# THE BAS SPEAKER

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*Editorial Office:* 2 Eden Street, Chelsea, MA 02150
*Subscription Office:* P.O. Box 211, Boston, MA 02126
*Editor:* Poh Ser Hsu *Publisher:* E. Brad Meyer
*Staff:* Carl F. Deneke, Howard Ferstler, Alvin M. Foster, David Hadaway, Robert Ludwig, E. Brad Meyer, David R. Moran, Stephen H. Owades

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# Open Forum

## Comments on Foster/Carver

I would like to make some comments on Al Foster's review of the Carver Amazing loudspeaker in Vol. 18 No. 1. First let me say that I think Bob Carver has produced fine electronic components. I own a C-1 preamplifier and an M500 power amp, and have been pleased with them for over seven years. They work well.

I like the Sonic Hologram too, and, like Alvin Foster, find that it improves about 20% of the records I listen to. I have four surround speakers, and the hologram usually muddies up the sound from the front side surrounds with most recordings. While the hologram does subjectively improve some recordings, and while a number of people (Carver, Matthew Polk, and others at Lexicon and Sound Concepts, among others) like that kind of effect, some do not. One notable member of the latter group is Stanley Lipshitz, who, in his paper in the September, 1986 *Journal of the Audio Engineering Society* (page 719), stated that such cancellation processing does not improve the accuracy of a stereo signal. In any case, with the right recording the hologram does seem to enhance the sound, and who can mind that?

My main subject, however, is the Carver speaker. First, I notice that the speakers Foster reviewed were supplied by Carver for the tests. I hope that David Moran will have had a chance to run some tests with the dbx analyzer, and that the result of those measurements will be appearing either in a future edition of *The Speaker* or in *CD Review*. [Moran's measurements will appear here soon.—Ed] So far, I have seen no better test procedures.

Before talking about the sound of the speakers and Foster's review, I want to comment on his observations about the ribbon tweeter and the woofers "loosening up" over time. This breaking-in period seems to be characteristic of ribbon tweeters (one Magnepan owner's manual also discusses the need for tweeter break-in) and I would imagine that the woofer break-in is related to the fact that the drivers are unbaffled, so that all their restoring force comes from their suspensions. This seems plausible, but one must wonder if, after an even longer period of time, the loosening up would continue to the point of sonic deterioration. I do not like the idea that my speaker drivers continually change their nature over their operating lives. In any case acoustic-suspension woofers, since they use cabinet back-pressure for most of their control, and since air should not ever wear out, will hold up considerably longer than any unbaffled drivers. As far as I know, typical dynamic midrange and tweeter drivers also require nothing in the way of break-in. They are up to spec out of the box and remain that way for a long time. So I have to wonder about the Carvers' durability. Properly designed gear should require no break-in period.

Mr. Foster also comments on the "sound" of ribbon drivers. I do not know about this. Mark Davis, whom Mr. Foster quotes and whom he obviously respects, once stated that the dynamic driver can reproduce analog signals as well as any exotic driver (*JAES*, November 1987 p. 891). If the ribbon used in the Carvers sounds different from a dynamic driver, it is because of its shape and not because of any inherent design advantage. A line of dynamic drivers (1/2" tweeters) would work as well in the front hemisphere. I do not believe there is any magical quality inherent in ribbon drivers.

Long, fixed-length line sources are funny. They are full-time near-field speakers, something that many of their promoters do not want to come to grips with. [Most manufacturers know this, and promote it as an advantage.—Ed] Because of the size of the vertical "arrays," it is impossible to get into the far field in any normal listening room. Phase coherence from these devices is often praised, and yet when you consider that most of them are several feet long, it is clear that phase problems must be inherent in their design, no matter how linear they are in mechanical operation. At typical listening distances, the listener's ears will be at different distances from the various sections of a large driving surface of the system. At lower frequencies, or really far from the system, this will not be a problem. However, close up and at higher frequencies (where wavelengths are short in relation to the distance to the parts of the long line source) our ears will receive signals that are out of phase with each other. The long, fixed-length line source's very size works against it at higher frequencies. The resulting wave cancellations produce comb-filtering effects of rather large magnitude.

Now, most other systems have such anomalies, particularly at the crossover points. However, those effects are swallowed up quite effectively if the system is a wide-dispersion design and if the listener is in the far field. The problem with the tall, fixed-length line source is that you cannot get into the far field in a typical listening room, but are stuck in the near field where the comb-filtering effects are very real. Because of this, a tall, fixed line source cannot produce a flat frequency response in typical listening rooms. In the November, 1986 preprint (2417 [D-4]), "The Acoustic Radiation of Line Sources of Finite Length," Stanley Lipshitz and John Vanderkooy indicate that "In the near field the response becomes irregular, distance-dependent, directional and not feasible to equalize."

The above paper is a devastating report on tall, fixed-line-source speaker performance, and one must wonder if the people at Carver, Magnepan, Apogee, Martin-Logan, etc. have read it and what their responses to it would be. I would certainly be interested in Alvin Foster's opinion of it.

My contention about line-source dipole systems is that most owners either like the rear-wall reflection—which (in spite of what the people at Bose may imply) does not reveal any hidden characteristics in the recording but merely adds a pleasant artifact to the

reproduction—or that they listen in treated rooms and turn their speaker systems into very large headphones. People who own other types of speakers also do this, of course, and the net result is a room/system that is quite revealing of recorded nuances but not very realistic-sounding. Such systems come across as having a very fine "speaker" sound but call more attention to themselves than wide-dispersion speakers do in more typical (i.e. living-room-like) listening rooms.

I dealt with this obliquely in my October, 1990 *Stereo Review* article on speaker radiation patterns, and more directly in a book on audio and video that I hope to have in print by early 1991.

Line sources *do* have their place, I might note, provided they are not too long in relation to the frequencies they cover. Up to a point, they can be useful in reducing ceiling bounce (mid- and high-frequency floor bounce can also be attenuated somewhat by decent carpeting), and they do sharpen up the imaging qualities if they are designed properly. Proper design involves controlling the size of the line source. This is done very well in some Polk models and may find its most perfected application in the Allison IC20, a combination of good driver design and good inter-driver cooperation. The best systems make *careful* use of the line-source possibilities.

— *Howard Ferstler (Florida)*

## Alvin Foster Replies

I was pleased that Mr. Ferstler took the time to submit a written reply to my article. [We have received considerable comment from other audiophiles, which will appear in future issues.—Ed] We disagree on which loudspeaker dispersion pattern, wide or focused, is the most natural-sounding. My personal bias is toward speakers that excite the fewest early room reflections because they permit more of the recorded signal to reach the listener in an uncluttered way. As I stated in my article, a speaker should also be judged by how much it interacts with the room, i.e., how its early-arrival sound is colored by the room's reflections. Later arrivals (from the rear wall) may actually enhance the listening experience.

My article stated that most speaker drivers or types can be designed to minimize room interaction. While doing the research for the article I conducted many tests which demonstrated that the quality of sound is much more dependent on the speaker's dispersion pattern than on whether the designer chose an electrostatic or dynamic driver. However, there are advantages to the line source, and to my taste it sounds more natural because it generates fewer room reflections, especially less floor or ceiling bounce. It is more likely to deliver to the listener what is on the record than a conventional dipole (such as the Quad) or the wide-dispersion loudspeaker. According to Stanley Lipshitz, the dipole speaker has 4.8dB less room interaction. The line-source dipole loudspeaker (represented in my study by the Carver) has even less vertical dispersion than either the typical dipole or the more common wide-dispersion loudspeaker such as the Acoustic Research 98LS I used for comparison.

The frequency-response variation and ripple, introduced because the line source is not infinitely long, is but a minor effect in a real listening room with stereo speakers. Measurements made in different positions in my listening room reveal fewer response variations with the Carver than with the wide-dispersion design. Over the years, I have measured only one other loudspeaker in my room (the Snell A-I) that equals the Carver in flatness of frequency response.

