PALATOGRAPHY AND SPEECH IMPROVEMENT*

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INTRODUCTION

The object of this study is to determine whether there are fixed and definite tongue-palate contacts for various sounds, which may be utilized in speech improvement. Previous experimenters—Rousselot, Scripture, Panconcelli-Calzia, Navarro-Tomás, and others—would, through their publications, lead one to believe that certain sounds have a definite pattern of tongue-palate contact, regardless of individual differences, or other factors, among subjects. L'Abbé Rousselot thought that brogue might be corrected by differences in tongue position. James L. Barker, in his article, "Correcting the Mechanism Causing Foreign Brogue," mentions the above fact, but maintains that during a period of five years Rousselot did not have a single success in eliminating English brogue in the pronunciation of French.[1] If the claims of Rousselot and other earlier phoneticians were true, palatography would be an invaluable aid in speech improvement instruction.

James L. Barker thinks that the important factor in pronunciation is movement.[2] He is practically alone among phoneticians, however, for the rest seem to consider position as the major if not the sole factor. Navarro-Tomás is probably representative of these. In his *Manual de Pronunciacion, Española*, he speaks, it is true, of American pronunciation of the Spanish final *z's* and *s's* as having excessive force and duration, but makes no comment on how one goes into position or out of position. By and large, his general view is probably best represented by his discussion of the *t*. He mentions that the point of articulation of the French *t* is lower than that of the Spanish *t*, and

*The palatographic material for this study is derived from a thesis, *Palatography—A Critical Study and Analysis of Contacts*, which was completed under the direction of Clarence L. Meader, John H. Muyskens, Leon L. Strong, Hide Shohara, Louis M. Eich, in partial fulfillment of the requirements for a Ph.D. degree in the Horace H. Rackham School of Graduate Studies, of the University of Michigan, June, 1936.

[1] *Journal of Speech Disorders*. September, 1937. p. 165.

[2] "Thus the difficulty (overcoming brogue) is one of habit, not of taking certain positions or maintaining them, but of movement in relation to breath-control; it is a difficulty that concerns, not static phonetics, but dynamic phonetics." "Correcting Foreign Brogue," *Journal of Speech Disorders*, March, 1936. p. 11.

that the German and English *t's* are articulated farther up against the gums and alveolar ridge, which, added to the aspiration which ordinarily accompanies the voiced occlusives, gives to the *t* a timbre which is quite different from that manifest in Spanish,[3] and he accompanies his observations by a palatogram of one Spanish *t* of one subject, leaving the impression that this would be characteristic of all. He makes no reference, however, to movement; his work is purely of a static nature.[4] He states that in order to pronounce the Spanish *t* as differentiated (moving away) from the English *t*, it is necessary on the one hand to advance the point of the tongue more than one centimeter toward the teeth, and on the other to cause the explosion of the consonant to be free and clear (limpia y sonora) without any friction or aspiration whatsoever.[5] He has not dealt with the length of the *t*, as it is moved into or out of position; and he apparently believes that in palatography position is the prime factor.

Sir Richard Paget believes that differences in consonants are of a harmonic nature.[6] Henry Sweet mentions the "on glide" and

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[3]"A la especial posición adoptada conjuntamente por dichos órganos en el momento de producir un sonido, se le llama articulación; al movimiento . . . también; pero en el presente libro esta palabra va siempre empleada en la primera de ambas aceptiones." p. 16–17, 4th edition. Madrid, 1932.

[4]In one instance (*Manual de Pronunciacion Española*, 4th edition, 1932, p. 96) in his discussion of *t* and *d*, Navarro-Tomás shows in median sagittal section the tongue tip touching the alveolar ridge and gums; while the corresponding palatogram shows the tongue touching completely around the outer edge of the hard palate. This is characteristic of his treatment without consideration of the movement to and from position of articulation.

See Plate II (*t* and *d*) of this study for a comparison of tongue positions for the articulation of the American *t* and *d*.

[5]In speaking of foreign brogue in the pronunciation of a *t*, his sole statement is: "La *t* francesa tiene su punto de articulación un poco más arriba que la española. La punta de la lengua en la *t* francesa no toca los bordes de los dientes. La *t* alemana y la inglesa se articulan aún más arriba que la francesa, contra las encías y los alvéolos, lo cual, unido a la aspiración que en estos idiomas acompaña ordinariamente a las oclusivas sordas, da al sonido de la *t* un timbre muy distinto del que presenta en español. La *t* inglesa con su articulación alveolar o postalveolar es la que más se aparta de la nuestra. Especialmente en aquellos casos en que va agrupada con una *r* siguiente, en palabras como *cuatro*, nuestro, tropa, etc., la *t* que pronuncian los ingleses y los angloamericanos llega a presentar un sonido completamente extraño a la pronunciación española normal.

