge	8 H
		DURA	9 P	10 T	11 C	12 CK
		MOLLE	13 B	14 D	15 G	16 G
		NASALE	17 M	18 N	19 Gn	20 n
		ORALE	21 U	22 R	23 L	24 j
			tedesco 25 ch	inglese 26 th		

ORTOGRAFIA
degli Elementi Fonetici classificati in questa Tavola

1. *Fama* Iosepà *philosophìe* (ph latino e francese).
2. *Sasso* suono spada (*ceci, ça, ço, çu* pronuncia francese)
3. *Scena* scimmia sciagura scioltezza sciugatoio.
4. *Hêros* haine (francese) *c* in *casa, cosa* (pronuncia toscano).
5. Vena vino uovo uva.
6. Sbaglio sdegno smeraldo svelto riso (da ridere) fuso (da fondere)
7. *G* (articolazione francese) *Géometrie juge.*
8. aAaAaAa!... *ehehehe!*... ihihihi!... ohohoh! uh uh! (strascico di voce che succede necessariamente nell'atto del ridere).
9. Pane panno pioppo pepe punto.
10. Tetto latte stantuffo.
11. Cecilia Cicerone cialda ciottolo ciuco.
12. Cane coda cuculo chiave schiuma *Kyrie* quota.
13. *Bambino babbo burro.*
14. *Dado* dito dubbio.
15. *Gengiva Giacomo Giobbe Giuda.*
16. *Gatto gomma gusto ghetto ghiro* unghia.
17. *Mamma mimmo mummia.*
18. *Naso* inno nuvola nebbia.
19. *Gnomone* Ignazio agnusdei montagna.
20. Ancora dunque un (francese).
21. *Uomo.*
22. Aurora *Roma* ramarro rumore *Rimini.*
23. *Luna* paglia allegria *allodola* cavaliere.
24. *Jeri.*
10 e 2. Marzo (ts), pozzo (t,ts) mefior (metsior), pafienfia, (patsientsia parola latine).
14 e 6. Manzo (mandso) mezzo (meddso).
12 e 2. (*x*) Crucifixus (cs) crucifcsus (in latino).
16 e 6. (*x*) exercitus (gs) egsercitus (in latino).

N.B. *Le cifre arabiche che si scorgono nei titoli delle lezioni ed in questi capi di linea, sono quelle che figurano nelle caselle della Tavola delle articolazioni riportata. Con un po' di riflessione fatta sulla collocazione di questi numeri d'ordine, si conoscerà agevolmente la cagione di questa nomenclatura tecnica, la natura d'ogni articolazione ivi segnata, ed il vantaggio che essa può recare allo studioso.*

— 15 —

Tav. A.

1

[1] Illustration taken from Antonio Michela «Stenofonografia Michela a processo sillabico-istantaneo ad uso universale mediante piccolo e portatile apparecchio a tastiera», Torino, Tipografia Roux e Favale, 1879.

Phonographic and phonostenographic Michela symbols, by Giulia Torregrossa ((licensed under CC BY-NC-SA 4.0 International on 22/2/19)

The «articulations panel» (table A), the «demonstrative numerical picture» and the «phonographic palette» - which we will discuss later - bear 47 graphic elements, to which are associated an ordinal number and a phonic element, classified according to the task performed in the formation of every syllable emanating from the human lip.

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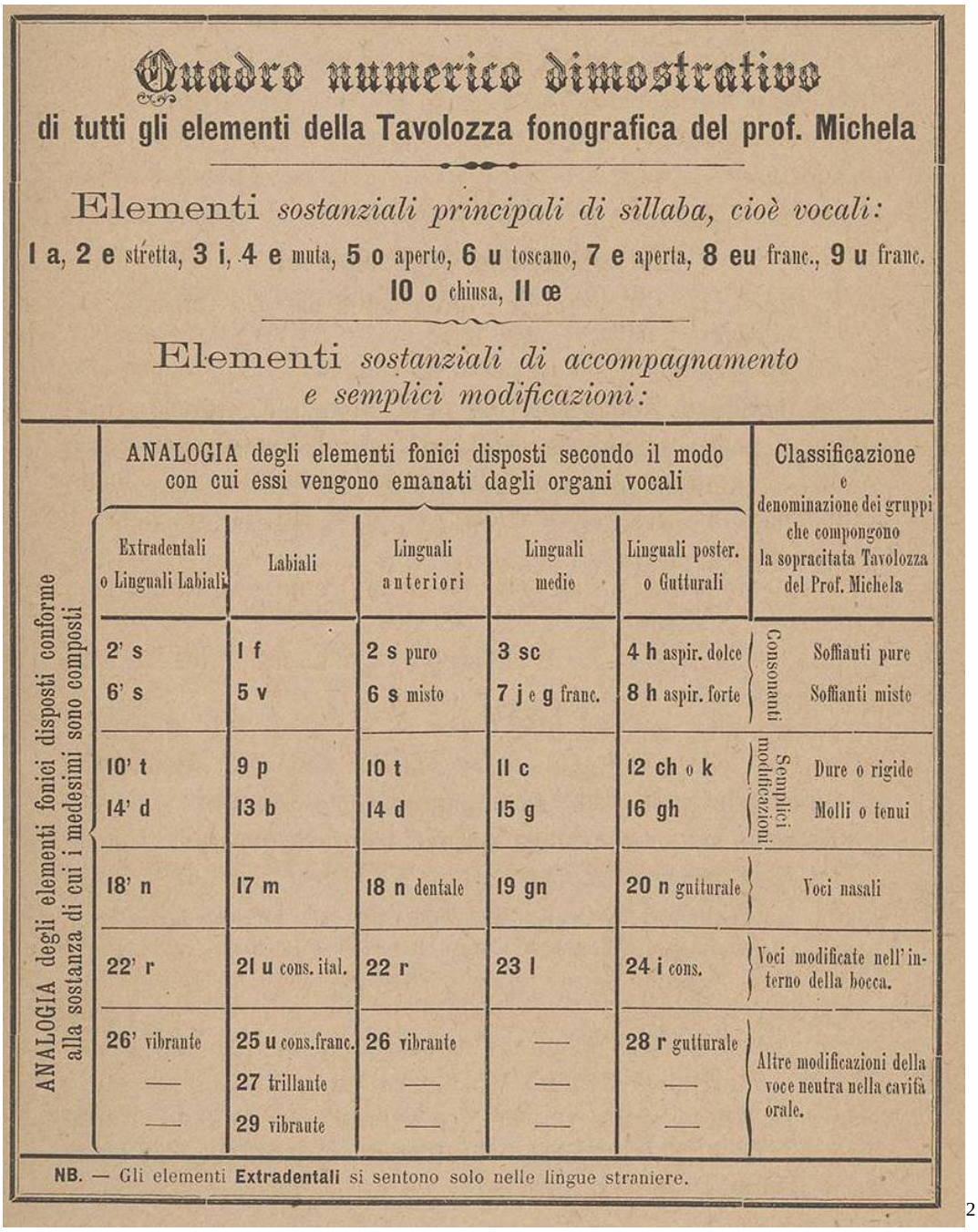

Quadro numerico dimostrativo

di tutti gli elementi della Tavolozza fonografica del prof. Michela

Elementi *sostanziali principali di sillaba, cioè vocali:*

1 a, **2** e stretta, **3** i, **4** e muta, **5** o aperto, **6** u toscano, **7** e aperta, **8** eu franc., **9** u franc. **10** o chiusa, **11** œ

Elementi *sostanziali di accompagnamento e semplici modificazioni:*

ANALOGIA degli elementi fonici disposti conforme alla sostanza di cui i medesimi sono composti

ANALOGIA degli elementi fonici disposti secondo il modo con cui essi vengono emanati dagli organi vocali					Classificazione e denominazione dei gruppi che compongono la sopracitata Tavolozza del Prof. Michela
Extradentali o Linguali Labiali	Labiali	Linguali anteriori	Linguali medie	Linguali poster. o Gutturali	
2' s	1 f	2 s puro	3 sc	4 h aspir. dolce	Consonanti: Soffianti pure
6' s	5 v	6 s misto	7 j e g franc.	8 h aspir. forte	Consonanti: Soffianti miste
10' t	9 p	10 t	11 c	12 ch o k	Semplici modificazioni: Dure o rigide
14' d	13 b	14 d	15 g	16 gh	Semplici modificazioni: Molli o tenui
18' n	17 m	18 n dentale	19 gn	20 n gutturale	Voci nasali
22' r	21 u cons. ital.	22 r	23 l	24 i cons.	Voci modificate nell'interno della bocca.
26' vibrante	25 u cons. franc.	26 vibrante	—	28 r gutturale	Altre modificazioni della voce neutra nella cavità orale.
—	27 trillante	—	—	—	
—	29 vibrante	—	—	—	

NB. — Gli elementi **Extradentali** si sentono solo nelle lingue straniere.

