The Chöömij of Mongolia A Spectral Analysis of Overtone Singing

Ronald Walcott

SELECTED REPORTS IN Ethnomusicology Volume II, No. 1 1974

CHÖÖMIJ* is the Mongolian name for a solo style of overtone singing where two distinct pitch lines are sounded throughout. One, a nasal-sounding drone of relatively constant pitch, corresponds to the fundamental; the other, consisting of piercing, whistle like tones, forms a melody, line above the drone and results from the reinforcement of individual overtones within the ambitus of the 5th through 13th partials.

Reinforcement of partials is achieved by characteristic changes in the shape and volume of the mouth cavity. This is reminiscent of the principle of the Jew's harp,' where a vibrating tongue sounded at the lips produces a drone fundamental which the player modifies by shaping his mouth cavity so as to form a resonance chamber of critical volume. The volume of this chamber, functioning on the principle of a Helmholtz resonator, reinforces a narrow frequency band area within an existing spectrum. This band is sufficiently narrow to enable the singer to select a given single partial above the drone in accordance with the degree of modification made by him. The principle involving the reinforcement of discrete partials by a specific shaping of the mouth cavity is thus common to both chöömij and the Jew's harp. A difference, however, lies in the physical origination of the fundamental.

In the Jew's harp it is produced at the lips, in the chöömij it originates in the throat region. The unusual quality of chöömij arouses special interest. Subjective statements cannot take us very far and we need a more objective basis for describing it. The Melograph Model C offers a mechanical approach to a more accurate and precise representation of this complex vocal phenomenon.

A number of recordings of this style has been made*' and an analysis of them will appear in a more comprehensive study. I have selected for detailed melographic analysis the initial phrase of one performance which is distinguished by the unusually long duration of its ictus, 1.4 seconds. This is reproduced on Plate 1 and transcribed in figure 1.

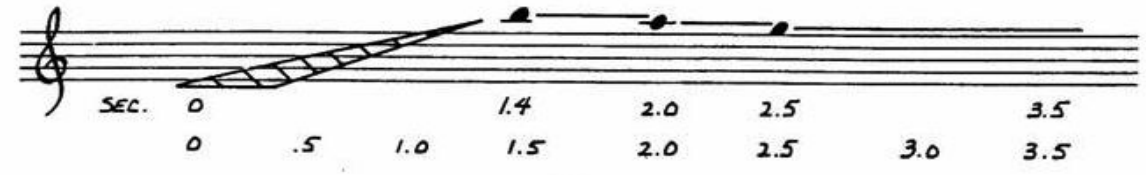


Fig. 1.

The phrase of three descending tones is preceded by a groan like attack. The spectral graph presents a pattern of equidistant bands, corresponding to frequencies that remain virtually constant for the duration of the descending phrase. This is, in fact, true for the entire piece from which this example is drawn. An equidistant band pattern maintained throughout the changes in the whistle-tone pitches suggests (a) that these are generated above a fundamental of constant pitch; and (b) that they are due to harmonic overtone generation, a predictable characteristic of wind instruments.

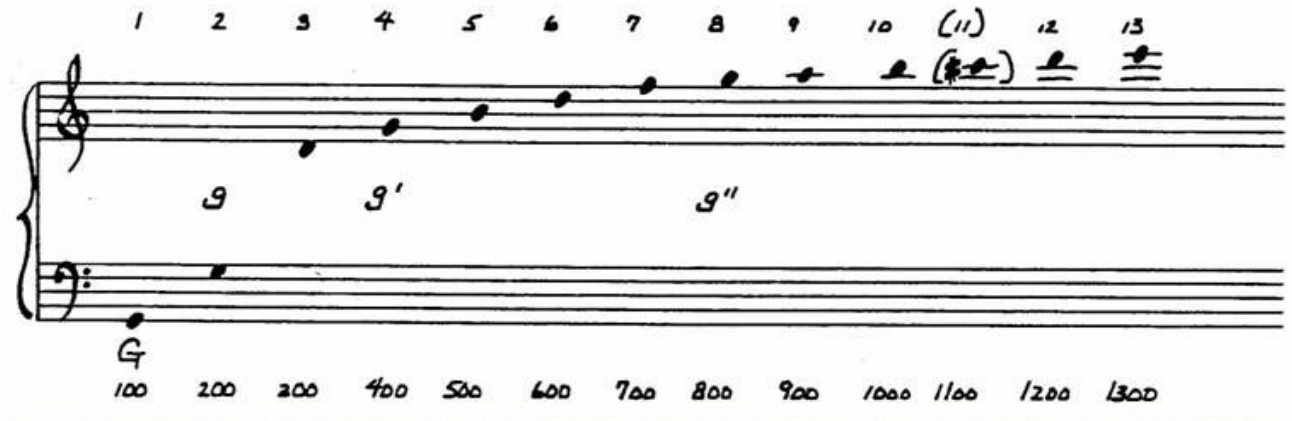
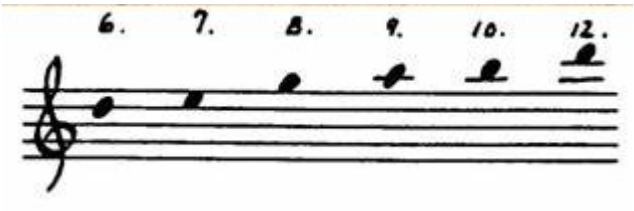