"Entre los defectos de pronunciación que los extranjeros necesitan evitar para hablar español correctamente, el que se refiere al punto y al modo de articulación de la *t* es uno de los más importantes. Para pronunciar la *t* española, partiendo de la *t* inglesa, es necesario, de una parte, hacer avanzar la punta de la lengua más de un centímetro hacia los dientes, y de otra, hacer que la explosión de la consonante resulte limpia y sonora, sin fricación ni aspiración perceptibles. *Manual de Pronunciacion Española*, 4th edition. Madrid, 1932. pp. 97–98.

[6]"Consonants are due to resonance like the vowels; but inasmuch as they are produced by movements of the vocal organs (like diphthongs) their resonances are characterized not only by pitch, but also by their change and rate of change in pitch. The consonants are all made by a complete or partial closure of the front or back orifice of the front resonator of the series which produces them. In every case there are more than two resonators in action." *Human Speech*, pp. 124–125.

"off glide" of voiced consonants between vowels, or the movement into position and the movement out of position[7] but he, too, is most concerned with the position itself.

Dr. G. Oscar Russell believes, as does Barker, that other factors besides tongue position may be involved. At least in one case he refers particularly to type of tongue movement.[8] More recently, he, in conversation with the author, has summarized the various factors he would consider as being vital, as follows:

(1) length of time the consonant is held,
(2) the way one moves into position,
(3) the way one moves out of position,
(4) the amount of breath pressure behind the consonant,
(5) position of the vocal organs,
(6) types; whether voiced or unvoiced, occlusive, fricative, affricative, nasal, or liquid.

All of the preceding information is of interest to the author and reader because our present study seems to show that there is no fixed tongue position for any given sound made even by a single individual at various times, much less by different people in the same language group. It tends also to substantiate Barker's statement that foreign brogue depends for its correction upon "changes in habits of movement and breath-control indicated and none of them may be corrected by a system of phonetics based on a study of static positions alone."[9]

This study involves two palatography projects. The first project was carried out in a class in dynamic phonetics at the University of Michigan in 1933 under the direction of Dr. John H. Muyskens, now Director of the Horace H. Rackham Clinic. This project later became the first of three projects of a doctoral thesis.[10] The second project involves a group of palatograms made by means of a new technique for the thesis study.[11] Both projects tend to prove that there is not a static position of the tongue for the pronunciation of certain sounds.

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[7]"Such a word as *cat* consists not only of the vowel and the two consonants of which it is made up, but also of glides or positions between these sounds. The glide from the initial consonant to the vowel consists of all the intermediate positions through which the tongue passes on its way from the *k* position to that of the æ. The number of these positions is infinite; but they are all implied by the mere juxtaposition of the symbols of the fixed sounds, it being assumed that in all transitions from one position to another the shortest way is taken." *Sounds of English*, p. 54.

[8]"The Pronunciation of the Spanish *R*." *Modern Language Journal*, III: 174–184, 1919.

[9]"Correcting the Mechanism Causing Most Foreign Brogue," *Journal of Speech Disorders*, March, 1936. p. 12.

[10]See author's thesis, "Palatography—A Critical Study and Analysis of Contacts," unpublished, in the University of Michigan Library, 1936.

[11]This project was designated as two projects in the thesis (Projects II and III).

