Table 1. Relative wire lengths and associated standard designation of the notes

	l_0 cm	l_1 cm	l_2 cm	l_3 cm	l_4 cm	l_5 cm	l_6 cm	l_7 cm	l_8 cm	l_9 cm	l_{10} cm	l_{11} cm	l_{12} cm
l_n cm	100	94.40	89.09	84.09	79.37	74.92	70.71	66.74	63.00	59.46	56.12	52.97	50
D	Sa	Ri_1	Ri_2	Ri_3	Ga_3	Ma_1	Ma_2	Pa	Dha_1	Dha_2	Dha_3	Ni_3	Sa
F			8/9	5/6	4/5	¾		2/3					1/2
			0.9	0.83	0.8	0.75	$(l_0\ l_{12})/2$	0.67					0.5

l_n, Normalized wire lengths calculated for l_0 = 100 cm using the equation $l_{n+1} = l_n/2^{1/N}$: N = 12, n = integers 0 to 12; *D*, Standard designations of the notes; *F*, Lengths l_1 to l_{12} as fractions of the total length l_0. These fractions approximate close to integer ratios. Consequently, specific higher harmonics of the concerned notes get inter-related; e.g., 8th harmonic of Ri_2 is identical to 9th harmonic of Sa and so on.

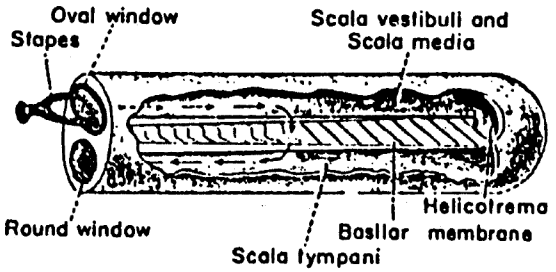

Figure 2. Schematic of the unwound cochlea showing over 20,000 basilar reeds (ref. 3).

also happen to be notes contained within the scale. In other words, the higher harmonics associated with any of the fundamental notes do not fall out of the musical scale for the values of N considered here. For all values of N other than 12, 24 and 22, the relations (1)–(7) are not satisfied and thereby the higher harmonics of any of the notes do not constitute satisfactory members of the scale.

Thus when one produces a fundamental tune of say, Sa Ri_2 Ga_3 Pa Dha_2 $\dot{S}a$, a second harmonic tune in the next octave $\dot{S}a, \dot{R}i_2, \dot{G}a_3, \dot{P}a, \dot{D}ha_2, \dot{S}a$, a third harmonic tune of $\dot{P}a\ \dot{D}ha_2\ \dot{N}i_3\ \ddot{R}i_2\ \ddot{G}a_3$ Pa, a fourth, fifth and sixth, etc., harmonic tunes starting with $\ddot{S}a, \ddot{G}a_3, \ddot{P}a$ and so on are also simultaneously produced. These tunes are said to be in concordance (samvada) with the fundamental tune. With the Sa to $\dot{S}a$ separations and the octaves divided into twelve parts as described above, even if the fundamental tune spreads over two or more octaves, the concordant tunes follow it faithfully. In the case of a musical scale with the octaves divided into 22 parts (i.e. N = 22), it will be found that such concordant tunes up to the order of twelfth harmonic accompany each fundamental tune, reasonably well. That Bharatha[1] could arrive at this number, (N = 22) among all other numbers using perhaps, only his trained ears is particularly commendable.

Besides, in an extended musical tune spanning over more than an octave, if a mistake is committed, say, in the example quoted above, a single note $\dot{R}i_2$ is replaced by $\dot{R}i_1$, even an untrained ear can recognize the resulting discordance in the tune. This suggests that the higher harmonic tunes accompanying the fundamentals are also recognized by our ears, although we may be aware of having heard only the strongest, fundamental tune.

What is meant by the statement that the musical tune along with its harmonics is 'heard'? Some details on the internal construction of our ear are relevant here (see ref. 3).

The human ear is an inverted, biological harmonica. From the eardrum, a three-bone lever mechanism leads the incident sound to the base of a compact, fluid-filled, spirally-wound cochlea tube. If spread out, this cochlea would open into a 35-mm long, folded tube as shown in Figure 2. Along a muscle fibre at the joint of the two folds are located numerous soft bone reeds, thick, short rods near the base, thinning and elongating towards the other end. Long-wavelength, low-frequency sound received from the eardrum, penetrates deep into the cochlea and causes resonating vibrations of the thin reeds[3]. Small-wavelength messages are attenuated closer to the base of the cochlea and are picked up by the reeds here. Numerous hair cells and vibration-to-electrochemical activity transductors located at the roots of each of the reeds, in association with fine nerve fibres convey the message picked up to the brain.

Thus we notice that the design of the musical instrument veena and the human ear form a one-to-one compatible pair and thereby the ear can perhaps 'hear' and follow a veena recital with least 'cross-talk' and rejection and hence with least 'efforts'.

