

A SKETCH OF THE HISTORY OF PHONETICS IN DENMARK  
UNTIL THE BEGINNING OF THE 20TH CENTURY

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1. Introduction

On the occasion of the 500th anniversary of the University of Copenhagen, I was asked to write a brief contribution to the jubilee publication on the history of phonetics in Denmark. The present paper is a considerably enlarged version of the first part of that contribution.

Danish phonetics from the end of the 16th century till around 1900 cannot be seen as a continuous development. Some of the early phoneticians did not even know each other, and were not read by later scholars either. From Høysgaard on, it is possible to speak of a tradition in the sense that everybody knew most of his predecessors, but it was not a closed tradition. They were all more influenced by what was going on in other European countries than by their Danish predecessors or teachers, and each of the scholars to be mentioned had his own marked personality and his own approach. It will therefore be a story of a number of individual scholars and their works rather than a history of the development of a discipline.

2. Isolated precursors

The medieval grammarians were much more interested in the sign function than in the material manifestation of the signifier. It was not until the time of the Renaissance with its emphasis on empirical observation and its growing interest in the mother tongue that the sound matter of language was given more attention.

## 2.1 Jacob Madsen Aarhus (1538-1586)

One of the most important books on phonetics in the 16th century (De literis libri duo) was written by a Dane, Jacob Madsen from Aarhus (Jacobus Matthiae Arhusiensis). Jacob Madsen went to school in Aarhus, and then studied at the University of Copenhagen 1559-65. He received the baccalaureus philosophiae degree in 1563. 1565-66 he was rector at Aarhus. In 1566 he went to Germany, where he spent eight years studying theology, philosophy, history, law, medicine, and, in particular, languages at the universities of Wittenberg, Leipzig and Heidelberg. In 1674 he returned to Copenhagen, where he was appointed professor, first of Latin, then of Greek, and finally of theology. The book was published in the year of his death, 1586. A large part has been republished by Techmer in Internationale Zeitschrift für Sprachwissenschaft V, 1890, and a Danish translation of the whole work with an introduction and comments was published in 1930-31. As was normal at that time, Jacob Madsen uses the word "litera" (letter) to indicate a general concept covering the sound, the written symbol, and its name. But Jacob Madsen considers the sound to be central in the concept of "litera", whereas the written symbol and the name are mere accidentia. He emphasizes that in order to explain the sounds, it is necessary to study their production and that it is important to find out what is universal in human speech sounds, and he starts out with a description of the human speech organs, which was quite uncommon at that time. He is the first to have set up the sounds in an articulatory system that was meant to be universal.

Jacob Madsen is strongly influenced by the French philosopher Petrus Ramus and his *Scholae grammaticae* (1569) and, as was usual practice at that time, he simply copied large parts of that work word by word, also the learned quotations from Latin authors, but it is evident that he also had a good, direct knowledge of the grammatical literature.

Jacob Madsen's vowel system is taken over from Ramus. Ramus distinguishes two types of vowels: a e i and o u y. The first are called "diducta", the second "contracta", indicating that the lips are separated in the first and constricted in the latter group. Madsen sticks to the two groups but calls them "tongue vowels" and "lip vowels" (linguales and labiales), and he gives a slightly more

precise description at some points. He follows Ramus in indicating that the tongue is gradually raised from a to e to i, but adds that for i the upper lip is retracted in a slight smile (this was, however, not his own invention - older authors have also distinguished the smiling i from the "tragic" u). As for o u y, Ramus gives a very incorrect description of the position of the tongue, mentioning that it is lowered for all three but most for y. Jacob Madsen is more cautious. He states that it is not possible to observe the position of the tongue for these vowels, but that it is sufficient to describe the position of the lips, which are more constricted and protruded from o to u to y. ε is called a more coarse e, and ø a sort of o.

Jacob Madsen shows more originality in the description of the consonants. Ramus has the traditional distinction between mutae (stops) and semivocales (the other consonants). Jacob Madsen attacks this distinction which, he says, is simply based on the position of the vowel in the name of the letters (pe, te, but em and ef). The consonants must be divided according to the articulatory organs involved.

He first makes a distinction between labiales and linguales (as in the vowels). The lip consonants are the bilabials p, b, m, and the labiodentals f and v. The others are lingual sounds. His further divisions of this group are peculiar. He makes the first division between linguopalatal and linguodental sounds. In the linguopalatal sounds the tongue tip approaches the palate. In the "mobile" linguopalatals (s and r), the tongue does not touch the palate but remains free and mobile so that the airflow can pass out, whereas in the "fixed" ones (n and l) the tongue tip touches the palate and stops the airflow, so that it must escape through the nose or at the corners of the mouth (but a difference between l and n in this respect is not specified). In the linguodental consonants the tongue tip touches the teeth, either the upper teeth, as in t and d, or the lower teeth as in k, h, j and g (h is called a weakly articulated k). In j and g the tongue is more fronted than in k and h, and the tongue tip is pressed firmly against the lower teeth.

Jacob Madsen has a fine observation concerning the difference between f and v. He remarks that in v the inner edge of the lower lip touches the upper teeth lightly, whereas in f the outer edge

of the lower lip is pressed against the teeth and the air is blown out vigourously. He has also observed that Danish has aspiration after short utterance-final vowels (dah, dih).

He is not aware of the difference between nasal and oral sounds, and thinks that air escapes through the nose in most stops, but he mentions that the nose channel is used for breathing "in order to prevent the mouth from always being open and thus disfiguring the face."

In the first part of his work he gives the "true" description of sounds, in the second part he attacks the "false" descriptions, among them the division in mutae and semivocales, the description of h as an aspiration and not a true consonant, and above all, the description of diphthongs as consisting of two vowels which, he says, is in contradiction to the true definition of vowel, consonant, and syllable: A vowel is a sound which is pronounced by its own force, whereas a consonant is pronounced together with a vowel, and the syllable is a combination of a vowel and a consonant or may consist of a vowel alone. Ramus tries to escape the contradiction by defining the vowel as a sound which is "capable of" forming a syllable alone, but this is a bad type of definition. A definition should be absolute, and the syllable should not be a presupposed concept. Therefore Jacob Madsen will describe diphthongs as consisting of a vowel and a consonant. And he thinks that the whole confusion has arisen because the letters i and u have not been distinguished from j and v. He therefore writes the Danish diphthongs with j and v, and this way of writing them has been preserved in present-day Danish orthography.

