

LAMBERT TEN KATE, AN EARLY PHONETICIAN

by G.L. Meinsma

It seems a suitable moment to present you with a paper on C.F. Hellwag a phonetician whose most important publications we remembered in 1981.

In 1781 he presented his dissertation called *Dissertatio Inauguralis Physiologico Medica de Formatione Loquelae* in which, for the first time, the well-known vowel-triangle figured. The book of which only a few copies are preserved was reprinted with a concurrent translation from the Latin text into Dutch in 1967 by the Institute of Phonetic Sciences of the University of Amsterdam on the occasion of the opening of a new building of this Institute.

A Dutch phonetician, however, will, when taking 1981 as his starting point, be put in mind of the year in which Lambert Ten Kate died 250 years ago. We will confine ourselves to Lambert Ten Kate. There will be reason enough to do so.

INTRODUCTION

Lambert Ten Kate was born in 1674 on January the 23rd in Amsterdam, the town in which he died also in 1731 on the 14th of December. The cornmerchant of Mennonite denomination seems to have derived his main revenues from teaching the following subjects: The languages German, English, Italian as well as bookkeeping, mathematics or just simply by giving writing lessons and composition. He amassed a considerable fortune which enabled him to gather an extensive library, besides making an art-collection and a collection of musical manuscripts.

Altogether activities which were the prerogative of affluent citizens. Some cabinets of curiosities have been preserved. Of Lambert Ten Kate we still have a not quite complete catalogue of his collection. Some of his contemporaries also bitten by the collecting bug of that period placed their collections in a science-museum as Teyler did.

I am referring to the Tyler Science Museum in Haarlem in the Netherlands. In the Low Countries this museum is the first science museum, I believe internationally it may be one of the first if not THE first science-museum.

It is accommodated in a building designed for the purpose in 1681. Ten Kate's work has more to it than a collection of curiosities even though it breathes the spirit of its time. From several sources we know that Ten Kate kept up a lively contact with a number of scientists and artists. He was a skilful mathematician and natural physicist, as can be inferred from his studies of colourshift, astronomy, botany and acoustics. Beside all these activities he wrote treatises on theological subjects and aesthetics, but not only that, he wrote poetry and translated from English and French.

However, the main purpose of this paper is to present the gist of Ten Kate's work as a phonetician to readers outside the Dutch speaking community.

His work on linguistics fills two heavy tomes and is called:

Aenleiding tot de Kennisse van het Verhevene Deel der Nederduitsche Sprake. Amsterdam, 1723.

(In pursuance of the knowledge of the eminent part, i.e. theoretical background, of the language of the Low Countries).

In this work the author shows his great erudition and the wide range of his reading. An enumeration of the many sources which he used can be found in the dissertation of Van der Hoeven (1896). It becomes evident that he must have been proficient in even more

languages than were mentioned above, such as Gothic and Latin. Even though his work is mentioned by Raumer, Grimm and Paul it never got the international recognition which is his due.

Lambert Ten Kate is the precursor of philologists such as Rasmus Rask (1787-1832), Franz Bopp (1791-1861) and Jakob Grimm (1785-1863), who all became internationally known, as the founders of Comparative Philology.

Even Current Trends in Linguistics (Sebeok, 1970-1975) mentions Ten Kate only in passing.

As a phonetician Ten Kate is the first, as far as I know, to include acoustics in his considerations. Even though some Dutch scholars name Montanus as the first Dutch phonetician. In my opinion he has no title to this claim as he did not include acoustics in his work apart from mentioning them by the way. This in contrast to Ten Kate who devoted a whole chapter to acoustics. Montanus' book Bericht van een Nieuwe Konst genaemt De Spreeckonst etc. Delft, 1635. (Communication about a new Art; The Art of Speaking) is a hard nut to crack even for Dutch readers. Not surprisingly very little has been written about Montanus in any language with a wider currency than Dutch. Prof. A. Vos devoted his PhD at Edinburgh University to him (Vos, 1962). Unfortunately it is difficult to get the gist of Montanus' ideas as Vos' thesis was never published. At this moment a publication is under consideration. Montanus' work remained obscure in the Netherlands for a long time. One reason for this is the fact that he presents his material as if it were a botanical flora sticking to a rigorous system and, the main factor for his obscurity, his book was written in Dutch instead of in Latin. A Dutch furthermore which is very difficult to read because of its many neologisms. He introduces about 600 new terms in his book. (Vos, 1962, p. 7) Montanus is writing in a period in which the language is groping for new terms. A mathematician and engineer Simon Stevin, flourishing in the same period, also makes use of many neologisms. Many of these are still in use, but the ones coined by Montanus are forgotten, (Dijksterhuis, 1970). Original thinker that he was Montanus never got more than fleeting at-

tention.

Back to Ten Kate the main subject of this study. His book is written in a language which excels in clarity and an efficient use of terminology. There is a final aspect in the work of Ten Kate which deserves international recognition. If Robinson (Fiedler, 1936) was one of the first to try out a phonetic alphabet it was Ten Kate who attempted a first analphabetic notation. This makes him the most important precursor of Otto Jespersen (1860-1943), well-known as a grammarian and phonetician.

This puts Ten Kate in the framework of his time as a phonetician even if the term is somewhat inadequate for that time. The first one to use the term phonetics was the Danish Egyptologist Zoega (1797), (Zwirner, 1966). Some fifty years later the term is reintroduced with greater effect by Baudry and Bréal as is mentioned by Rousselot who must be considered the patriarch of modern phonetics.

'Les introducteurs de cette science dans notre pays ont longtemps hésité entre les deux appellations phonétique et phonologie. Ils ont fini par répéter la seconde, qui, avec notre transcription, peut signifier la << Science du meurtre (φόνος) >>' (Rousselot, 1902).

It must give us pause to try and fathom why Ten Kate, publishing nearly a hundred years after Montanus, received so little attention outside the Dutch speaking community. Was it because his work was in the vernacular and not in Latin? The magnitude of the task of translating it must have proved prohibitive. It seems likely that J.C. Amman, who wrote the famous *Dissertatio de Loquelâ* (1700), writing it in a period more or less contemporary to Ten Kate, must have been aware of this handicap. He at least translated his Dutch treatise into Latin thereby making it accessible to foreign readers, and he elaborated it, among other things, by adding examples, Newton must have had something similar in mind when he decided as late as 1706 to have his *Opticks* published in Latin. He thereby furthered the accessibility to readers outside the English language community. Amman's Latin booklet got translated into several languages. The original Dutch treatise was

largely forgotten. The printing of it being sub-standard may have been instrumental to this. The reprint published by the present author needed a lot of touching up. (Meinsma, 1980).

In Holland at least Ten Kate was widely read as can be gathered from the Transactions of one of the scholarly societies: Maatschappij der Nederlandse Letterkunde te Leiden, a well-known literary society which flourishes up to this day. Kossman (1966) who wrote a history of his society gives us an inkling of how Jakob Grimm might have come into contact with Ten Kate's text. One of the society's members conducted a lively correspondence with Grimm. This gentleman, Hendrik van Wijn (1740-1831), was genuinely interested in linguistics. His literary contributions to the society makes this clear. The correspondence with Grimm was published by K.Th. Gaedertz (1888). It is not certain how much of the correspondence between Van Wijn and Grimm was preserved. It is more than likely that many of Grimm's ideas in linguistics have their roots in Lambert Ten Kate.

What I intend to do now is to bring Ten Kate in front of the footlights of a more international stage. I will try to give an overview of his work and more particularly of his 'phonetics'. The texts collected and printed by me may perhaps be illustrative for anyone who sets himself the task of reading C 18 Dutch.

As his preface gives a good impression of the concept from which this book emerged, as I said before a book consisting of two heavy tomes, the best way to give a clear impression of it must be to render this preface into English.