I am opposed to listening to music in an anechoic chamber—a room with no reflections—but today's typical wide-dispersion loudspeaker hides some of the vital information required for realism. Freeing the music from the room's early reflections enhances the listening experience.

Please remember that the BAS forum is always open. I am looking forward to more comments on my research.

— *Alvin Foster (Massachusetts)*

## Long-Distance Ripoff

In August 1989 my family spent the weekend at a small guest house in Newport, Rhode Island. There was a touch-tone phone in the kitchen, and Sunday morning shortly before 9:00 I placed a credit-card call to my office to pick up messages from my machine. After punching in the credit card number I heard a recorded voice say, "Thank you for using ITI. If your party does not answer, you may push '1' and leave a message."

This was worrisome, because to get my machine to play back messages I have to push the same key; but maybe after the connection was made ITI's computer would know enough to buzz off. My machine answered on the second ring, meaning there was at least one message waiting. I pushed "0" to interrupt the outgoing message, entered the 97-digit secret code to identify myself, then pushed "1" for playback. The connection was broken, and ITI's recorded voice said, "Please leave your message now."

I hung up quickly and dialed 10288, the access code for AT&T. The same recorded voice appeared again, saying that access could not be made to other systems from this telephone. Dialing "0" got me a real live ITI operator, but even after I explained that their system was preventing me from completing my business she couldn't or wouldn't connect me to AT&T.

There being no one in our pricey little hostel to complain to, I went out and tried the call again from a public phone, but it seems the answering machine didn't like being hung up on at that stage of our transaction, so the messages had to await our return to Lincoln.

The real kicker came with the next phone bill in the form of a separate sheet from ITI (whose motto is "We listen"), showing my call and a charge of $2.77 for one minute at their Day Station rate. My call, you'll remember, was made early Sunday morning; AT&T charges 23

cents to Newport from my office during business hours on weekdays.

The complaint number on the bill turned out to be New England Telephone, who referred me to ITI and gave me an 800 number, which is 999-5152, in case you find yourself in a similar situation. I chronicled my frustration to someone named Tony, who tried to justify the charge by saying they were an "added service" company. "Subtractive" would be a better word, I said, and he agreed to cancel the bill.

Moral: When you make a credit-card call, listen carefully right after you enter your card number. If you don't recognize the company, or if you do but don't want to do business with them, hang up fast. There are several of these so-called Alternate Operator Services around—Telesphere is another—who are free to charge pretty much whatever they want for calls. Read the fine print on that pay phone, and when you check in, ask at the hotel desk what your long-distance options are.

— *E. Brad Meyer (Massachusetts)*

## Sony D-11 Portable CD Player and CPM-200P Mounting Plate

I recently bought the above items for use in my car. The D-11 is available from Service Merchandise for $129, which is as low as any mail-order price I know. Unlike the earlier Sony portables I reviewed previously, the D-11 does not have audible low level problems (such as sputtery microphone hiss and abrupt dropout below a certain level). The D-11 runs off four AA size batteries. When I used rechargeable batteries, they last up to four hours.

In the car, the CPM-200P mounting plate is invaluable, making the D-11 virtually immune to vibrations and bumps. It costs an additional $38 or so, and is worth every penny of it.

— *Poh Ser Hsu (Massachusetts)*

## Pitch-Controlled CDs

The Technics SL-P8 was for years the only consumer machine with a variable-speed option. Pushing a button activates a small center-detented slider that regulates the player's clock speed, and with it the playback speed and pitch, to plus or minus about 6% (one semitone). This is great if you play an instrument and want to accompany a recorded performance. It has also been useful in synchronizing the player with others for double-blind comparisons: you feed the left channel of each player to the two sides of a pair of headphones and use the speed control to bring the image into the center (with thanks to David Clark for passing on that trick).

The only other speed-controlled players I know of are the Technics professional models. These are big, heavy top-loading console models with cue wheels and output meters, meant for disco or radio station use—a real bargain at around $1200 if you like this sort of thing, but not for the average living room.

Now in the latest press release from Denon comes the news that three models in their new line will have pitch controls. The players are the DCD-2560, -860 and -660. Range is ±9.9% in 0.1% increments, which means that there will be buttons labeled "+" and "–" rather than a slider. For my purposes the slider is handier, but others will probably like the easy reproducibility of settings in the Denon scheme.

— *E. Brad Meyer (Massachusetts)*

## Stereophile's *Poem* CD

I recently received *Stereophile*'s CD "Poem: Works for Flute and Piano" for review. It featured Gary Woodward (flutist) and Brooks Smith (pianist) playing various pieces by Prokofiev, Reinecke, and Griffes. It is a wonderful CD, with a very natural, open sound and excellent performances. I strongly recommend it. It can be purchased from high end dealers or direct from *Stereophile* for $11.98 plus postage and handling ($2 in the US, $5 foreign):

Stereophile
Records Department
1 800 435-0715 (USA)
1 815 734-6309 (Canada)

— *Poh Ser Hsu (Massachusetts)*

## The Quiet Lite, or Audio Nirvana for $49.95

For many years, I have used a standard twin 40-watt fluorescent light fixture in my listening room because it offers ample light and is economical (replacement tubes cost as little as a dollar each and last about 6000 hours). However, there is a constant hum due to the internal ballast.

All gas-discharge lamps require some kind of series element to limit the current, or they would overheat. Small lamps may use a resistor, but a resistor gets hot and is inefficient. Larger lamps use iron-core inductors called ballasts which are relatively efficient. Unfortunately, they suffer from mechanical hum at the power-line frequency.

Looking for improvements, I went to an industrial electric distributor and spent $25 for a ballast with an "A" sound rating (the quietest). It made no difference. I then tried a $12 fixture with a solid state ballast. This was worse, with a raspy buzz in addition to the usual hum.

I considered using a 12-volt system which operates at ultrasonic frequencies. However, a hum-producing transformer is needed to provide the necessary 12 volts, with added problems of finding a place for the transformer.

Finally, I found a mail-order catalog listing a 120-volt electronic ballast designed for twin 40-watt fluorescents for $49. It is completely noiseless [meaning that it produces no *audible* noise, but probably lots of ultrasonics—Ed]. As a bonus, it is 20 per cent more efficient.

By the way, for those who dislike the cool color of normal fluorescents, tubes whose light has a lower color temperature are available, albeit more expensive and slightly less efficient (although still vastly more efficient than incandescents). The catalog description of the ballast says, "ETTA Industries 2-Lamp Sinusoidal Electronic Ballast for use with two F40 40W T12 lamps. 0.58 Amps max, 280 volts open circuit. Starting temperature +50°F. High power factor, Sound Rating A." There are also two extra wires labeled "dimmer"(!).

[I use lots of Lights of America compact fluorescents which fit in standard incandescent sockets. These are 18W high-frequency-ballast types with light output equivalent to 75W incandescent lamps. The bulbs have life expectancy of 10,000 hours. Color temperature is 2800°C, very similar to incandescents. Their only drawback is they emit lots of RFI, enough to make wireless telephones sound very noisy when you get close to the lamps. If you live in Massachusetts in an area served by Boston Edison, you can get a rebate of up to $13 on each lamp!—Ed]

Source: Real Goods Trading Corp., Ukiah, CA 95482

— *David Hadaway (New Hampshire)*

# October 1989 BAS Meeting

## Open Forum

President David Moran began the meeting by reminding us of the BAS reputation for wanting audio nirvana for $49.95. In this vein he had found a "boom box" made by Goldstar (Saewoo) being sold by for $170 by DAK. It has a CD player, AM/FM radio, auto-reverse cassette deck and five-band equalizer. The unit includes line-level input and output as well as a mono FM switch and runs on ac or dc (either car battery or dry cells). The total power output is probably only about 4 watts per channel. With the equalizer set flat, the sound is midrange-heavy, like every other boom box. In Moran's words, a string trio will sound like 3 violas.

