Issue No. 10*

Fall/Year-End 1987

The Audio Critic®

*would have been Vol. 2, No. 4 under previous nomenclature

Retail price: $7

In this issue:

We discuss the circumstances of our demise, our absence and our resurrection.

We summarize our perceptions of today's audio scene and bring up to date our assessments of equipment in various component categories.

The best approach to optimizing lateral tracking geometry is finally given its due after 49 years.

Our power amplifier and preamp tests find the ultra-high-end hybrids wanting but uncover a brilliant all-tube design at a ridiculously low price.

The running controversy about Bob Carver's amplifier transfer-function duplications is analyzed in depth and laid to rest (we hope).

The Audio Critic

Issue No. 10* Fall/Year-End 1987

Consulting engineers and other technical advisers are engaged on a project basis, some contributing under their by-lines, others working anonymously.

The Audio Critic® is a quarterly advisory service and technical review for consumers of sophisticated audio equipment. Any conclusion, rating, recommendation, criticism or caveat published by **The Audio Critic** represents the personal findings and judgments of the Editor and the Staff, based only on the equipment available to their scrutiny and on their knowledge of the subject, and is therefore not offered to the reader as an infallible truth nor as an irreversible opinion applying to all extant and forthcoming samples of a particular product. Address all editorial correspondence to The Editor, The Audio Critic, Box 392, Bronxville, New York 10708.

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For subscription information and rates, see inside back cover.

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Note: All unsigned articles and reviews in this issue were written by Peter Aczel, Editor and Publisher.

A Word from the Editor and Publisher: The Demise and Resurrection of *The Audio Critic*

We departed from the ranks of living publications a little over six and a half years ago. It was a two-phase demise: first we stopped publishing in the original magazine-like format; then we stopped publishing the biweekly newsletter-size bulletins that had superseded the magazine. Bulletin 3, the last to be published, was dated February 12, 1981, and mailed a few weeks later. Soon after that we decided that the original format had been far more viable and boldly announced an immediate return to it, which of course did not take place—until now. Actually, in January 1983 we did have just about a complete old-style issue standing in type, but it was never printed and distributed, except for the preprint of one article that ended up being widely circulated by the Carver Corporation (see elsewhere in this issue).

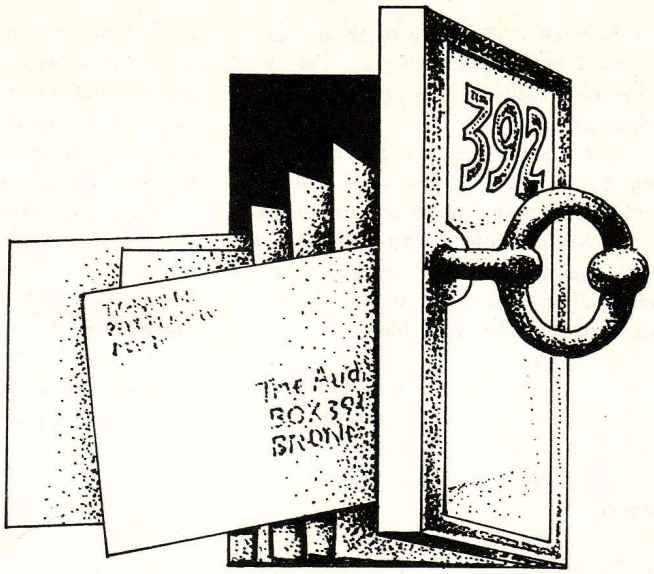
How and why did all this come about? It would be not only painful and frustrating for us to delve into the fundamental causes in print but also, after six and a half years, totally unproductive. No one today would benefit from such a discussion. Let us just state very generally but truthfully that there existed a combination of financial and personal reasons, which are no longer in effect. One of the worst and longest slumps in the history of the audio industry began shortly after we stopped publishing, making a quick comeback that much more difficult; as for our venture in the loudspeaker manufacturing business, it was our most obvious alternative after the cessation of our publishing business, rather than the cause of cessation, as has been malevolently suggested. (More about that, too, later on in this issue.)

The important thing is that we are back, risen from the dead as if nothing had happened, and that we are honoring all unfulfilled and unrefunded subscriptions without even counting the three 1981 bulletins toward fulfillment. If you are a former subscriber and we owe you some issues, please send us your name and current address immediately. We can verify the status of your old subscription from our records, but we cannot mail anything to a 1981 address, which in our nomadic society has a very high probability of being obsolete and no longer on record within the postal forwarding system.

Our resurrection, although clearly attributable to the removal of the original causes of our demise, has been greatly aided by the emotional support of innumerable audio enthusiasts. Time and again we were told that the equipment reviewing scene was just not the same without ***The Audio Critic*** *and that there had occurred an erosion of technical credibility, literary quality and just plain civilized discourse in the "alternative" audio press since we were gone. We could not find in our heart to disagree with that perception (ha-ha), but then of course a deceased body can use a bit of eulogy to rise again. Thank you, friends; it really helped to be missed.*

Just where we stand currently in relation to other audio publications and how our approach to equipment reviewing has evolved since 1981 will be amply apparent on the pages that follow and in future issues. Let us know what you think—not that we ever had to ask you to speak up.

Yes, it is good to be back.



Box 392

Letters to the Editor

As our former readers will remember, and as our new readers should understand, this column is more like a constitutional democracy than a lawless anarchy. There is freedom, certainly, but there are also rules, in order to establish justice and insure domestic tranquility. To wit: Letters from manufacturers in response to our reviews or other editorial comment about their equipment are published unabridged and unedited here, unless some very special reason exists to the contrary. The same goes for the correspondence of audio professionals on subjects specific to their expertise. Letters of general interest from readers may or may not be excerpted, at the discretion of the Editor. Ellipsis (...) indicates omission. The following are unwelcome and can be depended on to remain unpublished: Scurrilous or maliciously defamatory attacks on any individual, be it the Editor or anyone else. Untutored and undocumented technical disagreements with our findings by individuals without technical credentials. Elementary technical questions for which answers can be found in the "My First Book of Electricity" type of reference ("what is a volt?"). Other inanities. Letters should be addressed to The Editor, The Audio Critic, Box 392, Bronxville, NY 10708.

The Audio Critic:

Hi, Peter! I'm one of the original subscribers—from Volume 1, Number 1 back in '77—and yes, you do owe me some issues.

Now that I've said that, let me tell you how many of us feel out here. First off, let me tell you, you were absolutely, positively the best in these areas: (1) your ears, (2) your journalistic ability—absolutely magnificent and never, to this day, equalled—and (3) your recommendations, which were always, always correct, up until the last issue and the 3 Bulletins (or the point Mitch left the scene?). To this day, I still go back to those magical early issues, with greats like the LS3/5A, the T-1, the Vandersteens, the DQ-LP1 and of course the NAD 3020, and I say to myself, I was really happier with Peter's recommendations, more than anybody else's, to this day! All of the other "undies" never gave me concrete advice which they believed in (except P. Moncrieff—and occasionally he has hit it in the right direction).

We used to go into our local hi-end dealership (Chestnut Hill Audio in Philadelphia), and we would hear customers walk in and say to Jack, "What do you mean you don't have it in stock? I just read in The Audio Critic that this is the best there is and, damn it, that's what I want!!!" Now Peter, that's power. And power is what you had—before you blew it. Nobody, but nobody, was more upset than me that The Audio Critic was out of business—hell, we were even going to call Fourier and try to talk you into staying in reviewing.

As far as the original Fourier—we bought a pair without even listening to them. What a disappointment! Peter gave up all this—for this? We kept saying, what a shame, now all us "poor audio slobs" would have to rely on someone who uses Infinity speakers to judge his equipment—and those speakers are obviously happy with amplifiers that have 30-year-old technology inside of them. Amazing—and pitiful.

Oh, don't get me wrong, there's a lot of angry people out here—angry because (1) we didn't get any explanation when the isues stopped (please don't ever go back to those ridiculous Bulletins) and (2) it was obvious you had a fight with Mitch and it showed in the last issue. Nothing was the same, gone was that literary magic—yes, Peter, we even expected entertainment after you had given it to us in those Emmy award-winning 8 issues. But again, the biggest disappointment was the Fourier speaker company. Correct design, I guess, isn't everything after all. "Live and learn."

Now that you're trying it again (thank God), please try and recapture that greatness you had. It's going to be tough convincing everybody, but only you have a shot at it—someday you might even be a monthly like Stereophile is now. But the main thing is,

let's have an explanation of what really happened to The Audio Critic. I'd like to see it in issue #1, and yes, we have a right to know.

Yes, Peter, you owe me some issues, but I like you and your style so much that I'm going to donate $10.00 to The Audio Critic anyway, to get you going again. After all, "the best is the enemy of the good," and sure as hell you were the best. God bless and good luck.