[2]

Professor Michela's analysis starts from the syllable, the substantial elements of which are divided into principal elements (the 11 vowels, defined as «neutral voice decomposed into vowels») and substantial accompaniment (26 consonants, of which 10 are defined simple modifications).

[2] From Società fonografica Michela «Spiegazione della tavolozza fonografica universale ossia alfabeto universale del prof. Ca. Antonio Michela, inventore del sistema fonografico universale a mano e della macchina stenofonografica», Ivrea, stabilimento tipografico Garda Lorenza, 1887.

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There is therefore no distinction between vowel and consonant based on the fact that the second encounters an obstacle in the production, while the simple modifications - which in the various languages are however consonant and which for the international phonetic alphabet are plosive and affricate, voiceless and voiced - are distinguished from the «blowers» as they are the elements that mark the way in which the substantial element of the syllable, principal or accompanying, begins and ends and which cannot be pronounced unless supported by a vocalic sound (in fact, this is a definition of «plosive» consonants in different terms). On the right-hand side of table A, the Italian spelling of the classified phonetic elements is described, by means of some examples.

The universal alphabet Michela is phonic, therefore, to «photograph[3]» the sound of each word, each phonic element must be represented by the corresponding graphic element (the same concept is at the base of the international phonetic alphabet, in which we do not use combinations of letters to represent a single sound nor letters that represent two sounds); in fact, as can be seen from the illustrative tables, the phonemes corresponding to digraphs in the Italian language (as gl) are not classified or considered as formed by two sounds (such as z and x, both voiceless and voiced); some combinations were also free, for the phonemes of other languages (the articulations panel for the Italian language was purged by the extradental element typical of foreign languages).

The elements of each group were ordered in phonetic progression. The 26 consonants were classified and represented in an articulations panel (table A), according to two directions: the horizontal one, following an ideal progression from left to right, brings the place of articulation from the outside into the vocal organs from which the consonants are generated (lips and tongue); the vertical one bears the articulation way, that is the elements of which the consonants consist (the breath, the modification and the voice).

[3] From Società fonografica Michela, «Spiegazione della tavolozza fonografica, ossia alfabeto universale del prof. cav. Antonio Michela inventore del sistema fonografico universale a mano e della macchina stenofonografica», Ivrea, Stabilimento tipografico Garda Lorenzo, 1887, pagina 26.

There are good reasons to think that the articulation panel is a brilliant anticipation of the international phonetic alphabet, with particular reference to some elements: the classification of vowels in front, central and back, based on the position of the tongue; the way in which the letters representing two sounds are considered (such as z and x, both voiceless and voiced); the graphemes chosen to transcribe the phonemes - invention belonging to the classification of the sounds, summarized in the phonographic palette that we will explain later - deriving from the modification of the structure of the existing letters or from the addition of diacritical marks. In fact, the aforementioned phonograph manual of 1887 was written by the students of Professor Michela, who - in the final part, dedicated to their teacher's thanks - report that the theory behind the phonographic palette was the result of studies lasting about 47 years. The theory of Antonio Michela on the phonetic classification of consonants and vowels is therefore probably ahead of the one that gave rise to the international phonetic alphabet and, on the occasion of the performance of the phonostenographic machine Michela at the 1878 Paris Universal Exhibition, the professor could have illustrated the phonographic theory behind it, inspiring colleagues from across the Alps[4].

[4] The original development of the international phonetic alphabet originated from the English and French phoneticists under the auspices of the international phonetic association founded in Paris in 1886. The general principle of the letters that compose it is to provide a letter for each distinctive sound, as in the Michela theory, without using combinations of letters to represent a single sound (such as gn or gl in Italian) or letters representing two sounds (such as x), with the sole exception of affricates (such as z, c and g in Italian) transcribed with two combined symbols because they are considered as the succession of two indistinct sounds. Most of the symbols were taken from the Latin alphabet, the Greek one and other letters, obtained by modifying the structure of the existing ones (eg ɓ), turning them upside down (ɐ) or adding some symbols (diacritical and suprasegmental signs), following very systematic graphic criteria (the retroflex consonants have a hook at the bottom (ɖ), while the implosive ones have one at the top (ɓ), like the upper or lower "loops" of the Michela phonostenographic alphabet). The vowels are organized according to the position that the language assumes during their production, so that their arrangement takes the form of a trapezium.
Source: https://it.wikipedia.org/wiki/Fonologia_della_lingua_italiana.

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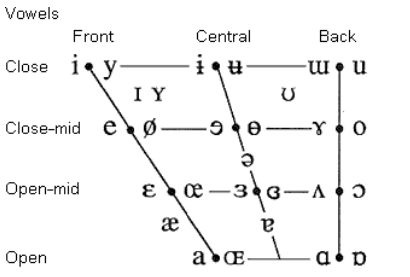
International Phonetic Alphabet (IPA) ˌɪntəˈnæʃn̩əl fəˈnɛtɪk ˈælfəˌbɛt

Consonants (pulmonic)

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



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If we want to proceed to a detailed description of the articulations panel (Table A), in comparison with the IPA, it emerges how, as regards the organs that generate the articulations, the division according to the lips coincides respectively with bilabial and labiodental consonants (while the column on the left, bearing the extradental or lingual-labial, it is a typical feature of foreign languages compared to Italian language); the subdivision according to the language as a place of articulation, in front, central or back position (the latter also called velar) reflects instead the classification of vowels in the front, centrale and back position and the consonants that belong to it correspond respectively to the alveolar and dental, to postalveolar, palatal and alveolar and finally to velar consonants.

The articulations classified according to the elements of which they consist (that is, according to the definition used in modern times, the mode of articulation) is divided into breath, modification and voice. To each phonic element are associated both a number and a graphic sign: the numbers follow a horizontal progression from left to right (then we start from the pure breath articulated by the lips, then from the tongue in the front position, etc.). The extradental elements are overlapped by numbers identical to those attributed to the column reserved for the anterior lingual consonants (with which they are considered in close relationship), but with the affixing of an index by exponent in the upper right corner (almost like a diacritic mark).