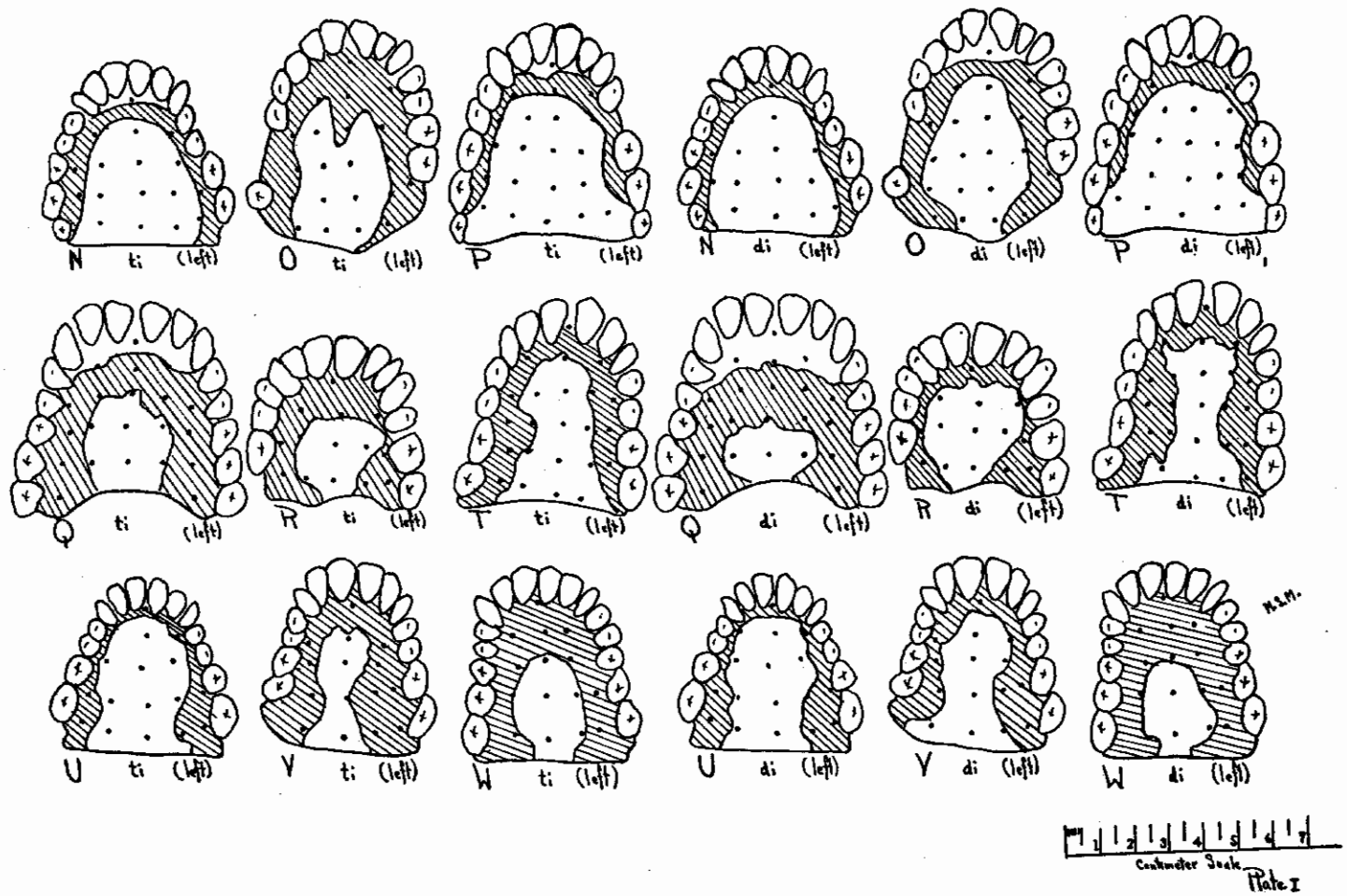
APPARATUS AND PROCEDURE

Palatograms for the first project were prepared according to the method then current in the University of Michigan Speech Laboratory. With Kerr's Impression Compound an impression of the hard palate was made. This impression was boxed with boxing wax; and into the bowl thus formed was poured a mixture of Castone (plaster preparation). Into the palate of the cast was swedged a square of ash metal No. 7 until the metal assumed the contour of the palate; then the metal was trimmed off around the teeth of the cast. Next the artificial or pseudo-palate was painted with jet-black enamel. By placing the pseudo-palate hollow-side-downward upon a piece of cardboard, an outline was made of the palate area. This outline of the pseudo-palate, cut from the cardboard, formed the pattern for prints of the pseudo-palate to be made on oil-skin tracing paper. Numerous sheets containing this outline, or pattern, of the palate were prepared. On the enameled surface of the pseudo-palate unscented talcum powder was dusted, the palate was inserted into the mouth, the sound articulated, and the pseudo-palate hastily but carefully removed. This tongue-contact picture was quickly drawn upon the palate-print on the prepared sheets of paper. That part of the palate on which the powder remained was blackened with pencil in the picture. After the tongue contact had thus been transferred to the paper, the sound symbols were written on the reverse side of the paper. It was from this side that the sheets later were blue-printed. In this manner the resulting blue-print pictures were identical with the tongue-contact pictures appearing on the pseudo-palate. This procedure was followed by each individual participating in the project.