Always hoping that such a translation will prove to be adequate. After that Ten Kate's phonetics will be discussed, which, as I said, was reprinted.

TEN KATE'S PREFACE

The preface gives the considerations which outline the work and it gives the contents of it. The book is, for the greater part,

written in the form of discussions.

Ten Kate starts his preface with the observation to the reader that when one undertakes to do some work this has a habit of growing to unexpected proportions. The first inducement to his work was the number and character of the strong verbs.

These verbs, often called irregular verbs, proved to be far from irregular. He distinguishes between strong and weak verbs each with their own regularity. This in turn led him to investigate verbs in Gothic, Frankish-German, High-German, Anglo-Saxon and Icelandic. He then realised that the same phenomena occurred in the same verbs in these different languages as he had noticed in Dutch. This in turn led to an investigation of regularity in languages. While working this out it occurred to him that there were quite a number of elements which had been introduced into Dutch. He discussed his findings with friends and experts which led to a discussion rendered in this book and which concerns a motivation, inducement and purpose of his work. The second discussion in the book contains an eulogy of speech, the magnitude and intrinsic value of speech. The third discussion is devoted to the consideration THAT LINGUISTIC LAWS MUST BE DERIVED FROM LINGUISTIC USAGE AND THAT THESE MUST NOT BE STATED A PRIORI. Further reference is made to the importance of language-study and of a polished style.

The 4th, 5th and 6th dialogues contain discourses about the distribution of peoples and languages across Europe and their relationships.

The seventh discourse is about the art of spelling, while the 8th treats the physical origin of sound, the melody of voice in singing and the formation of 'Letterklanken', 'lettersounds'.

The ninth discourse is devoted to common Dutch and its dialects. The tenth discourse up to and including the fourteenth between N. and L. as the two discussants are called (L. stands for Lambert Ten Kate) concerns parts of speech in general, as well as case and declension as characteristic for Dutch, and the question of accentuation (not included in my reprint). Subjects discussed by Ten Kate are nouns, adjectives, substantives, pronouns, infin-

itives and participles of verbs in Gothic and other languages already mentioned.

At the end of the first part there is an addition about Frisian. This addition will be published together with a number of other texts about phonetics of Frisian. These will form a separate publication.

The conclusion Ten Kate draws at the end of his linguistic investigation is that the truth in the old dictum: There is no rule without exception, CANNOT be applied to the Dutch language. The exceptions have become so rare that when seen against the law of large numbers the number of exceptions are reduced to nil. This consideration has its pictorial reflection in the engraving on the frontispiece of the book. I shall come back to this later. Then Ten Kate starts his overview of the second volume. The 'family tree' of the strong verbs is discussed. In the first place those which can be found in Dutch, to which are added verbs belonging to older and younger 'language-relations'. Next he deals with strong verbs which have already dropped out of the language or which are in a considerably eroded condition. All this he introduces with a contemplation on the importance of the persuance of etymology, which is the subject of the second chapter (second disquisition) including an expansion about regular vowel changes (Ablautseries).

In his preface Ten Kate states clearly that he has tried to observe the greatest care to work as accurately as possible. However, the enthusiasm with which he has carried out his task may have caused a number of omissions to have crept into his text, as he himself confesses.

His next subject is loan-words. Finally he makes clear that the greater part of the second volume consists of an etymological dictionary with approximately 20.000 Dutch words and as many again of related languages.

The last few pages of his preface are used again to state the contents of his work in rough outlines with a statement that he has included short contents with each chapter. This to make it possible

for the reader to choose those parts which interest him most. He says this quite metaphorically: that each choose from those dishes that which most takes his fancy. The present author felt quite justified to choose from this well-laid table the dish 'phonetics' and to make this subject into a separate reprint. (Meinsma, 1981).

Unpretentiousness induces Ten Kate to write at the end: If I might compare my work with a young man I would make a bargain with him that he would have to fend for himself for at least ten years before I would come to his aid. It was not given to Ten Kate to see after those ten years which elapsed after the publication of his book what had become of this 'youth'. In other words what his contemporaries thought of his work.

A clear caution consisting of eight lines on an otherwise empty page tells the reader the importance of first acquainting himself with the contents of the preface.

SOME NOTES ON TEN KATE'S ARTICULATORY 'PHONETICS

We will confine ourselves here to the chapters Ten Kate wrote about articulation and acoustics, beginning with the seventh discussion. Where necessary we will include references to texts in other chapters.

It is my intention to scrutinize the seventh discussion in Ten Kate's book rather closely. Its title 'Critique Spelkunde' might be translated as Critical Orthography. The whole chapter is written in the form of a treatise but the last dozen or so lines reveal it to be a discussion between two partners N. and L. The whole chapter is printed in italics apart from those concepts and examples which Ten Kate wanted to accentuate. The chapter is divided in twenty paragraphs.

I Paragraph one is the preface to the whole chapter. The author tells us he is not discontented with Dutch contemporary orthography as displayed by the most erudite writers. He is under the impression that Dutch orthography fits the Common Pronunciation better than is the case in most of the languages he knows. In his opinion this notion has an important bearing on a proper pronunciation which is, according to his concept, the backbone of eloquence and leads the way to a delicate distinguishing of sound. He thinks diacritical signs are indispensable.

II In the second paragraph T.K. explains the meaning of Critique Spelkunde or Critical Orthography. Here he tries to give a perfect - one might also say a mathematical - rendering of the sounds of a certain language. This critical or physical orthography is the counterpart of current orthography which is based on the best customary habits. Don't forget that there was no such thing in those days as a standard spelling-convention.

III In the third paragraph Ten Kate says that a critical orthography has to depend on the perfect execution of the task to give any particular sound in a language its own sign.

IV Without an explicit knowledge of the distinction between sounds it is completely impossible to write as one speaks.

V By diligently listening - I am introducing Ten Kate here as speaking himself - I have come to two means: the first was an investigation in the shaping of sounds and the other concerned a test and an investigation to see if the letter tokens, pronounced each in its own fashion, led together to the wished for word. This investigation consisted of a manifold and unusual syllable segmentation.

I (GLM) will try to make this clear with an English example

hostility

ho - sti - li - ty

hos - ti - li - ty

hos - til - it - y

host - i - li - ty

hos - til - i - ty

Listening carefully to the results of this syllable segmentation gave Ten Kate an insight into the character of sound formation hitherto unrecognized.

VI On page 115, in the sixth paragraph, a definition is given of vowels and consonants. I'll try a translation of this C 18 text. When investigating the forming of sound two completely different types must be distinguished. In one of them the sounds keep a clear, strongly continuing and an even-level carrying sound from beginning to end, however much they may be lengthened, the forming of which happens without any complete closure of throat, tongue or lips.

These are known by the name of vowels. The others cannot un-

dergö a pure or clear lengthening, as they consist only in a certain hissing sound which - before or after the vowels, - more or less clear or fast -, is formed to the measure of the distinguishable stepwise fluting of tongue or lips. These are called consonants.

VII This is the largest paragraph in this chapter and in it the Dutch vowels of Ten Kate's time are closely scrutinized. The articulatory description mentions ten levels between tongue and hard palate. Ten Kate starts from a position which is the most closed. He indicates that every step is accompanied with a more backward displacement of the tongue constriction. From the sixth step he mentions the role played by the lips in vowel articulation. This role of the lips is necessary because - as the author writes - up to then the tongue alone is able to set the boundaries to the space in the mouth so that tone-sound made in the throat may get the necessary letter-shape in the mouth.