Jacob Madsen was not only known in Denmark: he also influenced e.g. the Dutch scholar Petrus Montanus van Delft and his remarkable "Spreekkonst", which was published in 1635.

## 2.2 Jens Pedersen Høysgaard (1696-1773)

The Danish grammarians of the 17th century did not give any noteworthy contributions to phonetics. But in the 18th century two scholars must be mentioned for their original contributions.

One of them was Jens Pedersen Høysgaard. He is generally considered to be the greatest Danish linguist before Rask. He was born in Jutland, near Aarhus, and studied in Copenhagen, where he

acquired the baccalaureus degree, which gave admittance to teach at larger schools. He preferred, however, the very modest job of third porter at the University, which consisted of cleaning the class rooms and reading a passage from the Bible during meals. It was a rather light job since there were only three class rooms at the university; and since they could not be heated, the professors generally gave their lectures at home. Høysgaard even declined to be promoted to porter of the next degree, because he wanted to have time for his studies. Later, however, he got a somewhat better post as sexton at the university church.

Høysgaard's main work is a Danish syntax, but he also gave a very remarkable contribution to Danish phonetics in his Accentuated og ræsonnered Grammatica ('Accented and reasoned Grammar'), 1747.

Høysgaard sets up a very original vowel system:

	i		(IPA:
	e	y	æ = ε
	æ	ö	ø = œ
	ø	φ	
a	å	o	u
			å = ɔ)

It is based partly on alternations between vowels in related words, but at the same time the vertical dimension has a striking similarity to a dominating auditory dimension, which appeared in my experiments with perceptual dimensions of Danish vowels<sup>1</sup>: [i ey εøæ œuooa], the only difference being that œ was generally closer to the last group.<sup>2</sup>

His consonant system is more traditional, with a first division into mutae and semivocales, but he also mentions that bdgv are "weak" compared to ptkf. He has also given a system according to place of articulation.

- 1) Eli Fischer-Jørgensen: "Perceptual dimensions of vowels", To Honor Roman Jakobson, 1967, p. 667-671.
- 2) In my list, [æ] and [a] are variants of the phoneme /a/. At Høysgaard's time, /a/ was always pronounced [a].

The real merit of his book is, however, the description of the Danish prosodic system. Earlier grammarians often showed a total confusion of length and stress, mainly because Latin metrics was based on length, but in reading aloud, long syllables were rendered as stressed syllables. Høysgaard avoids this confusion and sets up four prosodic properties:<sup>1</sup>

- 1) accent (or tone). This is explained as high or low pitch. In a later work he states expressly that pitch does not change the word meanings in Danish, and he therefore does not treat the topic in any detail.
- 2) "Tonehold", which is defined as the stress (emphasis) one syllable has compared to another. He distinguishes three degrees: strong stress, weak stress, and lack of stress, e.g. Forhuset (pronounced [<sup>1</sup>fɔ<sub>1</sub> hu?səð]). But he adds that besides stress they also differ by the amount of time from the start of one syllable to the next, and that the syllable with strong stress normally has the highest pitch and the weak syllable the lowest pitch. Thus, Høysgaard has seen that stress is manifested not only dynamically but also by duration and pitch, whereas most later phoneticians, among them Jespersen, only talk of "expiratory" stress (which was opposed to musical accent). Høysgaard's description is based on a much finer observation of the real pronunciation as it was at that time, particularly in Jutland.<sup>2</sup>
- 3) Quantity (or length in verse). He remarks that this is in fact the same as stress, since Danish metrics is based on stress. "Tonehold" is the stress a syllable has according to its nature. "Quantity" is the stress it may have in verse, so-called "long" or "short". -- Here he uses the traditional terminology of metric descriptions, but his distinctions are quite clear.

- 1) His terminology varies somewhat in different works.
- 2) In modern Copenhagen pronunciation, the stressed syllables have low pitch.

- 4) The fourth prosodic category is called "åndelav" (approximately "breathing type") and is defined as "some peculiar thrusts or puffs of breath with which the syllables or their vowels and other sounds are pronounced". This category comprises a combination of length and "stød" and thus has four members, viz. syllables with short or long vowels, with or without stød. Høysgaard proposes to indicate them orthographically by accent marks. The two types of "åndelav" without stød are called "det kort-jævne" ('the short-even'), e.g. Ståd [sɔɑð], and "det lang-jævne" ('the long-even'), e.g. Brór [bro:r], and it is said that the short-even type permits the breath to pass smoothly and the long-even is drawn out. The two types with stød are called "det stødende" ('the thrusting'), e.g. Sång [saŋ?], and "det dobbelte" ('the double'), e.g. Flôr [flo:ʔɜ]. "Det stødende åndelav" is said to stop the breath flow, whereas "det dobbelte" first stops the breath and then lets it continue. He is well aware of the common feature of the two latter "åndelav" and sometimes mentions both as "stødende". This is the first time the Danish "stød" has been described in the grammatical literature.<sup>1</sup>

The "stød" is also compared to "a very little hiccup", and in a later work Høysgaard says that the pharynx is closed and stops the breath. He thus seems to assume that there is a complete closure, which nowadays is only found in very emphatic forms of the "stød" in standard Danish and as the normal manifestation in some dialects, but it is not improbable that it was produced with a real closure at Høysgaard's time, cp. that Otto Jespersen also describes the Danish stød as a glottal stop.

Høysgaard did not only set up the prosodic system and describe the pronunciation of the stød, he also gave detailed rules for its use in Danish words. His system was used in the grammatical literature until the middle of the 19th century. Later phoneticians have preferred to set up vowel quantity and stød/non-stød as two distinct categories.

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1) Jespersen (1897-99, p. 298) mentions that a Swedish author in the 16th century describes the Danish language in the following way: "they press the words out as if they were going to cough", and he thinks that this impression might have been due to the 'stød'.

Høysgaard has also written some pamphlets on Danish orthography (1743a and b). He has introduced the sign ö for /œ/, a sign which has been adopted by e.g. Rask and Jespersen, but not in the official orthography. Nobody has followed his proposal to use accents for the four "åndelav", i.e. for vowel length and stød.

### 2.3 C.G. Kratzenstein (1723-95)

C.G. Kratzenstein is the other scholar from the 18th century whose contribution to phonetics deserves special mention.