Sincerely,
Frank A. Pulli
Lansdale, PA

P.S. Keep the damn politics out, please.

Thank you, Frank, for your high opinion of us. Modesty prevents us from agreeing with you too vigorously. Your $10.00 will be gratefully applied to your unfulfilled subscription for three additional issues on top of what we owe you. (Other old subscribers who have likewise sent us money are getting the same deal, of course.)

We trust that our prefatory statement on page 2 and the article on the fate of Fourier Systems in this issue are sufficiently "disclosive" to satisfy your rightful curiosity. The decline in quality you discerned in our last full-length issue totally escapes us; we have no idea what to tell you. As for Mitch Cotter, he was never on the staff of **The Audio Critic**, *and our published opinions did not necessarily coincide with his. He was, however, a highly valued friend and informal technical advisor on a number of subjects, who in the end let us down terribly. We did not have a fight; we merely caught him, almost by chance, fabricating a web of blatantly false information about himself and his work, not so much with the intention to deceive or harm us, but rather for the purpose of professional and intellectual self-aggrandizement. We made no reproaches to him whatsoever, but when he realized that we had had a glimpse of him with his psychosocial pants down, he lost all interest in our friendship and began to stay away. That, apparently, has been the story of his life; he is incapable of dealing with anyone who has got his number and, from what we hear, he is running out of friends and wide-eyed disciples.*

It is regrettable that you bought the first-generation Fourier 1. It had some problems, as our article explains. You could have had it retrofitted to the second-generation format; many owners did. Not that there are any valid excuses for not getting it right the first time, but even Shakespeare messed up when he wrote the atrocious Titus Andronicus *just before he came up with* Romeo and Juliet *and long before* Hamlet. *Let no one compose a condescending epitaph for Fourier without having checked out the Fourier 8e, which definitely vindicates "correct design."*

Yes, Frank, we blew it. But as you can see, we are trying to unblow it.

—Ed.

The Audio Critic:

Some years ago, shortly after a decision was apparently made to "fold" The Audio Critic, I sent you a check for a subscription which, despite repeated requests, was never returned but apparently invested in your speaker business. Obviously, I never received any interest or dividends for what amounted to a loan.

I note with some interest, therefore, your intention to revive the journal, and since I don't have any choice in the matter (you still are not offering to return the money, which I would prefer), I want to have the money applied to a subscription. I'm not sure, however, how much I can respect the opinions of an individual who treated his subscribers so shabbily. Your interests are obviously more along commercial lines (such as Carver).

You have my permission to reproduce this in your "letter" column ("Box 392"), but I'm sure you won't.

Sincerely,
Heinz F. Eichenwald, M.D.
Dallas, TX

So, Herr Doktor, *you were sure but, as you see, you were wrong. You are also sure about the nonfulfillment of your subscription, and again you are wrong. Our records show that you did indeed receive a number of full-length issues as well as all Bulletins, and that on a refund basis we owed you exactly $12.50. (On a fulfillment basis, you get this issue and two more, since the Bulletins are not counted in that case.)*

Your expressed desire to have your letter published is the reason we have not answered you privately; two letters would be, after all, a bit too much to expect from us in a matter of $12.50, which is now reduced (since our published answer has reached you within the covers of a new issue) to $7.50. Do you still want it, and if you do, how much is the accrued interest on it according to your CPA? (Frankly, our plan was to spend it mostly on women and liquor.) No, Fourier never paid any dividends, and even if it had, you were not a captive investor by deceitful stratagem; the grotesqueness of that suggestion is addressed in our separate article on Fourier.

Our readers may be wondering why we are devoting editorial space to such petty and boring garbage. Ah, because your letter raises an issue that is very close to our heart. We happen to be old-fashioned enough to regard the practice of medicine as one of the exalted fiduciary professions, more like the calling of a priest than a mere business occupation. It disturbs us greatly to see an M.D., presumably a serious-minded and dedicated healer, reveal his preoccupation with the nasty backstairs gossip, rumors and infighting of the hi-fi trade, as if he were the merest audio-store cowboy. If you have the time to write studiedly acrimonious letters to high-end audio journals, when do you catch up on the staggering volume of new medical information? When do you read, let alone write to, the medical journals? We are glad we are not among your patients.

As for those so-called commercial interests, Carver's profit margins are almost certainly narrower than, say, Audio Research's or Monster Cable's. Or, for that matter, physicians'.

—Ed.

The Audio Critic:

...Welcome back, we missed you... Don't be afraid to charge enough to keep the magazine profitable. It was always worth more than you were getting, and with high-end equipment priced in the stratosphere, what difference would it make to an audiophile to spend a few dollars more for a magazine that was honest and reliable?

Good luck—give 'em hell, Peter!

Yours truly,
Michael R. Loreti, M.D.
Wyckoff, NJ

Thanks, doc. Your brevity allays our fears expressed above about the preemption of medical time by audiophilia and audio politics, and your kindness is in the Hippocratic tradition. Our new

subscription rate represents only a 10% increase over the last one, long ago; we hope we can hold the line. As for giving 'em hell, we can only repeat what Harry Truman once said: "I have never deliberately given anybody hell. I just tell the truth... and they think it's hell."

—Ed.

The Audio Critic:

...I was... overjoyed to read of The Audio Critic's resurrection. Your return to publishing comes not a moment too soon, for not only must we dedicated audiophiles contend with unparalleled levels of mediocrity in music reproduction (i.e., CD's), but we have also been without a journal which gives us a meaningful, lucid, critical examination of the design and performance of serious high-end audio equipment. Stereophile, TAS (especially TAS) and the others just don't cut it.

Unfortunately, I fear that you might once again have to introduce to a whole new younger generation of audiophiles and audio salespersons the seminal work of Bærwald on VTA *(Whoa!—Ed.)* and proper cartridge alignment. Go into any high-end store with salespersons in their twenties, and invariably they will not know a thing about this. In addition, I have noticed in my travels that salespersons of high-end equipment have lazily taken to demonstrating their wares to customers with any CD that happens to be handy rather than properly selecting, cleaning and playing a well-recorded disc. I don't know if this deplorable practice is prevalent in your area, but if it is, perhaps a few of the famous Aczel rejoinders on this subject might make an appreciable and much-appreciated difference.

...Welcome back and best of luck.

Sincerely,
George Evans
Haslett, MI

No situation is ever entirely black and white, but on the whole we share your lack of enthusiasm about the high-end audio journals. One of the principal motivations for our comeback is best expressed in the words of a Hungarian novelist of an older generation, who said, "When I want to read a good book, I write one for myself."

As you will see from the article summarizing our views on current audio equipment, we are very much in favor of the best CD's when played on the best CD players and appreciate the marvelous convenience that makes them so appealing to those lazy salespeople. That does not mean that a competent analog LP demo should not be part of a serious presentation to a customer in a high-end store.

We interrupted you reference to Bærwald because he never wrote about VTA, only about lateral tracking error. Our new article on the subject, which is probably the most important part of this issue, opens a smallish Pandora's box with an alternative, and probably superior, alignment; this may perhaps be what is needed to make those young whippersnappers pay attention. They love to tweak around with all kinds of ritualistic little add-ons and adjustments that make little or no audible difference; why would they resist something just as fussy but more important?

—Ed.

The Audio Critic:

I was very pleased to hear that you again are back to reviewing. I have always subscribed to The Audio Critic and have enjoyed every issue, but more than that, I felt like I was learning something. If some component is reviewed and sounds wonderful, I want to know why it sounds wonderful. The Audio Critic always tried to do that...

Sincerely,
Tom Hartvigsen
Tullahoma, TN

You may or may not be conscious of it, Tom, but that happens to be a real down-home, Tennessee sour-mash gem: "If some component is reviewed and sounds wonderful, I want to know why it sounds wonderful." That says it all and should be on the label of the stuff those subjective reviewers out there are drinking.

Of course, sometimes it is a mystery why it sounds wonderful—or not so wonderful. What makes us different is that we hate mysteries, so we always try to get rid of them.

—Ed.

The Audio Critic:

I was a subscriber to your magazine, and I was convinced that it was the only audio mag that reviewed equipment without a bias toward one "sound" (i.e., tube) or another. I am pleased you are starting up again...

Robert Barry
Los Angeles, CA

We do have a bias in favor of one sound: the sound that originally entered the microphones. The problem with that sound is that it can only be heard through the intervening medium of the recording and playback equipment. That is why each piece of equipment in the recording-playback loop must be separately evaluated for accuracy from input to output and the likelihood of hearing the original "catch" of the microphones determined from that evaluation. In the right hands, tubes and transistors are just about equally likely to produce accurate results.

—Ed.