At the end of the chapter he goes even further because after paragraph 20 he makes an addition which leads up to an alphabetical as well as an unalphabetical phonation notation. He distinguishes six levels of vowel articulation starting with 'more fine' and ending with 'more coarse' in sound-character. Thus the author indicates that the vowels are ordered from high to low timbre. Whereas the aforementioned distinction in ten articulatory levels allows of a broad transcription, which leans, as it were, against orthography, the latter division into six steps and subdivisions in between leads to a very narrow transcription indeed. This narrow transcription is effected in two ways: Alphabetically with the use of superscripts and unalphabetically in digitals with superscript. This unalphabetical transcription makes it possible to make use of the same digitals, but upside down, with superscripts for the consonants. It is important to bear in mind that he distinguishes six main articulatory positions both for vowels and for consonants but these are not interchangeable. The digi-

tals running from 1 to 6 indicate a front to back dimension. When making use of superscripts as well the author manages to distinguish 17 different vowels and 20 different consonants.

With the former ten levels we acquire, as it were, a one-dimensional description with three articulatory moments. If we re-write this in a three dimensional form, doing this in the right way of course, we find to our astonishment a vowel triangle.

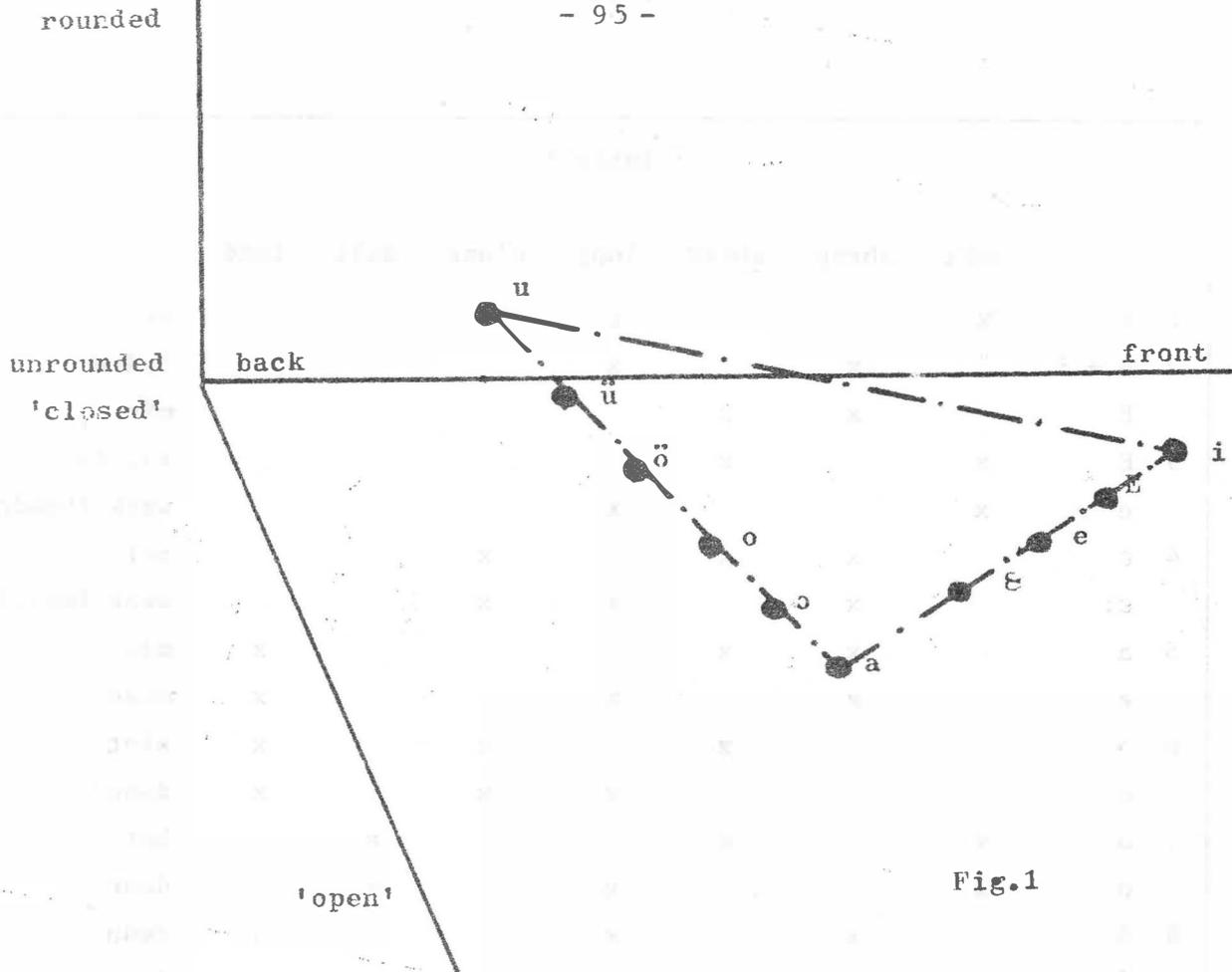


Fig.1

In the one-dimensional order of Ten Kate the vowels seem to fit up to [a], but after [a] he seems to go astray. The order in Ten Kate's work is:

[i], [ɛ], [e], [ɛ]: [a], [ɔ], [o], [ö], [ü], [u]

A present-day speaker of Dutch would present an order as follows: [a], [ɔ], [o], [u]. But then we would be omitting [o], [ö], [ü] from our system. As T.K. uses articulatory as well as auditory observations we might take it from the example given that he gave priority to the articulatory observations and especially to lip protrusion. As becomes clear from many of his observations he works with great care and therefore we must also take into account that he reckons with tongue-position - back or front -, width between tongue and palate and at the same time we must bear in mind the 'sound-colour' distinction he introduces. At this place we have to turn to present-day phonetics which may be useful in elucidating these historical data.

Table 1

		soft	sharp	short	long	clear	dull	loud	
1	i	x			x				die
2	e → i		x		x				lyden
	E		x	x					min
3	E	x		x					te, de
	e	x			x				week (hebdomas)
4	ε		x	x		x			bel
	ε:		x		x	x			week (mollis)
5	a		x	x				x	man
	ɑ		x		x			x	maan
6	ɔ			x		x		x	slot
	o				x	x		x	doop
7	o	x		x			x		bot
	o	x			x		x		door
8	ö		x		x				deun
	Λ → ə		x	x					dun
9	ü	x			x				zuur
10	u				x				zoet

Legend to Table 1

The ten levels indicated by Ten Kate are displayed here, vertically, together with the secondary distinctions he mentions, horizontally. Between some of the 'distinctive features' he writes 'or'. It is not clear whether this is an inclusive or an exclusive 'or'. The present author added a tentative phonetic transcription. The exemplifying words are those of Ten Kate. The examples 'te' and 'de' given at level 3 may show a change in pronunciation compared with in present-day Dutch, which is more like [tə], [də]. [tE] and [dE] are pronounced in an almost identical fashion. Ten Kate gives [ö] as the longer counterpart of [Λ] or [ə], showing again how well he listened. The ten levels are used

by Ten Kate for his alphabetical transcription where 1 and 2 are taken together as are 3 and 4, 6 and 7, 8 and 9. The levels 5 and 10 stand alone in the alphabetical transcription.