The equalizer has center frequencies at 100, 400, 1k, 4k, and 10k and with the equalization set to extremes (push 100 and 10k up and 400, 1k and 4k down) Moran measured a raw frequency response (speakers on the floor, using pink noise from Al Foster's Carver CD) of 100Hz–10kHz ±3dB. In other words, when equalized this boom box measures and sounds better than *some* $250 two-way speakers. Moran had not run it through other tests. The noise floor of the electronics might be higher than desirable and he expected that the tape deck was fluttery. But the CD and FM seemed fine. Although this was clearly not the last word in fidelity, Moran found that the Goldstar offered enjoyable music, both in the yard and around the house, fairly cheaply and very conveniently.

Al Foster reported on his new toy, an Audio Control 350A spectrum analyzer that costs $1200. It has a frequency response of ±1dB and has both peak-hold or instantaneous and SPL (sound-pressure level) displays. It can run for five hours on lead-acid batteries and has a parallel printer port so that you can save the data. The scale can be switched to display 1dB, 2dB, 3dB, or 4dB steps. The unit is small (4" high by 10" wide by 12" deep) and weighs only 12 pounds. It also has a pink-noise output that can directly drive a four-inch speaker to about 95dB SPL. There is a version for around $800 that lacks the battery and printer output.

Both models share the following disadvantages: First, the basic color is black, so the labels are hard to read in dim light. Second, the SPL reads down to only 59dB, and many homes are quieter than that, particularly within narrow bands. Signal-to-noise may be limited by the low output of the supplied 1/4" mike capsule. The mike is equalized for flat amplitude response, but you cannot overcome the high noise floor of the small diaphragm.

There are three integration times: 1 or 2 seconds (useful for pink noise), and a third which is much faster. Like the Ivie, and unlike the dbx RTA-1 (now the Sound Technology RTA 4000), this product will not average over long periods. However, there are five memories for the response curves. And better still, frequency curves can be averaged together and dumped into another memory. Thus you can build up sets of averaged response curves, minimizing the aberrations and unreliability of single-point measurements.

One member reported that musical DAT tapes can now be made at high speed, as opposed to the real-time duplication that was necessary before. The DAT format was designed to work with two tape types. One, with very high coercivity, was to be sold to consumers; this would give a two-hour recording time. The other tape had lower coercivity, used somewhat wider tracks, and could be duplicated using a contact printer that Sony showed in prototype form several years ago. These tapes were also to have been made at the 44.1kHz sampling frequency and were to hold an hour of music (or about as much as a CD). In contact printing, the duplicating master must have higher coercivity than the slave tape; otherwise the heat and magnetic fields used to transfer the signal would erase the master. But there is no tape with higher coercivity than DAT consumer tape, so special lower-coercivity stock must be used for high-speed duplication.

Cost is a major problem. The contact-printing systems for video tape cost about $100,000 complete. For that price you can buy a whole roomful of normal video recorders and produce the same number of finished tapes per hour, with the advantage that having a single machine fail does not stop the operation. Contact printing is less labor-intensive, however.

An advantage to using this printer technology for DAT production is that the lower-coercivity tape is enough cheaper that the final tapes could be sold for a lot less, regardless of the cost of the production machin-

ery. The final commercially duplicated tapes would cost about the same as, or even less than, a CD. This should discourage piracy.

Steve Owades reported that an audiophile of his acquaintance has been listening to 78s through the center-channel output of a Dolby Pro Logic decoder, on the premise that the steering logic would send the difference information (i.e., noise) to the side outputs. (Dolby Pro Logic is designed to steer mono dialogue to the center channel.) In theory the decoder could also function as a single-ended noise-reduction device. One possible flaw in this plan is that the individual channels of any logic-steering decoder are often not very pleasant to listen to, since all the steering artifacts become obvious when not masked by the other speakers. You might not be disturbed by a rapid image shift when hearing all the speakers but you cannot ignore level jumps coming from one channel. There is also severe noise gating; when the level goes too low, the signal disappears. (Even if this doesn't work well, the same principles might be used in a better device.)

Steve himself has found that for (noisy, mono) 78s the preamp should be in stereo, not mono, because the music comes from the phantom center channel while the noise tends to be focused at the speakers, making it easier to differentiate the noise from the music and concentrate on the latter. In this setup, it is the ear/brain of the human listener which does the noise "reduction". A low-cut filter to remove rumble might also prove useful.

We then heard reports of strange actions by older (1980s) Pioneer direct-drive turntables. In one case the platter first ran backwards, then speeded up beyond 78rpm, while another unit developed a fault in the disc size sensor and also began to run very fast. Both of these required either service or replacement. A ReVox A77 was also reported to have developed a fault in its servo circuitry. (Is there a servo virus going around?)

Some members recalled that early in the turntable's production history AR added a second motor to get the platter moving in the correct direction. (The very first AR turntables had a 50–50 shot of turning in either direction.) An English turntable of the same vintage used the same type of motor but the switch had a clever little rotating rubber thing that nudged the platter in the right direction as you flipped it on. Both companies advertised their weak motors (and relatively heavy platters) as decreasing wow and flutter.

For the December 1989 *CD Review*, David Moran measured four speaker systems. One of these was the Cerwin Vega CV 6. Moran confessed to the bias most of us have against Cerwin Vega, for making rock speakers with all their vices (boomy bass, peaky frequency response, a hot top end and so forth), but this large three-piece system sounded extremely good on both rock and Mozart. The tweeter is run a little hot, but it is not peaky; rather its response is a plateau a little above the midrange level. The blend between woofer and midrange was done as well as in other good three-piece systems. The CV 6 was also sensitive, played loud, and was inexpensive (in the $500–700 range). Somebody at the company has a good ear, so perhaps other Cerwin Vega speakers will merit our attention.

## Meeting Feature: Paul Gardocki, Desktop Loudspeaker Systems

The guest of the evening was Paul Gardocki, of Desktop Loudspeakers. Desktop has been making small speakers since April of 1982, which was before the recent flood of three- and four-piece systems. There is instant appeal in getting good sound from very small sources; many of us own speakers that are too heavy to lift.

Gardocki began by explaining how the latest system in the Desktop Loudspeaker line was developed. Previously, he had been trying to make reasonably priced speakers with excellent imaging that also met the criteria that his testing had determined were important to most listeners. Target price had been about $650 for the loudspeakers plus $600 to $800 in additional equipment to complete a system. He tried to fill a market niche and still satisfy critical listeners.

For a long time he had two speaker systems in his line. The Model 1 had a satellite that looked like the current speaker, plus a subwoofer about the size of a shoebox (7"×5"×16"). The Model 2 had one subwoofer per channel. These sufficed for the majority of what might be termed the mid-market. Gardocki's customers were most concerned with imaging quality, flatness of frequency response, and constant directivity. Because the low frequencies are always radiating into half- or quarter-space, the satellites also had to meet this criterion. Because the subwoofers are on the floor a perceived Q of 1 is what occurs to the listener's ear. So he tried to make the speakers as omnidirectional as possible by using the smallest possible baffle and enclosure. He claims the speakers meet this goal up to about 12kHz.

The other characteristics he tried to aim for included reducing the panel radiation that smears the imaging. He did this by making the only solid baseball-bat-ash enclosure on the market.

The satellite speaker is a solid hunk of wood with a small cavity milled out for the drivers and crossover. Without using massive cement or expensive composite enclosures, this (in Gardocki's opinion) is the only way to get good imaging. He feels this to be particularly true when listening up close or in small rooms.

Desktop is now trying to make a cheaper speaker with the same sound qualities from structural foam, because the ash is both expensive and difficult to obtain.

### The Underground Speaker Company

Gardocki's manufacturing plant is 150 feet underground in a limestone cave in Kansas City, Missouri. The 1.5-square-mile facility was originally used by the U.S. government for storing tax documents and other papers. There is minimal RFI and constant temperature, moisture, and humidity.