C.G. Kratzenstein's father was German, but his mother Danish. He studied medicine in Halle, where he took his degree in 1748. He then got a chair in St. Petersburg, where he succeeded in improving various nautical instruments. In 1753 he was appointed professor of experimental physics and designated professor of medicine at the university of Copenhagen, and from 1763 he was ordinary professor of medicine. He was a highly esteemed scholar, and during four periods he was rector of the University.

Through his physical studies Kratzenstein got interested in vowel production, and in 1780 he wrote a prize essay for the Imperial Academy of St. Petersburg. The requirement was a description of the vowels a e i o u and the construction of a machine that could produce them. Kratzenstein won the prize, and his essay (written in Latin) was published in 1781 in St. Petersburg. A French translation was published in a physics journal in Paris (1782).

Kratzenstein has a long discussion of voice production in the human larynx and how it can best be imitated. Among others, he quotes the famous physiologist Haller, who describes how the vocal cords are set in vibration by the air flow from the lungs, and how they give a higher tone when they are tight and tense than when they are relaxed. However, Kratzenstein does not believe that the small vocal cords are able to vibrate at the lower frequencies of the human voice, nor that they can produce a tone of sufficient loudness. He thinks that they rather function as a valve, and that the vibrations are mainly produced by the epiglottis, at least for the vowels a, e, o, whereas the vocal cords play a greater role for u and i. As is well known, this description has not been confirmed by later studies, but Kratzenstein accounts correctly for differences in fundamental frequency. As for the differences in



vowel quality, he thinks that they are due to the different forms and openings of the cavities above the larynx, which shape the passing wave differently, and to interference between parts of the wave.

The really interesting part of his essay is, however, his description of the position of the tongue, lips and teeth in different vowels. This description is quite up to date and far ahead of his time. He has measured the exact distances in inches and lines between tongue and palate and between upper and lower teeth as well as the lip opening horizontally and vertically, for all vowels. He has also investigated the position of the larynx by palpation with his fingers, and the position of the epiglottis by his index finger. He thus finds that the larynx is elevated for i, and that the tongue is retracted and elevated for o and u, and more so for u than for o. He is apparently the first European phonetician to have given a correct description of these back rounded vowels. In the 18th and far into the 19th century they were normally described as "labial vowels", and the tongue position was not mentioned, or was assumed to be as in a. It is also interesting that he has found a smaller distance between the teeth for e and i than for o and u (and particularly for i compared to u). (I have found this observation confirmed by informal questioning, at least for some speakers, including myself). - But although Kratzenstein gives exact measures for the normal pronunciation, he adds that these measures are not absolute. It is, e.g. possible to say a e i with the same distance between the teeth.

On the basis of these investigations he has constructed a machine for vowel synthesis, in which the voice is produced by means of a metal reed which he compares to the epiglottis, and a pair of bellows, to which are added cavities of different form for the different vowels (see Fig. 1). - He reports that the machine could say the vowels i e a o u and the words mama and papa. This seems to have been the first serious attempt at constructing a speech synthesizer. Von Kempelen's machine is slightly later (1791). Von Kempelen's could also pronounce consonants, but his description of vowel formation is much less accurate than that of Kratzenstein.

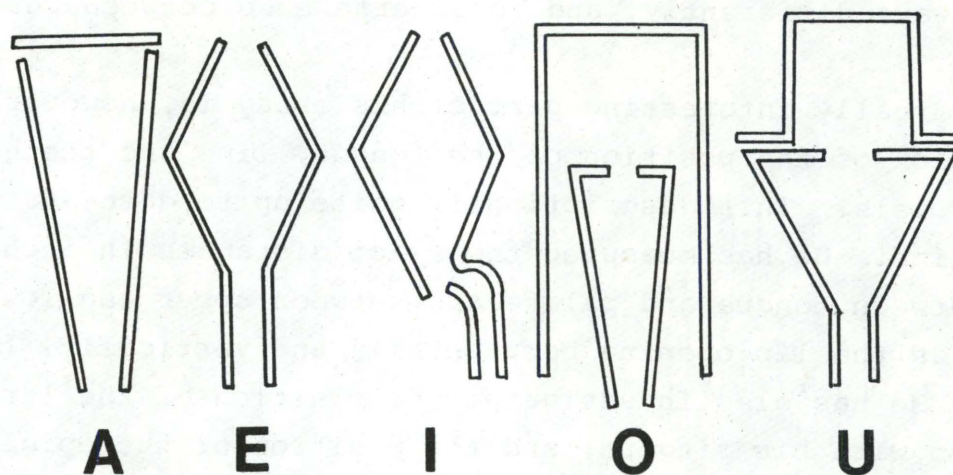


Figure 1

The cavities producing the vowels  
a e i o u in Kratzenstein's synthesizer.

Kratzenstein is very rarely cited in the phonetic literature. The fact that his prize essay was published in St. Petersburg may be one of the reasons, and the French translation in a physics journal apparently went unnoticed by phoneticians. Jespersen, who treats von Kempelen at some length (1897-99, p. 24-29), does not know Kratzenstein. But he is mentioned by Wheatstone (1879), who criticizes him for not being aware of the decisive importance of the length of a resonating tube, and by Ungeheuer (1962).<sup>1</sup>

Høysgaard and Kratzenstein, the two Danish scholars who have given essential contributions to phonetics in the 18th century, both worked at the University of Copenhagen, and they had administrative relations (we know that Kratzenstein got into trouble with his colleagues because he had reduced the dues Høysgaard had to pay to the University as a sexton), but the physics professor probably did not know the grammatical works of his porter, and his own treatise on vowels was not published until after Høysgaard's death, and thus it is improbable that they were ever aware of the fact that they had common interests.

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1) Jørgen Rischel first drew my attention to Kratzenstein's Latin essay. But it was not until quite recently that Preben Dømler drew my attention to a paper by V. Aschoff in *Acustica* 1979, where the French translation is quoted. I am grateful to professor I. Fónagy for having produced a copy for me from the Bibliothèque Nationale in Paris.

Rask's main work only belongs to the history of phonetics in so far as it is to a large extent based on sound comparisons; some of his other works are closer to descriptive phonetics. He collected a long word list from his Funish dialect which, together with his notes on Funish pronunciation and grammar, and a text in his own phonetic transcription, was edited by Poul Andersen (1938). His transcription shows a fine and very reliable intuition concerning the phonological system of his dialect and, according to Poul Andersen (1937), even modern phonetically well trained dialectologists with a profound knowledge of the dialect could not do better. His descriptions of the standard language were less reliable, probably because his pronunciation had retained many Funish features.