In this present form of the study, I have included Russell's additional technique of an exact centimeter measurement plan for showing on a flat surface the perpendicular arch of the palate.[12] Accordingly, a base-plate model of the hard palate was made.[13] Beginning at the median line of the palate, I marked off the entire palate surface by a series of pin-holes. These dots were located along parallel and right angle lines at intervals of one centimeter, thus blocking the whole off into units of one square centimeter. The palate then was turned over, a paper was placed on top, and the light shining through the pin-holes allowed me to trace the dots on paper. The result, with the dots in this arrangement, gives one an idea of the arch and the irregularities of the palate, because wherever the palate surface slopes the dots will be less than one centimeter apart, how much less being dependent upon the steepness of the slope. After preparing on tracing paper a series of master models for the subjects used in this experiment, I traced onto the master models from the original blue-print palatograms the tongue-palate contacts. These final palatograms were reduced to half-size for printing purposes. Refer to Plates I, II, III.

[12]This method is mentioned by Dr. G. Oscar Russell in *The Vowel*, p. 335ff.

[13]I had kept on file the original impressions from this experiment.



(See page 108 for explanation of Symbols used in this plate)

In the second project a new technique was employed. I prepared numerous casts of each student's palate.[14] To show the depth of the tongue contact on the hard palate, these casts were cut in half from the division between the medial incisors to the soft palate. I used the pseudo-palate described above. Each sound or sound combination was made three times by each subject,[15] and these three contacts were outlined, each in a different color, on the split casts. (An outline was used because, after considerable experimentation, it was found impractical to super-impose one color upon another in an effort to designate the entire area of each of the three repetitions.) In transferring the contact pattern from the pseudo-palate to the positive cast, the pseudo-palate was placed in the palate of the cast; certain directional marks were made on the cast; and, with the aforesaid marks as guides, and with calipers to measure the width of contact, an outline of the contact as shown on the pseudo-palate was drawn upon the positive cast.

When the subjects had completed the sound combinations, the marked casts were photographed so that a permanent and usable record of the contacts might be made.

SUBJECTS AND SOUND COMBINATIONS

Nine subjects, to be designated as subjects N, O, P, Q, R, T, U, V, W, participated in the first project, each completing a set of palatograms for the following sound combinations:

(The symbol "a" is used for the phonetic symbol "ae" in all examples throughout this study.) ad, at, da, ta, ɛd, ɛt, dɛ, tɛ, ɪd, ɪt, dɪ, tɪ, ag, ak, ga, ka, ɛg, ɛk, gɛ, kɛ, ɪg, ɪk, gɪ, kɪ, az, as, za, sa, ɛz, ɛs, zɛ, sɛ, ɪz, ɪs, zɪ, sɪ, aʒ, aʃ, ʒa, ʃa, ɛʒ, ɛʃ, ʒɛ, ʃɛ, ɪʒ, ɪʃ, ʒɪ, ʃɪ, la, al, lɛ, ɛl, lɪ, ɪl, ra, ar, rɛ, ɛr, rɪ, ɪr, ab, ap, ba, pa, ɛb, ɛp, bɛ, pɛ, ib, ip, bi, pi, av, af, va, fa, ɛv, ɛf, vɛ, fɛ, iv, if, vi, fi, aδ, aθ, δa, θa, ɛδ, ɛθ, δɛ, θɛ, iδ, iθ, δi, θi, ab, ba, ap, pa, ɛb, bɛ.

A history of each subject was recorded as follows:

Subject N.
Age—23 years. Nationality of parents—Filipino.
Languages spoken other than English—Philippine dialects.
Languages studied in school—English, Spanish.
Undergraduate scholastic average—C.

Subject O.
Age—38 years. Nationality of parents—English.
Languages spoken other than English—none.
Languages studied in school—Greek, Latin, Hebrew, French.
Undergraduate scholastic average—B.
This subject was an instructor in speech in a college.

Subject P.
Age—26 years. Nationality of parents—On father's side, English and Irish; on mother's side, German and Swedish.
Languages spoken other than English—none.