The Audio Critic:

Hurrah! I wasn't ripped off—it was just an investment in the future that has finally come due...

Lloyd Madzel
Arlington Heights, IL

You see? The immortal Samuel Johnson, whom we venerate as one of our spiritual ancestors, got himself into the same kind of pickle when he took subscriptions for his announced edition of Shakespeare and then delivered the superb eight volumes many years later than he had promised. Before he did, a nasty poet named Charles Churchill penned these lines about him:

He for subscribers baits his hook,
And takes their cash—but where's
the book?

Here's the book!

—Ed.

Lateral Tracking Alignment Revisited (Maybe Your Overhang Is Wrong After All)

A reexamination of the key papers published so far on lateral tracking geometry in pivoted tonearms reveals total consensus and consistency, but the granddaddy of all the researchers also suggested an alternative optimization that tends to rock the boat, as it may well be superior to what everybody is blithely using today.

As the tuned-in element in the audio world is well aware, **The Audio Critic** exerted considerable influence in its early years (especially 1977 and 1978) over the unofficial but almost universal standardization of tonearm geometry that later became more or less taken for granted. We were not the only ones who tried to bring order to the chaos of conflicting practices prevailing at the time; others who were quite vocal on the subject included Mitchell Cotter, Sao Win, Dave Hadaway, Frank Dennesen and Mike Goldstein, the last three of whom even devised and sold various ready-made alignment gauges. What made our own contribution unique, however, was an unintended development we were never really comfortable with. It seems that the alignment tables and instructions we published in Volume 1, Numbers 4 and 6 were so handy and comprehensive that they soon became widely accepted as the gospel on the subject and the starting point for all sorts of new designs in tonearms, gauges, protractors, record players, etc.

Now, it is true that we had researched the situation rather thoroughly and gave our readers the best information obtainable anywhere, at least until the present moment. Even so, our intention was to help audiophiles at home and dealers in their stores, not to provide a free R-and-D package to equipment manufacturers. If it had been our plan to design and manufacture expensive phono products, we would have immersed ourselves even more deeply in the subject and hopefully come up with the findings we are only now reporting. (If you wanted to make reflecting telescopes for astronomers, you would not go to the science section of *The New York Times* for your prime reference, marvelous as it is.)

Enter Græme Dennes, the elucidator.

While we were planning and writing the Winter 1982-83 issue that was never published, we had the good fortune to become acquainted with a remarkable Australian named Græme F. Dennes, who at the time was working in the American ærospace industry in California and Georgia. (Meanwhile he is back in Australia, to the best of our knowledge.) As an avocation, Græme had delved into the theory, mathematical fundamentals, literature, history and implementations of lateral tracking alignment more thoroughly than any human before or since; his mission was, like Captain Kirk's, to go where no man had gone before—in that particular universe of investigation. He brought to this recreational obsession a scientific impartiality and mathematical savvy that provided desperately needed relief from the effusions of untutored techno-hysterics collecting in our mailbox. His massive thesis, "An Analysis of Six Major Articles on Tone Arm Alignment Optimization and a Summary of Optimum Design Equations," dated March 1983, is a minor masterpiece of comparative elucidation, even if it contains no previously unknown material and has not been printed anywhere, as far as we know.

Originally, Græme wanted us to publish this heavily mathematical paper in **The Audio Critic**, but we told him that it would be understood and appreciated only by a small minority of our readership, since it really belonged in the journal of an engineering society. Intent on exposing his work to a broader segment of the audio community, he then wrote a clear and nonmathematical overview of his findings and sent it to us in the form of a letter to the Editor. When he found out that our Winter 1982-83 issue was not happening and that we would not be able to print his letter, he sent it to *Audio* magazine, where it appeared in the May 1983 issue with a postscript by Barney Pisha, another recognized student of the subject. Dr. Pisha's otherwise thoughtful and receptive comments included the astonishing observation that "with the advent of the compact digital audio disc and the laser beam stylus, all this, of course, becomes moot as it is relegated to the pages of history"—as if new phono cartridges and tonearms were not being sold

anymore and mounted on new turntables every day with a need for correct alignment.

There can be no doubt that we are witnessing the waning days of the phono arts and that the century-old technology of a hinged stylus mechanically driven by a rotating spiral groove has a limited future. That does not mean, however, that the millions and millions of music lovers who continue to depend on that technology for their home listening pleasure cannot benefit here and now from the work of a Græme Dennes. The fact is that the very reason for this article arises from a little-known alternative approach to lateral tracking optimization that nobody but Græme has ever analyzed comparatively, let alone discussed in print, since its publication 49 years ago and that even he tended to treat only in passing until we started pestering him for more information. It is anything but "moot," as you will see, but first let us summarize the overall thrust of his work as it appears to us from his complete treatise as well as his letters, even if some of our readers remember that 1983 letter in *Audio*.

Erik Löfgren said it all in 1938.

The six major treatments of the subject that Græme Dennes compared from the ground up are those of Löfgren in 1938, Bærwald in 1941, Bauer in 1945, Seagrave in 1956-57, Stevenson in 1966, and Kessler and Pisha in 1980. These references are listed more specifically at the end of this article. (The alignment tables and instructions published in **The Audio Critic** in 1977-78 were based on the work of Bærwald; there is, however, a somewhat inaccurate acknowledgment of Löfgren's contribution in our response to a letter to the Editor in one of our 1979 issues, unfortunately B.D.— before Dennes.)

It turns out that Professor Erik Löfgren of the Royal Institute of Technology in Stockholm, Sweden, had the whole thing figured out from A to Z as early as 1938, three full years before Bærwald. Had there been no further writing by anyone on any part of the subject, one would still be able to mount and align a tonearm and cartridge today with the certain knowledge that distortion due to lateral tracking error cannot be further reduced. It is really quite poignant that a goodly number of highly qualified researchers devoted so many years to solving a problem that someone else had already solved before them. The reason why this was not more widely known until very recently is that the Swedish professor's definitive article is in German and was published in Nazi Germany virtually on the eve of World War II in a technical journal then only in its third year. The exposure in our part of the world was not the greatest, although Bærwald, who published his article in the U.S.A. immediately before Pearl Harbor, does give Löfgren as a reference, without doing him full justice.

After Percy Wilson's pioneering articles in the 1920's about offset and overhang, it was Löfgren rather than Bærwald who first pointed out that the weighted tracking error (i.e. the tracking error per unit of radius) is the quantity that must be minimized all the way across the record to obtain the lowest possible distortion. That was the conceptual breakthrough. After that the optimization of offset angle and overhang became a relatively straightforward problem in geometry. Græme Dennes clearly establishes in his paper that all major researchers starting with Löfgren understood the problem completely and solved it correctly, so that it is sheer nonsense to claim that any one of them is right and the others are wrong. (Remember Gerald Bearman and the Formula 4 arm?) Here are Græme's conclusions:

Löfgren, Bærwald, Seagrave and Stevenson produced mathematically identical, and exact, design equations for optimum offset angle and optimum overhang, differing only in notation and arrangement. Their solutions result in the familiar three-point, equal weighted tracking-error curve with two nulls, on which today's widely accepted alignment practices are based. In addition, Löfgren and Bærwald also produced identical, but approximate, equations for overhang.

Bauer's offset angle equation is an approximation, and his overhang equation is identical to the Löfgren/Bærwald approximation (not their exact solution). Seagrave also produced an approximation for overhang, different from that of Löfgren/Bærwald/Bauer and actually more accurate. Thus we have a single exact solution from four different sources so far, plus three different kinds of approximation that are also correct as far as they go.

Now comes the best part. Löfgren and Stevenson each presented still another approach, one quite different from the other. The aim in each case was a further reduction of the psychological annoyance factor of tracking distortion. The Stevenson rationale can be easily dismissed today, after more than 21 years, because it was obviously influenced by the typical styli of the era. Stevenson considered tracking and tracing distortion in the neighborhood of the innermost groove to be so annoying, albeit of brief duration, that he preferred his inner tracking-error null to be established at the radius of the innermost groove, rather than about a quarter of an inch further out as in the classic solution. A slight increase in overall tracking distortion across the playing surface was the trade-off, quite unnecessary today because the various modern line-contact styli trace the innermost grooves better than a 1966 spherical stylus did the outermost, so that inner-groove tracking distortion is no longer aggravated by tracing distortion. The Löfgren alternative, on the other hand, which we shall call the Löfgren B alignment (Löfgren A being identical to Bærwald's and our 1977-78 tables), deserves the most serious consideration.

Löfgren B: the surprising advantages.

Löfgren's alternative optimization was based on the assumption that the annoyance factor of tracking distortion is cumulative with time and that short stretches of slightly higher distortion are therefore more tolerable than long stretches of relatively lower distortion—just the opposite of Stevenson's approach.

