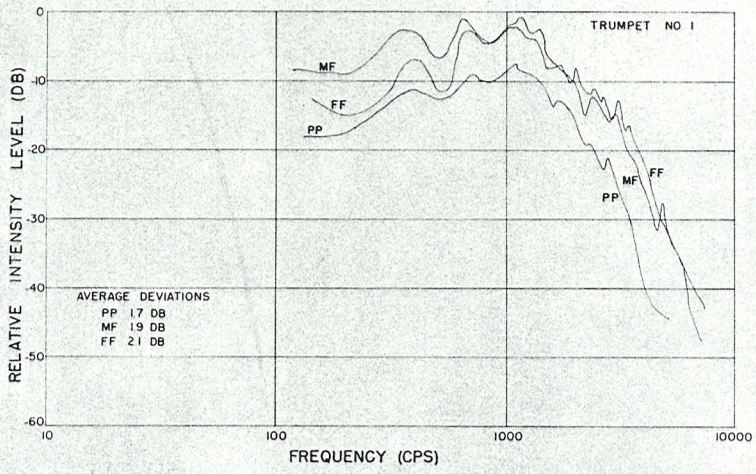

FIG. 2. Spectral envelopes of Trumpet No. 1 at three dynamic markings.

3. We selected the normalization frequency mentioned in Step 2 above so that the deviation from a smooth curve of the normalized amplitudes of the partials of the various notes in the group was minimized (as judged visually), when these amplitudes were plotted versus the frequencies of the partials. To this end, a repetitive display of this plot on an on-line oscilloscope attached to the computer was indispensable.

4. The average deviation of the points from a smoothed curve was computed with this value of the normalization frequency. To compute the smoothed curve, all normalized amplitudes within a width of frequencies broad enough to eliminate tuning effects were averaged. This width was usually chosen to be approximately equal to the frequency of the lowest note normally played on the instrument. Such averages, in turn, were for each instrument so that appropriate statistical averages can be computed to reveal features, such as spectral envelopes, that would otherwise be hidden. (One must also remember in this connection the large tolerance of the auditory process for amplitude changes from one note to the next.[4]) The existence of a spectral envelope implies that the relative SPL's of various harmonics is determined by a single curve that is independent of the fundamental frequency of the played. For example, c quency is 880 cps. This a note at 110 cps, the fourth harmonic of a note at 220 cps, or the second harmonic of a note at 440 cps. The relative amplitude of the eighth and fourth harmonics of a 110-cps note will be the same as that of the fourth and second of a 220-cps note.