His interest in the Danish sound system was closely connected with his interest in the principles of orthography. As far back as 1808 he constructed a new, radically changed orthography for Danish, which he used in his own writings, and in a manuscript dating from 1808-09 he claims that there should be one and only one letter for each sound (evidently in the sense of phoneme). In 1826 he published a comprehensive treatise, Forsøg til en videnskabelig dansk retskrivning ('An attempt at a scientific theory of Danish orthography'). His claims are here less radical, but he maintains among other things the distinction of ø and ö and the use of å instead of aa, proposals which he took over from Høysgaard. In his description of the Danish system he also takes over Høysgaard's "åndelav", although with some modifications.

Rask has systematized Danish vowels in two different ways. The system he sticks to in his book on Danish orthography (1826) is the following:

a	æ	(IPA:
å	ö	a = a
o	ø	æ = ε
u	y	ö = œ
e	i	å = ɔ)

He motivates it (as did Høysgaard) by alternations between related words, caused by ablaut and umlaut, - e.g. kamp-kæmper ('(a) fight' - (he) fights'). The two columns are called hard

and weak, respectively, and these designations are motivated by the palatalization of k and g before the weak series. This was true of the pronunciation at Rask's time, except that k and g were also palatalized before e, as objected by his critics. Rask's answer was that they were not palatalized before -e in weak syllables, e.g. hakke (he would not admit that the pronunciation in weak syllables was [ə]). He would therefore write the palatalized k before e as a cluster, kj-, as before "hard" vowels (kjole), whereas the automatic palatalization of k and g before "weak" vowels should not be indicated in the orthography. In a letter of 1819 he writes that in setting up this system he was inspired by the Finnish vowel system (where a, o, u alternate with ä, ö, ü according to the rules of vowel harmony, and i, e do not change). In this way he achieves a regular and harmonious system which, particularly in his later years, was a very essential motive. His consonant system is less interesting. It is mainly based on that of his teacher, S. Bloch. In his prize essay (1818) he distinguished between mutae and liquidae, and the mutae were set up in a two-dimensional system according to place and manner of articulation.

	hard	weak	breathy
labials	p(v)	b(w)	f
linguals	t	d	þ
palatals	k(j)	g(j)	x, h

In his later book (1826) he goes back to an older system, closer to Bloch:

palatals	k	k'	g	g'	g̃
linguals	t	(þ)	d	ð	n
labials	p	f	b		m
semivowels		j	v w		
liquids	l	r			
sibilants	s				
breathing sound	h				

k', g', g̃ indicate [x] [ɣ] [ŋ], respectively. The designations are phonetically correct (perhaps with the exception of the

"linguals"), but as a system it is not quite satisfactory, since the vertical dimension is a mixture of place and manner of articulation (see Marie Bjerrum (1959), p. 197-203).

### 3.2 Jacob Hornemann Bredsdorff (1790-1841)

Rask's contemporary and friend Jacob Hornemann Bredsdorff was a brilliant mind and a very productive scholar both in natural sciences and in linguistics. Like Rask he grew up in Funen, where his father was vicar. He was taught at home, but at the age of 17 he was sent to the grammar school in Nykøbing, where Rask's former teacher Bloch had just been appointed rector. Two years later Bredsdorff enrolled at the University, where he received a bachelor's degree in divinity; in 1817 he received the gold medal of the University for an essay on paleontology, and the same year he defended a thesis on taxonomy in the natural sciences. From 1817-19 he taught Greek and Latin at the school in Roskilde. In 1821 he got an appointment at the department of mineralogy at the University, from 1823 as reader. From 1828 to his death in 1841 he taught botany and mineralogy at the Academy of Sorø.

He has given lasting contributions to geology and botany, but at the same time he wrote important papers on comparative Germanic linguistics, Danish phonetics, runology, and general linguistics.<sup>1</sup>

In 1817 he published a Prøve på en efter Udtalen indrettet dansk Retskrivning ('Sample of a Danish orthography based on pronunciation') which contains the first published phonetic transcription of Standard Danish.<sup>2</sup> In 1833 he published a paper, Om Tegn for de enkelte Lyddele i de europæiske Sprog ('On symbols for individual sounds in European languages') in which he presents a transcription system intended for a comparative analysis of European languages. In these works he appears as a very fine phonetic observer and analyst, in this respect superior to Rask. He sets up four degrees of "hardness" for stop consonants, exemplified by Danish p, French p, Danish b and French b; the difference between

1) His works within linguistics and runology have been republished in 1933, edited by Jørgen Glahder.

2) Including samples of different styles.

French p and Danish b is, however, described as problematic. Danish bdg must thus have been voiceless also at Bredsdorff's time.

Bredsdorff's main linguistic work is, however, the short treatise Om årsagerne til sprogets forandringer ('On the causes of linguistic change') 1821. In his linguistic work Bredsdorff certainly has received inspiration from Rask, but he was a very independent mind. Henning Andersen, in his excellent essay on Bredsdorff (1979), mentions his relations with Bloch and Rask, but at the same time the differences in Rask's and Bredsdorff's approaches. Rask sets up sound correspondences between languages by means of which he proves their relationship; Bredsdorff describes historical developments and tries to explain their causes.

Bredsdorff starts out by stating that the fact that language changes is easy to understand since we learn language from others, but the problem is why it changes in definite directions. He rejects the cause most frequently adduced in older works on linguistic change, viz. euphony, for we generally find that euphonic which we are accustomed to hear. Instead he mentions a number of other causes, of which he considers indolence to be the most important. This may lead to weakening and finally omission of sounds. Vowels may change to ə, and as far as consonants are concerned, he gives an instructive schematic account of the most frequently found weakenings, viz.

$$\begin{array}{rcccl}
 p - b \} & - & v - u & & t - d \} & - & \delta & & k - g \} & - & \gamma - \underset{u}{j} \\
 f \} & & & & \underset{p}{d} \} & & & & x \} & & \\
 \\
 m \} & - & \text{nasal vowel,} & & s - z & \check{s} - \check{z} & & & f \} & - & h \\
 n \} & & & & & & & & x \} & & \\
 \eta \} & & & & & & & & s \} & & 
 \end{array}$$

Another aspect of indolence is assimilations between neighbouring sounds, often so that they are pronounced with the same speech organ.