The classic (or A) alignment results in three equal peaks of weighted tracking error, and therefore of tracking distortion, as the stylus travels across the record: one at the

outer groove, one at the inner groove and one between the two zero-error points (or nulls). On either side of the middle peak, between the two nulls, the weighted tracking error changes relatively slowly with the radius and hence with time. The annoyance factor comes into play. By minimizing the integral of the distortion function weighted by the application of the method of least squares, Löfgren proposed to reduce the middle peak and obtain lower tracking distortion over the long, slow stretch between the two nulls, thereby alleviating the annoyance factor. The price to be paid for this is the automatic increase of the other two peaks, at the outer and inner grooves, but the resulting higher tracking distortion is of relatively short duration and therefore has little effect on the annoyance factor. In terms of actual dimensions, the Löfgren B alignment results in the same optimum offset angle as A, a slight increase in optimum overhang over A, and a fairly sizable relocation of the two nulls. Therefore, new alignment tables and/or new gauges and protractors are required.

Græme Dennes is neutral when it comes to expressing a preference between Löfgren A and B, since both are mathematically correct and exact solutions in terms of the underlying assumptions. The A alignment minimizes peak distortion at the expense of total, continuing distortion; the B alignment minimizes total, continuing distortion at the expense of the short-term peaks. It is our impression that Löfgren himself leaned toward B, and we are also inclined to favor B after examining the trade-offs.

Let us compare. Both alignments result in two nulls, where the tracking error, weighted and unweighted, falls to zero and so does tracking distortion. In the vicinity of these two points along the arc described by the stylus, the sound is the best possible with either alignment, although the two points are not identically located. So far, no preference. Now, between the two nulls, where more than half of the playing time falls, the B alignment sounds better because the tracking distortion is held to lower values. B moves ahead. At the very beginning and very end of the record, the A alignment sounds better because the tracking distortion peaks are not as high, but the first better passage is soon over, and the second does not even happen on discs that are not recorded close to the label or else is equally brief. So the A alignment does not quite catch up in the trade-offs, and therefore B wins, at least in our book.

It should be pointed out that the above conclusions are based partly on logic and partly on informal listening tests, each confirming the other. The differences are audible but small, since the geometrical difference between A and B is also small. Considerably more rigorous listening tests were conducted some time ago in California by Sao Win, whose fine credentials as a phono technologist are matched by the keenness of his hearing and his musical taste. Sao is more enthusiastic about Löfgren B than any of the aforementioned dramatis personæ and claims that his new stylus geometry, discussed elsewhere in this issue, makes the superiority of the B alignment even more obvious.

Incidentally, before the publication of the new alignment table accompanying this article, the only parties privy to the exact IEC-normalized values of the Löfgren B zero-tracking-error radii, as far as we know, have been Græme Dennes and friends, Sao Win and friends, and your Editor and friends. Thus there has never existed a sufficiently large sample of initiates for the purpose of testing the alignment and comparing notes.

Where do we go from here?

We are not going to repeat here the nuts and bolts of tonearm mounting, cartridge and arm jockeying for accurate alignment, protractor fabrication and use, etc., which we published in 1977-78. These things are common knowledge today—or ought to be. All we wanted to communicate at the twilight of the phono era is that an almost forgotten insight by a very early pioneer may help you obtain a small improvement in sound quality from your records.

It would be even better, of course, if a straight-line tracking (SLT) tonearm became available that incorporated the refined construction details and superior mechanical characteristics found in the very best pivoted arms today. That would indeed make all of the above "moot," but we have yet to see and hear such an arm, although we cannot state categorically that it does not exist.

At this point, our recommendation is that you try the Löfgren B alignment with the aid of our new table of optimum values and just listen. We hope you do not have to drill a new hole for your tonearm to achieve the increased overhang but can simply move the cartridge forward in the headshell or else discover sufficient play in the existing hole. As for the makers and marketers of factory-assembled turntable/tonearm systems, and of ready-made alignment gauges and protractors, we shall just sit back and observe how they handle this one.

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6. *The Audio Critic*, Vol. 1, Nos. 1, 4, 5 and 6 (1977-78).

7. M. D. Kessler and B. V. Pisha, "Tonearm Geometry and Setup Demystified," *Audio*, Jan. 1980, pp. 76-88.

Metric Table of Optimum Overhang and Offset Angle Alignments for Pivoted Tonearms

Optimization Parameters

LP Record Diameter	30	cm
Recorded Area (IEC Standard)		
Maximum Radius	146.05	mm
Minimum Radius	60.325	mm
L sin ß	93.445	mm

Null Radii (Tracking Error = 0)

Löfgren A (also Bærwald, etc.)	120.90 mm & 66.04 mm
Löfgren B	116.60 mm & 70.29 mm

1 mm = 0.03937 in 1 in = 25.4 mm

Effective Arm Length (mm)	Optimum Overhang A (mm)	Optimum Overhang B (mm)	Optimum Offset Angle (°)
200	21.05	21.66	27.85
201	20.94	21.54	27.70
202	20.82	21.42	27.56
203	20.71	21.30	27.41
204	20.59	21.19	27.26
205	20.48	21.07	27.12
206	20.37	20.96	26.98
207	20.26	20.85	26.84
208	20.16	20.73	26.70
209	20.05	20.62	26.56
210	19.94	20.52	26.42
211	19.84	20.41	26.29
212	19.74	20.30	26.15
213	19.63	20.20	26.02
214	19.53	20.09	25.89
215	19.43	19.99	25.76
216	19.33	19.89	25.63
217	19.24	19.79	25.51
218	19.14	19.69	25.38
219	19.04	19.59	25.26
220	18.95	19.49	25.13
221	18.86	19.39	25.01
222	18.76	19.30	24.89
223	18.67	19.20	24.77
224	18.58	19.11	24.66
225	18.49	19.02	24.54
226	18.40	18.92	24.42
227	18.31	18.83	24.31
228	18.23	18.74	24.20
229	18.14	18.65	24.08
230	18.05	18.57	23.97
231	17.97	18.48	23.86
232	17.88	18.39	23.75
233	17.80	18.31	23.64
234	17.72	18.22	23.54
235	17.64	18.14	23.43

Effective Arm Length (mm)	Optimum Overhang A (mm)	Optimum Overhang B (mm)	Optimum Offset Angle (°)
236	17.56	18.05	23.33
237	17.48	17.97	23.22
238	17.40	17.89	23.12
239	17.32	17.81	23.02
240	17.24	17.73	22.91
241	17.16	17.65	22.81
242	17.09	17.57	22.71
243	17.01	17.49	22.62
244	16.94	17.42	22.52
245	16.86	17.34	22.42
246	16.79	17.26	22.32
247	16.72	17.19	22.23
248	16.64	17.11	22.14
249	16.57	17.04	22.04
250	16.50	16.97	21.95
251	16.43	16.89	21.86
252	16.36	16.82	21.77
253	16.29	16.75	21.68
254	16.22	16.68	21.59
255	16.16	16.61	21.50
256	16.09	16.54	21.41
257	16.02	16.47	21.32
258	15.96	16.40	21.23
259	15.89	16.34	21.15
260	15.83	16.27	21.06
261	15.76	16.20	20.98
262	15.70	16.14	20.90
263	15.63	16.07	20.81
264	15.57	16.01	20.73
265	15.51	15.94	20.65
266	15.45	15.88	20.57
267	15.38	15.82	20.49
268	15.32	15.75	20.41
269	15.26	15.69	20.33
270	15.20	15.63	20.25
271	15.14	15.57	20.17

Today's Audio Equipment and the Reviewing Discipline: Where We Stand

After an absence of six and a half years, it is obviously necessary for us to make a "statement of the art," defining our current position in the audio world, bringing up to date our preferences and antipathies in various component categories, and redrawing the line between valid equipment reviewing and self-satisfied subjective expertizing.

Audio in the late 1980's is not a good illustration of *plus ça change, plus c'est la même chose*. Very little today is "the same thing" after all the changes of the past few years, even from a broadly philosophical point of view. Of course, Mozart is still the same and so are our ears, but the technology, the equipment, the expectations of the consumer, the available program material and the sales pitches have all changed so radically that any competent audio journalist's perspective also had to change in the process. In our case, that change in perspective may at first blush seem a little abrupt without a written record of its evolutionary stages over the past six and a half years; closer scrutiny of specific instances will reveal, however, that our basic standards of excellence and logic remain as before.

The equipment reviewer and the marketplace.