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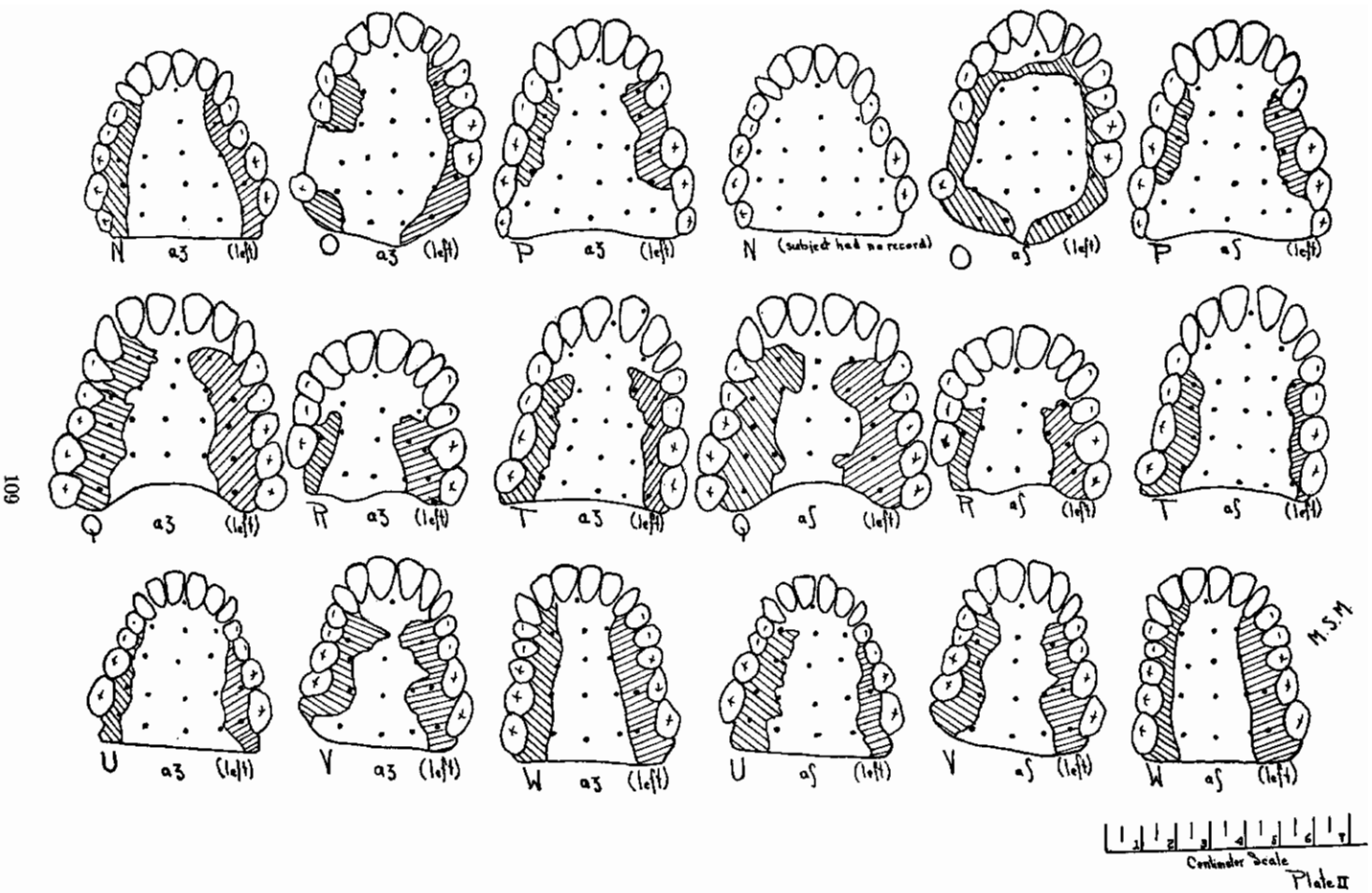
[14] I discovered that by the use of the dental preparations, *Dentocol* and *Reprolastic*, and the sculptor's method of glue-mold casting, I could produce any number of casts desired from the one original negative impression.

[15] See the author's thesis, appendices III, IV, V.



(See page 108 for explanation of Symbols used in this plate)

Languages studied in school—Latin.
Undergraduate scholastic average—C.
Remarks: Post-operative cleft-palate speech.

Subject Q.

Age—25 years. Nationality of parents—English.
Languages spoken other than English—none.
Languages studied in school—French, Spanish, Russian, Latin.
Undergraduate scholastic average—B+.

Subject R.

Age—27 years. Nationality of parents—American.
Languages spoken other than English—none.
Languages studied in school—French, Latin.
Undergraduate scholastic average—B+.
Remarks: Had taught diction and dramatics.

Subject T.

Age—21 years. Nationality of parents—Father, German; mother, English.
Languages spoken other than English—none.
Languages studied in school—French, Latin, German.
Undergraduate scholastic average—C.

