

XXX. Meditation on vocal formation

I have often pondered a great deal what the reason is for the rather diverse and nearly innumerable sounds which humans can produce to make their thoughts clear to others. For the human voice is such that no instrument can imitate it, nor have craftsmen up to now been able to express with any instrument its various inflections. Instruments which are outfitted with pneumatic devices to duplicate the human voice do not, in fact, reproduce the voice itself, but only human singing, a certain simple sound. Nor can they express the various vowels with these same instruments—to say nothing about consonants—, although it is easy to perceive that the different sounds produced come close to different vowels. When these instruments produce higher-pitched sounds, they come very close to the Latin *ae* or Greek α . Lower-pitched sounds, however, approach *o*, or rather a shortened (*obtusum*) *u*. As I observed these phenomena, I wondered whether instruments such as these could not be fashioned so that they would be able to produce each vowel. Something which, I noticed, depends upon the shape of the horn, and in the same way, the various shapes of the mouth is one cause of different vowels. If we come to understand the configuration of the mouth, it would then be possible to determine the shape of a horn needed to produce a given vowel sound. Let us examine, therefore, the movements we make, the shape of the mouth, the form of the lips, the placement of the tongue, and the position of the jaws when we make different vowel sounds.

If we concentrate upon this matter, we perceive two classes of vowels: thicker (*crassior*) and thinner (*gracilior*), between which are infinite intermediates, or gradations, from one to the other. These two classes are the extremes. The essential difference between these two classes is the shape of the mouth in relation to the jaws, or the form of the jaws. If the jaws are contracted, they produce thinner sounds, and thus the opening of the mouth is made to converge towards the jaws. But if the jaws then allow the mouth to widen, thicker vowels are produced. Each class supplies distinct sounds in infinite ways, according to the different shapes of the front part of the mouth. But in particular, each class contains three primary vowels, according to whether the front of the mouth is opened to the greatest extent, closed to the greatest extent, or holds the position in between these. As for the first vowel that I place under the class of thinner, if the anterior cavity of the mouth is opened, the vowel *ae* is produced, which is commonly and wrongly considered a diphthong (how the matter stands with diphthongs will be clear from what follows). Among Germans, this vowel is used most often with the sign of *e*, especially in the terminations of verbs such as *werden*, *leben*; in this way, the letter *e* is often produced, and is called *e feminine*. If the cavity in the back of the mouth is narrowed as much as possible with the tongue, the sound will be *i*, and this is a high-pitched (*acutus*) vowel, as pronounced in the German words *ich*, *Mathis*. If the cavity of the mouth is in the intermediate position, the vowel *e masculine* results, as in the German words *stehen*, *gehen*, etc. And so the three principal vowels of the first class are: 1. *e feminine*, 2. *e masculine*, 3. *i acute*.

Between these there are, of course, numerous intermediates. Between 1 and 2, however, there are none in use. Between 2 (*e masculine*) and 3 (*i acute*), the most commonly used is the intermediate, namely the shortened (*obtusum*) *i*, as in German *dich*, *richten*, etc. The three primary vowels of the second class (the thicker sounds) are produced in the same way. If the anterior cavity of the mouth is opened as much as