Throughout the late 1970's, in the golden age of **The Audio Critic**, good and bad equipment coexisted in the stores in every price category (except the lowest, where everything was bad) and competed for the audiophile's dollar with virtually equal plausibility. Shoppers who were not reasonably knowledgeable, or did not pay for reliable outside advice such as ours, were pretty much dead meat. That is no longer the case today. The low-priced stuff is now just about uniformly listenable, occasionally very good and hardly ever catastrophic. In the medium-priced range, the audible performance often approaches the current state of the art and the great disparities have almost entirely disappeared. The high end and ultrahigh end are still a problem in terms of true value per dollar and genuinely sophisticated engineering, but it is no longer possible to buy dreadful sound for multiple kilobucks as in the wild and woolly days.

The major exceptions to these generalizations are loudspeakers, which have also improved but not nearly enough considering the available technology, and recordings in all formats, which are not "audio equipment" as such and do not compete at greatly different price points but certainly come within the purview of the audio journalist. The gradual convergence toward a single standard of quality is most evident in purely electronic components such as amplifiers, preamplifiers and control units, CD players, etc.

The so-called alternative audio press has not squarely faced up to the new situation, apparently regarding it as a threat to their importance as tastemakers. With only a few commendable exceptions, they still report exquisitely perceived differences where there are none and come up with scientifically unverifiable explanations for their subjective self-indulgences. They obviously believe that component A must "blow away" component B, especially when the large-circulation hi-fi slicks have reported otherwise, if their readers are to feel like a highly enlightened In Group. The melancholy truth is that big bad *Stereo Review* and *Audio*, commercial, insincere and superficial as they are, have a firmer grasp of the nuts-and-bolts realities of today's audio technology than the supposedly purer and more deeply discerning esoteric journals. Julian Hirsch and Len Feldman may not point out the small but audible differences between the analog output stages of two fairly similar CD players, but at least they will not tell you to hook them up with cables made of phlogiston-free kryptonite to make the lower part of the upper midrange more liquidly multidimensional and thus reveal the vast superiority of A to B.

One might even be tempted to conclude that the evolution of the market and the resulting improved product have reversed the roles of the pop-tech reviewers and the high-end pundits. The former used to be wrong all the time with their everything-sounds-good Pollyannaism but are beginning to be frequently right; the latter, who used to be right most of the time when they pointed out the major sonic differences that existed, are now getting panicky as the differences dwindle and taking refuge in cuckoo land , so *they* are wrong all the time. If that is too sweeping a con-

clusion, it is mainly because of loudspeakers, about which both contingents have always had the habit of being wrong, then as well as now, regardless of affiliation. Even the late great Richard C. Heyser, who operated on an intellectual plane far above that of either camp, did not make a solid connection in his technically brilliant articles between measurements and audible performance, perhaps because it would have been so devastating as to elicit front-office opposition. If we were starting a new publication at this time instead of resurrecting an old one, it would have to be *The Loudspeaker Critic* because that is where the greatest weakness lies in audio reviewing—and that is where a large part of our future efforts will be concentrated.

Criteria for valid testing and reviewing.

What, then, is the correct and credible approach to evaluating a piece of audio gear for the sophisticated music lover and audio enthusiast? First, we must get rid of a tired old shibboleth founded on hypocrisy. We are referring to the familiar protestation of the subjective audio reviewer that his only standard is "the absolute sound" of live music. How noble, how pure! Pure bunk.

Undeniably, the purpose of audio technology is to reproduce the exact auditory experience originally produced by a live source of sound. Thus, if we were evaluating a total system of sound reproduction, from microphone diaphragms at the live source to loudspeaker diaphragms in the listening room and all the hardware in between, then the sound of the original, live event would indeed be the only valid criterion. (That was the thinking behind the advertising as well as the critiques of the early Edison phonographs, and justifiably so, since the recording and playback processes were mirror images of each other with identical signal paths.) But to proclaim that a separate electronic component, such as a power amplifier, reproduces or does not reproduce "the absolute sound" is fatuously simplistic. The amplifier can only reproduce its own input and pass it on at a higher amplitude to a loudspeaker. Whether or not the resulting sound bears a close resemblance to live music as remembered and desired by a concertgoer depends on so many factors in addition to the design and construction of the amplifier that the mind boggles. In his heart, even the most pretentiously pure subjective reviewer knows that, but it is hard to give up well-worn, facile answers to difficult questions.

Our own equipment reviewing procedure, as we now intend to standardize it in **The Audio Critic**, comprises three important stages. First, a component must be screened for reviewworthiness, to coin a word. There are thousands and thousands of models listed in the annual directories, and hundreds of new ones are introduced between issues (even when published on schedule). No audio journal can address itself to more than a small fraction of them, but what are we to do every time someone raises his hand and calls out that his is the best, or at least the best for the money? We need some sort of rationale for focusing our attention. It could be a whole new technology or just an interesting new circuit, the latest effort of a highly respected maker or the debut of serious new talent, a previously unreviewed classic or a particularly polished and promising new execution of a reliable old idea—whatever it is, something distinctive. We cannot just proceed because the product is available. Thus, a new speaker system consisting of a woofer, a tweeter and a first-order crossover network in a rectangular box would not get past our screening process unless the woofer or tweeter or box were made of a special material, or some special claim were made for the tuning of the box, and so forth. Another reason for screening out a piece of equipment, even if it were of a highly intriguing design, would be a total lack of practicality, common sense or safety. Dr. Hill's bizarre Plasmatronics speaker system comes to mind, with its large thirst for compressed helium in industrial cylinders and the telltale odor of poisonous ozone in the room where it is playing. Thank you—next!

The screened, reviewworthy equipment is then passed on to the second stage, which consists of laboratory tests and measurements. These are absolutely essential to the evaluation process and will be discussed in full detail in the context of specific component categories and individual reviews. The purely subjective reviewer will insist that all such efforts at the laboratory bench are irrelevant because there is little or no correlation between measurements and sound quality, and no laboratory report can change his mind about what he is plainly hearing, anyway. Again, pure bunk. Loudspeakers, to bring up the most painfully obvious example, exhibit dramatic differences in a number of easily measurable response characteristics, and their sound varies accordingly and quite predictably. Electronic gear is a bit more subtle, but anyone who has read the articles on the Carver "t-mod" projects in this issue will have an idea just how closely measurements are related to amplifier sound. The main purpose of measuring a component before listening to it, or even after having listened to it, is to determine exactly how, and exactly how much, it deviates from the theoretical ideal for such a device, from its Platonic form so to speak. Audiophiles are familiar with the concept of a straight wire with gain as the model for the ideal amplifier; similar models can be set up for other components, though not always so neatly. The point is that when we measure an amplifier, we are quantifying its resemblance to "the absolute amplifier," which is a better clue to audible quality within a system than... you already know what.

That bring us to the listening tests, the third stage of evaluation. It can be dispensed with, unless sheer curiosity prevails, if the equipment has been found seriously delinquent on the lab bench. Just as the taste of lobster with chocolate sauce is of no interest to the gastronome, the sound of its audio equivalent is of no interest to us. There is no reason to try it. The object of extensive listening tests, such as we insist on in certain cases, is not to experience the full range of "the good, the bad and the ugly" but to sort out the nuances of good, better and best sound, see how they correspond to engineering features and measured characteristics, and determine whether they are consistently distinguishable by the trained ear. There has been a great

deal written and said on this subject, and it is not our intention to present an entire philosophy of critical listening within the confines of this article. Our current views will become fully evident from our treatment of individual products; meanwhile we want to establish our position on a few very general points.

Folklore and reality in listening tests.

If you read of some of the more precious high-end periodicals and amateur audio-society reports, you are undoubtedly familiar with the sensuously lingering style in which their writers relate their impression of a particular component's sonic anatomy, in almost pornographic detail. "The warm fullness of the upper bass is emphasized by the slightly recessive lower midrange; the upper midrange could be more liquid and is slightly hooded at times; the highest highs are too silky for complete realism, but the lower highs are quite incisive yet nicely rounded and almost free of grain." When a fellow thinks like that about a piece of audio equipment, we would hesitate to shake his hand after a listening session.

Seriously, though, that kind of super specific characterization of reproduced sound has no foundation in reality. Yes, we are willing to contemplate the possibility that somebody actually heard something just like that from a given seat, in a given room, listening to a given recording, through a given stereo system, with the component under test inserted into that system. Now, change any one of the givens, or let the listener just move his head six inches, and those exquisitely delineated specifics are no longer exactly the same. They are not consistently applicable to the same component under different conditions. If there existed an absolutely perfect stereo system made up of absolutely perfect components, and one substituted for one of the latter a new and less-than-perfect component, the changes one might hear could probably be described in terms such as loss of clarity, veiling, less sharp focus, less information, thicker or thinner or coarser textures, reduced depth, less air around the instruments, bloated or constricted stereo image, loss of directional clues, shifting localization, stridency or dullness, etc. General imperfections like these could be assumed to be intrinsic to the component itself and therefore relevant to a critique; however, if one heard a rainbow effect of octave-to-octave changes, some for the better and some for the worse, they would surely be due to local conditions, interface peculiarities and other nonrecurrent causes, if not entirely a figment of the imagination. Thus an authoritative report of a listening test is always fairly general though unequivocal; only the dilettante dwells lovingly on the 128 facets of his kaleidoscopic misperceptions.

