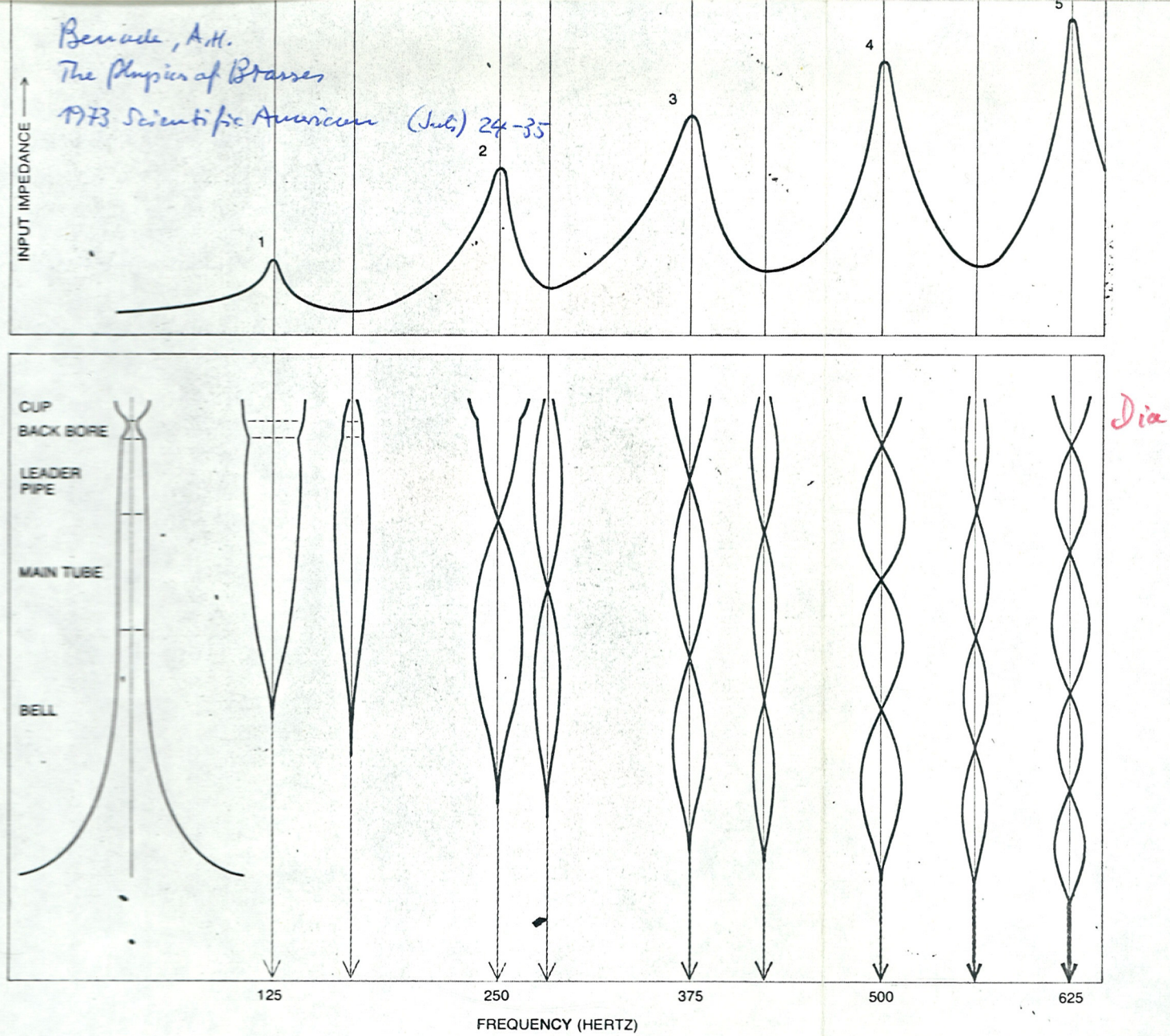
Benade, A.H.
The Physics of Brasses
1973 Scientific American (July) 24-35



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RESONANCE PEAKS OF A TRUMPETLIKE INSTRUMENT can be plotted (*top*) in terms of the impedance measured at the mouthpiece. Impedance is defined as the ratio of the pressure set up in the mouthpiece to the excitatory flow that gives rise to it. The impedance depends on whether the sound wave reflected from the bell of the horn returns in step or out of step with the oscillatory pressure wave produced in the mouthpiece. The shape of the air column in the trumpetlike instrument is shown at the extreme left of the bottom part of the diagram. The curves at the right are the standing-wave patterns that exist in the air column of the instrument at frequencies that produce the maxima and minima in the impedance curve. The first maximum is at about 100 hertz (cycles per second), when the reflected wave is precisely in step with the entering wave. The small irregularities in the standing-wave pattern are produced by the abrupt changes in the cross section of the instrument. The first minimum comes just above 125 hertz, where the returning wave and the incoming wave are exactly out of step with each other in the mouthpiece of the instrument. The subsequent maxima and minima are similarly explained. The number of nodes in the standing-wave pattern increases by one at each impedance peak.