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This Week

Research Notes

Articles

Cover: The acidity of raindrops changes as they trickle through the foliage and soils of an Adirondack forest. A recently completed study shows that the pathway water takes through the soil has a large effect on the acidity of water entering a lake. (Photo: Ivars Peterson)

Departments

Letters

Digital vs. analog

We would like to congratulate you for your timely and very important article on a valid comparison of digital and analog recording technologies ("Analog 'Apples' and Digital 'Oranges,'" SN: 3/12/83, p. 170). Credit should also go to pianist Jim Boyk for being concerned enough and taking the time to design and execute this kind of test. Such experimentation is long overdue.

As manufacturers of high-end speaker systems, we and our consultants spend endless hours listening to the best live and recorded music. It has become apparent to us that virtually no digital disc available properly preserves the harmonic structure of instruments, or captures enough transient or ambience information to make recorded music sound real. As pointed out by Steve Ember, some of this is certainly the fault of poor production and engineering. Most of the problem is simply related to the low sampling rate (approx. 44,000 per second) of most currently used digital recording systems. It is simply *impossible* to faithfully reproduce, for example, a 17,000 cycle per second waveform when it is only sampled about 2.5 times per cycle by the recorder. Loud transient information is perceptible even above this frequency and is virtually lost in such a recording process. The major side effect of slow sampling is an annoying kind of harmonic distortion in which the upper harmonics are attenuated and systematically mutilated. This distortion sounds particularly non-musical and somewhat "mechanical," and is considerably more difficult to ignore than the typical random high frequency noise found on analog recordings. The result of this distortion is that when you hear a digitally recorded french horn, violin, or saxophone, it doesn't sound like the instrument you remember. Also, both transient and ambience information, present on good analog recordings and reproducible with state-of-the-art high-fidelity equipment, is lost from digital recordings, making many of these recordings sound lifeless and unreal.

This is not to say that all digital processors are inadequate. We think that the dbx digital recording system is on the right track. Sampling rates on the order of 700,000 per second are most likely *not* excessive, and may be necessary.

Certainly, digital discs have superb dynamic range and low noise, but it makes no sense to achieve this if the cost is to produce a lifeless, non-musical recording. We think it is about time the recording industry as a whole started to consider these facts, and also started some serious testing before any more money is wasted on the current slow sampling digital recording process. Both manufacturers of digital disc players and the recording industry seem determined to settle upon a standard that cannot work. And it doesn't take a "golden ear" to hear that something is very wrong.

Edward C. Uberbacher
Jordan B. Fishman
Oak Ridge Acoustics, Inc.
Oak Ridge, Tenn.

The crucial test of any recording system is *not* how many people, professional or otherwise, "like" or "dislike" its sound, but how closely it replicates the audio signals fed into it. The test for this is supremely simple: Switch back and forth between the sound of the original signal and a playback from each of the recording systems, and let trained ears ascertain which playback sounds more like the original.

In tests like this, digital reproduction has

Continued on page 334

Continued from page 323

consistently come out on top. (Skeptics who do not have access to a direct feed from a microphone need only make a digital copy from an analog tape and an analog copy from a digital tape, and see which sounds more like its original.) This is not to say that digital *per se* is perfect; some digital recorders are less perfect than others. But the *amount* of fidelity loss from a digital recording is invariably less than that from an analog tape recording.

Mr. Boyk—for whom I have great respect as a musician and critical listener — had the right idea here, but his methodology was flawed by the insertion, in the digital-playback part of this signal chain, of an amplifying device which was *not* in-circuit when his subjects listened to the direct feed. Thus, he was comparing the original signal feed with the sound of the digital recording *plus* whatever distortion the amplifying device may have introduced. Mr. Boyk has explained to me that the amplifying device was necessary in order to match the volume of the playback to that of the original, to validate the listening comparisons. He also claims that the signal distortion introduced by that device was "negligible," but when we are dealing with systems having as low inherent distortion as do the better digital recorders, who is to say what is and is not negligible?

Several magazine reviewers have in fact criticized that specific amplifying device for adding certain "extramusical" colorations to the signal passing through it. Mr. Boyk's tests would have had more validity had he first had his subjects compare the direct feed with the direct-feed-through-the-amplifier, before proceeding to the digital tests.