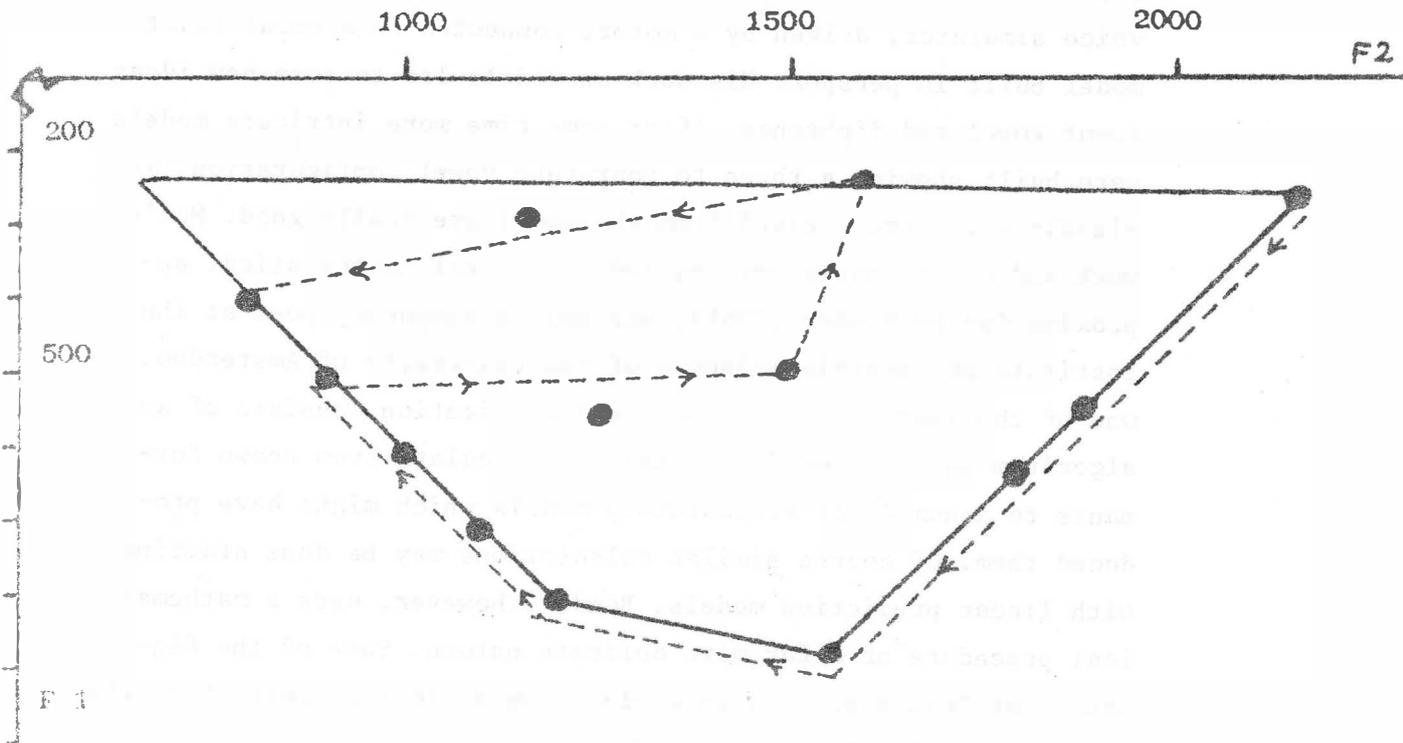


Fig. 2

The dotted line reproduces the track of ten levels, indicated by Ten Kate, in a vowel-triangle of Modern Dutch.

INTERLUDE

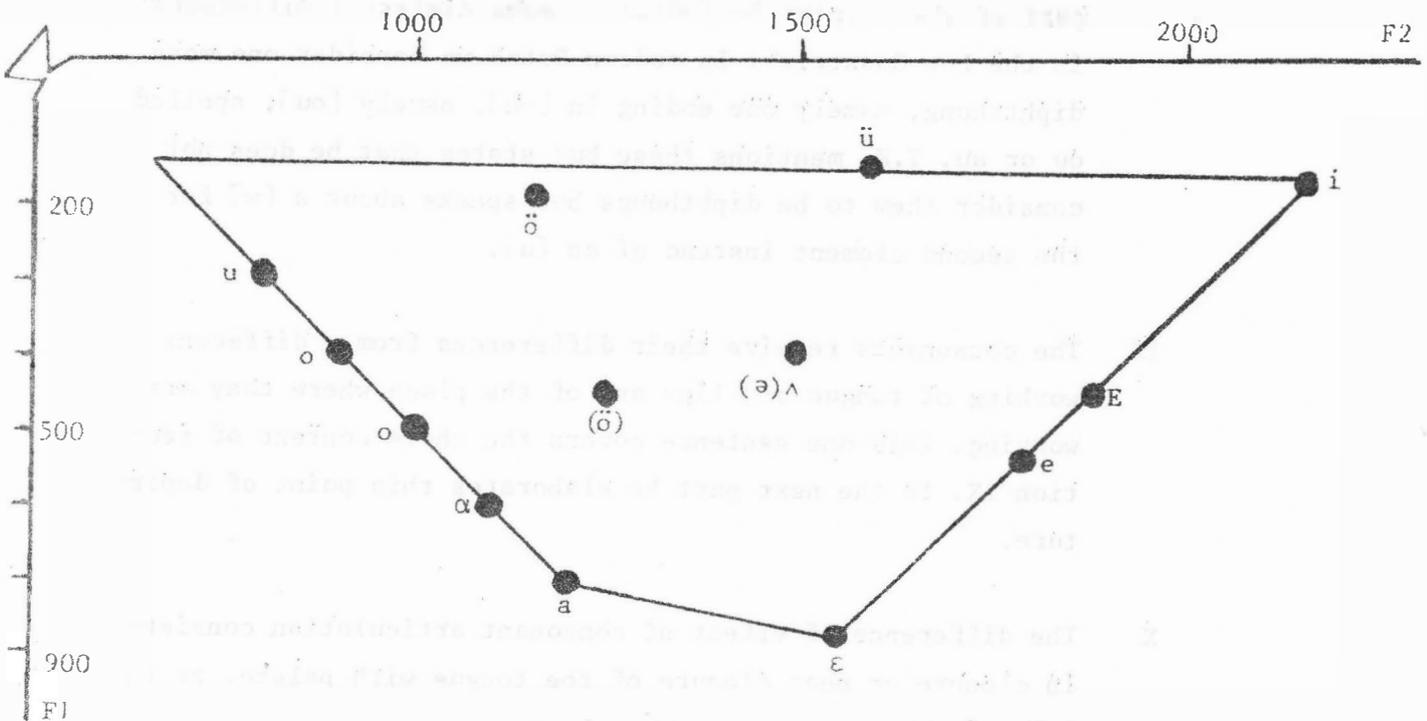
It is a well-known fact that the vocal tract may be represented by a two-tube model in articulating vowels (Flanagan, 1965). This model can be simulated by an electronic circuit which in turn can lead to mathematical representation. This was the way Mol (1970) came to his solution of the twin-tube approximation. Of course such a model is no more than a rough rendering of the real vocal tract. Mol (1969) had a physical model built with a voice simulator, driven by a motor, connected to a vocal tract model built in perspex. His work on models led to some new ideas about vowel and diphthongs. After some time more intricate models were built showing a three to four-tube vowel configuration. The signals which are derived from the model are really good. Mol's work and other considerations led to a purely mathematical approximation by Bonder (1981), who held a temporary post at the Institute of Phonetic Sciences of the University of Amsterdam. One of the last parts of Bonder's investigation consists of an algorithm which makes it possible to calculate from known formants to a number of articulatory models which might have produced them. Of course similar calculations may be done starting with linear prediction models. Bonder, however, uses a mathematical procedure of a far more delicate nature. Some of the figures that follow give us an explanation as to the order of vowels indicated by Ten Kate.

We all know it is possible to articulate a large range of vowels. On the other hand it has now also been shown that vowels of the same sound quality can be produced by different forms of the vocal tract. It is up to us to choose from possible configurations in order to point to an explanation when we are confronted with distinctions by 'older' writers which to us may seem awkward. There remains the fact of course that vowels used in an older language phase need not have had the same sound quality as present day ones. Even so it remains true that other articulatory forms like the ones shown here offer an explanation.