But an opposite tendency is also at work, the tendency to distinctness. As examples he mentions venio to vengo, Icelandic ll to dl, and, as the opposite of assimilation, the tendency to differentiation of neighbouring sounds, e.g. ei to ai, etc. Under the heading "The imperfection of the speech organs" he has some interesting observations concerning sounds which seem to be more

difficult than others, e.g.  $\gamma$   $\delta$   $l$   $r$   $\dot{z}$   $\dot{s}$   $\beta$   $x$  and the vowels  $y$   $\emptyset$   $\ddot{o}$ . These sounds are learned late by children, and some never learn them. He also mentions the factor of analogy and the possibilities of mishearing and of faulty memory. But these two latter factors are almost exclusively active in foreign words and thus particularly in the special situation of interference between languages, i.e. in borrowings, and in cases of language shift which may involve very radical changes in the adopted language.

In this brief paper, Bredsdorff has succeeded in mentioning most of the causes which have been alleged up to the present times, and his presentation is very clear and well balanced.

Kristian Sandfeld (1934) has characterized this treatise as the first rational theory of linguistic change, and Vilhelm Thomsen (1902, p. 55) called it a masterpiece of observation and penetrating insight which was 50 years ahead of its time. - Only the fact that it was published in Danish in a provincial school programme prevented it from influencing the development of historical linguistics.

#### 4. The period of classical phonetics

##### 4.0

In the second half of the 19th century phonetics developed quickly from spread and fumbling beginnings into a well established scientific discipline, a development which was partly due to the progress of physics and physiology, but was also conditioned by the increasing refinement of the methods of the dominating linguistic trend, comparative historical linguistics, which was based on regular sound correspondences and which required phonetic knowledge. This development occurred, above all, in England and Germany but quickly spread to the Scandinavian countries.

In 1881 Vilhelm Thomsen gave the first course in general phonetics at the University of Copenhagen, but his main achievements belong to other areas of linguistics.

##### 4.1 Karl Verner (1846-96)

The Danish linguist Karl Verner was interested in phonetics in all its aspects. In his school days in Aarhus he read Rask's

work on Danish orthography, and during his studies of Slavic languages at the University of Copenhagen he was particularly attracted by the problems of accent.

After having obtained his M.A. in 1873, he returned to his home town because he felt tired and ill and had no prospect of getting a job. It was here that he discovered what was later called "Verner's law". Verner's own story of how he made this discovery, as related by Jespersen in his obituary of Verner (1897), is not without interest for the understanding of the progression of science. Verner felt that he needed an afternoon nap, and when looking for a book to send him to sleep, he happened to take Bopp's Comparative Grammar, where the Sanskrit words are printed very prominently, and as he turned a page, the two words pitār and bhrātār stared him in the face, and it struck him that it was strange that they had different medial consonants in the old Germanic language. He then looked at the accent marks, and it occurred to him that the original Indo-european accent might be the cause of the difference. The next day when he was again going to take a nap, he hit upon an obviously wrong explanation of the difference, and so he sat down and went through the material and found one example after the other confirming his idea. In the course of the year 1874 he wrote the paper Eine Ausnahme der ersten Lautverschiebung, which was published in 1876. The final version of this paper did not retain any traces of its casual origin. It is brilliantly written, proceeding with inexorable logic and as convincing as a mathematical proof. He goes through all of the relevant material, comparing the forms of five older Germanic languages with the corresponding Sanskrit forms. According to W. Lehman (1967, p. 132) it "may be the single most influential publication in linguistics". It is of particular importance, (1) because it showed how deeply prosodic phenomena may influence sound development, and (2) because a large number of hitherto inexplicable exceptions to the first Germanic sound shift were now reduced to one simple rule, saying that the Germanic obstruents  $f \text{ } \beta \text{ } x$  in medial position remained voiceless only after an immediately preceding Indo-european accent, otherwise they were voiced. And it was in particular this elimination of a large number of exceptions from a well-known law that permitted the neo-grammarians to assert that sound laws were not subject to exceptions ("die Ausnahmslosigkeit



der Lautgesetze"), a thesis which was much debated in the following years. Verner himself, however, never accepted this doctrine in its strictest form.

As for the phonetic explanation of the rule, Verner suggested that the old Indo-European accent, which was assumed to be a pitch accent, had retained its place in the words in the oldest stage of the Germanic languages but had probably become partly expiratory. The extra airflow of the accented syllable thus preserved the voicelessness of the following consonant (which according to Germanic metrics belonged to the preceding syllable). This may be the right explanation, but now that we know of the relation between voiceless consonants and high pitch, the assumption of a change in the manifestation of the accent may perhaps not be considered necessary.

Verner was only 29 years old when he published this paper, but during the rest of his life he published hardly anything, and the whole body of his works comprises less than a hundred pages. This was not due to lack of knowledge or ideas; he had planned to write comprehensive treatises both on Slavic and on Scandinavian accents, but he was extremely conscientious and modest and without any ambition. He enjoyed struggling with linguistic problems but had no interest in publishing the results, and he would not have published his first paper either if it had not been for the strong pressure from his friends, particularly Vilhelm Thomsen. It was also his modesty which made him refuse a chair in Graz and a post as leading librarian in Jena, but he accepted a more subordinate post as librarian in Halle, and later, under pressure from his friends at home, applied for a post as reader of Slavic at the University of Copenhagen, which he received in 1883 and which was changed into a full professorship in 1888.

Although Verner did not like to publish, he was eager to expose his ideas in long letters to his friends, particularly Julius Hoffory, C.W. Smith, and Vilhelm Thomsen, and a good many of these letters have been published after his death together with his papers (1903). Among the few reviews he wrote, the most important is his review of Axel Kock's book on Scandinavian accents, in which he also develops his own views on this subject, including his observations on the Danish stød. He had previously (e.g. in a letter to C.W. Smith 3/7 1872) described his own production of the Danish stød. He feels an increased energy in his larynx and

also, by palpation, finds a sudden movement of the larynx muscles. He therefore thinks that there is a sudden and strong closure or at least constriction of the glottis. In the above mentioned review he adds to this description that, whereas words without stød are characterized by a falling tone, the words with stød have a quickly rising tone in the first syllable, ending in a sudden closure of the vocal cords and a lower tone in the following syllable. Verner now suggests that the stød has developed out of such a rising tone, which has led to an "überschnappen" of the vocal cords. His explanation was accepted by Jespersen (1897-99, p. 608, see 4.3). He also refers to the rising accent I in Norwegian (it had been known since the middle of the century that the Danish stød is historically related to accent I), and to similar phenomena in Baltic languages. He found in his own speech the same rising tone in words which have accent I in Norwegian and Swedish, but which do not have stød in Danish (e.g. kat) because they lack the so-called stød-base (i.e. a long vowel or a short vowel + voiced consonant). The origin of the Danish stød is still under debate, but Verner has given interesting contributions to its solution. His description of his own pronunciation is probably also quite correct, and not an individual feature, but particularly the pitch characteristics vary very much according to dialect.