Subject U.

Age 17 years. Nationality of parents—German, Russian.
Languages spoken other than English—none.
Languages studied in school—Latin, Greek, French.
Undergraduate scholastic average—B—.

Subject V.

Age—20 years. Nationality of parents—English, Irish.
Languages spoken other than English—none.
Languages studied in school—French, Latin.
Undergraduate scholastic average—A—.
Remarks: This subject had 36 hours of speech study.

Subject W.

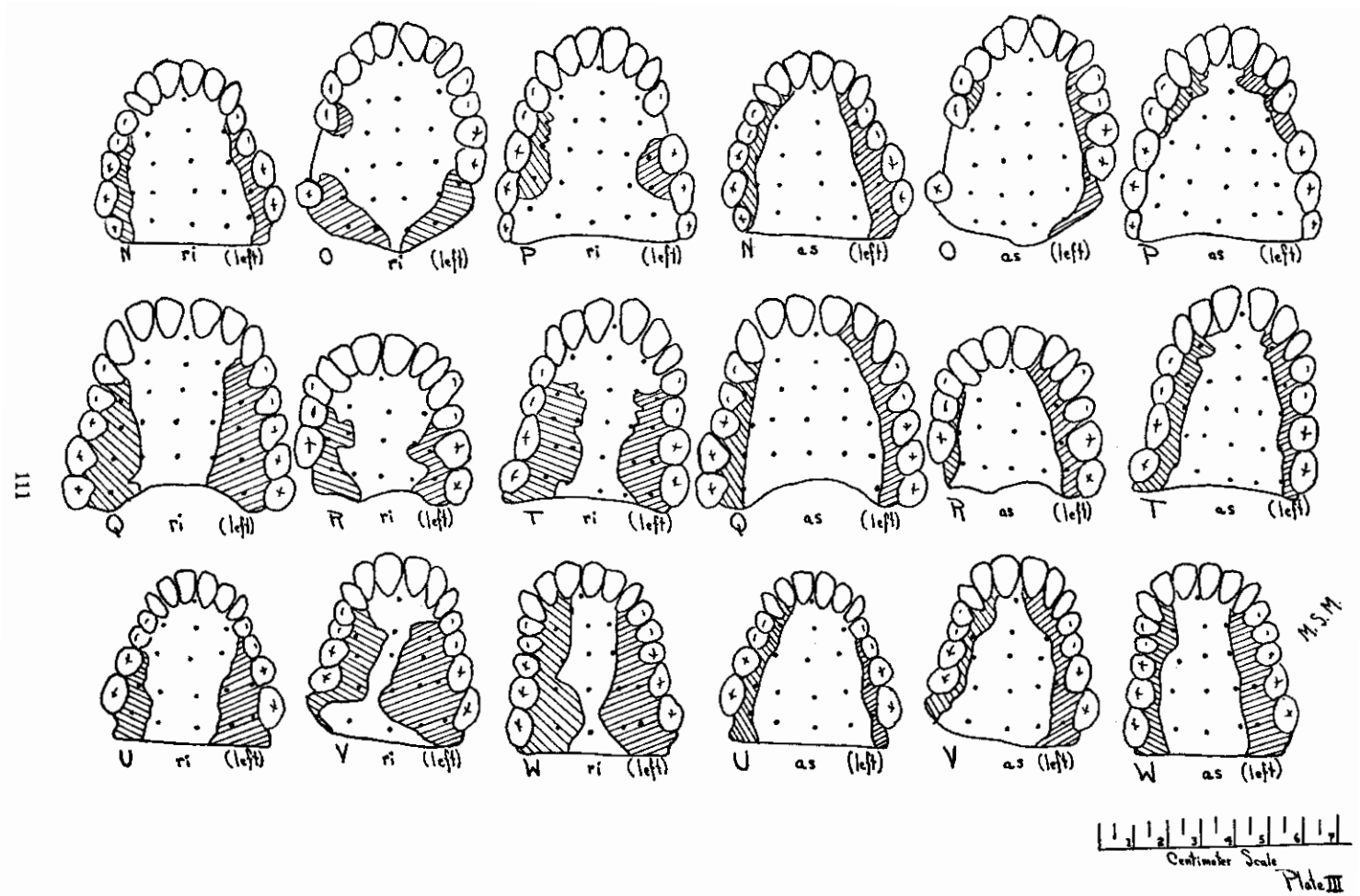
Age—20 years. Nationality of parents—American.
Languages spoken other than English—French, German.
Languages studied in school—French, German, Latin, Italian.
Undergraduate scholastic average—C.