[5] From https://www.omniglot.com/writing/ipa.htm

Elements of the articulations		**Organs that generate the articulations**			
		LIPS (Bilabial/labiodental)	**TONGUE**		
			FRONT (Alveolar)	**CENTRAL** (Postalveolar)	**BACK** (Velar)
BLOW (Fricative)	**PURE** (Voiceless)	1 - F [f] Voiceless labiodental fricative	2- S [s] Voiceless labiodental fricative	3- Sc [ʃ] Voiceless postalveolar fricative	4- H [x] Voiceless velar fricative
	MIXED (Voiced)	5 - V [v] Voiced labiodental fricative	6 - s [z] Voiced labiodental fricative	7 - Ge [ʒ] Voiced postalveolar fricative	8 - H [ɣ] Voiced velar fricative
MODIFICATION (Plosive / affricate)	**HARD** (Voiceless)	9 - P [p] Voiceless bilabial plosive	10 - T [t] Voiceless dental plosive	11 - C [ʧ] Voiceless postalveolar affricate	12 - CK [k] Voiceless velar plosive
	SOFT (Voiced)	13 - B [b] Voiced bilabial plosive	14 - D [d] Voiced dental plosive	15 - G [ʤ] Voiced postalveolar affricate	16 - G [g] Voiced velar plosive
VOICE	**NASAL**	17 - M [m] Bilabial nasal	18 - N [n] Labiodental nasal	19 - Gn [ɲ] Palatal nasal	20 - n [ŋ] Velar nasal
	ORAL (Semiconsonant, approximant, liquid)	21 - U [u] / [w] Back close vowel / Velar semiconsonant	22 - R [r] Liquid labiodental trill	23 - L [l] Liquid lateral alveolar approximant	24 j [j] Central close vowel / Palatal semiconsonant
		25 (tedesco) ch [χ] Voiceless uvular fricative	26 (inglese) th [θ] / [ð] Voiceless / Voiced dental fricative		

The first two horizontal rows of the articulations panel show the substantial accompanying elements classified as blowing consonants, i.e. the articulations classified according to the blowing element, which corresponds to the modern fricatives and is divided into pure breath (voiceless fricative), characterized by the trait of being voiceless, and mixed breath (voiced fricative), characterized by the trait of being voiced (the mixed blowers of voice and breath are also called

Phonographic and phonostenographic Michela symbols, by Giulia Torregrossa ((licensed under CC BY-NC-SA 4.0 International on 22/2/19)

"buzzing" because considered similar to the buzz of a hornet (this is the definition of the voiced consonants according to the fantasy of Professor Michela).

According to the organ that generates it, the blow is pronounced by:

- Extradental Position:

    * Pure blow (pure s / English th) (n. 2') = voiceless dental fricative [θ] IPA[6]

    * Mixed blow (n. 6') = voiced dental fricative [ð]

- Lips

    * Pure blow (n. 1) = voiceless labiodental fricative f

    * Mixed blow (n. 6) = voiced labiodental fricative v

- Tongue, in its three positions:

    * In front position:

        . Pure blow (n. 2) = voiceless alveolare fricative s

        . Mixed blow (mixed s, n. 6) = voiced alveolare fricative [z]

    * In central position:

        . Pure blow (French ch, n. 3) = voiceless postalveolar fricative sc [ʃ]

        . Mixed blow (French j, n. 7) = voiced postalveolar fricative Ge [ʒ]

    * In back position:

[6] When the graphic symbol of the international phonetic alphabet is identical to the Italian spelling for that pronunciation, the IPA symbol has not been shown in square brackets.

. Pure blow (French sweet aspirated h, n. 4) = voiceless velar fricative h [x]

. Mixed with voice blow (German strong aspirated h, n. 8) =

voiced velar fricative h [ɣ], pronounciated while laughing[7].

The second pair of horizontal lines of the phonographic palette shows the modifying element (i.e. the articulations classified according to the elements they consist of), respectively hard or rigid (voiceless) and soft (voiced). The hard or rigid modification corresponds to the modern voiceless plosive and affricate (in the following order: bilabial, dental, palatal, alveolar and velar) and the consonants that are part of it took the name of hard or rigid simple modifications of the substantial elements. The soft modification corresponds to the modern plosive and affricate sound (in the same order as above, i.e. bilabial, dental, palatal, alveolar and velar, that we find in the modern IPA classification) and the consonants that are part of it took the name of simple modifying articulations (soft or tenuous). The author considered the consonants to be part of this group according to their role within words, even if in the various languages they are considered consonants too, and therefore he defined them as simple modifiers of the substantive elements of syllable (vowels) and of the accompanying elements of syllable (consonants), because they mark the way the substantial elements begin and end. They are in total 10.

These are essentially the plosive consonants (because they are produced through a momentary occlusion of the phonatory channel, that is followed, with the passage of air, by a sort of explosion, and in fact can also be called stop or oral). While giving a different definition, linked to the close substantial element - because they cannot be pronounced without a vocalic support, unlike the continuant consonants - the professor guessed the characterizing element, i.e. they have no duration, in contrast to the other consonants whose sound «we can keep alive as long as the vocal

[7] A. Michela, «Stenografia Michela a processo sillabico-istantaneo ad uso universale, mediante piccolo e portatile apparecchio a tastiera», Torino, Tipografia Roux e Favale, 1879, page 9.

organs allow us, that is for a time corresponding to the maximum dilatation of the lungs[8]» (such as the fricatives, whose sound can be prolonged, which in fact are also called continuants, the affricates and the liquids, that, according to Professor Michela, all belong to other categories than modification).

According ot the organ that generates them, the simple modifications and modifiers are pronounced by:

- Extradental Position[9]:

    * Hard modification (n. 10') = voiceless interdental plosive [t̪] IPA

    * Soft modification (English sweet th, n. 14') = voiced interdental plosive [d̪]

- Lips:

    * Hard modification (n. 9) = voiceless bilabial plosive p

    * Soft modification (n. 13) = voiced bilabial plosive b

- Tongue, in its three positions:

    * In front position:

        . Hard modification (n. 10) = voiceless dental plosive t

        . Soft modification (n. 14) = voiced dental plosive d

    * In central position (that is to say postalveolar or pre-palatal):

[8] From «Spiegazione della tavolozza fonografica», page 20.
[9] Not having been able to define more precisely this sound present in foreign languages, due to the poverty of the means available at the time, Professor Michela for this sound refers to the living example of the teacher. The IPA symbol approached is therefore only presumed as the most similar to the description of the professor, who speaks of pronunciation with the tip of the advanced tongue outside the upper teeth with firm support.

. Hard modification (n. 11) = voiceless postalveolar affricate c [tʃ]

. Soft modification (n. 15) = voiced postalveolar affricate g [dʒ]

* In back position:

. Hard modification (n. 12) = voiceless velar plosive ck [k]

. Soft modification (n. 16) = voiced velar plosive g [g].

The last three horizontal lines of the palette show the articulations classified according to the element of the voice (oral articulation mode), which is articulated in nasal and oral, depending on whether it is produced in the nasal cavity or is modified inside the mouth.

The nasal semivowels, as substantial elements of accompaniment, coincide with the nasal consonants (modified from the lips, m, or from the tip of the tongue, n); the voices that are modified inside the mouth are equivalent to the semiconsonants and the liquid (lateral and trill alveolar): the first (j, w and ü) has been assigned a double graphic form due to the double role they play (main or simple main elements) substantial elements of accompaniment, that is to say vowels or semivowels) and for this reason are marked in all four shorthand series on the keyboard Michela, as we will see. Other modifications of the neutral voice follow in the oral cavity.

According to the organ that generates them, the modifications that happen inside the nasal or oral cavity can be pronounced from:

- Extradental position[10]:

* Nasal voice: (n. 18', n pronounced with the tip of the tongue in the middle of the incisor teeth) = interdental nasal [n̪] ?

[10] Like before.

* Oral voice (n. 22', r) = [ⱱ̟] dental trill?

- Lips:

* Nasal voice (n. 17) = bilabial nasal m

* Oral voice

. (n. 21) = velar semiconsonant [w]

. Other modifications: (n. 25) [y] French consonant u (see semiconsonants)

- Tongue, in its three positions:

* In front position:

. Nasal voice (n. 18) = alveolar nasal n

. Oral voice (n. 22) = alveolar liquid trill r

* In central position (that is to say postalveolar or pre-palatal):

. Nasal voice (n. 19) = palatal nasal [ɲ]

. Oral voice (n. 23) = lateral alveolar liquid l

* In back position:

. Nasal voice (n. 20) = velar nasal [ŋ]

. Oral voice (n. 24) = palatal semiconsonant [j]

The professor made a distinction, which he considered relevant, between alveolar and veolar nasals, valid both for Italian and French language - the last one is always cited because it was very widespread at the time in the Piedmont Region from which the author originated - with the

following, enlightened description: «Pronouncing the nasal consonant n. 18, the tongue moves towards the palatine and dental parts», what is called the palatine alveolus and which gives its name to the alveolar nasal category; «to pronounce instead the nasal consonant n. 20 the tongue swings and beats against the back of the palate, so that it is not immediately prepared to pronounce the following syllable and is obliged to make a very small effort in the oral cavity, as it happens in pronouncing the following Italian and French words: fungo, ancora, éloquence, soin, ecc[11]».