In his later years Verner developed a certain scepticism with regard to articulatory descriptions and hoped for a much more precise and objective description from the acoustic analysis of speech sounds. In 1878 he had occasion to see the new Edison phonograph and this gave him the idea to construct an ingenious instrument for acoustic measurements of vowels. He used the Edison phonograph in its first form in which it is driven by hand and the impressions of the sound are made vertically on tinfoil. To the small pin which followed the tracings he attached a small mirror which was tipped by the movements of the pin, and these movements were enlarged approximately 2000 times by means of a beam of light reflected from the mirror on to a large measuring yard placed 4-5 meters from the instrument. Through a telescope placed close to the mirror it was possible to see the mirror image of the enlarged measure and to read off the exact value. The horizontal axis of the vibrations was enlarged by means of a system

of gear wheels and could be read off a measuring disc which turned 1344 times for one revolution of the drum. In this way he could make exact measurements of the first ten harmonics and he also found a simplified method of making the mathematical computations. However, when he heard that Otto Pipping in Helsinki had built a similar instrument, he discontinued his experiments and did not publish anything about them. But he has given some information about his methods in two letters to Otto Pipping, which were published in 1913, and in a letter to Georg Forchhammer, now in the Royal Library. A short description of the instrument by his brother Rudolf Werner, who was an engineer, was published as an appendix to the collection of Verner's papers and letters in 1903.

Even if he had continued his experiments, the technical development of his time would not have allowed him to reach lasting results. All the attempts at acoustic analysis at the end of the 19th century were soon outdated. Verner's interests were ahead of his time.

#### 4.2 Julius Hoffory (1855-97)

Karl Verner's friend Julius Hoffory must also be mentioned in a history of phonetics in Denmark. He had a broad knowledge and an acute intelligence. His main works are, besides his thesis on Old Scandinavian consonants, a paper on general phonetics, "Phonetische Streitfragen" 1877 and a book in which he criticizes the views of the German phonetician E. Sievers, "Professor Sievers und die Principien der Lautphysiologie" 1889. In his view of phonetic problems he was particularly influenced by the German physiologist Brücke. He was particularly interested in systematizing the sounds of speech and wanted to keep physiological and acoustical classifications apart. In 1883 he lectured on the principles and methods of the physiology of sounds at the University of Copenhagen. Shortly afterwards he went to Berlin, where he lectured at the University, from 1887 as professor of phonetics and Scandinavian languages. But at the age of 34, severe illness forced him to give up his work.

Both Verner and Hoffory were excellent phoneticians, but they buried almost all their knowledge in their private correspondence. Therefore they did not have much direct influence on the development of phonetic studies in Denmark. In this respect, the work of Otto Jespersen was much more important.

### 4.3 Otto Jespersen (1860-1943)

Otto Jespersen was born in Jutland in 1860. In 1870 his father, who was a judge, died and the family moved to Zealand. At the age of 14 Jespersen also lost his mother, and he had to finance his university studies himself by means of a job as stenographer in parliament. He started studying law (1877), following a family tradition, but after four years' study - shortly before the final examination - he changed to Romance philology, and in 1887 he passed the examination intended for teachers at senior schools which had recently been instituted, with French as a main subject and Latin and English as secondary subjects. He also attended courses in Russian with Verner and in linguistics with Vilhelm Thomsen, whom he admired very much. Jespersen was in opposition to the classical tradition of the University. He hated Latin, which was at that time compulsory as secondary subject, and was much more interested in modern languages and in practical problems of language teaching.

Almost from the start he took a lively interest in phonetics. He attended the first courses given in this subject at the University, in 1881 by Vilhelm Thomsen and in 1883 by Hoffory, and he read the works of Sweet, Passy, Viëtor and Storm and was very much influenced by their ideas concerning better methods of language teaching using the spoken language and by means of texts in phonetic transcription. In 1884 he translated a treatise by Felix Franke on language teaching, and for some years Jespersen and Franke corresponded intensively on linguistics, phonetics, and language teaching. They had the same aims and out of the correspondence grew a friendship which meant much to both of them. But they never met. Franke died of tuberculosis at the age of 25. In 1885 Jespersen published a small English grammar where all examples were in phonetic transcription. In 1886 he published a paper "Zur Lautgesetzfrage", which he reprinted in 1904 and 1933, in both cases with long postscripta, elaborating his view in more detail. At its first appearance in 1886, the paper was a contribution to an ongoing heated debate on the possibility of exceptions to sound laws. Jespersen was not willing to accept the dogma of the "Ausnahmslosigkeit der Lautgesetze". He considers "sound laws" as generalisations which are only valid in a "telescopic" but not in a microscopic perspective. In details there are exceptions

which may be due to the communicative function of the words (words which are easily understandable from the situation, e.g. greetings, may be weakened more than other words), and to their meaning.