It should be remembered however that modern phonetic methods can

only be applied with a large dosis of discrimination in a historical subject. It is true to state, I believe, that our predecessors worked with greater discernment than we give them credit for. On an average they cannot have been less intelligent than we think we are in our conceitedness.

The two formants of Dutch vowels are shown in the next figure:



For every one of the vowels indicated the articulatory forms are calculated in a four-tube model of the vocal tract. The following figures display those forms. The closure at the left indicates the closure of the vocal cords.

We will have to return to Ten Kate now.

VIII In the eighth section of this chapter a consideration about diphthongs is given. His definition is: When two different vowels follow one another within one syllable they are called a double-vowel and are produced in one respirational puff. According to him every double-vowel in Dutch ends in [-i] to which the first vowel 'overrolls'. He distinguishes the following clusters: ei, aai, ooi, oei and ui of which the modern Dutch version is [ɛɪ, aɪ, oɪ] and [ü]. In this part of the chapter he indicates some dialectal differences in the Low Countries. In modern Dutch we consider one more diphthong, namely one ending in [-u], namely [ou], spelled ou or au. T.K. mentions these but states that he does not consider them to be diphthongs but speaks about a [w] for the second element instead of an [u].

IX The consonants receive their differences from a different working of tongue and lips and of the place where they are working. This one sentence covers the whole content of section IX. In the next part he elaborates this point of departure.

X The difference of effect of consonant articulation consists in closure or near closure of the tongue with palate, or in lip with lip, or in lip with teeth.

When closure is complete this may result in the consonant sound either being followed by a resonatory buzzing in the nose or a sharp stop. I am trying to put this in T.K.'s words. The sharp stop does not produce a hissing sound at the end of the syllable. When closure is nearly complete there may also result two sorts of consonants: strident ones or husky ones. The strident ones, according to T.K., are [l] and [r], the first gets a lateral vibration of the tongue and the second vibrates at the top of the tongue. The articulatory manner of [v], [b], [d], [z] and [g] is called soft, [f], [p], [t], [s]

and [χ] is called sharp.

Note that the distinction of voiced vs. voiceless is not explicit but there is an articulatory distinction together with a sound-distinction, linking the measure of closure and the 'sharpness' of the sound produced.

XI With marked finesse T.K. gives distinction in articulation-place for his consonants and the differences in sound produced. They give an impression of being modern. He places them in 6 articulatory classes from front to back and indicates at the same time whether closure is complete or incomplete. At the end of the paragraph he remarks that the hissing sounds produced differ in finer or coarser sound quality depending on the place where they are formed in the mouth. Finer sounds are formed in the front, coarser ones are emitted from the back.

Although voicing is not explicitly mentioned he does speak of a buzzing sound which can accompany his consonants.

XII The next paragraph deals with the diagraphs ch, ng and nk. For T.K. these sounds have to be considered as one sound.

XIII Here T.K. mentions that some letters which are printed in Dutch and in some other languages do not deserve their own particular letter-sign in Critical Orthography. An example is: x.

XIV In this part T.K. lists soundclusters in Dutch before and after vowel. A consonant cluster is, according to him, only a true cluster if the sounds can be produced without insertion of a vowel. In the beginning of the syllable he calls this property the pushing or driving-on of consonants, at the end of a syllable he talks of the over-rolling of one consonant in an other.

X Discussion of diacritical signs.

XVI Here he repeats the necessity of using the right sounds even more so now that differences are known.

XVII This paragraph deals with possible assimilation. He talks about hard and soft consonants. The examples he uses reveal the meaning of hard and soft to be voiced vs. unvoiced. The use of assimilation is largely controlled by euphony.

XVIII T.K. talks of the Dutch sound [ou]. He reasons that it is not a true diphthong as it can not be segmented nor lengthened. He therefore suggests a spelling ow. His reasoning that segmentation is not possible is very near the truth. When trying to segmentate a diphthong on tape, for instance by reducing sections from it on either side, there remains a section somewhere in the middle, however short, that has a diphthong-like quality.

XIX Deals with plural forms, both of verbs and of nouns. In English only a few plural forms in -n have been left out of a much larger corpus in older phases of the language. I am thinking of course of brethern, oxen. He states that final -n is not pronounced. A number of consonants seem to preclude the pronunciation of plural -n.

XX T.K. closes his treatise with the remark, more or less: 'this is the end'.

However the chapter is followed by an epilogue in which T.K. gives his alphabetical and analphabetical transcription of which mention was already made.

TEN KATE ABOUT ACOUSTIC PHONETICS

We now have to deal with the second treatise on the subject (p. 132 ff.) which is confined to the eighth discourse. We might

call this discourse: The Physical Discourse of Sound, which deals with the physical cause, but also with pitch-change in singing and especially the physical cause of speech sounds.

On the whole this chapter is less well-balanced than the chapter on articulatory phonetics. Understandably so, as articulatory phonetics admit of proprioceptive and digital investigation. But the techniques to investigate acoustic problems, especially the nature of sound, in this case produced by the human throat, were primitive to say the least.

Then Kate's interlocutor N. starts the second discourse by noting the marvellous way in which speech sounds are formed which - and here N. takes up T.K. again - can be made with differences in 'form' of higher and lower tone and of intensity. And something extra too, which can not be simulated by any instrument, be it percussion, wind, or string.

Further discussion reveals that the 'tone-sound' made in the throat has to get its distinct speech-character in the mouth. N. asks T.K. how he is to understand this process.

Didactically the chapter on acoustics is very sound. It has a systematic construction as becomes clear from the indications in the margin. He starts with the question what sound consists of, how it is transmitted, what are the properties of pitch and loudness and he makes comparisons with the properties of strings. Next he talks about changes in pitch in speech and in musical instruments. He discusses the ratio of tones within octaves. Then he treats the manner of voicing in speech and in singing after which he discusses the acoustical manner vowels and consonants are produced.

From the answers T.K. gives his interlocutor it becomes clear how he has to wrestle with the subject, but towards the end of the chapter his vision on the subject of acoustic phonetics becomes more and more clear.

I'll follow the section of T.K. in broad outline.

In order to have a basis of investigation we must first know what sound is.

He mentions that it is easy to state that sound exists and that it originates from certain movements of 'soundable' particles in the air, and that the air surrounding us must be full of such particles. These particles are capable of transferring sound movement to their mates and that these particles must be filling the air around us without any gaps as sound is propelled in every direction without hiatus.

It can be empirically shown from the vibration of strings that the intensity of sound depends on the force with which a sound is made. The force with which a bell or a string is brought into vibration accounts for the intensity of the sound, not for the pitch of it.

But the difference between higher and lower pitch arises from more rapid or slower renewals of vibration.

After some further considerations T.K. comes to the conclusion that the propagation of sound in the air, and here I am to translate him again, has to be ascribed to 'in- and pro-truding' of bubble-like or spherical globules of air.

In the following paragraph he gives his reasons why there is no parallel in the waves caused by a stone in water and the propagation of sound in the air. His main argument is that the former occurs in a plane and the latter, the propagation of sound, is three-dimensional (cubice).

After that T.K. states the most important properties of sound in five points.

- I Deals with the propagation of sound in every direction;
- II Points to the dependence of sound-intensity on the force applied

to the globules of air and their subsequent transference on other globules. He indicates that the sound produced will continue longer and bear farther as a measure of the intensity of sound;

III T.K. enumerates five ways in which sound might originate in the air.

1. a fast banging-like action, sharp and biting as in the action of strings;
2. by the wedging of air between two solid bodies;
3. by forcing air over a sharp ridge of a solid body as is done in a flute;
4. by the outburst of air on air as the thundering of a cannon;
5. by the squeezing of air-pressure, as when the air gets forced through the throat as happens in voicing or as happens with the movement of a reed in a wind-instrument.