As already mentioned, there are some letters of the Italian alphabet that do not exist in phonographic writing, as the pronunciation that corresponds to them is composed of two sounds, which are then represented by the juxtaposition of the same number of corresponding graphic signs to them. This is the Italian letter z and the Latin letter x, which can be both voiceless or voiced. The professor perfectly dispelled the sound of the voiceless alveolar affricate [ts], which he defined as a sweet sound, and of the voiced one [ds], which he defined as «confident[12]» sound, without giving such definition, but using some effective examples: «if one considers the correct phonic value of the letter graphically expressed with z, the one who pronounces well will hear, in emitting this sound, first that of the letter d and then that of a sweet s, as if it were written dsolla». The same applies to double z (dozzina = doddsina o pozzo = pottso)[13].

Finally, the digraph gl (corresponding to the liquid palatal lateral marked with the symbol IPA [ʎ]) is not mentioned, but will be introduced at a later time, when it will be attributed to a certain combination of keys on the Michela keyboard.

The elements marked by the numbers 21, 24 and 25 in the numerical demonstrative frame are also found among the vowels n. 3, 6 and 9: since «they perform two different roles in the

[11] «Spiegazione della tavolozza fonografica ovvero alfabeto universale del prof. Cav. Antonio Michela», page 23.
[12] *Ibidem*, page 25.
[13] *Ibidem*, page 26.

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formation of the syllables», they have assigned a double graphic form. It is a group of consonants that sometimes perform the role of substantial main elements of syllable, that is the vowels, and that in later times were defined as semiconsonants (or semivowels) because in reality they have shorter duration than a normal vowel and an intermediate sound between a vowel and a consonant (and therefore it is mainly i and u when they are unstressed and followed by another vowel):

- The Italian vocalic and the Italian consonant, that is to say i and y in the «phonographic palette for the use of the universal alphabet» (number 24 in the numerical demonstration picture), today distinguished by the symbol IPA [j];
- The Italian vocalic u and the Italian consonant u, that is to say u and w in the aforementioned phonographic palette (number 21 in the numerical demonstration table), today distinguished by the symbol IPA [w];
- The French vocalic u and the French consonant u, that is to say  and x in the phonographic palette (marked with the number 25 in the numerical demonstrative table), today distinguished by the symbol IPA [y].

As for the other modifications of the neutral voice in the oral cavity, the professor defines the elements outlined with numbers 26, 26 ', 27, 28 and 29 as «simple vibrations of induction elicited by the larynx and communicated to the modifying organs of the substantial phonic elements of

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accompaniment[14]», referring to the teacher's oral example; so it will only be tested to hypothesize the classification based on modern IPA extensions:

- Number 26: front lingual trill = [ɾ] alveolar trill?
- Number 26': extradental trill or labial lingual = [ʋ] labiodental trill?
- Number 27: labial trill = uvular trill [ʀ] ?
- Number 28: (German velar ch,) = voiceless uvular fricative [χ] ?
- Number 29: labial trill = bilabial trill [ʙ] ?

The vowels (neutral voice decomposed into vowels), in the 1887 manual section dedicated to their «ortoepia[15]» (the correct pronunciation, or spellings, considered both in the oral development of the language and in relation to writing), are identified in the number of 11 (but only 10 concern the Italian language) and the graphic form attributed to them is «pure body». They are marked by a progressive ordinal number too (sub-signed, to be precise, because it is placed underneath them), like the other elements of the phonographic palette, and by a graphic sign. Besides a, e (closed), i, o (open), u, the five vowels of the Italian language, whose spelling corresponds exactly to the pronunciation (respectively sub-signed with numbers 1, 2, 3, 5, 6), we have other signs (for completeness, we hereby present the indication of the phonographic signs indicated below in the phonographic palette):

- c, that is to say French mute e at the end of the words (number 4);
- ə, open e (number 7, that is to say the IPA symbol for the central mid non rounded vowel);

[14] *Ibidem*, page 25.
[15] *Ibidem*, pages 16-18.

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- æ, that is to say the pronounciation of the French diphtongs eu and oeu and of the piedmontese eu (the symbol in fact results from the merger of the open and of the closed e, as it is attributed to a vowel considered to be composed, subtended with the number 8; it corresponds to the IPA symbol of the phonic extension named Latin small letter turned Ae);
- ʏ has the sharp sound of French and piedmontese u (sub-signed bu number 9, that corresponds to rounded close front vowel, marked with IPA y symbol);
- Ò that is to say Italian close o and French narrow o;
- Last but not least, œ, sub-signed with number 11: it has no equivalent in the Italian language, but it similar to the English anomalous u (nowadays marked with ʌ), but IPA œ marks front open-mid rounded vowel.

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3. The universal phonographic palette as a phonetic writing tool

The next step to the classification of all the phonemes pronounced by the human speech, as we have anticipated, was the attribution to each of them a single unmistakable graphic sign. The professor then invented «a handwriting system easy to learn and common to every language[16]», i.e. a phonetic writing method aimed at writing the sounds of any language of the world, even unknown by the writer, and aimed at rereading them after a long time, in order to «fraternize men». Considering the means at the time, this same expression already illustrates the impressive foresight of Professor Michela. This type of writing, in the intentions of the author, would also prove to be very useful to facilitate the learning of foreign languages and their language for elementary school children: let us not forget, in fact, the professional and cultural matrix of Professor Michela, who was just an elementary school teacher.

The graphic sign attributed to each phonic element was schematized in the «universal phonographic palette», whose name is strongly evocative of an analogy with painting: the phonic elements of each syllable draw upon it the relative graphic productions, as a painter makes from the palette with the colors needed to paint a picture. It is a sort of synoptic framework that, reflecting the same pattern with which the classification of sounds was organized in the articulations panel and in the numerical demonstrative picture, orders the phonic structure generated by human vocal organs and harmonizes it with the shape of the letters, in order to have a universal manual spelling in phonetic mode.

The graphic representation chosen is defined as the «conventional form of the letters visible in the Michela palette[17]» and has at its base rigorous logical reasons to be precisely that one and not another. From a purely graphic point of view, as it is evident at a first glance at the table, the body

[16] *Ibidem*, page 9.
[17] *Ibidem*, subtitle of Part III, Chapter I.

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of the graphic signs consists either of the sign c (for the extradental elements of foreign languages) or of numerical figures, ranging from 1 to 4 and «they indicate the part of the apparatus of the articulations where the phonic element is modified, or where the modifying organs communicate the modifications attributed to them[18]», marking respectively the place of articulation of the lips (1) and of the tongue, in the three positions: front (2), central (3) and back position (4). These numerical digits and the c of the extradentals - which form the body of the 36 non-vocal letters, to which other distinctive elements are added - have the same height as the 11 vowels (placed separately from the consonant table), thus the body of all the letters has the same height. The graphic signs corresponding to the vowels consist of only one part, the body, without the addition of further signs (unlike the other non-vocal letters), therefore their height is equal to the body of the other letters: the height of the consonants instead it is by convention double compared to that of vowels, because they bear a straight line above or below their body, while that of simple modifications is triple compared to that of vowels, because they bear a straight line both above and below their body.