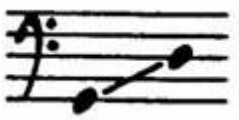
Fig. 2. (The tolerance of the filter permits only approximate readings of the frequency values.)

Figure 2 shows in staff notation the approximate partials as they appear in consecutive order above a fundamental of about 100 Hz.

Most important to note here is not the precise distance between the bands or their absolute frequency value, but rather (a) the pitch vocabulary of the partials from which the melody tones are selected, namely the 6th to 13th partials but excluding the 11th; and (b) the general range of the fundamental. As concerns the chöömij style, I would suggest that a physiological limitation prevents the singer from descending below the 6th or from ascending above the 13th partial if he wishes to isolate the desired melodic tones with sufficient intensity. The melodic style would seem to dictate the selection of tones agreeable to an anhemitonic penta scale widespread in Mongolian music, and this would naturally require the lowering of the 7th partial from f- to e' and the avoidance of the 11th partial altogether,



Finally, the stable drone fundamental is in the author's experience invariably selected from within the approximate range of G-d,

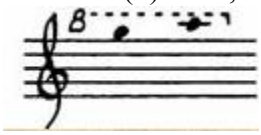


The reason is that only this range permits the generation of a corresponding complement of partials that the mouth cavity can effectively filter.

Chöömij closely resembles borbannadyr, one of four Tuvan overtone singing styles described by A. N. Aksenov (3) that are largely characterised by the ranges in which they occur.

P. Crossley-Holland(4) describes two styles of overtone chanting cultivated by the Tibetan monasteries of Gyume and Gyumo that are differentiated from chöömij by their placement in a somewhere lower range.

We have so far provisionally established the nature and vocabulary of tones comprising the chöömij style, the physiological mechanics for their production, their relationship to general acoustical laws, and their general frequency range. Our attention now turns to the ictus. In the graph, the ictus is represented as a successive development and decay of overtones. For reasons to be discussed, it is considered as a progression toward "normal" sustained chöömij timbre. The graph of the 1.4-second-long period of attack reveals an upward flowing glissando of overtone emphasis extending across a wide chöömij range, namely from the fundamental to the 10th partial. This dramatic upswing, accompanied by a smoother downward resolution of the 12th, 11th, 10th, and 9th partials into the 9th partial alone, is a composite of varied partial durations and intensities unfolding in time and resulting in an attack "shape." We are dealing here with a complex of duration, intensity, overlapping, pitch, and grouping of partials. Aural perception is not one of an ascending glissando of individual overtone pitches, but rather of a gradual change of colour during the ictus from whose complex sound emerges the pure, whistle like b'' sounding above the drone of G(5) Also, the 16th and 18th partials (1600 and 1800 Hz)



appear at the end of the ictus and remain faintly present through to the end of the phrase. Our microanalysis, deliberately scrutinising a 1.4-second-long detail, captures a delicate moment of vocal timbre which the singer of chöömij must effectively control in order to establish "normal" sustained chöömij sound. The ictus, representing a drive toward the sonal norm, isolated here for study, may well prove to be the key to a precise physiological explanation of this style(6).

Following our description of the ictus that precedes the unfolding of the melody, we now come to the "normal chöömij sound" as typified by the descending notes b", a", g". The spectral configuration of the three descending whistle-tones shown by the melogram during the 2.1 seconds following the ictus is here considered typical and representative of chöömij sound; or, to speak more objectively, the distinctive "nasal" quality pervading this style results from the spectral configurations shown by the melogram and presented schematically in figure 3. These show the sounding areas of the formants in relation to non sounding areas.