There are a number of valid criticisms which can be aimed at some digital recording systems, but I have personally used two of them whose reproduction, in direct and legitimate comparisons with original sound sources, was virtually indistinguishable from them. I have never heard analog reproduction of which that could be truthfully said.

J. Gordon Holt
Editor, Stereophile Magazine
Santa Fe, N.M.

Thank you very much for your coverage of the experiment at CIT. It saved me a lot of uncertainty, by confirming my "a priory" logical reasoning.

The point is that for a long time I have been pondering over the rivalry of analog and digital recording and reproducing. The line of the reasoning was: "The sound is one of the sublime examples of continuity in nature. Digitalizing the sound means making it discrete." The conclusion ran: "Hence, digitalized music must appear artificial, unnatural to the ear — for discrete is the opposite of continuous—regardless of the digital equipment or the frequency of digital chopping." However, I wasn't sure whether human nature would be able to get the distinction, in particular considering our most-contaminated-by-artificiality milieu.

Now, I am convinced that the appeal of digital recording consists mainly of its being novel, sophisticated and "scientific," rather than of its being inherently superior to its old analog ancestor. I am not certain that the advantages of digital recording, such as absence of background noise, longevity of laser read discs and solid state, would be able to offset its artificiality. It is also doubtful whether the new recorder of "Phillips"/"Sony" tandem would have something more than initial market success.

Valentin D. Fikovsky
Oakland, Calif.

Books

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Chimpanzee Politics: Power and Sex Among Apes — Frans de Waal. Describes in fascinating detail the power plays that frequently occurred in the course of a six-year study of an ape colony at the Burgers' Zoo in Arnhem, Holland. Although the apes' interest in power seemed to be inflated at times, the author surmises that it is not greater than that of humans, just more obvious. Also examines the formation of social ties, the different ways in which females bring up their children, sexual intercourse and adolescence. Har-Row, 1982, 223 p., illus., $16.50.

Dance of the Continents: Adventures with Rocks and Time — John W. Harrington. In very readable fashion this book tells how science is done and in the process leads the reader to "develop the ability to see the real world . . . and experience the thrill of knowing." Begins in the field watching geologists at work. "Once we know what geologists do, we need to learn how they think. We'll know we're making progress when we discover that we have learned to read rocks and see time as they do. . . . We will see how a time scale covering the last 4.5 billion years was assembled and calibrated. We will even begin to see the structures produced when continents break apart and then collide with one another." JP Tarcher (HM), 1983, 254 p., illus., $15, paper, $9.50.

The Essential Guide to Nonprescription Drugs — David R. Zimmerman. Provides a comprehensive consumer guide to the selection of over-the-counter drugs marketed in the U.S. Evaluates active ingredients, rates 1,000 popular individual products, describes diseases and conditions whose symptoms respond to over-the-counter medication and explains how to judge whether or not the condition calls for a doctor's visit. Har-Row, 1983, 886 p., $27.50, paper, $10.95.

Hen's Teeth and Horse's Toes — Stephen Jay Gould. Another collection of essays on natural history by this outstanding scientist. This collection treats both the fascinating debates over evolutionary theory now occurring as well as the "purely political and nonintellectual controversy" stirred up by modern creationists. Norton, 1983, 413 p., illus., $15.50.

Kennedy, Khrushchev and the Test Ban — Glenn T. Seaborg with Benjamin S. Loeb, foreword by W. Averell Harriman. Harriman, in the foreword, says, "It is important that the story of the Limited Test Ban Treaty be told, not only for its value as history but also for the guidance this experience can provide for the conduct of future East-West relations." Atomic Energy Commission Chairman Seaborg's detailed journal was the basis for this dramatic account of the delicate diplomacy that made the treaty possible. Originally published in hardback in 1981. U of Cal Pr, 1983, 320 p., illus., paper, $7.95.

Wanderer on My Native Shore — George Reiger. An attempt to answer the hows and whys of life in coastal waters. It is a readable book about marine ecosystems from Key West to Maine, but it is also about people since we are now the dominant ingredient in every marine ecosystem. Beautiful drawings of the coastal inhabitants by Bob Hines. S&S, 1983, 286 p., illus., $14.95.