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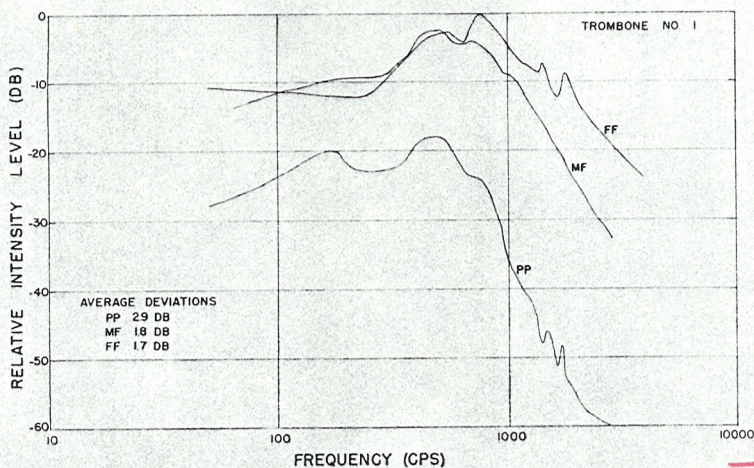


FIG. 5. Spectral envelopes of Trombone No. 1 at three dynamic markings.

- The amplitudes of partials during an attack transient do not always increase monotonically in that frequently there are approximately cyclical increases and decreases of the amplitude that may last one or a few cycles. These modulations are called *blips*. The amplitude and number of blips is greater for low notes than for high ones. These amplitude blips disappear entirely for notes whose frequency is above 900 cps.
- The duration of the blip(s) is more nearly a constant time (3-10 msec) than a fixed number of cycles as the note frequency is changed.
- The amplitude and duration of the blip(s) increases by a factor of about 4 as the dynamic marking is changed from pianissimo to fortissimo, about 9 dB.⁴
- Frequency modulation at the beginning of the note

scales, but such a procedure would have consumed much more time. If we approximate the part of the spectral envelope above the cutoff frequency of 1000 cps with a straight line, the result is an average rolloff for the scale used in deriving the envelope. Figure 4 is a plot of this average rolloff versus the average intensity level of the relevant scale. Figure 4 indicates that as the intensity of a note increases, the levels of the high-frequency partials increase more rapidly than the levels of the low-frequency partials.

B. Trombone

We next discuss characteristics peculiar to the trombone:

- In the low registers, the waveform is very impulse-

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 Luce & Clark, Physical Correlates of Brass-Instrument Tone
 1967 JASA 42
 1232-1243 | p. 1238