Another preciosity we have little patience with is a hairsplitting description of every nuance of imaging and soundstaging, as if equipment designers possessed a varied palette of these ingredients, from which they decide to apply larger or smaller portions to their creations according to their personal taste and style. Rembrandt always put in those rich browns and golden yellows, and Conrad-Johnson always puts in this fantastic front-to-back depth, you see... The fact is that correct design, with accurate performance in the time domain, automatically results in the proper rendition of time-related information in the program material. Whatever you want to call such information—imaging, soundstaging, depth, width, localization, or anything else of the sort—it consists of complex time relationships, which must be preserved undisturbed in the playback. And that, amigos, is not a separate performance feature that can be dialed into a design; it simply comes with the territory when all is well in the time domain. Nobody even has to talk about it. For example, beveling or rounding the front edges of a rectangular speaker enclosure reduces diffraction effects and thereby improves the coherence (i.e., time-domain accuracy) of the wave launch. Presto, you have clearly better imaging, soundstaging, etc., than with sharp edges. Not because of the magic touch of some great design guru who lies awake at night thinking about the position of the piccolo, but as a result of good engineering practice based on the laws of physics.

It should be added that dozens of microphones going into as many channels, and then mixed down, equalized, overdubbed, reverbed and otherwise console-processed, will not yield a stereo signal in which time relationships are faithfully preserved. To talk about authentic imaging or depth or natural space in such cases is like pretending to discern fresh dairy tastes in a processed cheddar spread. The whole thing is a dead issue except when the microphoning is quite simple and console shenanigans are at a minimum—hardly the usual situation. And then there is that question much dreaded by high-end party-liners: just how much directional and spatial information is available to the ear at a live concert, anyway? Our typical experience has been that, with eyes shut and no cheating, one can distinguish left, right, center, front and rear, and not much more. A very few additional in-between sectors, maybe two or three, become vaguely apparent as one moves to the front row, which is more or less representative of the expected distance of microphones from the musicians. Under no circumstances can one hear anything resembling the pinpoint localization and directionality craved by the imaging addicts. That is always an artifact of the recording process and possibly of the playback equipment, e.g., a very beamy speaker on axis or something similar.

We once heard Oscar Peterson make a comment to the effect that there may be a lot of controversy about the correct definition of the blues, but when you hear the real thing you know it. The same is true of imaging and soundstaging. Whenever, in our listening tests, we play an ungimmicked, simply miked recording through electronics and, especially, speakers that are reasonably free from time-dispersive anomalies, the spatial/directional effects we hear sound natural and unproblematic in terms of our live-concert experience and not at all like the aural fetishes of the cultists. (Even Bob Carver, who is not one of the latter but still in love with his Sonic Hologram after all these years, will admit in an unguarded moment that the darn

thing should be turned off and the music enjoyed straight when the program material and the stereo system are as we just described. Lifelike sound is very holographic.)

Double-blind listening tests.

As you must have noticed by now, our opinions on critical listening have been highly polarized by what we perceive as the excesses of the purely subjective reviewers; on the other hand, we still believe that the ear is the final arbiter of quality in audio equipment and are always eager to find ways to impose some sort of objective discipline on our listening tests. We have therefore purchased an **ABX Double Blind Comparator** from its designer, David L. Clark, and are planning to use it extensively in our future listening evaluations. The few specific test reports in this issue do not yet reflect this capability and methodology, but the ones in the next issue will; until now we have concentrated on studying the overall possibilities of ABX testing and sorting out our own thoughts on the subject. Let us just state at this point that Dave Clark happens to be one of the clearest thinkers among today's audio technologists and that the tweako press has most unjustly identified him (and by implication his ABX system) with the everything-sounds-the-same school of know-nothingism. We may not agree with all particulars of his controversial *Stereo Review* listening surveys, but we subscribe 100% to his basic tenet that anyone who claims to hear differences between two pieces of equipment should be able to prove to others that he really does. Who can argue with that?

As far as the actual ABX hardware is concerned, it merely does more neatly and effortlessly what can be done, and has been done, with tedious manual A/B switching and randomization by coin tossing. Every time the logic/display module of the ABX system is powered on for a listening session, a random series of sequentially numbered trials is established, in which X = A or X = B, and only the module knows which is which. The hand-held remote control unit used by the listener has buttons for A, B and X, as well as Up and Down buttons to go on to the next trial or switch back to a previous one. Thus the test is truly double blind, since neither the listener nor the test giver (if there is one) knows the identity of X. One can switch endlessly between identified A and identified B to learn the sonic signature of each, and then try X, switching back to A or B for verification and again to X, all without compromising the validity of the test. Once you hit the Answer button on the logic/display module, the test is over; all you can get is the identity of X in each numbered trial for scoring purposes.

We are completely satisfied that the headphone-type plugs and jacks as well as the relay contacts of the ABX system are transparent to the signal; they introduce no more loss or degradation, if any, than the plugs, jacks and signal switches of a state-of-the-art preamplifier. Those who try to shoot down ABX test results on that basis are doing so without ammunition. Any exceptions taken to such results would have to be founded on specific weaknesses of procedure in individual cases; there exist no general grounds on which ABX testing can be condemned, in our opinion. If you are only familiar with the golden-ear protests against the system but not with the system itself, here are some basic facts to keep in mind.

To begin with, any two audio components of the same general category (other than loudspeakers) will sound astonishingly similar if listened to at exactly the same volume level, matched within ±0.15 dB or better. We are not suggesting that they will sound indistinguishable from each other, but the similarity will in most cases be almost frightening to those who have never tried the experiment before. Casual A/B comparisons in an audio showroom or at home simply do not prepare you for this phenomenon, which in a formal ABX listening test at matched levels can result in stress due to prolonged concentration, even when differences are reliably detected in the end. Our belief is that maybe one audiophile out of ten is genuinely suited to be a panelist at an ABX session that will be written up, as the task requires more than just the desire to participate. For valid conclusions at the highest level of expectations, the requirements include an exceptionally keen ear, considerable previous training in listening for small differences, a long attention span, high resistance to stress caused by listening fatigue, and complete sincerity, which is especially important because it is often easier to start guessing wildly than to keep on concentrating and making considered choices.

Let us examine a hypothetical situation in which two components, A and B, have been compared through the ABX system by a panel of listeners and correctly identified only 50% of the time on an average, with no individual panelist doing much better or much worse than that. Since sheer guessing can be expected to yield the same percentage, a "no difference" result is declared, and various groups of cultists go into orbit. We would in such a case consider the following possibilities: (1) A and B are in fact sonically indistinguishable from each other; (2) A and B are actually distinguishable, but only by exceptional ears, of which there were none on the panel; (3) A and B are sufficiently similar to require a stereo system of exceptional resolution to be distinguishable, and the system used was inadequate; (4) the panelists were so poorly motivated and insincere that they proceeded to guess at random when sustained concentration became uncomfortable but did not tell anyone; and (5) someone was hogging the remote control unit or was officially assigned to be its sole operator, and the others got tired of asking him to switch this way and that way, finally just writing down their choices before they were quite ready. We find it quite depressing that those who claim to hear large differences in their conventional, unrigorous listening tests are always ready to denounce the ABX approach in toto before eliminating possibilities (2) through (5), which are very real and could be supportive of their arguments. Our own ABX experiences lead us to believe, however, that (1) is the case more often than not.

There is a lot more to be said on this subject and will be said in future issues. For the moment we just want to go on record as follows: Any self-styled expert who publicly

declares that A sounds unquestionably superior to B, and is then unable to distinguish A from B in an unhurried blind test at matched levels through his chosen reference system, is a despicable charlatan. If the shoe fits, wear it.

The digital revolution.

Before we summarize our stand on some of the currently available audio components in specific categories, it behooves us to make a few comments on today's pervasive digital technology, which was still in its infancy when **The Audio Critic** ceased to publish in 1981. In our last full-size issue, we printed a short filler item with the headline, "Help Stop the Digital Epidemic!" As successful propaganda, that must rank with the McGovern presidential campaign and the Edsel automobile promotion. We are now aware that our not altogether unjustifiable little tantrum (triggered by some god-awful early examples of the genre) was based on incomplete information. More than a few of our fellow journalists are still arrested at that level of perception, but we shall try here briefly to offer more up-to-date insights.