While the 11 vowels are divided by the respective ordinal numbers, from 1 to 10, the other graphic signs indicating the non-vocal letters (consonants, semiconsonants and modifications) are supersigned by a figure placed at the right apex (which is the same attributed to same positions in the numerical demonstration or in the table of articulations), which makes it easier to identify and name them: the numerical digits that accompany the graphic signs follow a horizontal order for groups of four, starting from the labials; the extradentals bear the same apical ordinal numbers as the previous linguals, with the addition of an apostrophe or an apex («overlapping index») next to the number; this way, the elements forming part of the same vertical column dedicated to a place of articulation will follow a numerical progression that goes from four to four.

[18] *Ibidem*, page 28.

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Looking at the vertical columns of the palette, at first glance there is immediately a visual impression of great mathematical order, from which the simplicity, but also the genius of the system, are revealed. In the first vertical column on the left, dedicated to the anterior extradental or labial lingual elements - which are modified outside the incisor teeth, the tongue and the upper lip - the body of the letter, as we have said, consists of a c.

In the following four vertical columns, proceeding from left to right, bearing the phonic elements respectively generated by the lips and the tongue, in the three positions front, central and back, the body of the graphic elements is characterized respectively by the ordinal numbers 1, 2, 3 and 4, which are differentiated by the affixing of projections, which indicates the nature of the elements (i.e. the articulation mode, if deriving from the breath, the modification or the voice). These protrusions may be rectilinear or curvilinear, underneath or above straight lines in the upper part or in the lower part of the line, in turn sometimes bearing a sort of loop, as a diacritical mark, in an upper position (which in the mixed blow and in the soft modification indicates if the sounds are voiced) or in the lower position.

At a first glance of the graphic element, the phonetic nature is immediately understood and therefore the pronunciation: seeing the body of the letter bearing the number 3 we will know that it is an average lingual consonant; seeing a straight vertical line above the body of the letter we will know that it is a pure blowing consonant and if that straight line also bears a final loop we will know that it is a mixed or buzzing consonant.

To a horizontal analysis of the lines in which the phonographic palette is divided, the criteria underlying the choice of the different protrusions applied to the body of the non-vocal letters will appear immediately clear. The first four horizontal lines (relative to pure and mixed blowers and to modifications and modifiers) have in common a superior projection (straight upward appendix). In

the first and third rows (pure blowers and simple hard modifications) this upper protrusion has a rectilinear shape, which indicates they are voiceless. In the second and fourth (mixed blowers and soft modifiers) the upper protrusion has a curvilinear shape (a straight line with a sort of final loop), which indicates they are voiced.

The modifications also have a lower projection, so they have a double projection, which is straight for the voiceless sounds (double rectilinear projection) and curvilinear for the plosive voiced sounds (double curvilinear projection). There is no matching of a straight projection and a curved projection in the same graphic sign. «The double straight projection marks the way the substantial element begins or ends - and we are talking about both the principal or the accompaniment element of a syllable, but never about the substance of it - and still indicates that said element must begin with a sharp click when it precedes the modified element, and with a similar truncation when it follows[19]»: these are the voiceless plosives (and the voiceless postalveolar affricates). «The letters marked with the double curvilinear projection also indicate that the respective role is to make a click or truncation» depending on whether they precede or follow the vowel, «but somewhat softer and tender»: here are the voiced plosives (and the voiced postalveolas)».

The graphic signs corresponding to the articulations of the voice have lower protrusions. The rectilinear inferior projection («rectilinear descending appendix») «expresses the transformation in nasal form of each of the ten voices called vowels and inversely the transformation of the nasal voice into one of the ten vowels», according to whether the nasals respectively follow or precede the vowels. These are the substantial accompanying elements (nasal voices) that today we call nasals (bilabials, alveolars, palatals or velars, depending on the place of articulation, lips or tongue, always according to the known progression from the left to the right-

[19] *Ibidem*, page 29.

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hand side). The curvilinear inferior projection characterizes the simple modifiers, soft or tender: «the letters indicated by the common curvilinear appendix below indicate that the marked elements are simple voices modified inside the mouth» (they are the semiconsonants and the liquids).

Other ancestors of the diacritical signs are also the different symbols applied to the body of the other modifications of the voice in the oral cavity indicating the sounds of foreign languages («lower protrusions in the guise of bow and tail[20]»). The trills (marked by the order numbers 27 and 28) have an arch-shaped underlying protrusion, while the vibratings have a protrusion with the form of a tail (marked by order numbers 26, 26 'and 29): both indicate changes in the neutral voice in the oral cavity and «they express induction vibrations caused by the larynx, the organ that produces the neutral voice».

Following, the adaptation of the phonographic palette for the Italian language, from which the first column was eliminated, relating to the extradental, a typical feature of some foreignlanguages:

[20] *Ibidem*, page 30.

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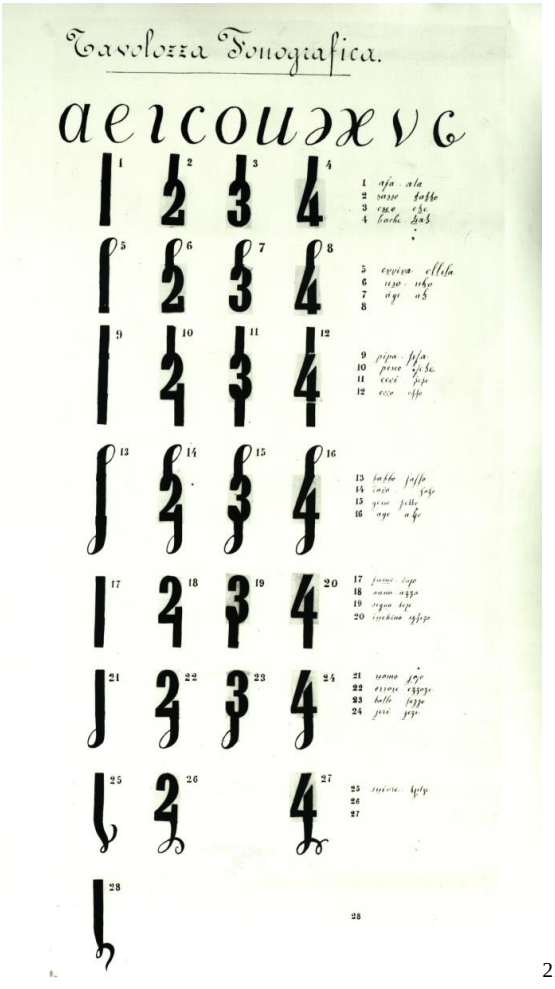

21

[21] Photograph from the private archive of the Michela Zucco family. As can be seen from the examples of the words, on the right, written in the phonographic mode, the Professor established the arrangement of the phonic elements within the syllables in order to transcribe them simultaneously in the manner in which they are written in the ordinary system in straight lines readable from left to right.