In view of these considerations, some interesting questions might however be raised. It is unlikely that other means of production of musical notes, say vocal or by wind instruments, follow the same mechanism of sound production and hence produce the same pattern of the notes as those obtained from a veena. It might be interesting to analyse the basis of commonalities musicians adopt, while they tune themselves or their instruments to accompany a veena recital.

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Medical journals for free

Secretary-General of the United Nations, Kofi Annan announced in his Millennium Report (DPI/2147/B) in August 2000, several initiatives of effective partnerships the United Nations can catalyse. Among these is the Health InterNetwork

The Health InterNetwork aims to bridge the 'digital divide' gap between the developed and developing countries, by enabling health care workers, researchers and policy makers in developing countries to gain access to state-of-the-art health information using modern technology, – including the Internet –, primarily by increasing the information available both to the public and to health workers. Thereby doctors and other health care workers can exchange information, access training and educational resources, and provide services across geographic and social boundaries.

The announcement had stated 'Working in partnership, the United Nations and the US-based WebMD Foundation are seeking to bring together industry donors and partners from the information and communication technology field, national and multilateral agencies, and local non-governmental organizations. The core partners – the United Nations and its specialized agencies, led by the World Health Organization (WHO), and the private sector, led by the WebMD Foundation – are in the process of starting a pilot phase with support from the United Nations Foundation and the Bill and Melinda Gates Foundation.'.

Working with the *British Medical Journal* and the Open Society Institute of the Soros foundation network, WHO approached six biggest medical journal publishers (Blackwell, Elsevier Science, the Harcourt Worldwide STM Group, Wolters Kluwer International Health & Science, Springer Verlag and John Wiley), with the aim of bringing them together with the countries concerned to seek a more affordable pricing structure for online access to their international biomedical journals.

Now, after nearly a year, in a Press Release (WHO/32) on 9 July 2001, the WHO and the six medical journal publishers announced an initiative which will enable close to 100 developing countries to gain access to vital scientific information that they otherwise could not afford.

'The arrangement agreed to by the six publishers would allow almost 1000 of the world's leading medical and scientific journals to become available through the Internet to medical schools and research institutions in developing countries for free or at deeply-reduced rates.'

The Director-General of WHO, Gro Harlem Brundtland, said at the time of the Press Release: 'As a direct consequence of this arrangement, many thousands of doctors, researchers and health policy-makers, among others, will be able to use the best-available scientific evidence to an unprecedented degree to help them improve the health of their populations. It is perhaps the biggest step ever taken towards reducing the health information gap between rich and poor countries.'

The press release went on to state: 'Until now, biomedical journal subscriptions, both electronic and print, have been priced uniformly for medical schools, research centres and similar institutions irrespective of geographical location. Annual subscription prices cost on average several hundred dollars per title. Many key titles cost more than $1500 per year. This has made it all but impossible for the large majority of health and research institutions in the poorest countries to access critical scientific information.

Scheduled to start in January 2002, the initiative is expected to last for at least 3 years while being monitored for progress. It will benefit bona fide academic and research institutions, which depend on timely access to biomedical journals. Between now and the end of this year, these institutions will be identified individually and the process put in place so that they can receive and use access authentication'.

Under the proposed rules, institutions, in countries where per capita GNP is less then $ 1000 a year, would get the journals free. In countries where the per capita GNP is between $ 1000 and $ 3000, there would be a minimal charge. Access to the journals will be through an internet portal which the WHO is creating as part of Health InterNetwork

The *Washington Post* noted on 8 July 2001 that 'The initiative is the publishing world's counterpart to the drug industry's newfound commitment to make medicines for AIDS, malaria and tuberculosis more widely available to Third World countries. The democratization of medical information, however, is likely to be far easier and cheaper than the democratization of pharmaceutical therapy'. The website, http://www.washingtonpost.com/wp-dyn/articles/A33714-2001Jul8.html provides a detailed comparison of the existing subscription rates for the world's most important medical journals and the benefits that this proactive reduction in 'digital divide' gap brings about. Hopefully these will act as paradigms of many more partnerships between the rich and the poor.

While acknowledging that the United Nations is playing a major and important role of a facilitator, one may note that there have been many other independent efforts by smaller NGOs in promoting on-line cheaper or free access to journals in developing nations. See, for example, the article 'Online databases' by Canor Tenopir in *Library Journal* (November 2000, p. 34) (website: www.libraryjournal.com)

The web-site http://www.freemedicaljournals.com/ has noted on 1 August 2001 that: 'Within the next two years, the most important medical journals will be available online, free and in full-text. The access to free scientific knowledge will have a major impact on medical practice and attract Internet visitors to these journals. Journals that restrict access to their Web sites will lose popularity'.

The Free Medical Journals Site is dedicated to the promotion of free access to medical journals over the Internet. The site has listed several journals under different categories (each arranged in decreasing order of impact factor); many of these could be accessed and full texts could be read for free.