After his exam in 1887, Jespersen studied abroad and met the influential phoneticians of that time, whose works he already knew: Sweet, Passy, Viëtor, Sievers. About that time Vilhelm Thomsen proposed to him that he should specialize in English because there would soon be a chair in that subject. So Jespersen studied English in Berlin with Zupitza. His thesis on English cases was accepted in 1891, and in 1893 he was appointed professor of English at the University of Copenhagen. In 1889 he published a small book, Articulation of speech sounds, in which he proposed a new type of phonetic transcription which he called "analphabetic" and in which each sound was indicated by a combination of symbols. It was inspired by Bell's "visible speech" system, but differed from the latter by the use of well known letters and numbers which could be found in every printing office. Jespersen used Greek letters to indicate the articulating organ, Latin letters to indicate the place approached by this organ, and numbers to indicate the degree of constriction. Thus a French voiced dental is, e.g., written  $\beta^e \delta \circ \varepsilon 1$  which means that the tongue tip ( $\beta$ ) makes a closure ( $\circ$ ) with the teeth ( $e$ ), the velum ( $\delta$ ) is closed ( $\circ$ ), and the vocal cords ( $\varepsilon$ ) are constricted in position 1 (for voicing), whereas a Danish voiceless  $\underline{d}$  is written  $\beta^e \delta \circ \varepsilon 2$ . Jespersen mentions as one of the advantages that the same components found in different sounds have the same symbols (as a matter of fact, the subgroups of the formulae (e.g.  $\beta^e$ ) come close to distinctive features). Jespersen uses the system in his subsequent textbooks of phonetics, but of course it cannot be used to render connected texts.

In 1889 he worked out a proposal for a more traditional, alphabetic phonetic transcription (later called Dania, because it was published in the periodical Dania), which was intended particularly for the transcription of Danish, and which has been used since in Danish dialectology. It will also be used in the forthcoming Danish pronouncing dictionary, edited by Jørn Lund et al. One of the principles was that symbols without diacritics are used for normal Danish sounds, which e.g. means that  $\underline{e}$   $\underline{o}$   $\underline{u}$  indi-

cate raised values compared to the IPA symbols. The most confusing discrepancies with IPA are probably that r is used for an unrolled uvular ʁ, that æ indicates a low, unrounded front vowel, and (worse) that Dania a is IPA ɑ and ɑ is a.

In 1897-99 Jespersen published his principal phonetic work, Fonetik, en systematisk fremstilling af læren om sproglyd, i.e. a systematic presentation of general phonetics, a work of more than 600 pages. In 1904 two German books appeared which together covered the content of the Danish work, viz. Phonetische Grundfragen and Lehrbuch der Phonetik. Compared to the Danish work they are somewhat abbreviated and brought up-to-date. Most of the Danish examples found in Fonetik were left out, but they were utilized in his book Modersmålets Fonetik, a book on Danish phonetics which appeared in 1906 and has been reprinted and revised several times since then.

Jespersen is not a pioneer in phonetics like Bell and Sweet. His work should rather be seen as the culmination of the trend which may be called classical phonetics, and which may be characterized by a mainly physiological description of speech sounds, built on what can be observed without instruments, except for a mirror, and perceived kinaesthetically, and what can be concluded about articulation on the basis of auditory perception by means of known correlations between articulation and perception.

Like Sievers and Sweet, Jespersen considers the new instrumental methods, as they were described and used e.g. by Rousselot, with a good deal of scepticism. He objects that the instruments may make the informant speak in an unnatural way, that the curves may not mirror the pronunciation exactly, that it is not possible to control afterwards what has been said, that the material is generally not comprehensive enough for generalizations, and that the communicative function of speech is not always respected. It must be admitted that this criticism was in most respects justified at Jespersen's time. But the best experimentalists, like Rousselot, were well aware of the limitations of their methods. And the negative attitude of the leading figures in classical phonetics contributed to delaying the progress in methods and the establishment of phonetic laboratories. This was also true in Denmark.

On the other hand, by his emphasis of the communicative aspect Jespersen prepared the soil for phonological points of view. In his descriptions of sound systems in different languages he very often quotes minimal pairs, and in his treatment of quantity he distinguished sharply between "inner" length, i.e. phonological length, and "outer" length, i.e. length differences conditioned by the environment.

Jespersen's Fonetik contains all the knowledge of his time with elimination of assertions and descriptions which he considered to be dubious. He had a critical mind and a good deal of common sense, combined with a gift for acute observation. And he was very careful not to mention sounds which he had not heard himself and, generally, learnt to produce to the satisfaction of native speakers. His examples are therefore mostly taken from Danish, English, French, and German, and in a few cases from other Romance languages and from Russian. This involves a restriction of the scope of the book, but at the same time it means that it is unusually reliable and that it can still be read with profit. It should be kept in mind, however, that the languages described have developed further during the 80 years that have passed since his Fonetik was published. In particular, his description of Danish pronunciation - correct as it was for his time - is in several points at variance with the pronunciation of the younger generation in Copenhagen. This is particularly true of the variants of the phoneme /a/, the short /ɔ/, the consonant /ɣ/, which has disappeared in the pronunciation of the young generation, and the place of the stød in words with /ð/, /j/, /v/ and /β/.

The description of the individual sounds, as also of the whole system, is based exclusively on sound production. In a short chapter he gives an account of what was known at that time about the acoustics of speech, and motivates his choice of production convincingly by the fact that much more is known about this aspect. He adds that sound production is more important for the explanation of sound change, and he believes that speech sound perception is closely connected to and conditioned by sound production. It is well known that the latter point is still under debate.

More problematic, but characteristic of Jespersen's empirical approach, are his arguments against Pipping, who had maintained

that children produce the same vowels as adults and, since their speech organs have much smaller dimensions, that they must articulate differently, and thus the acoustic aspect of sounds is more stable than articulation. In order to refute this assertion, Jespersen has measured the length of the lower jaw for different age groups and found that the differences are small compared to the more general differences of body height. This is correct, but he would have got different results from measuring the length of the pharynx. However, he could not be expected at that time to be aware of the importance of the pharynx in sound production and acoustics.

As far as the general system of speech sounds and the individual characteristics of the sound types are concerned, Jespersen's book does not contain new points of view compared to his immediate predecessors (except for the distinction between "groove" and "slit" consonant types). But he has many fine observations on details (for instance in the long chapter on r-sounds), and the chapters on the syllable and on stress contain original contributions to the description of some controversial concepts in phonetics. In the description of the syllable and of prosodic phenomena, Jespersen - like most other phoneticians - abandons the physiological point of view and takes his starting point in perception. The syllable is considered to be a peak of relative sonority. This is not a new definition, but Jespersen goes into more concrete detail. He sets up a scale of sonority for speech sounds: 1. voiceless sounds, (a) stops, (b) fricatives, 2. voiced stops, 3. voiced fricatives, 4 (a) nasals, (b) laterals, 5. voiced r-sounds, 6. high vowels, 7. mid-vowels, 8. low vowels. -- In each sound chain there are as many syllables as there are relative peaks of sonority. This is exemplified graphically in the following way:

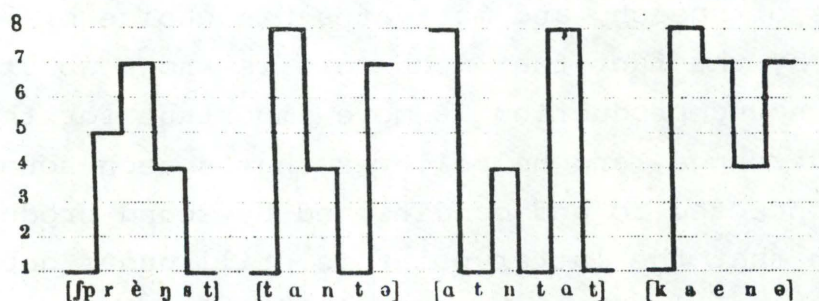


Figure 2

From Lehrbuch der Phonetik p. 192.



