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Chapter One:
Understanding the "Sound Machine"

Principles of Sound Production

An awareness of the physical properties of the vibrating string is key to understanding sound production. It is also a common language by which teachers, players, conductors, and composers can communicate. Basically speaking, *in order to produce sound efficiently, the act of bowing must coincide with the physical properties of the vibrating string*. In other words, the string is the master of the bow, not *vice versa*. To explore this further, it is necessary to think like a scientist or physicist. The following is based on observable physical and mechanical principles.

How It Works:

The three most common bowing factors determining good tone quality are: a) *bow speed* (or velocity—the amount of bow drawn per unit of time), b) *bow pressure* (between the bow hair and the string), and c) *distance from the bridge* (placement, contact point, or sounding point). What may not be as clearly understood is the *relationship* between these factors in changing conditions. Tone production is a three-way balancing act where a change in one factor influences the others, similar to a mobile. One additional factor is the direction of the friction applied to the string via the bow hair. This friction must be applied perpendicularly *at all times,* because any given point on the string moves essentially in that direction. However, the angle of the bow to the string can vary as long as the perpendicular friction is maintained (see Oblique Bow Angle, p. 16).

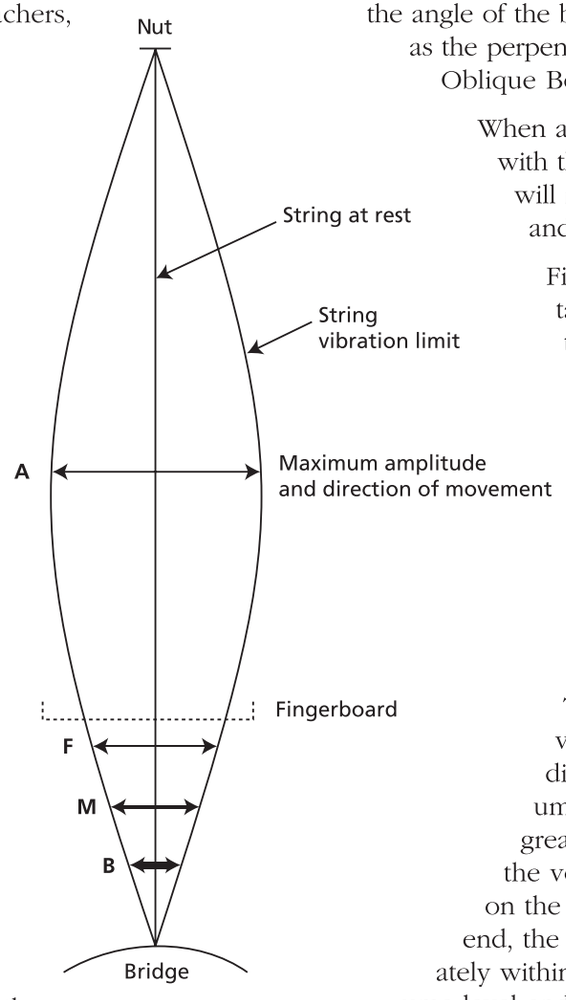

Figure 2: *The "Map"*

When all bowing forces are in harmony with the vibrating string, good sound will result (limited only by the quality and adjustment of the instrument).

Figure 2 is a simplified representation of the vibrating string and the resulting interrelationships of bow speed, pressure, and distance from the bridge. The length of the string represents a given pitch and the width (amplitude) represents volume level. When viewed from either end, it moves essentially in a circular path, not straight back and forth as implied in this two-dimensional drawing. The maximum width of the vibration pattern (point A) is directly proportional to the volume level produced; that is, the greater the amplitude the greater the volume. Notice that, at points on the string which are closer to either end, the amplitude decreases proportionately within the context of a constant volume level and pitch. The changing amplitude of the string vibration relative to the distance from the bridge shows how bow speed and placement are actually independent of volume level.

Notes:

1. The term "tone quality" refers to that which is recognized as good or bad, whereas the term "timbre" refers to variations of sound quality within acceptable tone quality.
2. The entire string vibrates in a complex pattern called the "Helmholtz motion"; nevertheless, any given point on the string moves more or less perpendicularly to its length.
3. "Pressure" is the proper term for what happens where the string and bow hair meet, but, "weight" is the preferred term for how that pressure is achieved.