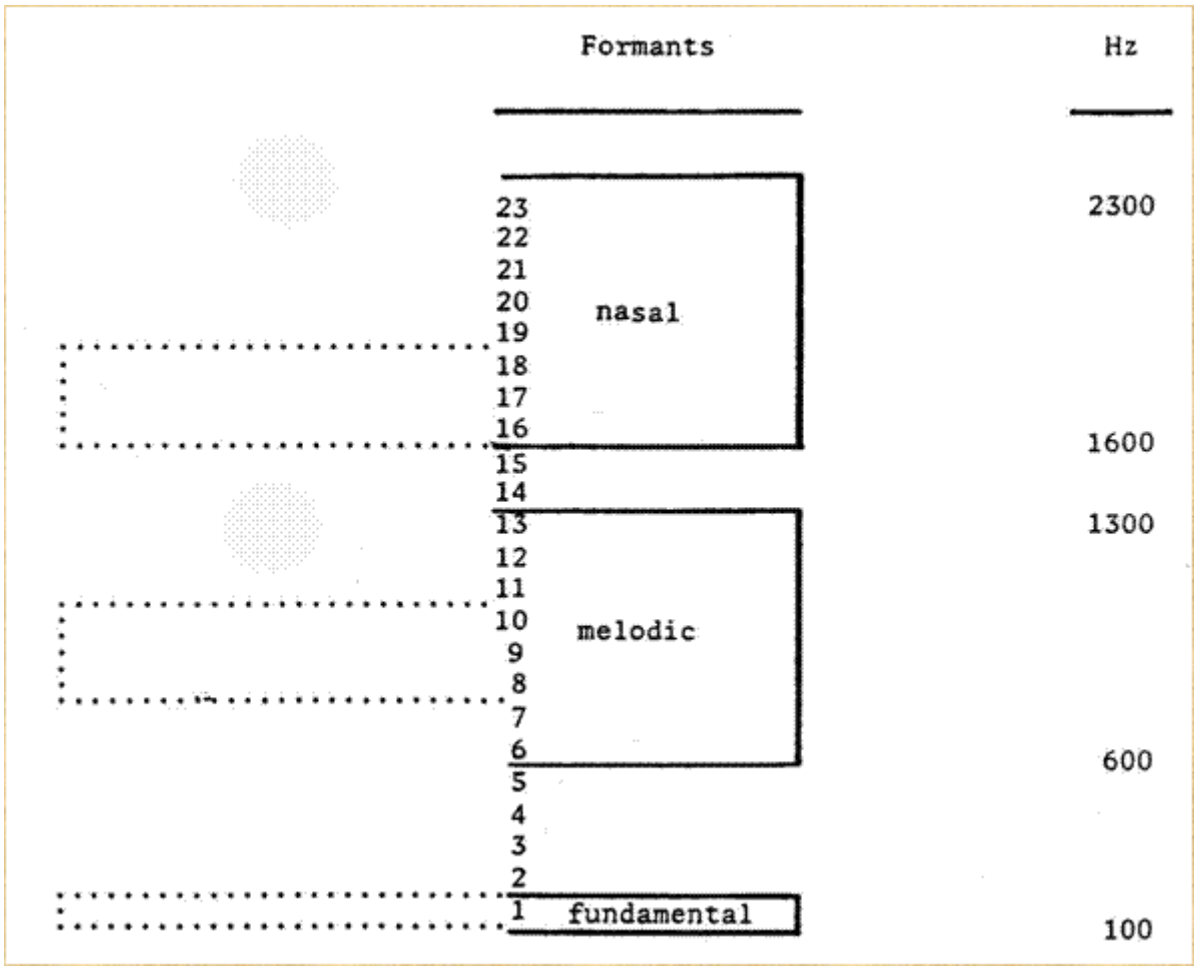


Fig. 3. A stylized diagram of chöömij vocal sound. The dotted lines refer to the melogram shown in Plate 1 above.