He adds the rule that between a given sound and the syllabic peak only sounds of the same or a higher sonority class are permitted. Sonority is defined somewhat vaguely by saying that the most sonorous sounds can be heard at the longest distance. The problem of s and ] is solved by putting voiceless stops and fricatives in the same class. In an interjection like pst, s forms the syllabic peak, but compared to a neighbouring vowel (papst), the difference is too small to give the impression of a separate peak in s. - The fact that, e.g., words like Cimbria are heard as having three syllables is accounted for by the principle that a relatively sonorous sound following a less sonorous sound is often heard as a separate syllable even if the following sound is still more sonorous, particularly if it is relatively long, as in Danish [suldne] ('sultende', vb. (starving)) (which differs from [suldne] ('sultne', adj. (hungry))).

A reduction in intensity between two sounds of the same class is at the same time a valley in sonority and may also give a syllable boundary, like i Italien [i i...], or bonden [bɔnn̩].

The difference between Danish [vi?n] ('vin' (wine)) and [bi?n] ('bien' (the bee)) is explained by the n being weak and almost voiceless in the first case, so that it does not give a new peak, but fully voiced in the second case. -- This is certainly right, but Jespersen is very bold when he asserts that if the apparently same consonant has different syllabic functions in different languages, one can be sure that it is pronounced differently. Jespersen's sonority principle functions quite well for the languages he has chosen to include in his description, and may perhaps be considered as a definition of the optimal syllable type, but if the principle is considered to be universal, as he seems to intend, he would get into trouble already with Russian, to say nothing of many African and American Indian languages.

In the chapter on stress he introduces some useful new concepts. He distinguishes four types of stress: (1) traditional stress (i.e. stress that is bound to a particular syllable of a word), (2) "value" stress (which may be either stress of "novelty" or stress of "opposition"), (3) "unity" stress, which combines parts of a word or a syntactic group by stressing the final part, and (4) "rhythmical" stress. The syntactic unity stress has a particularly clear function in Danish compared to German,

English, and French. The frequently found stress of the first part of a compound he considers to be stress of opposition.

As mentioned above, Jespersen was very much interested in language teaching and particularly in applying phonetics to language teaching. As early as 1891 he started writing text books in English with phonetic transcription of both texts and word lists, and this approach was generally accepted and applied in text books for schools in the following years. In 1901 he published a book on language teaching.

After 1900, however, he concentrated his efforts more on the study of English grammar and the history of the English language and on the theory of grammar. His main work in the former field, Modern English grammar, appeared in seven volumes from 1909-42, and in the latter field his main work is Philosophy of grammar from 1924. He also wrote a book on child language and an often quoted paper on the symbolic value of the vowel i.

Another of his main works is Language (1922), which deals with language and linguistics in general. In this book he also treats the idea of progress in language which was one of his favourite ideas. In his general attitude to life and to language in particular he was influenced by Darwin, Spencer, and Stuart Mill. He believed firmly in progress, both in politics and in the development of language. The introduction to his thesis (1891) starts with a chapter on progress in language, and 50 years later he published a book with the title Efficiency in linguistic change.

#### 4.4 Georg Forchhammer (1861-1938)

Jespersen's contemporary Georg Forchhammer, originally an engineer, later a teacher of the deaf, deserves to be mentioned briefly, partly for his vowel cubus with three dimensions: tongue height, rounding, and place of articulation, and partly for his theory of vocal intensity. He is opposed to the traditional view that intensity is due to expirative force and points to the function of the vocal cords. A more precise closure will give the most economic utilization of the air pressure, and thus more force, whereas a lax and unprecise closure will give a stronger airflow but a relatively weak voice. Forchhammer now thinks that in singing the intensity is mainly governed by the expirative muscles, but in speech the unstressed syllables are often pronounced with

less compression of the vocal cords and more airflow. -- This is probably a correct description of the unstressed syllables in the Germanic languages (schwa). Jespersen quotes this theory as an alternative to the traditional description of weak stress as due to less expiratory force. However, lack of stress is hardly due to lower intensity caused by this type of phonation, but rather to factors of pitch and duration combined with the neutral vowel quality.

Forchhammer also constructed a phonoscope by means of which the oscillations of speech sounds were transferred to a gas flame and recorded on a revolving drum.

##### 5. Brief outlook on the 20th century

Due to Jespersen's influence, language teaching in Danish schools was based on phonetic transcriptions. This meant that also the teachers were supposed to have phonetic knowledge, and from the twenties onwards phonetic training played a greater role in language studies at the Danish universities than in most other countries, and phonetics was part of the requirements for the MA in modern languages. But there was not much phonetic research going on until the middle of the forties. In the following years three main trends may be distinguished: (1) a continuation of the Jespersen tradition (descriptions based on auditory observation) represented by Aage Hansen and, in recent time, by Brink and Lund; (2) instrumental phonetics, starting with Svend Smith's thesis on the Danish stød from 1944, and since 1966 mainly concentrated in the Institute of Phonetics in Copenhagen and its laboratory; (3) phonological research, inspired by the various European and American trends and by Hjelmslev's glossematic theory, whose main representatives, after Hjelmslev, are Jørgen Rischel and Hans Basbøll. It should also be specially mentioned that due to a strong influence from phonology, Danish dialectology has been based on methods of structural linguistics since the early thirties. Among its chief representatives one may mention Poul Andersen and Anders Bjerrum.

A brief sketch of the external history of this period is found in ARIPUC 10. A detailed history and evaluation of its scholarly achievements may better be left for the future.

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