IV In this part T.K. reasons that the 'inward-movement' of the air-globules is rapidly lost, partly because they communicate their movement to other globules, and partly because they (the movements) are very small. So they have to be renewed time and time again if there is to be any sound at all. The swiftness of renewal is the origin of the distinction between higher and lower pitch; while from a measure of the inward movement of the globules originates the intensity of sound. The rapid vibration or oscillation of the instruments by which the sound, or inward-movement of the air-globules, is formed can be referred to as the origin of the renewals mentioned before.

V With a normal skilled sense of hearing the smallest sound-changes may be detected. The lowest vibrations, however, which accompany the lowest, perceptible tone is so rapid that the ear is unable to pick up the intermittant spaces between the renewal of the tone anymore than the ear can pick up in a tone when it is four octaves higher and therefore sixteen times as fast.

Answering his interlocutor T.K. tells in the next section that it may be empirically shown that higher pitch goes together with more rapid renewals of sound pressure. He is well acquainted with the string laws and elaborates his knowledge in the following pages in a clear way.

We will abstain here from his theorizing and pick up only those parts from his text which refer to speaking. On p. 138 and 139 of the first volume of his book he repeats his statement that voicing originates from squeezing pressure through a slit, but he adds that the pressed sounding-globules of air need a cavity in which they will obtain their distinctive definition of tone. He further states that the capacity or content of the cavity defines the tone produced. His meaning is not quite clear. If we explain its meaning to conform with what T.K. writes a few pages onward, he means to say that the cavity of the mouth resonates in a distinctive way for every articulatory form. The way he formulates reflects his mental wrestling for a proper understanding of the production of speech sounds.

In a note in one of the following pages T.K. refers to a book which he came upon while writing about tones. This book, by Crousaz, contains a calculation of the amount of 'sound-renewals', which we would refer to as frequency. The frequency of a tone is given per second or per pulsation of the pulse. It is not the first instance in which velocity is figured out in terms of pulse-pulsations. After all there were no reliable clock or chronometers for short time intervals. It is clear that T.K. is conversant with calculations made by Sauveur and with the Proceedings of the Parisian Académie. (1700 and 1701).

Now we will turn to the section where T.K. writes about the voice (p. 141). He writes: 'In free breathing the air is expelled from the lungs without any hindrance through the nose and the mouth'. After that T.K. again compares voicing with playing the flute or the oboe. He states that sound is not made in the mouth in the

latter case but in between the reed or on the tongue of the flute. Likewise the making of speech sound does not occur in the lungs or in the trachea, but is formed with the first tool suited to the purpose, which consists in this case in cartilaginous lips, below the epiglottis near the thyroid of the trachea top and which when closed form a line not unlike that in the reed of an oboe. Citing him again: 'As soon as this mean publican (that is to say the cartilages squeezing together) keep the exit so close that the jostling air particles can not pass without being pressed in, at that moment a certain sound or sound movement is created but not yet properly defined in all sorts of tones or tone-changes'. His knowledge about the behaviour of air particles may not be correct but his approach to the subject is. He further elaborates that the vocal tract is responsible for the forming of the sounds emitted and that the cavity of the nose plays a role as well. The idea T.K. had about voicing appears to be somewhat equivocal throughout the whole chapter. But he was quite near the truth and some of his formulations are quite acceptable. Let us have a look at some of the ideas about the vocal tract. In the latter half of C 16 Vesalius gave a rather fanciful anatomy of the throat and the vocal folds. Leonardo da Vinci did better at the beginning of C 16 but his studies of the vocal tract were not published. Fabricius ab Aquapendente, middle C 17, usually gets the credit for the anatomical description of the subject under investigation. He states that voicing was done by means of a slit in the throat. The fact that a different nomenclature is used in those days makes it difficult to decide where these people considered the vocal organs to be situated. Somewhat lower or at the top near the epiglottis. T.K. however got it nearly right when he states where the 'rima laryngis' is situated and the voice is produced. It stands to reason that he learned something from J. Swammerdam one of the better-known contemporary physiologists. Whatever his mistakes, the overall picture T.K. produces in his book is acceptable to a high degree, but T.K. does not clearly distinguish between voice production and the 'resonatory' conduct of the vocal tract.

His wavering attitude becomes clear when he writes that the larynx is not equipped for different tones because of its rigid nature. But considering the whole of the text this must weigh as no more than a 'slip of the mind'. We can have a degree of empathy with T.K. again when he states (p. 144) that when one wants to sing without letter-sounds as birds in the field, it is only voicing we talk about, but in order to turn voice into speech-sound it is necessary for the mouth-cavity to arrange things.

T.K.'s interlocutor asks him which is the essence of speech-sounds as he has not found anything so far in books. 'Nor did I', is T.K.'s reply and then he reveals something about the method he has followed.

T.K. states that he likes to find solutions by himself. He likes to do his research empirically but leaves books more or less aside, however not quite out of sight as at times they may be helpful. He likes to do his work without any let or hindrance.

T.K. mentions that when he was reading those authors which were considered to be the most important on the subject of speech-sound there appeared to be nothing on the problem of how speech-sounds come into being. 'However', he says, 'when searching I found a lot which I laid aside or rather, which I skipped across in a manner comparable to a fowl scratching among glowing cinders, because I did not find them to be my favourite toys'.

The sections XV to XVIII mentioned in the margin give a description of how vowels and consonants get their peculiar sound-quality.

The first of those sections deals with the differences between vowels, which may be ascribed to the definition, the limitations of the oral cavity. The voice receives a sort of resonance there. In fact he actually uses the word resonance (resonantie). He states that he does not know of any other essential cause of the production of speech-sound. The smaller the cavity of the mouth the higher its resonance and the larger the mouth the lower the

resonance will be. Thus the differences between the vowels are created. The voice needs a free passage when vowels are articulated. In this way it is possible to sing vowels without their losing their distinct features.

When the passage through the mouth is not quite free consonants may be emitted. There are several levels of hissing sound in them. The place where the consonants are formed is responsible for the higher or lower tone-quality. Also they may be produced with or without a buzzing sound, he means voicing.

In a note T.K. mentions the functions of the velum in the articulation of nasals. He acknowledges an anatomist who told him about the inner structure of the mouth-cavity and the many muscles involved. He makes a clear distinction between the acoustic effects of a pre-vocalic and a post-vocalic consonant.

The last part of this chapter on acoustics deals with a comparison of speech-sounds in German, French and English with those of Dutch. Some general characteristics of the languages mentioned are added.

I hope you have gained some insight into the ideas and conclusions of a Dutch phonetician writing more than 250 years ago. Conclusions which he arrived at without having any recourse to any gadgets or instruments to which later phoneticians were able to turn. Ideas, though ~~clothed~~ in old-fashioned language seem surprisingly modern today.

DIVERTIMENTO

Notes revealing an early symbolization
of phonetic sciences

Petrus Montanus van Delft may be considered the first Dutch phonetician. The title of the Reverend's book: Bericht van een Nieuwe Konst, genaemt De Spreeckonst, which may be translated as Communication about a New Art, the Art of Speaking, was published in 1635.

On the title-page a small engraving is printed, showing two stone tables, reminiscent of the ten commandments. The picture does not show the Mosaic law but a sort of phonetic alphabet. We might think such a picture more or less profane in a book written by a clergyman.

Somehow the engraving stirred my mind. I remembered seeing something like that before. After some time I stumbled on the book which was the source of my recollection: Herrn von Leibniz' Rechnung mit Null und Eins (Hochstetter, 1966).