Blocks of wood are susceptible to checking and absorb moisture from the air until they are sealed, so the envi-

ronment is very important. The limestone stores little moisture and keeps the temperature constant.

"All of the company's money" is in these wood blocks. The firm has to bid for each lot, and it takes four years to process the wood from tree to speaker. The job is now done for them by the Louisville Slugger company. The tree is kept under water for 18 months, until its moisture content is 25% throughout. Then the wood is slowly dried and cut. Each piece is put into a resinous environment, where water is replaced with resin. (This is why a baseball bat can get wet without cracking.) Finally, the company reduces the moisture to 8% and tries to keep it that way until it is sealed. The wood block then can be machined like metal.

The company is almost always back-ordered, because it takes so long to get and process the blocks, which are the limiting factor in production.

**Ultrasonic Response**

Gardocki has long held that response beyond 20kHz is desirable. Initially, designing a speaker with response to 40–50kHz did not seem to be cost-effective. However, he has gotten a number of inquiries about cost-no-object systems, often from audiophiles doing their own recording using particularly good equipment where there is no high-end filtering. Such individuals sometimes record pieces with enormous amounts of high-frequency energy, often using instrumentation mikes that have frequency responses out to 40–50kHz and in some cases 70kHz, and they claim that phase-shift distortions resulting from filters at 20kHz destroys the realism of these recordings. Gardocki told us that the late Dean Jensen (who designed and made transformers) could "... make a demonstration where fully 80% to 90% of the audience, generally being Audio Engineering Society members, recognize and identify the insertion of filters in the 50, 70, and 90kHz range."

When asked when and where these results had been published, Gardocki said, "I don't know that Dean published it a lot. He would go around and make the demonstrations, but because he tried to keep the mathematics proprietary so that he can manufacture these parts—as either input transformers on mixing consoles or line transformers on long lines—in other words, he could demonstrate that there is a factor there, and that it's perceptible, maybe even audible." [Publisher's note—A call to Bill Whitlock at Jensen revealed that Dean's paper and demonstrations were designed to prove that nonlinearities in the ultrasonic region can cause audible distortion below 20kHz. Whitlock insists that Jensen never said frequencies above 20kHz were audible. He promised to send a copy of the paper, which I will summarize in these pages if that does not interfere with plans for its publication.—EBM]

Once the number of customers who said that cost was no object reached one hundred, Gardocki began to look at ways to make a system for them. About 70% of these prospective customers were outside the United States, where high-quality playback seems to command more money. This is not a reflection of a stronger desire for better sound, but simply an economic fact.

Desktop Loudspeakers has a new (patented) tweeter made from titanium and natural rubber elements. The titanium diaphragm assembly is said to have relatively flat energy output into a hemisphere up to about 50kHz, but the cone breakup and distortions are obvious and unpleasant to the ear. This distortion and masking negate any beneficial effects of extended bandwidth, so damping was required. After testing plastics and foams, Gardocki found that natural rubber (which is made of about 20 different polymers) had the best tradeoff between damping and mass, mass being the enemy of high frequencies. Adding the rubber dropped the –3dB point from 50kHz to 35kHz. There was a 10% increase in mass but the tweeter's response still extends, with low distortion, 10–12kHz beyond the generally accepted upper limit of hearing.

Only five of these systems were available at the time of this meeting. Four were in Europe, being demonstrated with LPs as the source. Desktop Loudspeakers currently has orders for about 200 systems and deposits for 120. It seems there is real interest in a super-extended bandwidth with good imaging in a small box.

Gardocki's claim is that the apparent depth of the sound stage increases dramatically with the extension of high-frequency response. He told us this view was supported by studies of pinna effects on localization and imaging. For these studies a plastic ear and head were molded from a human form, and a precision microphone was placed in the ear cavity with another just outside the ear to measure the ambient sound field. Repeatable pseudo-random noise was used as a source to avoid the masking effects found in musical signals.

Gardocki said that analysis of the comb-filter response generated by the reflections from the pinna and the sound entering the ear canal directly suggests that directionality can be perceived to a precision of one degree. One could also duplicate the filter and add it to existing recorded sounds. When listening though earphones (projecting sound directly into the ear canal to minimize reflections) subjects could be convinced the sound was coming from any desired direction (front, back, or side) by varying the comb filter. [For comments on hearing and ultra-high frequencies see the writer's addendum.—CFD]

Gardocki had also listened to the B & K (Bruel and Kjaer) demonstration of a speaker with a claimed response flat on axis to 150kHz. B & K uses the speaker to demonstrate their microphones, for example by recording the rustling of leaves. The individual mikes have very different sounds although they roll off at 45, 70, or 90kHz. Gardocki said that it was easy to identify the sonic signature of the individual mikes, even when the outputs were adjusted to a constant output level.

Even in the absence of flat high-frequency hearing sensitivity, ultra-high frequencies would be perceived when the signal and sensitivity are greater than the noise floor. For example, suppose a person with an 18dB loss

at 25kHz were presented with a 90dB 25kHz signal in a room with a 60dB noise floor. The signal would be 12dB above the noise floor and could be perceived, Gardocki concludes. He claims there are small peaks in sensitivity, due to bone structure and fluid resonances, which may add several dB to the nominal baseline in the 30kHz range.

In conclusion, Paul Gardocki feels that a playback system that reproduces these high frequencies may be deemed better, or more realistic, than one that does not.

**Driver Design and Power Handling**

Gardocki also tried to address a perhaps more obvious, and more common, shortcoming in home playback: very-low-frequency response. Any speaker that rolls off the low end at a frequency higher than 20Hz is "clearly" going to alter the sound of some recordings. The importance of the octave from 10 to 20Hz is a matter of taste. Some BAS members seem to enjoy shaking walls. Gardocki tries to obtain extended low-frequency response in a two-cubic-foot enclosure. In the last listening room in which he tested, he told us this module's response was down 5dB at 24Hz relative to 1kHz [The harmonics were higher in level than the fundamental during the test.—Ed] The claimed system frequency response extends down to 22Hz ±4dB.

He noted that many manufacturers had followed him into the $600–1000 price range with three-piece systems, but he was not sure if others would follow him into the $2000–5000 price range for a similar type of system. He has been surprised by the sales of this product. If it continues to sell as well as it has already, this single high-end product will surpass, in dollars, the total sales of all of his other products. He never imagined there was such a market for a small $2500 speaker system.

The system includes two satellites and stands, the passive crossover, and two subwoofer modules. He estimates that retailers will be selling it for $1999.

For his less-expensive systems he just makes the speakers as well as he can (claiming ±3dB from 65Hz–19kHz); it is then up to the customer to optimize the system by careful placement. For this product, if the consumer can measure the low-frequency response in the listening room Gardocki will then tailor the response of the low-frequency driver to that room.

Desktop Loudspeakers makes four different low-frequency drivers for the expensive speaker. Dealers in the Europe and the Far East will stock all four. These dealers can install their demo unit, measure the client's listening room, and then install the correct driver, getting the system within specification without shipping the speaker back to the factory.

During manufacture, Desktop conducts measurements and three hours of listening tests on the satellites; low-frequency units are simply measured.

Desktop's other speakers can accept (dissipate) a constant 30-watt sine wave over the 20Hz–20kHz band; the high-end models are designed to accept a continuous 100W at most frequencies. The tweeter is tested with a five-minute exposure to 100W of 15–25kHz (band-limited) pink noise. Surprisingly, the power handling of the midrange is lower than that of the tweeter. The tweeter dissipates more heat than a conventional design because it has a metal diaphragm bonded to the bobbin, which is a titanium-and-Nomex sandwich. The coil transfers energy into the metal diaphragm, which then dissipates the heat into the air in front of the speaker. It does not use ferrofluid. Gardocki said that during testing the tweeter diaphragm actually gets warm.