Three subjects, to be designated as Subjects E, B, M, participated in the second project, each completing a set of palatograms for the following sound combinations: ad, at, da, ta, ɛd, ɛt, dɛ, tɛ, ɪd,, ɪt, dɪ, tɪ, ag, ak, ga, ka, ɛg, ɛk, gɛ, kɛ, ɪg, ɪk, gɪ, kɪ, ða, θa, da, ta, ga, ka, za, sa, að, aθ, ad, at, ag, ak, az, as, ði, θi, di, ti, gi, ki, zi, si, az, as, za, sa, ɛz, ɛs, zɛ, sɛ, ɪz, ɪs, zɪ, sɪ, aʒ, aʃ, ʒa, ʃa, ɛʒ, ɛʃ, ʒɛ, ʃɛ, ɪz, ɪʃ, ʒɪ, ʃɪ, la, al, lɛ, ɛl, lɪ, ɪl, ra, ar, rɛ, ɛr, rɪ, ɪr, ɪð, iθ, id, it, ig, ik, iz, is.

The histories of these three subjects are as follows:

Subject E.

Age—27 years.
Nationality of parents—American.
Languages spoken other than English—none.
Languages studied in school—Latin, French, German.
Undergraduate scholastic average—B.
Remarks: Had taught diction, dramatics, voice; was a graduate student in speech.



(See page 108 for explanation of Symbols used in this plate)

Subject B.

Age—27 years.
Nationality of parents—American.
Languages spoken other than English—none.
Languages studied in school—none.
Undergraduate scholastic average—Did not have a college education.

Subject M.

Age 28 years.
Nationality of parents—American.
Languages spoken other than English—none.
Languages studied in school—French, Spanish, Latin.
Undergraduate scholastic average—A—.
Remarks: The subject held a Master's degree in history; had taken some work toward a doctorate in speech; had done considerable technical work in speech experiments.

RESULTS AND DISCUSSION

When the nine students had completed the first project, I had in my possession 864 palatograms covering 102 sound combinations. Of this number, some were found impractical for use in an experiment such as this one. The sound combinations ab, ba, ap, were found not to give any palatal impression, for there is no contact between the tongue and the palate in the articulation of these sounds. The combinations eb, pa, be, showed contacts in some instances: pa in 2 cases out of 9; be in 6 cases out of 9; eb in 6 cases out of 9. Of this group showing contacts where others failed to show contacts, only one subject had a speech abnormality. It is plausible, therefore, to state that certain vowel-consonant combinations produce contacts in some instances and not in others, depending upon the individual articulating the sound.

The second project involved 276 photographs of split palate casts, covering 92 sound combinations.

Selection of the palatograms appearing on Plates I, II, III, was made at random. Plates I, II, III, show the following contacts for aʃ, aʒ, id, it, as, it, the same sound being made by each of the nine subjects.

Plate IV shows subjects E, B, and M each making the same vowel-consonant combination three different times in successive articulations. After each articulation the pseudo-palate was removed so that the pattern might be drawn upon the cast. The plate shows the following vowel-consonant combinations: ɛk, kɛ, ga, ka, ar, ra.

Even a cursory examination shows that no one of these subjects makes tongue contacts for the vowel-consonant combinations which are the same, or even generally the same, either as compared with the others or from one of his trials to the other. They all vary considerably. The same type of variation occurred in the majority of the contacts made by these same subjects.[15] In those vowel-consonant combinations which were identical in the two projects, each subject of Project II made contacts quite different from those made by any one of the other subjects, N, O, P, Q, R, T, U, V, W, all of whom also differed from each other. It may be concluded from