A loose page from Leibniz' scientific notes, dated 15 martii 1679, bears the title: De Progressione Dyadica. A facsimile was published in the book aforementioned. It contains the beginning of binary mathematics. Scientific reviews did not exist at the time. Communication between scholars was in writing letters.

One of the letters written by Leibniz on the binary system was to a duke interested in science: Rudolf August zu Braunschweig und Lüneburg. The letter also contains a design for a medal. The design indicates as well the importance of the binary system in science as the symbolization of creation. Again we are reminded of the tables with the ten commandments. Was it slightly profane?

Writers were sometimes playful and not every playfulness might

have been profane. There was in the work of Lambert Ten Kate (1723) something I was reminded of. Ten Kate was the first phonetician in the Netherlands who included in his work not only a phonetic alphabet, as a forerunner of that by Jespersen, but also a chapter on acoustics.

In an engraving on the top of the first chapter which was not mentioned before, as far as I know, we can find a small circle in which phonetics is symbolized: a mouth in profile and an ear. The mouth is not that recognizable and perhaps intentionally drawn in such a way that two meanings are possible: a tongue and a mouth in profile with nose, a large beard and moustaches, the tongue now acting as moustaches. In the edge the text: Not without these. The text might mean: the considerations in the following chapters cannot go on without studying the speech-organ or without listening carefully. At the same time the meaning might be: nothing can be done without giving a willing ear to the Lord.

It is not unacceptable to suppose a double meaning. The frontispiece facing the title-page gives some indications of the playfulness of the author, who had - I am sure - a word in the production of the engravings. Hidden information is included in more than one way.

In the foreground of the frontispiece is a cherub that on first sight is busy writing. From its hand a piece of ribbon has dropped on which is written: Qui quaerit invenit (He who looks will find). It does not immediately become evident that turning the book upside down will make clear what it is the cherub is in the act of writing. On first sight it is just a lot of scribbles. The first impression, when looking at the picture the right way up, being 'he who seeks will find' renders a saying substantial enough to produce a whole book. Driven by curiosity and therefore turning round I discovered another saying which can only be read in part because the book cherub's hands cover part of the text which says:

Daer is g Regel
zond ex tie

(translated: there is no rule without exception. Well, I said to myself, Ten Kate finds rules but is aware of the limitations of such rules. But close inspection revealed something else, which in first instance was overlooked by me (Meinsma, 1979)).

The ribbon on which the cherub is writing appears on close inspection to have been partly torn in half. This tearing of the ribbon must have been put in on purpose. If it had been the intention to make clear that there are no exceptions on any linguistic rules then the ribbon with the text would have been torn right through. This double meaning seems acceptable in the light of the engraving on top of the first chapter spoken about above. Ten Kate must have chosen his symbols deliberately: he who seeks finds. He, Ten Kate, was a seeker. Some of the hidden meaning was revealed to me only after a period of prolonged seeking.

NOTES

Amman (1700); J.C. Amman, *Dissertatio de Loquela qua non solum vox humana et loquenda artificium ex originibus suis eruuntur: sed et traduntur media, quibus ii, qui ab incunabilis surdi et muti fuerunt, loquelam adipisci, quique difficulter loquuntur, vitia sua emendare possint.* Amstelaedami, 1700, apud Joannem Wolters.

(Reprint in an edition by R.W. Rieber of an English translation from 1873, North-Holland Publishing Cy Amsterdam, 1965).

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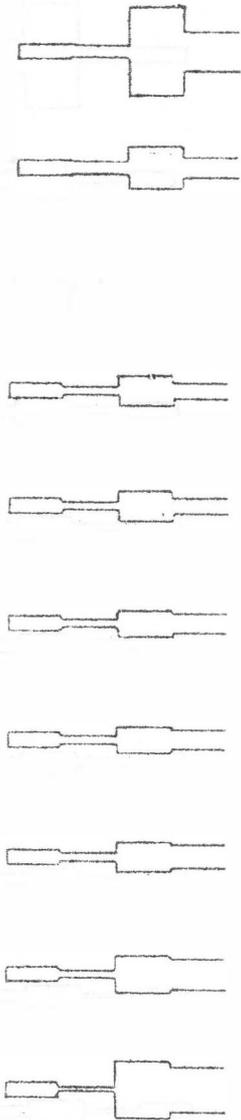
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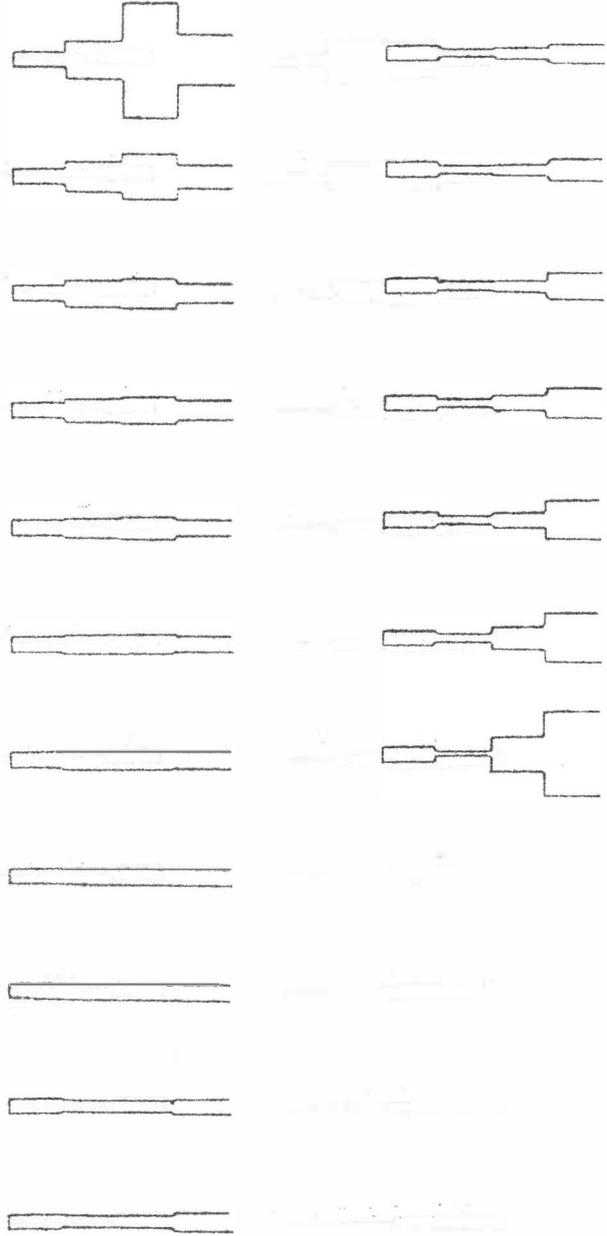
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F 2 = 900