He said that heat dissipation was increased because the diaphragm was constantly moving and that less heat was generated because the speaker was so efficient (sensitivity is 98dB/W before damping, 90dB/W after damping, which Gardocki said represented 15% efficiency). [Assuming omnidirectional response radiating into a hemisphere, 90dB/W at 1 meter is less than 1% efficiency. As for the claim that the metal dome lets the speaker radiate 100W of input, consider for comparison purposes a TO-3 transistor, which has a larger surface area than a 1" dome and which, like the dome, is shiny, and therefore not a very efficient radiator of heat. The manufacturer gives a specification relating the amount of power the transistor dissipates to its rise in temperature. This thermal resistance specification is 35°C/watt; in other words, for an input of 6W the temperature rise will be about 210°C.—Ed]

The claimed benefit for this much dissipation was that distortion levels would not increase due to heating of the voice coil after a few seconds of high output. Although Gardocki does not expect many listeners to feed the system 100W of high-frequency noise, he noted that many real-life sounds such as rustling leaves, jangling keys, or closely-miked castanets, have large amounts of high-frequency energy.

Various BAS members noted that such high energy is not present on commercially available music recordings, to which Gardocki replied that many of his customers had 30ips tape machines that could record high frequencies to 40kHz. Some orchestral sounds have significant output in the extreme high frequencies; he cited cymbals, flutes, and triangles, though the output of all these is low compared with the total sound level. [At typical distances of microphones from the instruments, the energy at 40kHz would be strongly attenuated by air absorption.—Ed]

The rubber is bonded to the titanium tweeter diaphragm with a vaporized adhesive. Assemblers inject rubber vapor and adhesive vapor together into an enclosure where the diaphragms sit on the bottom with their front surfaces facing up. The vapors settle and adhere, slowly and evenly, onto the diaphragm.

Gardocki does not believe in user-removable grilles (his have to be pried off, breaking the glue) because in his previous speakers 95% of failures were from external damage. The grille does attenuate the highs somewhat. Gardocki joked that all his dealers had the necessary tool (a screwdriver) for this job. The company has made a

transparent grille by cutting a hole in the ABS of a normal grille and covering it with silk.

The new system uses a 3/4" tweeter, which is relatively nondirectional up to 12.5kHz, increasing to a Q of 4 (i.e., a radiation pattern of 90°) at 25kHz. The damping is "holding the diaphragm together," elastically damping the cone breakup so that the center remains pistonic; the effective radiational surface decreases as frequency increases. At 25kHz the center of the diaphragm is still 80% pistonic.

The tweeter uses a multi-slope crossover; there is a 6dB/octave filter with a –2dB point of 5kHz, and another with a slope of 12dB/octave beginning at 3.5kHz. To keep directivity more constant, the midrange is crossed over to the tweeter lower than usual; above 3.5kHz the midrange starts to beam. At the crossover the midrange has a Q of 2, the tweeter a Q of 1, a relatively small change. A driver with a Q>2 (180° directivity) "tends not to interact with the room properly"; the difference between on-axis and reflected frequency responses interferes with the illusion of reality.

Gardocki paraphrased Richard Heyser to the effect that it is important not to distract from the magic of listening to music with the sense of listening to a high-fidelity system. Heyser helped persuade the Disney management, when Gardocki was working there, to use a beryllium-diaphragm tweeter that was flat to 22kHz even though everyone else felt that 15kHz was good enough. In the end, all concerned felt the greater bandwidth was beneficial.

The 3" midrange rolls off at 150Hz, again with a stepped crossover. In free air the midrange driver has a resonance of 70Hz, which is an octave below its band edge in the system. This driver can tolerate a continuous 40W, as opposed to 100W for the tweeter and woofer. It has a 28mm long coil, 20mm in diameter, wound with fairly heavy wire for heat sinking, but no ferrofluid. The impedance is about 6 ohms. It is derived from his previous midrange so in effect it has seven years of manufacturing experience behind it.

Each woofer box uses four of the 6.5" low-frequency drivers and four 8" passive radiators. Gardocki tries to maximize the driver surface and minimize the cabinet surface that can generate spurious radiation. Gardocki claims that he achieved a smoother bass rolloff by tuning the four passive radiators to different frequencies. [This unfortunately does not work. The output from a highest-tuned passive radiator does not simply roll off below its corner frequency; it also changes phase, which will cancel the output from the lower-tuned radiators. In effect the higher-tuned radiators act as an acoustic short circuit for the lower-tuned ones. The net effect is of having one passive radiator down to the highest passive-radiator frequency, and little clean output below that.—Ed]

There is a special $4800 system in which all the surfaces on the subwoofer cabinet are drivers; there is no cabinet available to resonate. (Gardocki also feels that air in an enclosure stores energy which is later transmitted to the environment, so that a vacuum in the cabinet would theoretically be better. This is the exact inverse of the Villchur acoustic-suspension idea.) In pursuit of part of this "ideal," outer dimensions of enclosures are kept small, as is their interior volume. The solid wood is milled out just enough to hold the drivers.

Because the enclosure is small relative to the bass wavelengths, all the drivers couple. His model 1 (which has a 0.1-cubic-foot enclosure) uses two 6" drivers and is flat to 70Hz; the frequency response below that is bumpy down to the –4dB point of about 50Hz.

The woofer is overdamped, with long voice coils and huge magnets, so that the air in the cabinet is not an important component in the design. With a $Q_t$ of about 0.06, the speaker is said not to see the air mass at all because it is so overdamped. [The laws of physics dictate that the speaker will see the air mass no matter what the Q is. If Paul's driver has a $Q_t$ of 0.06, then it must be the lowest-Q woofer in the world. Even full-range units like the Lowther PM-5A, which has a super-light cone, a *huge* Alnico magnet, and a voice coil which is completely in the magnetic gap cannot achieve this low a $Q_t$.—Ed] Gardocki does not like the idea of storing the energy in the enclosure's air, then either radiating it through a vent (as in bass-reflex designs) or using heavy cones, low-sensitivity speakers, and lower dynamic range (as in acoustic-suspension designs) in order to prevent the sound from radiating back through the cone. [Assuming that the passive radiator has a perfectly linear suspension with negligible mechanical damping, the electrical equivalent of the passive radiator is similar to the bass reflex system, with at least as much potential to "store energy."—Ed]

He feels that part of what we hear in audio is what we have been trained to expect from listening to various types of speakers—bass reflexes for many years, then acoustic suspensions—so that we come to think that the sound from these speakers is realistic.

### So How Does it Sound?

Gardocki had planned to demonstrate his speakers with half-speed-mastered disks, but they and the turntable got left in Connecticut. He did use a cartridge with a resonance in the 25kHz range.

The usual cautions of the BAS speaker demonstrations apply here. We were listening in a large, low-ceilinged room to music which was often new and occasionally very strange. Such a small loudspeaker can be overwhelmed if called on to fill a big room with orchestral sound. I should also say that I do not hear 20kHz at all, so extended bandwidth is lost on me, and that the pinpoint imaging small speakers can often provide is not one of my primary goals in music reproduction. Given these caveats, I can summarize the audience as generally lacking great enthusiasm. The speakers are pretty good, but to me (and some others) not great, and they are fairly expensive.

In the early parts of the demonstration there was something peculiar about the sound. Perhaps the speakers were too far apart (12 feet is Gardocki's recommen-

dation) and there was a hole-in-the-middle effect. Later, we saw that the amp was clipping in loud orchestral passages and the midrange was visibly out of control.

### Some Thoughts on Wire

Gardocki gave Eugene Pitts III, the editor of *Audio*, a lot of static about an article by R. A. Greiner (Audio, August 1989, p. 46) on connecting cables. He agreed with the engineering conclusion but disagreed with the audio conclusion, which was that the connecting wire had little effect once a minimum size was reached. Greiner concluded that wire has no effect below the 30–35kHz range and recommended finessing the whole problem by using bi- and tri-amping and putting the amps next to the speakers with the shortest possible wires. Gardocki pointed out that some listening conditions required 20 or 30 feet of wire and so high-frequency response could be compromised. Again, he feels high frequencies above 20kHz are important, so even a 30–35kHz restriction would be of concern.