Figure 3 shows three formant areas for chöömij: (1) the fundamental; (2) the melody area, 6th-13th partials; and (3) a higher nasal area that is new to our description for the range of this style. This third formant lies in the 1500-1600 Hz range in this excerpt, and is present as the'16th through 23rd partials in chöömij style generally. We have made the experiment of eliminating the third.formant, and have found that this effectively negates the nasal quality so typical of this style. If the three formant areas in the arrangement presented by figure 3 are considered an accurate description of chöömij style, it suggests that a spectrum judged to he nasal has a non sounding "hole" in the area of 900-1300 Hz. This further implies a more objective definition of our perception of nasality. In order to indicate the existence of a non-sounding hole, the range initially presented in figure 2 (1st through 13th partials) for the chöömij must be extended to include the area of the 16th through 23rd partials. They exist as a stable upper drone cluster of tones vital to maintaining the nasal character of the style and their existence may be a function of physiological necessity. Our recognition of the "nasal formant" as an integral part of the style thus provides a further possible clue to its vocal production. Attention to detail during the sustained tone production may give further insights into this problem. At the point where the melody descends from the b'', the dovetailing of pairs of melodic overtones results in transitional areas where both can be heard simultaneously,. resulting in the interval of a major second. Further, in our own experience, the last note g" predominates on first hearing; however, after an examination of the melogram where the a" is seen to be simultaneously present, the interval of a major 2nd can be heard quite distinctly.

We may have here an indication of the degree of efficiency of the mouth cavity as a selective overtone filter. It is clear that effective filter width permits the passing of more than a single partial. The question then arises: Is a single melody note more likely desired by the human mechanism unable to produce it? Or, alternatively: Is it correct to end some phrases with a blend of two partials such that the performer is in fact adhering to a canon of style?

Further, the two pitches C and g" are accompanied by a rhythmic accent of the fundamental pitch. This accentuated accompaniment to melody tones occurs throughout this style. It might reasonably be anticipated that such accentuation would find some reflection in the display. Our melogram, however, shows no significant change in overall dynamics, such as would be typical of a push of air from the diaphragm. On the contrary, we find this dynamic swelling of the fundamental pitch to correspond to a strengthening of the 2nd and 3rd partials and, to a lesser degree, of the 5th. In reference to the physiological factors considered above,

we could now ask what process involved in shifts of melodic whistle-tones necessitates the emphasis of other partial groups. It must be considered further, however, whether this accenting is related to an unconscious physiological necessity of resetting the mouth cavity filter for emphasising a different melody partial, or whether it might be a stylistic trait effected by an independent alteration of the mouth cavity consciously cultivated to accompany and punctuate pitch change. Or is it both? The answers to these questions necessarily await further research.

Finally, the overall dynamic graph peaks during the initial attack and remains unusually stable during the length of the phrase (8). The stability of this graph during notes of long duration suggests an ability on the part of the singer to supply constant air pressure to the vocal mechanism producing the fundamental pitch. This may be another consciously cultivated feature.

The latter part of this article emphasises the relevance of melographic analysis to the physiological processes of voice production. It would be fascinating to go further and to add computer facilities. It might then be possible to calculate a progression of mouth and nasal cavity configuration corresponding with the normal vocal style (9). When this can be realized, it may well bring a new dimension into the objective study of musical styles.

