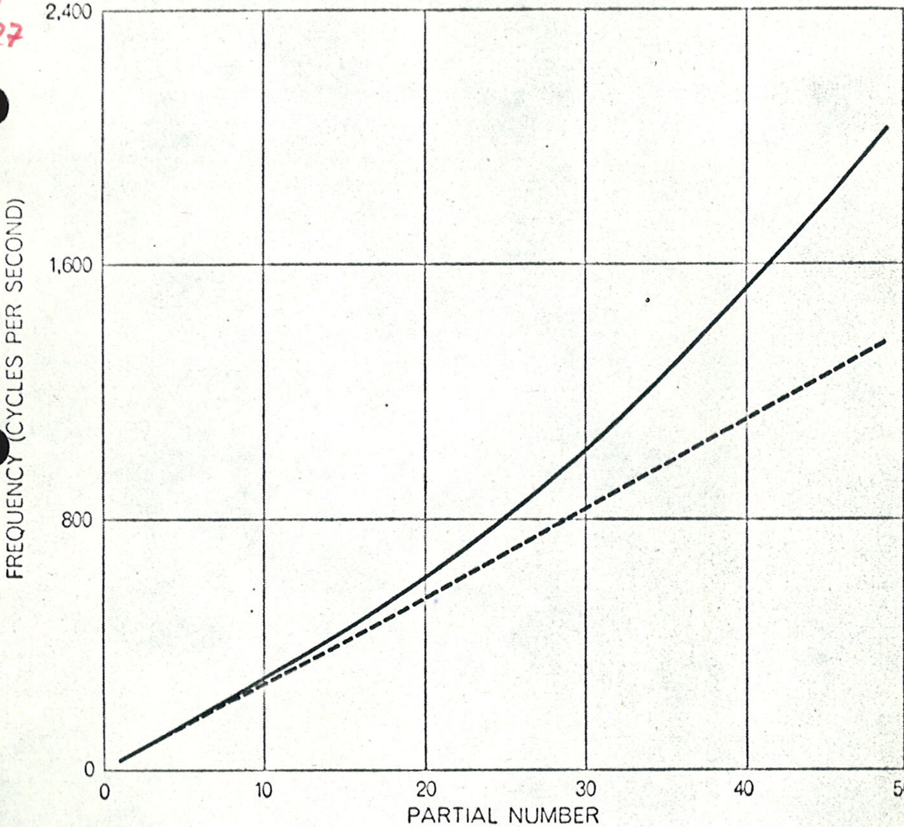
Vorl

Blackham, D.: The Physics of the Piano
1965 Scientific American 213/6, Dec. 88-96+99

21/27



Dia 21/27

INHARMONICITY of a real piano tone is evident in this graph, based on data obtained from an electronic analysis of the partial tones of the lowest note on the piano keyboard (an *A*). The partials of the real piano tone (*solid line*) become increasingly sharper—that is, higher in frequency—compared with the partials of a pure harmonic tone (*broken line*).

S. 94

copper or iron. Two such wrappings are often used in the extreme bass.

The vibration of a string that is attached securely at both ends is caused by a restoring force—a force that seeks to return the string to its original position after it has been displaced from that position. In a string that lacks stiffness the partial tones set up under the influence of the restoring force will be harmonic. In the piano the stiffness of the strings affects the restoring force to such a degree that some of the partials generated are not harmonic. This effect was known to Lord Rayleigh, who

50 to 15,000 cycles per second. Fine tuning is achieved by means of an attenuator connected to each oscillator circuit; the attenuator covers a range of 50 decibels, 10 decibels being a tenfold increase or decrease in the intensity of sound. With this apparatus it is possible to build up synthetic tones that represent a wide variety of partial-tone combinations. Real piano tones can be closely imitated by tuning a separate oscillator to the precise frequency and intensity associated with each partial tone of the real tone. The complex synthetic tone thus generated can then be fed into

Wheneve
tone wer
could giv
of the rea
of the qu
Record
alyzed d
tional au
adjusted
frequenc
ond). Th
frequenc
response
analyzed
oscillator
lyzer, and
it gives
same set
An elect
sure the
to an acc
of 1 perc
to be th
being an
A sam
the lowe
(an *A*)
the left.
of the re
that is,
with the
tone. Th
a semito
than it
The 23r
tone sha
two tone
the analy

In additi
tones
partials
vary con
ation is
the tone
partial s
partial s
measure
partial
frequ