He does not recommend specific wire, but uses various types of Kimber wire or Live Wire (a twisted four-pair configuration). He commented that twisted pairs were the standard at Disney, saying that twisted pairs sound very neutral and cancel many problems. Desktop has its own wire now, which is 0-gauge. They claim that it is the highest-efficiency wire for a given volume. The conductors alone measure 5/16" in diameter, and the cable contains about 20 strands. The bigger wire conducts more efficiently. His ideal is to use 1" square bus bars from the amp to the speaker.

In their CES displays Desktop never uses a piece of wire longer than about eight feet, generally with multiple strands. At this demo the wire had eight conductors in each leg, each using 7-gauge single wires.

Internal wiring is 16-gauge solid wire for the bass and 17-gauge coated wire for the highs. The coating is tin and zinc, and is used for the high-pressure welding process by which Desktop connects the leads to the drivers. Gardocki does not like soldering because he feels exposed copper oxidizes badly, so his connectors are all pressure-welded onto the end of the wire. Most connectors are brass, but in the low-frequency enclosures the wire is welded directly onto the speaker terminal.

Amplifiers all need to be terminated differently. The impedance of an output transformer can be three ohms, and he makes loudspeakers with a lower impedance than that. In such a case he claims that wire may be very important.

### Some Design Criteria

When Gardocki was the chief loudspeaker designer at Disney, the French theater (which has over $10,000 of audio per seat) was his personal experiment in audio realism. There are 110 seats, 7 screens, and 13 audio channels. One film scene had a glider going through a fireworks display. "The original show killed people," he claimed; allegedly they had to stop showing the film because some viewers had heart attacks. Rex Reed said that one film was worth the price of admission ($17) but there was no insurance to cover such risks, so they had to cancel the film after only 30 showings.

To test loudspeakers they would use three different loudness levels, restrict listeners to the better seats, and do A/B blind testing. They compared about 4300 loudspeakers in different price categories. (According to Gardocki, Floyd Toole has now tested over 100 speaker systems at the Canadian National Research Council in Ottawa.)

At Disney they took 40 loudspeakers and measured them to get four units matched for frontal frequency response. They then covered the outside of one pair with two inches of concrete and compared the two pairs. Listener preference was 90% for the concrete-coated units, which should have differed only in radiated cabinet noise. This led them to decide that cabinet radiation is undesirable. The concrete-covered speakers played about 0.5dB quieter, so in this case the louder speaker was not judged superior. David Moran pointed out the concrete would change the radiation pattern, but Gardocki said that there was a 1.5" protruding baffle which should have been the major source of diffraction.

Gardocki went to *Audio* magazine and proposed a similar set of tests; Eugene Pitts supposedly said that based on the feedback he got from the article about wire—which was that it had cost the magazine $250,000 in sales over the short term—defining listener criteria for loudspeaker quality would cost the magazine valuable advertising revenue. Supposedly any manufacturer that did not attempt to make a speaker to the standard would pull ads, and some of the largest advertisers fall in this class. [Gene Pitts replies, "I hate to contradict Paul, but I don't think he is remembering our conversation correctly. What I said to him was that such a scheme was impractical logistically because the reviews would never finish." Pitts confirmed the story about the loss in revenue from the cable article.]

A good loudspeaker has flat frequency response (smoothness). The Los Angeles section of the Audio Engineering Society, Gardocki said, was able to pick out speakers which had flat frequency response (within 0.25dB). In the listening portions of his correlated tests, 55% of the people ranked flat frequency response on axis as clearly important. The second most mentioned criterion, at 52%, was constant directivity, meaning that the reflected frequency response should match the on-axis response.

Gardocki designs for good full-space radiation, which is why he cuts off drivers at such low frequencies and operates at low Qs. Designing the speaker to interact well with an average listening room makes for a more realistic image. There are fewer problems if the speakers have flat frequency response both on and off axis and small diaphragms that cut off before their resonance and Q change, and if direct and off-axis radiation do not interact inappropriately.

The third most important thing is that the frequency response must not change with input level over the range of 0.01–30W. This means that all the drivers have

the same dynamic compression, so a peak does not change the frequency response. The ear expects a source to sound the same at whether it is quiet or loud. (Actually the ear itself changes with level, but we are used to that.) Most drivers are not strictly linear—that is, increasing the electrical input 1dB usually does not change the acoustical output by exactly 1dB. [The common use of "linear" to refer to flat frequency response is incorrect.—EBM] Most systems are frequency-balanced at about 1W, but may change at higher levels.

David Moran pointed out that *Audio* reviewers use time-delay spectrometry to measure compression and that it's there, but not very much. In reply, Gardocki claimed that peak/average ratios of 30 to 40dB are not uncommon. Most speakers compress more and more as they get louder. A 3% input/output differential can create huge ringing peaks at the crossover because the phase alignment goes out of the designed range. His speakers are designed to be linear to 30W (15V) and have the same compression in all three drivers, especially at the crossover points. He said this was easy to hear when comparing speakers.

Low cabinet noise is the fourth problem. Gardocki described an experiment at the BBC in which engineers constructed pair of reverberant rooms with a test rig between. The front of a speaker fired into one room while the sides and back radiated into another. The energy in the two rooms differed by only 6dB with most speakers. The Celestion SL600, the B&W Matrix [sic.], and the Wharfedale sand-filled enclosures tend to emit much less acoustic energy from their cabinets than others. For his speakers, the cabinet radiation is –30 to –40dB relative to the cone radiation. He claimed this was 15–18dB better than the Celestion SL600 and 20dB better than the B&W Matrix, thanks to small rigid cabinets, small drivers, and the high internal damping of ash wood.

Gardocki is also concerned about reflections from the back of the cone. The back of the midrange speaker is mechanically attached to the back of the box. The back of the frame is faired, and the top plate of the magnet assembly is stepped to break up the wavelengths small enough to fit in the enclosure. The crossover is behind the tweeter, and the capacitors and coils act as diffusers. The satellite enclosure only has 0.01 cubic feet of air. In the woofer box, there is an angular dispersion structure to break up standing waves.

### The Audio Business

Gardocki had much to say on journalists, their ethics, and audio.

In his opinion, foreign journalists are very interested in going out in the field and finding small manufacturers or even hobbyists who had new, interesting and potentially useful ideas about sound. Irrespective of whether the product or the company was going to make it in the long run, they would report the ideas so that the audio community as a whole could make a judgment on their value. An interesting and valuable idea can come out of a poorly managed company, even if it's not a commercial success.

Gardocki made several pointed accusations of American hi-fi journals. "It seemed to me," he said, "that magazines that would threaten me with bad reviews if I didn't let them keep product I had lent them, reviewers who told me how much per line inch of space in their magazine it was going to cost me to pay them to print things about my product, and so on, were more of an American phenomenon, although not exclusively. There was another [foreign] magazine where they just refused to give the products back, and didn't write anything at all ... sort of like the black hole of journalism ... but this was after they had written a very nice review, and I think accidentally I had taken the product back because I didn't know better, and then when I sent them another set of product they felt that that was their payment, as opposed to a second reviewing sample."

On the subject of audio magazines and their relationship with advertisers, Gardocki had some harsh words. He said flatly that *Audio* can review products that never advertise, but cannot criticize those products that do advertise. [Publisher's note: Pitts replies, "At *Audio* the house rule is, and has been since 1975, that you don't have to advertise to get a review, and that being an advertiser doesn't get you a good review." See also the publisher's addendum at the end of this write-up.—EBM]

Turning to *Audio's* larger corporate cousin, Gardocki said, "I got it in writing that *Stereo Review*'s policy is they don't review any products made by anyone who doesn't advertise in the magazine." Asked if he could produce this document, he said, "No; Eugene Pitts [remember, *Audio* is owned by the same company that publishes *SR*] showed it to me two weeks ago. I'm not sure how recent it is, but he said it's been long-standing policy and so he was reading it [to me]." [Pitts replies, "I never had anything in writing to that effect." *Stereo Review* Editor-in-Chief Louise Boundas says there has never been such a policy during her fifteen-year tenure at the magazine.] [I did hear from two sources about such a letter around the time of the *Stereo Review/Audio/High Fidelity* mishegas, but I mostly discounted it.—DRM]

David Moran said that if this was Stereo Review's policy it was a new one, and that in his experience at dbx over the last several years the ad people from *Stereo Review* "... pester you, but not more or less than before the review". Moran summarized the editorial and advertising relationship as "clean"; the two groups just do not talk much to each other.