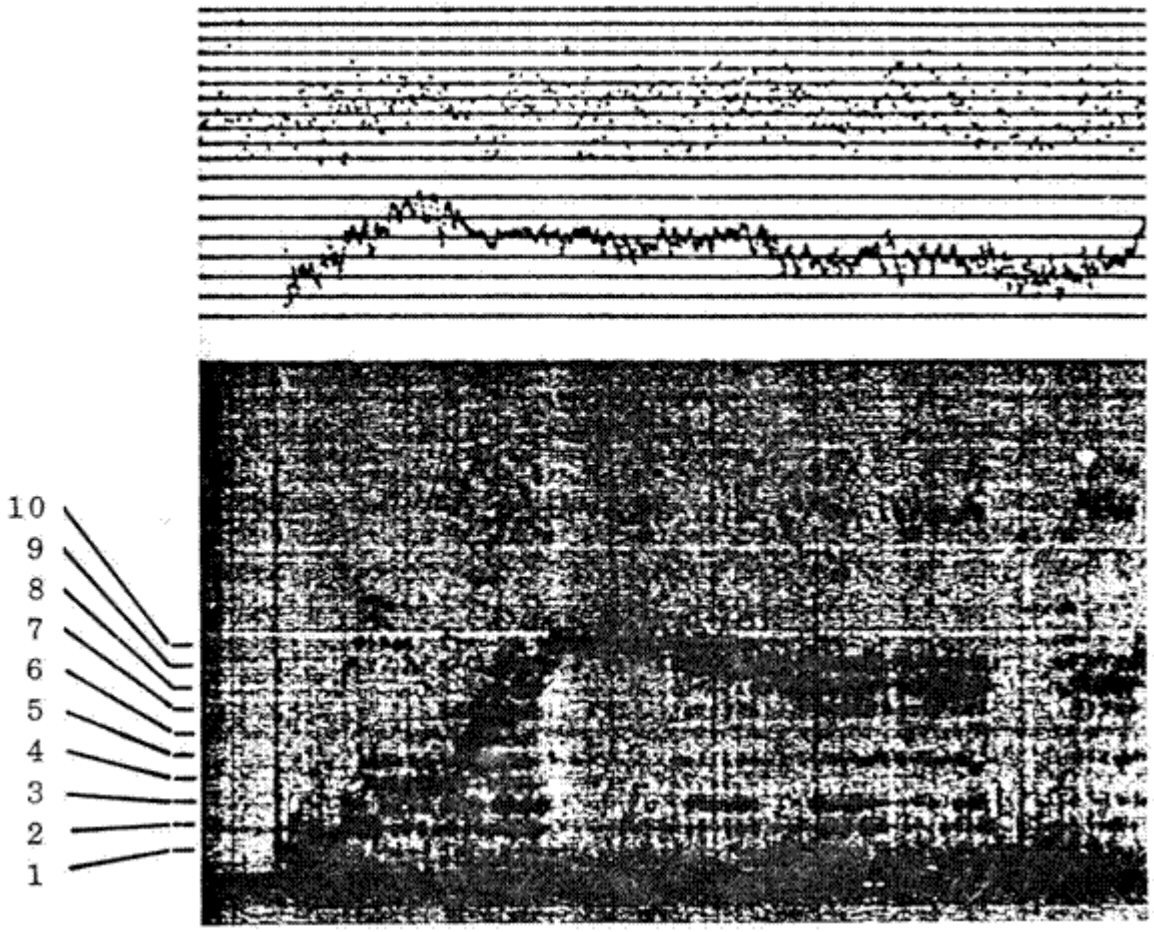


Plate1

NOTES

* chöömij (Hans-Peter Vietze, Lehrbuch der Mongolischen Sprache [leipzig: VEB Verlag Enzyklopädie 1969] , pp. 15-16) or khöömii (J. E. Bosson, Modern Mongolian [Bloomington: Indiana University, 1964 1, P. 11) are two possible transliterations for the Mongolian “хөөмий” which in Khalkha dialect means pharynx; throat; windpipe (A. Luvsandendev, Mongol’sko-russkii slovar[Moscow: Gos. Izd-yo Inostrannych i Natsional'nych Slovarej, 1957], p. 553). In Classical Mongolian it is written K ØGEMEI, Which means pharnyx; throat (F. Ussing, Mongolian-English Dictionary [Berkeley: University of California Press, 1960], p. 479). Aksenov (1964) writes chöömij and Vargyas (1968) hö-mi.

1. The comparison of chöömij with the Jew's harp was suggested by Lajos Vargyas, "Performing Styles in Mongolian Chant," in Journal of the International FoLk Music Council XX (1968), 70-72.
2. Professor D. Dinowski of the Ethnology Department, University of Warsaw, has kindly facilitated a study of this material.
3. "Die Stile des tuvinischen zweistimmigen Sologesanges," in Soujetische Volkslied-und Volksmusik. forschung. Erich Stockmann, ed. (Berlin: Akademie Verlag, 1967). Pp. 293-308.

4. Notes to the recording, "The Music of Tibet: The Tantric Rituals," Disk AST-4005, New York, Anthology 1970. Musical analysis by Peter Crossley-Holland; acoustical analysis by Kenneth N. Stevens.
5. This was investigated through a synthesis of this same excerpt on a generator of sine-tones produced through a process using insulated light. This apparatus was constructed by Dr. K. Schiigerl, Phonogramm-archiv, Vienna, in 1970.
6. This topic is under study by Dr. Frank, Laryngologisches InstitiA, Vienna.
7. This result is based on filtration experiments carried out with the help of Dr. R. Brandi, Phonogramm-archiv, Vienna, 1970.
8. It is the opinion of Mr. Michael Moore, based on the perusal of a large number of melographs, that the dynamic display shows little fluctuation when compared with other vocal sty es.
9. Apparatus of this nature already exists and is being further refined and developed by Dr. P. Ladefoged in the Phonetics Laboratory at UCLA.

Return to Mongolian Khöömii Singing main page