F 1 = 500

F 2 = 1500

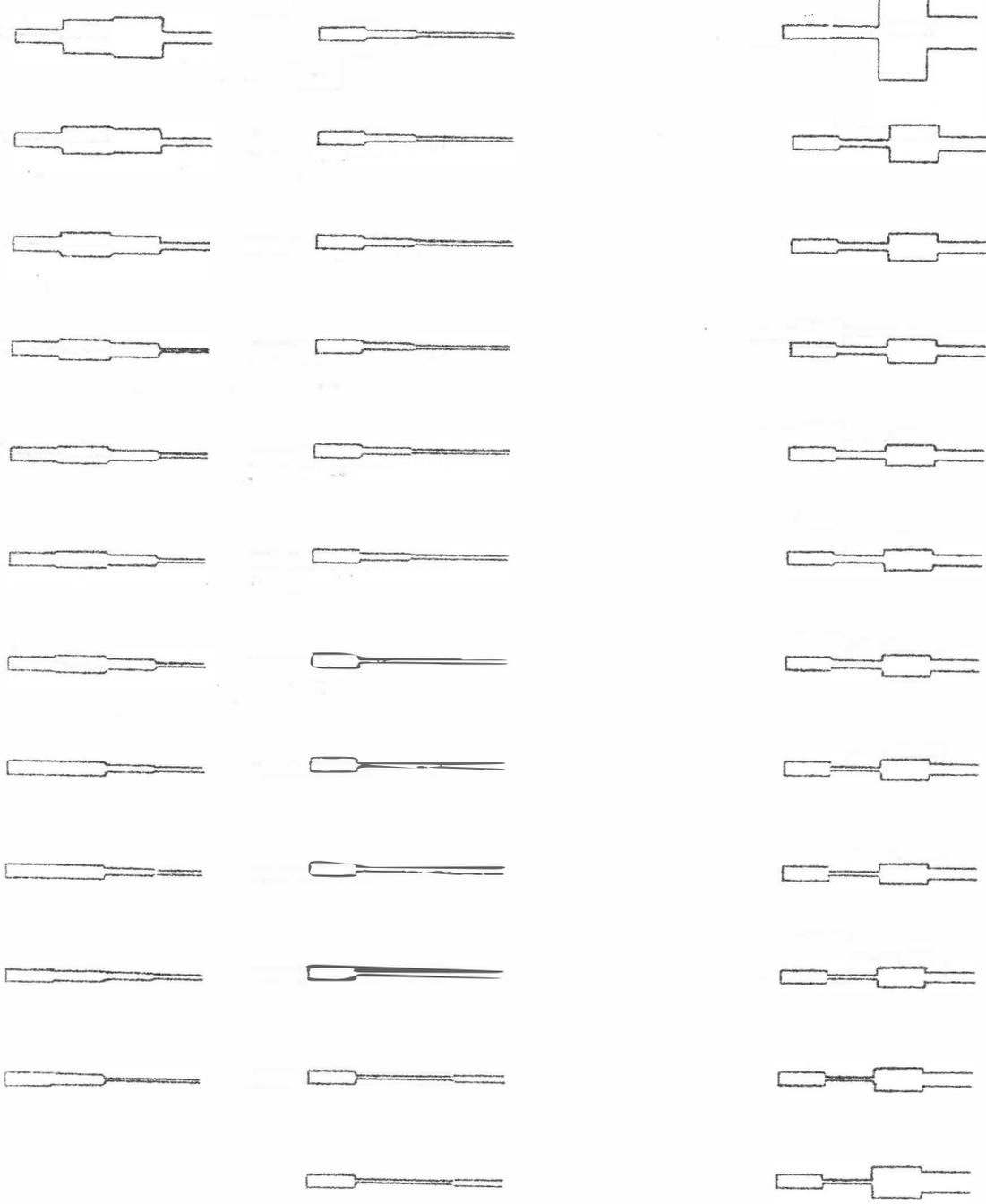


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F 2 = 1600

F 1 = 400

F 2 = 800



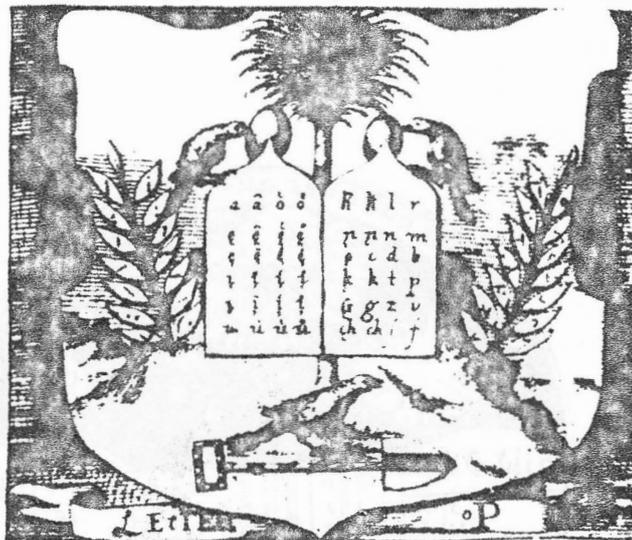
BERICH:
VAN EEN NIEWE KONST,
genaemt
DE SPREECKONST:

ontdeelt ende beschreeven door

PETRUS MONTANUS van DELFT,
Bedienaer van Goots Woort inden Nieuwen Hoorn.

VVaer in verhandelt ende in't licht gebracht wort, den rechten en
tot nu toe verborgen aert van alle uitspraec: als met naemen, vande
Oude ende veel Nieuwe Letteren, vande Woordleeden, Woorden,
Reedenfleen, Reedenleeden, ende Reedenen:

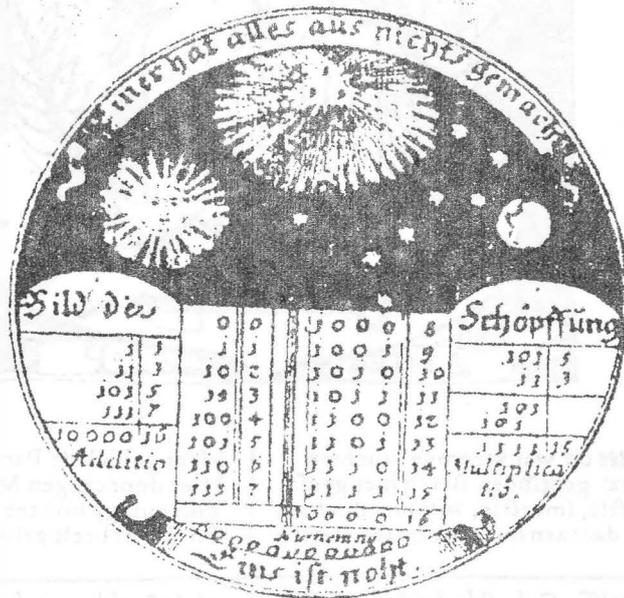
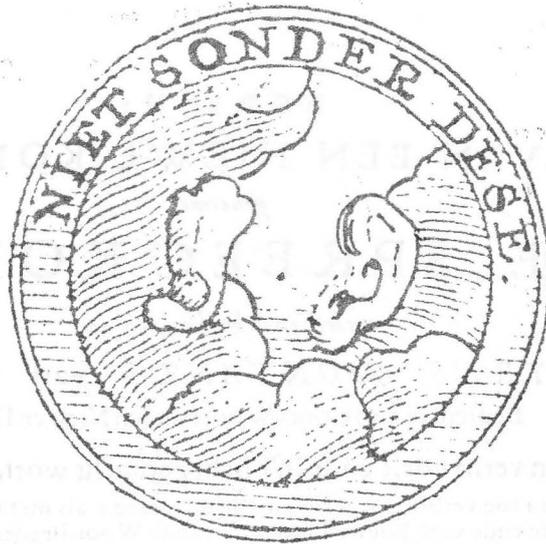
*Zeer nut ende dienstich voor alle Mensen, en in's byzonder voor alle gemeene School-
meesters, Taalmeesters en de Taalen leeren, Biechers, doosende Leyscaen Enspira, en Ridders, Woneef-
meesters, en Onders, als inde Inleiding, wort genoont: daer in ooc eenige nieuwe stuc ken
vande SPREECK-ALFABET beschreeven sijn.*



Letter op wat vreemde vruchten
Deez' gedeldden Berch hier geeft:
Ploeste, smaecke, wilt niet duchten
Dat daer aen quaer naesmaec cleeft.

Maer gelijk de Paepgacien
Hier door crigen Menten-schijn:
Zoo zult gy ooc zeer verfracen.
En Goots keelt gelijker sijn.

Tot Delft, Gedrukt by Jan Pieterse, VVaelpot, by's Stadthuy's inde Druckery, 1635.



Design of a medal by Leibniz.