Gardocki reported that he had a discussion at CES about getting his loudspeakers reviewed when *Stereo Review*'s advertising manager was present. The ad manager allegedly said that reviewing Gardocki's speakers would seriously damage Stereo Review's advertising situation with Bose, so it wouldn't be possible. Various BAS members reacted with skepticism to this story, pointing out that even Julian Hirsch has little voice in

deciding what will be reviewed; the Technical Editor selects the products in consultation with colleagues.

Gardocki does not find the American press as keen on audio news as he would like. Most magazines, he said, are interested in supporting their advertisers or, like *Audio*, are forced to support their advertisers. He claimed that editor Eugene Pitts told him that he (Pitts) could not afford to send out reporters into the field: audio news has to come to him as a press release. [See the publisher's addendum.—EBM]

In David Moran's opinion, however, the coverage of non-proven audio ideas by the big circulation magazines, and especially by *Audio*, verges on excess. It may be necessary to send a press release to get their attention, but Bert Whyte and Anthony Cordesman write about "more crackpot stuff..." and Whyte gives the math behind it in a manner that Moran characterized as, "this month the heavens opened, the veils fell away and I saw revealed the face of music, because of the polynomial of the Wadia, or whatever it is ...".

Gardocki pointed out that his products predated those from Bose, Henry Kloss, and Design Acoustics, offered what he felt to be superior performance for the money, and therefore should have been reviewed before this. Moran answered that Henry Kloss had both a product and a marketing approach that were newsworthy, as well as a history in the business.

Gardocki also accused "some audiophile magazines" of "holding the audiophile retailers for ransom," reviewing products those retailers carry in exchange for sales of advertising space. He said "the magazines at the audiophile end tend to be the least professional, in my opinion ... I have contributors to the magazines who come up and say, 'Hey, you know, for a thousand dollars I can get you an inch in this magazine; I can write about you'".

When asked for specifics, he said he would give cases that had happened to him personally. "I've personally had *Stereophile* magazine—Gordon Holt—pull two reviews out of his filing cabinet and say, 'If you don't let me keep these speakers, instead of printing this good review I'm going to print this really nasty one.'" [J. Gordon Holt replies, "I was impressed with the speakers, but not *that* impressed. And I would never say anything like that to anyone." See also the publisher's addendum.—EBM] "*Nouvelle Revue du Son* was the magazine that never sent back my second samples, never reviewed the product." And the writer who offered editorial space for a certain price per inch? Specifics weren't forthcoming, but apparently the offer was never authorized by the publisher of the magazine, and the person who made the offer got in trouble over it.

Peter Tribeman, president of NAD, testified from the audience that though NAD had never advertised in *Stereophile* or *The Absolute Sound*, they had gotten "a lot of press," including reviews every year or so; "We always get the product back," and there has never been any impropriety of any kind.

Lou Souther, who used to manufacture tonearms, confirmed this view: "I was in this for a long time, and I never paid anybody anything. The most I ever did is at Christmas I sent them a basket of fruit." (This confession was greeted with exaggerating finger-pointing and much laughter.) Souther always got his equipment back from all the high-end publications.

When Gardocki's loudspeakers were favorably reviewed in *International Audio Review*, other manufacturers allegedly asked how much equipment he had to give in exchange. But he had no basis for any criticism of *IAR*; they did the review, took care of the equipment and sent it back. But in *Stereophile*, he had two reviews: the first was excellent, while the second, published about a year and a half later, slammed the product a month after he took the loudspeakers back. [The magazine has more than a month's lead time.—EBM] David Moran commented that high-end reviews vary over time anyway, as new equipment comes along and reviewers rethink their positions.

One BAS member pointed out that the magazine is also a product that has to sell. If there is a breakthrough or a perceived breakthrough, magazines will cover it because people are interested in it and news sells magazines. Gardocki replied that his loudspeakers have been on the market for seven years with the small-speaker-with-subwoofers concept, that they have been sold by 47th Street Photo, which is located near the publishing offices of the magazines, and that other manufacturers have copied his basic design idea. The copies (Bose, Kloss, Design Acoustics) have then been reviewed. BAS members expressed skepticism at the implication that magazine staffers were reporting design ideas to their advertisers, and noted that the big magazines have not reviewed Bose speakers especially well over the years even though they are widely advertised.

— *Carl Deneke (Texas)*

## Writer's Addendum

Paul Gardocki uses many arguments to support his thesis that "ultrasonic" frequencies are audible. He cites research that states that the localizability of sound is related to (high-frequency) reflections from the pinna and discusses the effects of phase shift at ultrasonic frequencies. It is unclear that extension of speaker high-frequency response past 20kHz has any significant effect on pinna cues. I know of no convincing evidence that frequencies above 20kHz are audible or that phase shift at high frequencies is audible. You can test the effects of the pinna on directionality either by moving the external ear while listening to music or by moving headphones on and off your ears. From doing a crude version of these experiments I would conclude that other cues are more important for normal voice and music.

Second, I am not sure how much musical energy above 20kHz is present in a "normal" hall at a normal listening position and, even if 20–35kHz energy were present, how much would survive the LP mastering

process. Certainly there is no energy in this band from FM or from CD, and probably not from cassette tape, although phono-cartridge mistracking and radio-frequency interference (RFI) can add energy in this band.

Extending the high-frequency response of a loudspeaker beyond audibility should have no bad side effects so long as the added range is linear and does not stress the loudspeaker components. It may not be a major virtue but it should cause no loss except for the increase in price.

As for the B&K mike comparison, there are a number of audible effects and colorations in any microphone, from causes far more significant than high-frequency rolloff. See Peter Mitchell's column in *The Stereophile* (February 1990) about the colorations of professional mikes. The difficult point is that people do not hear much above 19kHz, and high-frequency sensitivity decreases with exposure to excessive levels of energy in the middle or high bands.

Gardocki's calculations based on presumed hearing loss and noise floor are optimistic. Most people's hearing loss in the extreme high frequencies is not just 18dB but *much* greater. I find that an oscillator signal that is very loud, even irritating and nearly painful, just goes away totally as it passes my high-frequency limit. I would guess my hearing is 60 to 80dB down by 20kHz. Now his (or your) hearing may extend to 25kHz, but I suggest that this is unusual and would like to see auditory tests confirming such sensitivity before believing that frequency response beyond 20kHz has any effect on audio perception. [Existing tests show the opposite. And yes, above the frequency at which the cell hairs in your inner ear stop responding the response curve is a "brick wall".—DRM]

As for the claim that an audio magazine couldn't afford to promulgate loudspeaker standards, I think this is a simplistic judgment. Gardocki tested 4300 speakers while he was with Disney, and Floyd Toole has also tested a large number of systems, so at least some of the data should be available. In any case, measuring just what a given speaker is doing is notoriously difficult. Even on-axis frequency response varies with the environment. Also, if designing a loudspeaker were as simple as following a "desirability" formula, speakers would all be the same already. In fact, designing a loudspeaker, like much of engineering, is a hard set of tradeoffs: size vs. bass vs. efficiency, high frequency vs. damping, low frequency vs. damping vs. control, and any of these vs. cost. Some desirable goals may even be impossible to achieve. I think that many of us accept that a flat frequency response from 20Hz to 20kHz ±0.1dB would be desirable, but as yet no manufacturer has done it.