A fair assessment of the digital approach to sound reproduction must address three entirely separate issues. The first is the concept itself, which is beyond reproach. It used to be a truism that nothing in this world is black and white; everything is a different shade of gray. Well, in the world of digital data processing that is no longer the case. When you chop things into small enough pieces, all those subtleties can be characterized by 0's and 1's, either-or, black or white, nothing in between. All vagueness is gone and with it the possibility of various slippery inaccuracies generally referred to as distortion. Of course, the digital concept creates its own class of errors and consequent distortions, but these are not as formidable as the elusive gremlins of analog processing and can be reduced to insignificance with fairly straightforward techniques. Theoretically, digital is the way to go—neater, more foolproof, better.

The second issue is the adequacy of digital recording and playback standards, present and future. That chopping up of information into small pieces and the retrieval of the pieces must, of course, proceed according to fixed protocols, and these must be sophisticated enough to permit results that live up to the theory. The key specifications in such a standard have to do with digital word length (quantization) and sampling frequency (or Nyquist rate). At the time we expressed our doubts about the then young digital audio technology, the state of the art was a 16-bit linear PCM system with 50-kHz sampling. To our surprise, that has not changed to this very day. We keep reading and hearing about new systems using more bits and higher sampling frequencies, but we have yet to see and listen to one, even in early prototype form. The general consensus has been that pushing the limits of technology in this area may create more problems than benefits. The CD standard ended up specifying 16-bit encoding with 44.1-kHz sampling, and we now believe that this is an adequate standard per se, in the sense that it puts no inherent limitation on the audible results as long as the hardware implementation is highly refined. That was definitely not the case at first, and it took us a while to realize that the faults we kept complaining about were not intrinsic to the established parameters of the system. The DAT (digital audio tape) standard has evolved a little differently but will prove to be equally satisfactory unless the monumentally stupid copy-code chip is legislated into it. (A separate article on that subject is in the offing.)

Thus we come to the third and decisive issue, namely the hardware that implements the unexceptionable concept and the quite adequate standard. Ay, there's the rub. As in the initial phases of other major breakthroughs in audio (LP records, stereo, cassette recorders, etc.), the first-generation equipment left a great deal to be desired. The earliest Sony professional PCM recorders delivered to the studios had some unsolved problems that ended up in the sound of the highly promoted early CD releases; the D/A converters in the first-generation CD players were quite unsophisticated; a lot of refinements that should have been there from the start came quite late in the game. For that reason, a fair critique of the capabilities of digital audio would have to be in terms of the most recent CD's, produced by the technically most progressive element in the industry and played on the very latest CD players using 16-bit dual D/A converters with four-times oversampling digital filters, advanced error-correction circuitry, etc. There is no doubt in our mind that such 1987 digital sound represents the state of the art in home stereo reproduction. The complete freedom from all nonmusical noise, the virtually unlimited dynamic range, the unshakable pitch, the clearly defined bass are irrefutably convincing, and the highs have at last been tamed to our satisfaction. It matters little that the best commercially available stereo sound we have heard so far came from a few direct-to-disc analog recordings; that was the outcome of a selection process spanning several decades and based on thousands of LP samples, whereas our favorite CD's were picked out of a hundred or so over a couple of years. On the negative side, there is no CD so horrendous in sound that we cannot find a fairly recent analog LP that is even worse.

It should also be remembered when making these analog vs. digital comparisons that there remain a lot of analog stages in nearly every signal path we think of as digital. Ideally, the output of each microphone at the live source should go into an A/D converter, the signal kept in the form of 0's and 1's throughout the recording and playback process, then decoded through a D/A converter placed as far downstream in the circuit toward the loudspeaker input as possible. In typical current practice, the signal undergoes much more analog processing than that; for example, just about all mixing consoles are still analog, the new digital ones being very expensive and scarce. In CD players, too, the analog output stage is subject to all the miseries ever experienced with analog preamplifiers, such as degradation of the signal through inferior coupling capacitors, etc. The purely digital era is not here yet. Many recording engineers still have analog reflexes as a result, compensating in their microphone setup and digital masters for anticipated analog-type losses and masking—and getting nasty exaggerations

instead. It will take years before digital techniques become the cozy native idiom of all audio practitioners; until then all kinds of awkwardnesses can be expected, but the essential superiority of the new medium is no longer in doubt.

So much for generalities. When it comes to actual equipment recommendations and discommendations, we shall make no futile attempt to fill in a gap of more than six and a half years, during which we did relatively little comparative testing except to satisfy our own personal needs and those of a few friends. Now we are once again in the midst of ongoing equipment tests to provide material for full-length reviews, beginning in this issue but mainly in others to follow; the frustratingly sketchy and haphazard summaries below are presented for the purpose of further positioning our current viewpoint, and to serve as first aid in case of desperately urgent shopping.

Loudspeakers.

In comparison with highly developed components such as amplifiers, all loudspeakers are bad, but some are less bad than others. One major problem is that there is no agreed-on theoretical model for the perfect loudspeaker, equivalent to the straight-wire-with-gain ideal in amplifier design. Is the perfect loudspeaker a point source? A line source? A figure eight dipole? A collimated source, i.e., a plane wave from the start? A multiple point source that synthesizes a coherent plane wave—where? There are as many answers as there are speaker designers. If there is no clear definition of what is theoretically best, how can the existing solutions be good? It is indeed a puzzlement.

That is one reason why we have a great deal of respect for the **Quad ESL-63** electrostatic loudspeaker (suggested retail price $3600.00 the pair in the new, slightly sturdier version with the US suffix—you should have paid attention when it was $2450.00). The design makes a commitment, without any pussyfooting, to a very specific model—a dipole source with hemispherical radiation, creating a virtual point source about a foot behind the diaphragm—and then implements the concept to the limit. No other speaker we have ever tested has an output that so closely resembles the input in every way, over a relatively large solid angle. It is definitely the most accurate, most neutral speaker known to us, as long as it is not stressed beyond its disappointingly limited dynamic range, at which point all bets are off. As for bass, there is a broad bump centering on 60 Hz and no significant output below 40 Hz. A chamber music, jazz and solo vocalist speaker par excellence, it is most emphatically not for showing off your favorite Telarc blockbuster CD. There is no other electrostatic design, however, that we can wholeheartedly recommend, although we are quite familiar with most of the currently fashionable models.

In more or less conventional electrodynamic speakers with woofers, tweeters, etc., the weakness is usually in the crossover network and/or the tuning of the bass enclosure to the woofer. Sophisticated computer optimization can do wonders in these two areas; that is where the strength ought to be in a modern design, since nowhere else are good and bad solutions so similar in production cost. But no—most speaker designers just keep flying by the seat of their pants, as if the network analysis, filter synthesis and brute-force optimization programs were as recondite as Edward Witten's string theory. (See also the "disclosure" article on the now defunct Fourier loudspeakers in this issue.) What do we like in this category? The **B&W Matrix 801 Series 2** looks like a very intelligent design to us (at $4500.00 the pair it had better be), with full evidence of solid computer work behind it; furthermore it sounded excellent when we auditioned it, although in all honesty we are much more familiar with the older, plain-vanilla 801 and 802. We are less sure about the new darling of the ultrahigh-end crowd, the giant **Duntech Sovereign 2001** from Australia ($15,000.00 the pair); we have heard it sounding both good and bad in various places on various occasions, but we shall give it the benefit of the doubt until we can check it out more closely, especially the crossover network. It is certainly not a negligible item. At the other end of the scale, among tiny boxes, the **Celestion SL600** ($1797.00 the pair) has been the prestige model for years. We have measured it and listened to it; other than the very fine tweeter, there is nothing remarkable about it. No bass, so-so midrange, roller-coaster impedance curve—if it sold for $475, people would say it sounds nice and clean, and that would be the end of it. A much better value per dollar, albeit for a totally different buyer, is the **Spectrum 108A** ($249.00 the pair). Cosmetically appalling but quite musical and balanced in sound, it even produces a decent amount of bass for a really small box, and our laboratory tests revealed nothing shameful (nor anything amazing). A smart bargain-basement product with a touch of audiophile appeal. A more high-tech small speaker that we respect is the **Spica TC-50** ($450.00 the pair); computer-aided design makes its response very accurate and the sound beautifully uncolored, but it is still essentially a small-signal system with very limited bass.