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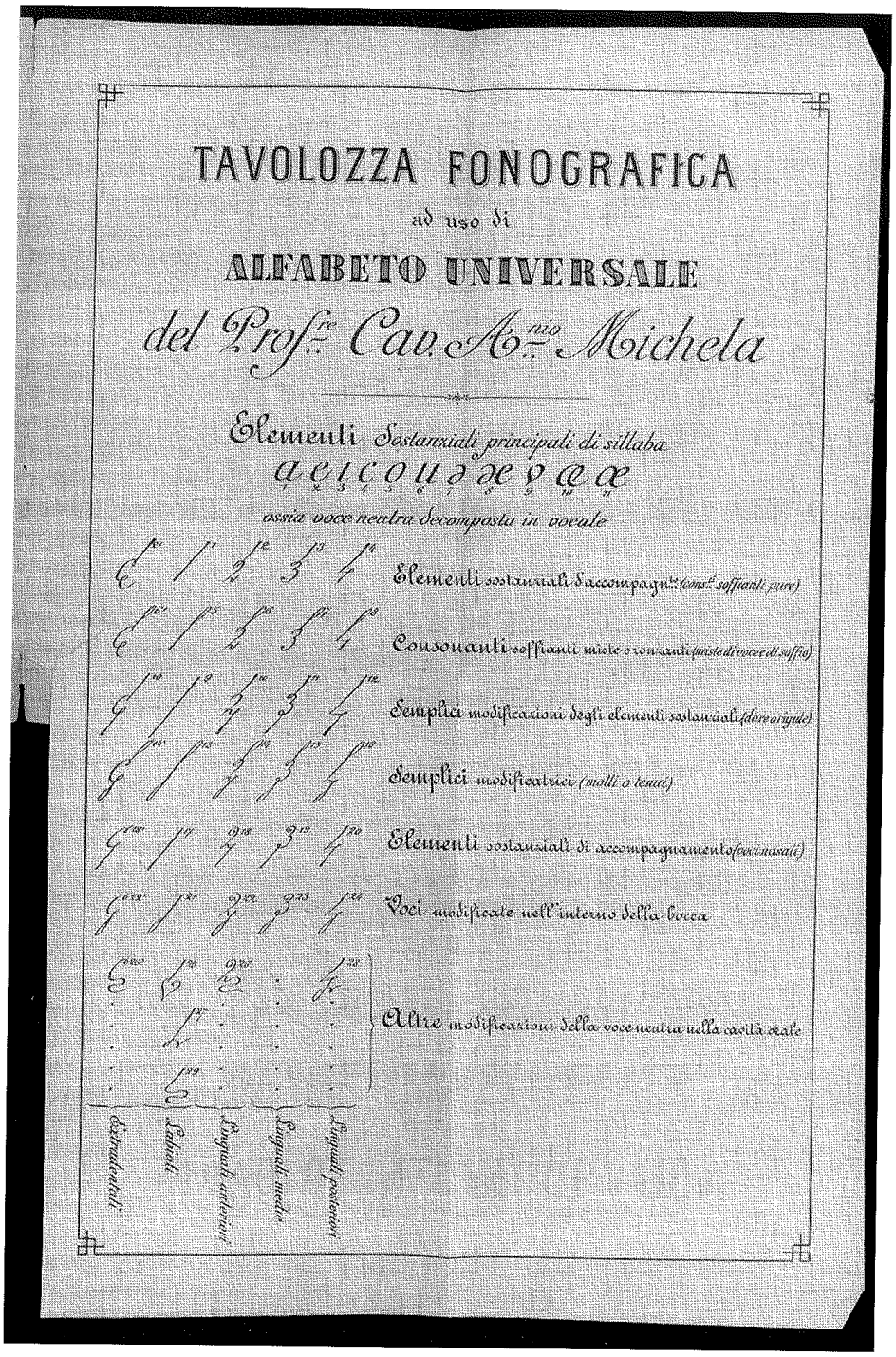
Here is the complete palette of graphic symbols with extradental sounds:



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4. The Michela keyboard, first shorthand machine, and the stenotypic signs

Having classified and schematized the sounds reproducible by the human vocal apparatus, the Professor sought a practical application for his studies, devising a system - both manual and mechanical - able to transcribe and then reread such sounds that were universal, therefore valid for all the languages of the world. The study of the phonographic palette and that of the phonostenographic system proceeded in parallel and the first was perfected and continued by his students, in particular by Vincenti. The oldest Michela phonostenography manual we hold, by Professor Michela himself, dates back to 1879, while the first written encoding of the theory behind the phonographic palette is owed to his student Vincenti and dated to 1887.

Thus was born the idea of «replacing the hand ... always imperfect, with the mathematical logic and the punctuality of a perfect machine[22]», which served to capture and imprint the instantaneous and synchronic graphic reproduction of all the phonic elements contained in each syllable pronounced by human organs, for stenographic use. Being the syllable the fulcrum of the Professor's studies, the novelty constituted by the machine was precisely the fact that it allowed to type more than one sound simultaneously[23] - then all the sounds of one or more syllables simultaneously - «in the very same instant when you would mark a dot», as if they were playing chords on a piano[24]». In fact the Michela machine is a chord keyboard.

This made it possible to reach great speeds, sustaining the rhythm of speech, making the work of the stenographer easier and faster. Here then is the origin of the «Michela syllabic-instantaneous process for universal use, through a portable keyboard device», which was exhibited

[22] A. Michela, «Stenografia Michela a processo sillabico-istantaneo ad uso universale, mediante piccolo e portatile apparecchio a tastiera», Torino, Tipografia Roux e Favale, 1879, page 3.
[23] *Ibidem*, page 5.
[24] From this musical instrument, in fact, the keyboard has borrowed the layout, also because it was easy to find and relatively inexpensive to build at that time, resulting very ergonomic and composed of the lowest number of keys (only 20) compared to the other steno keyboards invented after, which on average had and still have around 24.

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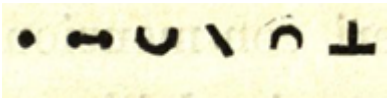
for first time in 1863 in the Brera Palace of Milan on the occasion of the third Italian Pedagogical Congress and then on the Universal Exhibition of Paris in 1878.

The aims of the author were therefore mainly two, one mediated and one immediate: to have a very rapid means of writing to overcome manual stenography, considered not sufficiently precise; to introduce the idea of the universal alphabet, which represented with scrupulous regularity all the phonic elements indispensable to represent any syllable of any language. But there was a third one, no less important: to have a device that would help disability, especially for the visually-impaired (thanks to the strip of paper produced by the machine, which was first impressed by relief punches and not printed in ink[25]).

The machine produced a strip of paper on which a line was punched for each syllable or numerical frame (therefore a horizontal line, perpendicular to the same strip of paper and equidistant with respect to the others), readable from left to right.

In the original project, the signs adopted, in number of six, as well as the apparatus, could have varied infinitely in shape, but still produce the outcome of the discovery (and indeed, around the 80s of the last century, such signs graphs were decrypted and turned into letters).



The inventor then combined six numbers (1, 2, 3, 6, 9, 18) to the aforementioned graphic signs: with these numbers, variously combined and repeated, he obtained all the necessary combinations to cover the sounds classified in the table of the joints.

[25] «This mode of representation ... has not yet been observed or put into practice by anyone» (*ibidem*, page 6): the professor had no news of other scholars who, probably in the same years, were working on other stenotypical chord keyboards in others Countries of the world, so if it is difficult to say with certainty that the Michela was the oldest stenotypic keyboard, it was surely one of the first.

He combined these signs or numbers adopted in the invariable manner indicated in Table I, originally written in French, which forms the main basis of the process, so that they could be rapidly handled on the keyboard by the ten-fingered stenotypist.

Having classified the articulations according to the organs from which the sounds are generated and given a numerical value to the phonic elements classified in the articulation panel (table A), the next step was to establish the position of the phonic elements in the syllable, in order to impress them simultaneously and reread them from left to right.

As for the translation of the theory into practice, to find a material arrangement of the sounds to be transcribed on the keyboard and to establish a correspondence between them, the author gathered the phonic elements into four series, arranged from left to right on the keyboard, according to the direction in to which western languages are written and read (1st, 2nd, 3rd and 4th series).

The keyboard is divided into two almost perfectly symmetrical half keyboards, which are both divided into two series: since in any syllable the main element is the vowel, the 3rd series was assigned to the vowels, placed in the right-hand half keyboard, while the other three were assigned to the elements of accompaniment of the vowel. Hence in the 1st, 2nd and 4th series there are the consonants, that is, the elements of accompaniment of the vowel, depending on whether they are respectively placed at the beginning, in the middle or at the end of the syllable; the 1st series is symmetrical to the 4th (as if they were at the mirror) according to whether the same consonants are at the beginning or at the end of the syllable; the 2nd series is occupied by other consonants and semi-consonants (i and u, as well as liquids, very useful for writing consonantal groups or abbreviations that require the elimination of an internal vowel). The 2nd and 4th series are therefore symmetrical only for the position of i and u (which however in the 2nd series play the role of

semiconsonants when they precede the vowels of the 3rd series). In fact, i and u, by virtue of their dual role, are the only two letters to be represented in all four series.