Besides, taste in speakers is like taste in food or wine—very personal. I doubt that I could live happily with Gardocki's speakers and I doubt that he would be very happy with mine. Considering the members of the BAS as a whole, I doubt that any ten of us have the same primary loudspeakers. Yet we all are seriously interested in audio and all consider loudspeakers carefully.—CFD.

## Publisher's Addendum

The troubling allegations made by our guest concerning review policies in audio magazines led to several interesting conversations. First, Eugene Pitts III on the subject of audio news: "We don't have a big budget for travel, and we do depend on people coming to us. The big companies all have PR departments, so they are sometimes more effective at doing that. In general we try to sort out what we publish according to how the equipment sounds to us, and what plays and works well."

Asked about the alleged memo concerning *Stereo Review*'s review policies, Gene said he had never seen one. "About fifteen years ago I was told by someone on the *Stereo Review* staff that it was then a policy, *de facto* if not discussed, that big advertisers' products were much more likely to get reviewed. But I've never seen anything in writing about it, and I don't think there's any such policy now."

Historically, *Audio* has been more willing than SR to review high-end equipment and other stuff from small manufacturers. "We assume that our readers will go farther to find a product than theirs would," Pitts says, "so we're more willing to review products with just a few dealers. We generally won't review a piece from a company that makes only one model, or that doesn't have any dealerships—though Cambridge Soundworks, a big company that sells direct to the customer, is an obvious exception. I'll refuse if someone calls me up and offers to make me an amp just for review, which has happened. And if a company is in financial trouble I'd be reluctant to take on a review until their difficulties are resolved. But those policies are meant to serve our readers, not our advertisers."

Pitts has worked to increase the separation between the reviewing staff and the sales department. "When I first came to *Audio*, in 1970, I was put in charge of sending out galleys of reviews to our advertising department, who would pass them on to manufacturers for comments and changes. We don't do that now, though we do send them our description of the product and our copy of the specs because we want to get the details right the first time."

Michael Riggs, who headed *High Fidelity* for years and is now an Editor-at-Large at *Stereo Review*, was another useful source. Addressing the connection between advertisers and reviews, he said, "In *Stereo Review* I could probably find a counter-example pretty easily—Conrad-Johnson, for example. The only thing that I can say is that it's probably true that if you're a big advertiser you're less likely to be ignored if you call up and ask to have a product reviewed. As for *High Fidelity*, anybody could get a review if he had an interesting product and we had space for it. The only difference [between small companies and big advertisers] was that

a big advertiser could occasionally get a review for a product that didn't meet one of these criteria."

Riggs also pointed out in passing that those who accuse SR of pandering to manufacturers by playing down the sonic differences among electronic components don't understand the nature of the business. "The view, for example, that amplifiers sound pretty much the same is a source of great trouble for us," he said, "and it's even more true of CD players." It's not just high-end manufacturers who need to convince the customer that there is a sonic reason to trade up.

One final observation about J. Gordon Holt: Gordon was a true pioneer in this field, rarely equaled and never excelled at what he does. But he is probably no better than I at getting copy written or edited quickly, which means that the likelihood of his preparing two completely different reviews far enough ahead of a deadline to choose between them is insignificant. And I agree with his self-assessment: threats would be completely out of character.

— *E. Brad Meyer*

# Bob Ludwig on Digital Audio

[Mr. Ludwig is the Chief Engineer at Masterdisk, one of the most respected and well-known CD and LP mastering facilities in the country. While researching a recent article on Ludwig, *db Magazine* found that 48 out of the country's top 200 records were mastered at his facility. Ludwig recently sent a short article on digital and analog recording to BAS member and *Stereo Review* editor-at-large Michael Riggs. Michael passed it on to us, and we are printing a slightly modified version here with permission from both parties.—Ed]

It seems that my opinions about recording systems are being misquoted in certain quarters, so I'd like to set the record straight. First, I want you to know that I am a musician. I played first trumpet in a symphony orchestra before I was employed professionally as an engineer. Maybe I speak with forked tongue?!

When the CD was invented (and I mastered the first CD ever mass-produced in America, *Born in the USA*) I stopped buying vinyl records.

I listen to a *lot* of music. On wide-range acoustical music, where hall ambience and background silence are important to the experience, I always prefer a digital medium—CD or DAT. Having cut records my whole professional life, I never once thought of pops, ticks and stamper rumble on a disc as anything but totally unmusical. Obviously a lot of vinyl mavens have different criteria for distinguishing music from noise. Rock, as with any music of restricted dynamic range in which pops and ticks on a pressing are not such a nuisance, sounds fine on vinyl. In fact, I think the LP gives the most hi-fi per dollar for this kind of music.

Regarding the resolution of the CD and the LP: I can make a digital recording of an LP that would sound identical to the original to almost everyone in a controlled A/B/X test, but I don't think even the high-end writers would suggest that one could make an LP of a CD that would be indistinguishable from the CD! This comparison reveals what I would call resolution, and to me the CD far surpasses the LP in this regard.

The question of musicality, however, is a more complicated one. I believe the LP to be the more musical of the two formats. Now, what does this mean? And is the vinyl disc inherently a musical medium, or do we think it so because our ears have grown accustomed to it, so that anything different is *de facto* less musical?

I engineer many CD reissues of old recordings, and often the CD sounds to me far superior to the original LP. There are times, however, that the LP sounds not only better than the CD but also better than the original master tape! Sometimes the echo seems to last longer on the disc than the master; sometimes there is more spaciousness on the LP; sometimes the record sounds brighter or more "open" in the top end. Since I cut a lot of these LPs in the first place, I *know* there was nothing "artificial" done to them.

What is going on here? My CD master tape sounds identical to the original output of the analog recorder, but the LP sounds better than either of them!

To help answer that question for myself, I have done the following trick: I make a DAT recording of the surface noise of the particular pressing I'm comparing, perhaps from the 3 to 10 seconds of silence between movements. With a digital editor I make a long loop of that noise. Then I play back the loop of the surface noise and mix it through my console with the sound from the original tape. Presto! The CD master sounds nearly identical to the pressing. It is brighter and more spacious, and the echo seems longer! Take away the record noise from the CD and it again seems drier and more closed-in than the pressing. There are certainly some interesting psychoacoustic phenomena here! So potentially, in some areas, the LP can offer greater musicality than the CD. It is not more accurate, but in my opinion it is sometimes more musical.

Also, in many cases a good original pressing will simply be more enjoyable to listen to on a good system than a CD. This is because all too often the CD is poorly made—done by inferior engineers on inferior equipment, without the artist or original producer having a single thing to do with the process. The artist and producer probably baby-sat the original recording through many hours of careful mastering and care in manufacture, but it is now seemingly no longer cost-effective for the record company to hire them to do it again. I have mastered the LPs on hundreds of gold and platinum recordings, but have been hired to do only a small fraction of their CD reissues because of the cost. Frankly, I can't listen to the new, butchered versions of some originally very fine records.

One final point: It is hard to make an unmusical sounding LP (ticks and pops aside), but it is easy to make a rotten-sounding digital recording. We spent a lot of money on Pygmy Computer Systems (64-times over-sampled, 1 bit Delta-Sigma) analog-to-digital converters and we have a $9000 Wadia professional (meaning, among other things, that it has a +4dBm output) D/A converter to make the digital data sound good. A special converter like the PCS eliminates the degradation that can sometimes occur with normal professional equipment.

I think the introduction of Bob Adams' dbx converter chips and the Pygmy Systems converter have upgraded the sound of digital audio a lot; note, however, that these have become available only very recently. In the current CD catalog there are precious few recordings made with these good converters. I think that when they hear the new CDs on good-sounding equipment like the Wadia or the Sony 77ES CD player, a lot of critics will shut up!

— *Bob Ludwig (New York)*

[The critics will eventually hear the new CDs with the Wadia or Sony converters, but it is not in their nature to shut up, any more than it is in ours.—EBM]

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