possible, the vowel *a*, flat and open, is produced—Hebrew א (aleph) in *patach*, German, *Blatt, matt*. If the same part at the front of the mouth is narrowed to the greatest extent and the lips pushed out, the vowel *u acute* will be heard, as in German *Uhr*. If the same cavity at the front of the mouth is placed in the intermediate position, the vowel *o* will be perceived. Therefore, the three primary vowels of the second class are: 1. *a open*, 2. *o*, and 3. *u acute*. Among these, the vowel *shortened a (obtusum)* holds the intermediate position between 1 and 2, as in German *Grad* and almost every *a* as it is pronounced by Suebians and Bavarians. In Hebrew, it is *long a* (א kamets).¹ Between *o* and *u* the intermediate vowel in use is *shortened u (obtusum)*, as in German *Bruch, Stuck*, etc. We can now give as well the intermediate sounds between the vowels of each class, when the posterior part of the mouth holds the intermediate position between maximum extension and maximum contraction. And so between the first vowels of each class, *e feminine* and *a*, there is in French an intermediate vowel, thicker than *e* but thinner than *a*, as in the words *infaillible, paille*, also in *Roi*, etc. Between the second vowels of each class, *e masculine* and *o*, there is the intermediate *oe*, used by Germans in the words *König, Göttlich*, etc. Between the third vowels, *i acute* and *u acute*, the intermediate *ü acute* is in use. For this sound the Swiss say *eu*, as in *heulen* when they read *hülen*. Between the intermediate vowels of each class, *shortened i (obtusum)* and *shortened u (obtusum)*, we have finally the intermediate *shortened ü (obtusum)* in the German words *Übel, verkündigen*, etc. We have explained how vowels are formed and where their differences are located. Therefore, we come to the consonants, which are particular modifications of vowels, by which their beginning or end is affected. We are able to begin vowels with a sound in various ways, and likewise to end them in various ways, and from this arise the various consonants. The means by which either the beginnings or endings of vowels are affected are: 1. breathing through the mouth, 2. breathing through the nose, 3. lips, 4. tongue, and 5. jaws. If breathing through the mouth precedes the sound, the letter *h* is produced (the “rough breathing” of the Greeks). If the breathing follows the sound, this is likewise indicated by the sign *h*. If the tongue is so positioned that the air escaping against it produces the same effect as when air strikes the reed in reed instruments (that is, if the tongue by a vibrating motion at one time gives passage to the air and at other times closes off the passage), and this is accompanied by a sound, the consonant *r* is produced. In this way, another consonant can be formed by applying a vibrating motion of this sort to the lips, so that they in turn release and trap air; but this modification of vowels is, as far as I know, not in use in any language. The remaining consonants take their origin from changes in the lips, tongue, and opening and closing of the jaws. If the lips are suddenly opened or closed, without any additional breathing through the mouth or nose, the letter *b* is produced; if this is accompanied at the same time by the aspiration *h*, the letter *p* is produced. If the same thing occurs with the tongue, so that it allows or prevents the breath to escape with a sound by suddenly removing the tongue from the palate or moving it onto the palate, we have the letter *d*, and with aspiration, *t*. When the jaws are suddenly opened at the beginning of the sound or closed at the end of it, without any breathing, the letter *g* is produced; if the same thing happens with aspiration, the

¹ *Aleph kamets* has a vowel pointing (a small t-shape, indicating the vowel sound) underneath it, which I can't reproduce on my computer (Leopard doesn't currently support right-to-left fonts). *Kamets* is the Hebrew term for this long *a* sound.

letter *k*. If the lips are opened or closed in the same way, but with breathing through the nose, the letter *m* is produced. If breathing through the nose accompanies the same operation of the tongue, the letter *n* will be produced, and lastly, if the opening and closing of the jaws is accompanied by breathing through the nose, the Hebrew letter *ayin* is produced,² if rightly pronounced by means of *gn*. If the lips are not completely closed so that the breathing can freely occur, the letter *w* is produced. But if the tongue is moved close to the palate, but does not deny free passage to the breath, the letter *l* will be heard. If the same thing occurs with the jaws, we will have the letter *j* as a consonant, as in German *ja, jagen*. If, finally, the lips, tongue, and jaws are closed a little more, but the air can be expelled by force, the lips will form the letter *f*, the tongue the letter *s*, and the jaws the letter *ch* (Greek χ , Hebrew *sin*).³ Therefore, a human can form the following simple consonants: 1) *h*, 2) *r*, 3) the one produced by the vibration of the lips, 4) *b*, 5) *d*, 6) *g*, 7) *m*, 8) *n*, 9) [*ayin*], 10) *w*, 11) *l*, 12) *j*, 13) *f*, 14) *s*, 15) χ . I do not count the three consonants *p*, *t*, and *k* among these, even though they are composed from *b*, *d*, *g*, and *h*. I believe this is a complete enumeration of consonants, nor can any other be formed which is not included here or not composed from these.

² I suspect, though I am not sure, that the Hebrew letter printed (*ayin*) is a mistake, since *ayin* does not correspond to the sound Euler describes. He might mean the actual name of the letter, since the second syllable of *ayin* could be the sound Euler describes. It could possibly be *gimel*.

³ Again, there must be a mistake, since the Hebrew letter printed (it could be pronounced *sîn* or *shîn*; a dot should be printed at the top left or top right to indicate the difference) in no way corresponds to the sound Euler describes. The letter should be *het*, or possibly *qoph*.