In Table I, the author schematizes with mathematical precision the phonetic symbols and the numbers attributed to each phoneme previously classified and attributes to them a position on the keyboard with a logical and linear reasoning, which immediately makes clear the reason for the placement of each element in a precise position. The table was written in French because that language was very popular at the time, like English today, and thus the translation costs could have been saved.

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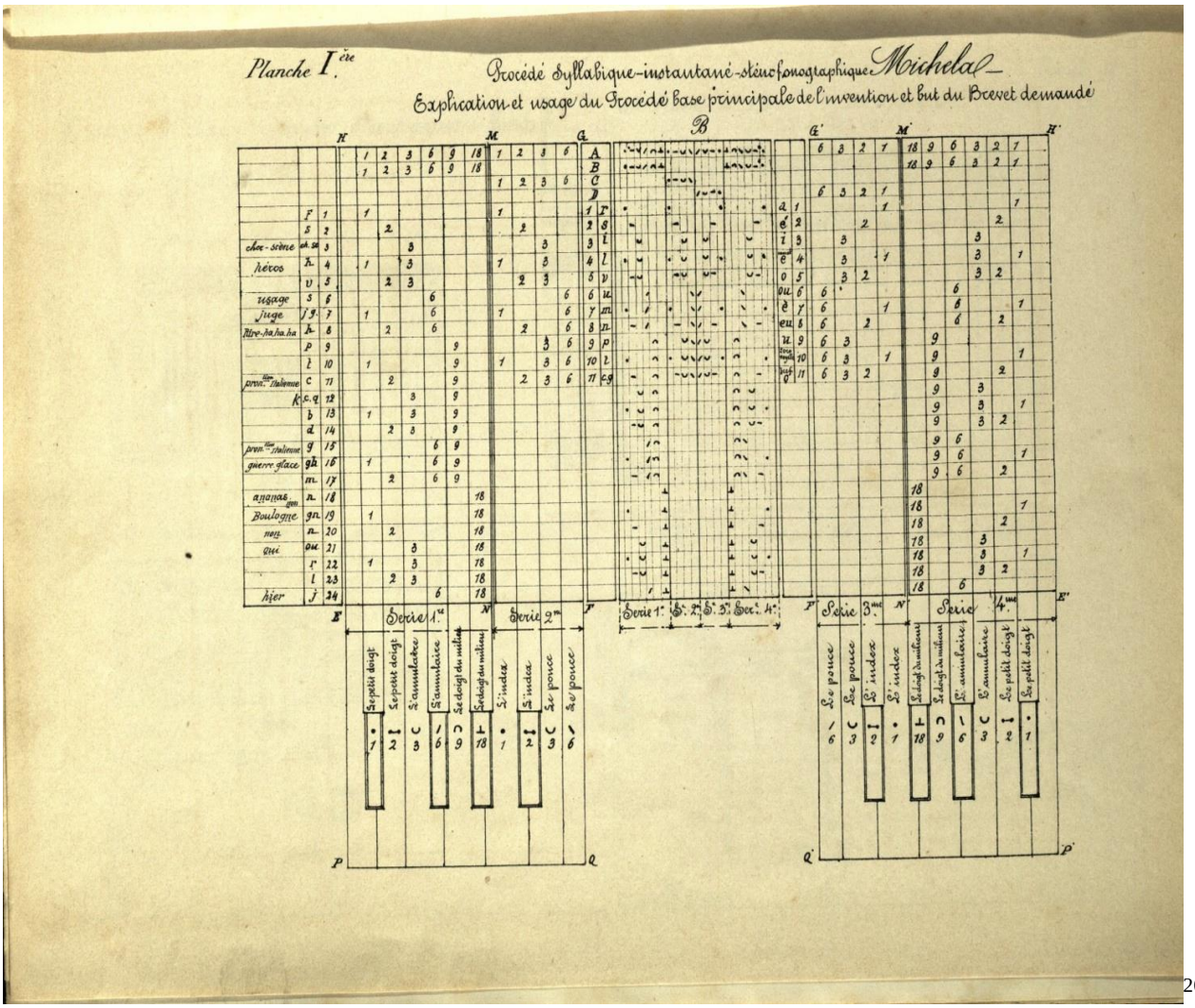

[26]

The lower part of the graph shows the two symmetrical half keyboards, named respectively EFPQ, the right one, and E'F'Q'P ', the left one. On the top of each key is indicated which finger competes it: as to the position of the hand, to each finger compete always and only the same two keys (one white and one black), but never both at the same time in a combination (with the exception of the thumb, the only finger to which two white keys compete, then the movement that must perform - logically, given its position with respect to the other fingers - is horizontal, and only that finger that can also press a third white key, performing a further shift and slipping under the index finger, in an extra-ordinem bar that allows the very useful combination ea). All the other

[26] A. Michela, «Stenografia Michela a processo sillabico-istantaneo ad uso universale, mediante piccolo e portatile apparecchio a tastiera», Torino, Tipografia Roux e Favale, 1879.

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fingers then perform a very small movement on the keyboard - longitudinal, i.e. from top to bottom, so that the position of the hand does not change - and this makes it unnecessary to look at it while writing, thus allowing to use the blind transcription mode: this minimum movement is aimed at obtaining the maximum speed[27].

Above the indication of the fingers, on the drawing of the two half keyboards, the four shorthand series are reported, in order to clarify their position on the keyboard. They are arranged symmetrically, although the 2nd and 4th series, as previously explained, are not entirely identical. The 1st and the 4th series, the external ones, are greater, since they bear six signs each (1, 2, 3, 6, 9, 18 and, symmetrically, 18, 9, 6, 3, 2, 1); the 2nd and 3rd instead are minor, internal and bear four signs each (1, 2, 3, 6 and 6, 3, 2, 1).

- 1st series: consonant before vowel (syllable main element) or before another consonant (that can be preceeded by the so called impure s):
    - 1 = f, 2 = voiceless s, 3 = sc, 6 = voiced S, 9 = p, 18 = n
- 2nd series: second consonantic element of the syllable (preceeded or not by the so called impure s) and followed by a vowel (then liquids, nasals, dentals, bilabials and semivowels):
    - 1 = r, 2 = s, 3 = i, 6 = u
- 3rd series: vowels:
    - 6 = u, 3 = i, 2 = close e, 1 = a (those two are different from the 2nd series)
- 4th series: consonantic element following the vowel:
    - 18 = n, 9 = p, 6 = voiced S, 3 = sc, 2 = voiceless s, 1 = f

[27] *Ibidem*, page 10.

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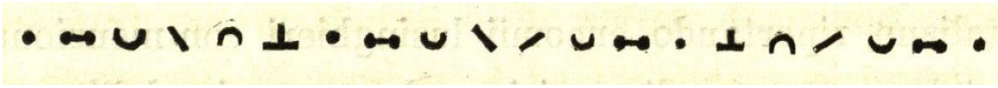
At the center of the diagram, between the tables corresponding to the two half keyboards, there is the reproduction of the facet-like of a central stenographic strip in natural size, clarifying the position of the stenographic signs adopted in each of the four series, in line B (1st and 4th series), in line C (3rd series) and in line D (4th series), corresponding to the numerical and phonic values, which are on the sides and correspond, respectively on the left and right, to the 2nd and the 3rd series.