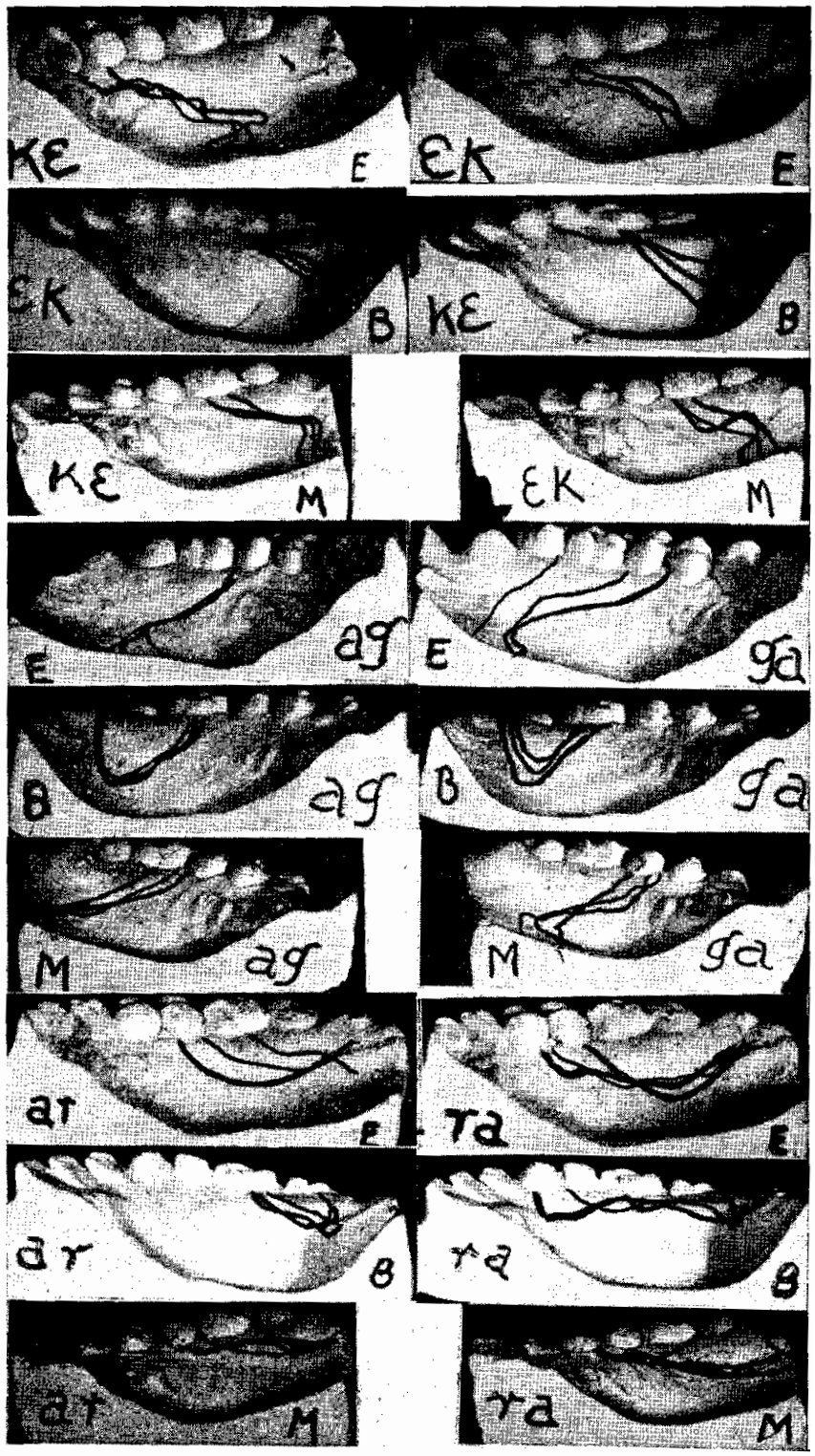

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PLATE IV

1140 tongue-palate contacts of 13 subjects[16] in 102 sound combinations, that:

> no two persons make the same tongue-palate contact for the same sound or sound combination, and that no person makes the same tongue-palate contact for the same sound in the same way, even on the same day.

CONCLUSIONS

In view of the above results, it may be concluded that

1. In the correction of foreign brogue or speech defects, it is not justifiable to say that any so-called correct tongue position for any consonant can be indicated exactly.
2. There is a possibility not only that different persons speaking the same language do not make the same tongue-palate contact for the same sound or sound combinations; but that the same persons do not make the same contact for the same sounds, even on the same day.[17]

These conclusions infer that in the correction of foreign brogue and speech defects, palatography may be used, but that it cannot be used so extensively as it has been by phoneticians in the past. Because of other factors, already mentioned, it cannot be said that in the articulation of a given sound or sound combination the tongue should strike the palate at a given place in a given contact pattern. Needless to say, factors other than position must therefore be involved; and these, too, must therefore be given more attention while position is given less than has been customary in the past.

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[16]An additional subject was used in the thesis (Subject S, cuts found in Appendix V), but has not been included in this particular study.

[17]Statistical analysis of contacts is not a part of this study; the author, however, has made such a statistical study for the above-mentioned sounds in his thesis.