Also in the lower part of the graph, on the two symmetrical half keyboards, in addition to the fingers of competence, there are also marked the stenophonographic symbols and the respective numerical values attributed to them. The graphic symbols appear in the stenoscript in substitution of the alphabetic figures and letters: the reason for this choice lies in the need of the maximum simplicity both for a universal shorthand process and for the typographic means available at that time. Here we have the graphic symbols arranged in horizontal line, in number of twenty, as many as the keys of the machine, and the corresponding numerical values attributed to them, in Arabic numbers (see line A of the "list B", the shorthand strip, at the center of the scheme):



1 2 3 6 9 18 1 2 3 6 6 3 2 1 18 9 6 3 2 1

At the top of each half keyboard is shown the corresponding table, containing «the fixed combinations adopted ... for the representation of the phonic elements». The phonic elements in the two specular tables are the same as in the articulation panel, but are placed vertically, and not in horizontal rows, bearing four elements at a time: looking at the third column from the left, in fact, you can see the various corresponding letters of the Latin alphabet (starting with pure and mixed

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blowers), arranged vertically, placed side by side in the adjacent column by the numerical values attributed to them in the numerical demonstrative picture, arranged in progressive order (1, 2, 3, 4 ...); therefore, to be clear, the pure labial blower f always corresponds to the number 1, in each table and therefore also on each of the two half keyboards.

By combining the six simple signs from the 1st and the 4th series in various ways, all the 24 phonic elements obtained from the articulations panel are obtained (and the corresponding numerical values, which are also attributed to them in the numerical demonstration table). The numbers that require two keys to be formed are 12 (4, 5, 7, 8, 10, 11, 12, 15, 19, 20, 21, 24) and those that require three are six (13, 14, 16 , 17, 22, 23). The unions are shown in the graph in the column called HMNE, from the four letters which mark the angles, and in the respective H'M'N'E ', on the opposite side, which bear the numerical values to be added to obtain the result: sum of these unions - which include up to three keys to press simultaneously - is shown in column HE:

- 4 = 1 + 3 ... voiceless h = f + sc
- 5 = 2 + 3 ... v = voiceless s + sc
- 7 = 1 + 6 ... j = f + voiced S
- 8 = 2 + 6 ... voiced h (later z) = s + voiced S
- 10 = 1 + 9 ... t = f + p
- 11 = 2 + 9 ... sweet voiceless C = s + p
- 12 = 3 + 9 ... hard c = sc + p
- 13 = 1 + 3 + 9 ... b = f + sc + p
- 14 = 2 + 3 + 9 ... d = voiceless s + sc + p
- 15 = 6 + 9 ... sweet voiced G = voiced S + p
- 16 = 1 + 6 + 9 ... hard voiced g = f + voiced S + p

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- 17 = 2 + 6 + 9 ... m = voiceless s + voiced S + p
- 19 = 1 + 18 ... gn = f + n
- 20 = 2 + 18 ... velar n (later gl) = voicedless s + n
- 21 = 3 + 18 ... u = sc + n
- 22 = 1 + 3 + 18 ... r = f + sc + n
- 23 = 2 + 3 + 18 ... l = voiceless s + sc + n
- 24 = 6 + 18 ... i = voiced S + n

Please note how in most cases the chosen combinations are not random or arbitrary, but are at the base of the chosen phonemes because they appear as the closest to the final sound (j = f + voiced S). The sum of several graphic signs in the same series always indicates a single phonic element resulting from their sum and never two or more phonic elements or different numbers.

In fact, even the numerical triples are instantly marked as the syllables, followed by their denomination (thousandths, thousands or millions): the first series corresponds to the hundreds, the 2nd to the tens and the 4th to the units, while there will be no elements in the 3rd series, indicating that it is not a syllable (since the founding element is its vowel), but of a numerical triad. The lack of signs in a series indicates the presence of zero.

The pre-established unions of the simple signs of the two minor series (2nd and 3rd) form 11 numerical values each (and consequent phonic elements), as can be seen from the rectangle MGFN and the homologous M'G'F'N '. Regarding the 2nd series, in the column GF we read the numerical value, on the left, and the corresponding letter on the right; for the third series, in the G'F 'column are the vowels, on the left, and the numerical values on the right, which are the same as the column GF. In the 2nd series:

- 1 = r

- 2 = voiceless and voiced s
- 3 = vowel and semivowel i
- 6 = vowel and semivowel u
- 4 = 1 + 3 ... l = r + i
- 5 = 2 + 3 ... v/f = s + i
- 7 = 1 + 6 ... m = r + u
- 8 = 2 + 6 ... n = s + u
- 9 = 3 + 6 ... p/b = i + u
- 10 = 1 + 3 + 6 ... t/d = r + i + u (if i + u = p, then t = r + p, but in the 1st series = f + p)
- 11 = 2 + 3 +6 ... both sweet and hard c = s + i + u (= s + p as int the 1st series)

Please notice how in the 2nd series a combination is valid both for the voiceless and for the voiced sound (labial, dental, velar) and as the numbers attributed to some phonemes correspond in the 1st and 2nd series (v = 5; p = 9; t = 10; c = 11), as some numerical sums are always the same (4 = 3 + 1; 5 = 2 + 3; 7 = 1 +6; 8 = 2 + 6) or as some symbols correspond in both series (s = 2 = the colon).

Regarding the 3rd series:

- 1 = 2
- 2 = open e
- 3 = i
- 6 = u
- 4 = 3 + 1 (mute e, or i + a)
- 5 = 2 + 3 ... o = e + i (same sum for v = 5 in 1st and 2nd series, where the fingers position too is the same than in the 3rd series)

Phonographic and phonostenographic Michela symbols, by Giulia Torregrossa ((licensed under CC BY-NC-SA 4.0 International on 22/2/19)

- 7 = 6 + 1 ... è = u + a
- 8 = 6 + 2 ... eu (later ue) = u + e
- 9 = 6 + 3 ü (later diphtong uo) = u + i
- 10 = 6 + 3 +1 zero vowel (later diphtong ua/uia) = u + i +a
- 11 = 6 + 3+ 2 ... close o (later diphtong ui) = u + i + e.

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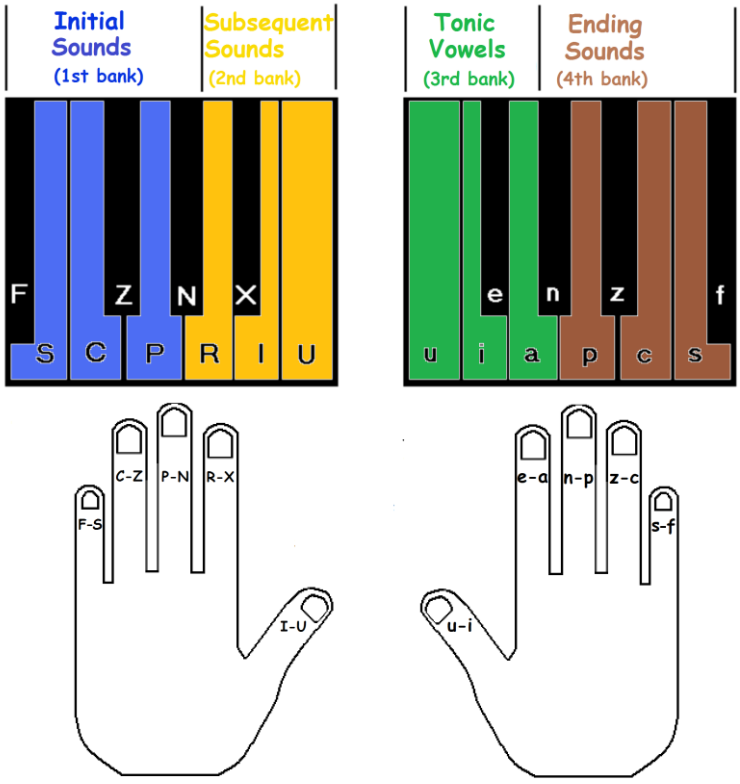
5. **The decryption of the original signs: the letters**

Finally, the following diagram illustrates the arrangement of the four series on the Michela keyboard, bringing the decryption of the original symbols, made in the modern era (around the 80s of the last century) to facilitate the keyboard interface with the computer:



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