Our pet peeve as we look at the electrodynamic scene is the entire line of **Polk SDA Series** speaker systems (from $799.90 to 2990.00 the pair). Stereo Dimensional Array (SDA) is Polk's name for what is nothing more than a naive and inferior version of Bob Carver's old invention, Sonic Holography, already referred to above. Signal processing of this sort should always be used selectively (if at all), with caution and good taste; Carver's active circuitry and controls make that possible, but Polk's implementation of the concept is passive within the speaker systems and is not intended to be turned off, ever. The permanently built-in holographic processing, whether or not appropriate to the program material, makes the speakers sound "different" and helps to cover up their intrinsic mediocrity of performance. We do not expect the large-circulation hi-fi magazines to point this out, since Polk is probably their heaviest buyer of full-color advertising pages, but we are offended by the carnival-toned ballyhoo and hoopla in all the ads, making outrageous claims of utter originality for Polk's copycat technology and featuring Matthew Polk as a grotesque wax-museum figure of a "genius" in white laboratory coat. The

fact that this kind of lowbrow marketing works, as it obviously does, is a sad commentary on the audio marketplace.

We must not forget the relatively new category of full-range (or almost full-range) ribbon loudspeakers. These are especially intriguing because they combine the virtues of the force-over-area principle used in electrostatic designs with the ruggedness and large-signal capability of the better electrodynamic systems. The new **Apogee Diva** ($7000.00 the pair) is claimed by its makers to "redefine the state of the art" in full-range ribbon technology; we have not tested it but have heard it demonstrated under supposedly excellent conditions and are only mildly impressed. Apogee ribbon systems (there are now five of them) can sound extremely transparent and uncolored or quite disappointing, depending on the room and the ancillary electronics; Krell amplifiers are generally recommended because of their ability to drive very low impedances. We tend to suspect unsolved design problems when a very high-tech audio component produces inconsistent results, but we should not jump to conclusions before some thoroughgoing laboratory tests. The **Carver** ribbon speaker system ($1576.00 the pair), modestly named The Amazing Loudspeaker, has suffered from inept demonstrations at trade shows and in dealers' showrooms; it also needs to be broken in, alas, to lower the fundamental resonant frequencies of the ribbon and the bass drivers. In the right hands, the speaker is capable of outstanding results that belie its price; we have done some preliminary testing on it, and a full-length review is coming in the next issue.

Power amplifiers.

There is enough material on power amplifier design elsewhere in this issue to make general philosophical observations unnecessary here. We are restricting ourselves, therefore, to a few comments on specific makes and models not reviewed in full.

Although we always suspect any ultrahigh-end audio product of being opportunistically priced, the **Krell** line of pure-class-A stereo and mono power amps ($2550.00 to $16,000.00 per two channels) can at least offer a plausible defense against that charge: the uncompromising and unarguably costly design of the Krell power supplies. These have sufficient current capability to permit the rated power output to double whenever the load impedance is halved, all the way down to 1 ohm, and to maintain stable operation even into 0.1 ohm. Is that really necessary? According to a recent paper by the redoubtable Matti Otala it is, and who are we to contradict him? Nor can we contradict designer Dan D'Agostino when he opts for straightforward circuitry, minimal feedback, discrete solid-state devices and various little touches of the latest available technology. With that approach, what could be bad? Even on the basis of our somewhat limited laboratory and listening experience with Krell amplifiers, we are not afraid to endorse them as long as price is not a consideration.

Utrahigh-priced vacuum-tube power amps are another matter altogether. We have serious reservations about either the performance or the practicality, or both, of all models known to us. Proceed at your own risk.

Getting back to the real world where satisfaction is at least vaguely related to the price paid, we can recommend the **Adcom GFA-555** ($699.95) as an outstanding buy. Our measurements as well as our listening tests qualify it to be considered competitive against other 200/200-watt stereo power amplifiers at far higher prices. The next significant step up in the same power class would be the **Aragon 4004** ($1495.00), a very nicely built unit we have auditioned but not yet measured; our initial impressions are excellent, and a full-length review is forthcoming. We also have a good feeling about the **Tandberg** line of no-feedback power amps ($1095.00 to 3595.00), after looking, listening and considering their design philosophy. Complete laboratory tests are in the planning stage.

Preamplifiers and control units.

It is becoming quite clear that the program sources with a long future are the ones that have a line-level output and need no preamplification: CD players, cassette decks, Hi-Fi VCR's, DAT decks and, of course, tuners. As the phono arts approach their *Götterdämmerung*, there are even super cartridges that deliver a line-level signal (see the Win FET-10 below). Even the best phono preamps today are like elder statesmen, highly respected but not included in long-term plans. Most serious audiophiles either have a preamplifier/control unit they are satisfied with or are ready for their last one. We have done very little investigation in this area during the past few years; some of the equipment we still enjoy using is no longer on the market. Here are a few stray thoughts on the subject:

To route and control the various program sources in a phonoless system, of which there are more and more, the entirely passive (i.e., unamplified) **Mod Squad Line Drive** ($400.00) seems to be made to order. In a pinch, you could even plug a self-powered outboard phono stage into it; a very good and inexpensive one, for moving-magnet pickups only, is the **Phœnix P-100-MM** ($149.95). If you still want a high-endish phono-and-everything unit with sophisticated MC and MM facilities at a not quite insane price, we can recommend the bottom-of-the-line (some bottom!) **Krell PAM-5** ($1550.00), which we have tested on our lab bench and in our listening setup. The RIAA equalization error is merely small instead of nonexistent; the high-level stage and controls may be a tiny smidgen short of straight-wire-like transparency; but the overall performance is superb. For a lark, try to find a used but not abused sample of the late Stew Hegeman's 1959 (or was it 1960?) vacuum-tube kit preamp, the **Citation I** , and have somebody who knows what he is doing restore it to perfect operating condition. It is not difficult, and you will be amazed by the sound. (See also the full-length review of the Audio Research SP11 preamplifier in this issue.)

Turntables and tonearms.

We are still using the Win Laboratories SDC-10 turntable with SDA-10 tonearm we designated as our "Reference

A" before we stopped publishing in 1981. We never felt a need to upgrade, although a later version of the turntable with a more sophisticated drive system is available in very limited quantities under the name of **Win Research SEC-10** ($4000.00). The SDA-10 arm is now history; the ingenious Win pantograph tonearm seen in prototype form at some trade shows in past years may eventually replace it.

Some audiophiles are undoubtedly looking for the last turntable and arm they will buy (as in the case of phono preamplifiers above); we are in no position to be dogmatic in our recommendations to them, but we can make a few modest ones. General rule: belt drive works very well in both high-end and moderately priced turntables; direct drive is suspect at low and medium prices but can be great at the highest levels of refinement in high-priced turntables. Also, stay away from turntables that do not have a suspension, no matter what the technical rationales are and regardless of price. (No dogma, just common sense.) Lastly, be wary of unipivot tonearms; other things being equal, four-point gimbals suspension is greatly preferable because it does not permit rotation around the longitudinal axis of the arm.

Those who hesitate to make a major investment in the waning phono medium but still insist on a certain measure of quality should consider the **Harman Kardon T65C** ($575.00). The arm may not be quite as good as the turntable, but the system as a whole is surprisingly close to many high-end products in performance. The current, fully updated version of our old whipping boy, the **Linn-Sondek LP12** ($945.00 without arm) is a very fine turntable, much as we hate to admit it. Not quite as completely debugged is the **SOTA Series III** line ($975.00 to 1995.00); even so, these turntables have many outstanding design features, not the least of which is vacuum clamping of the record in the higher-priced models—yes, it makes a difference. On one of our slumming expeditions we auditioned the massive **Basis "Debut"** turntable ($5000.00) with the **Air Tangent** straight-line tracking tonearm ($2850.00) mounted on it. Next to something like the $17,900 Goldmund Reference, this is still proletarian equipment; we refuse to call it overkill without a complete laboratory test, especially since the arm strikes us as having possibly solved some major problems in SLT and air bearing design. (Yeah, the sound was good.) Other, more mainstream tonearms that impress us favorably are the **SME Series V** ($2025.00) and, considering price, most of the **Micro Seiki** line ($195.00 to 1200.00).

Phono cartridges.

Sao Zaw Win, where were you when we needed you? The most sophisticated of phono technologists, after a decade and a half of piddling around with super products that were barely available, "soon" available, almost unavailable, limited production, just discontinued, etc., seems to have finally gotten his act together—now that the phono arts are about to go bye-bye. His revolutionary (the word is appropriate for once) field-effect transducer, the **Win FET-10** ($1850.00, complete with electronics) promises to be a real-world production item with real-world distribution, at least as it looks to us from here. We have seen it and even heard it briefly, so we can vouch for its actual existence and its ability to produce beautiful sounds. A full-length review is scheduled for the next issue. This is not a cartridge that drives a FET at the input of a preamplifier circuit; the FET *is* the cartridge, or rather the transducer element within the cartridge. The gate of the FET is physically separated from the semiconductor substrate and is attached to the stylus cantilever. The consequences of this entirely new design principle are far-reaching and nearly all favorable; the review will go into full details, but just for openers—no preamp is needed. Unless our tests reveal something unforeseen, we may very well have found our last phono cartridge. It should be added that, regardless of the transducer principle used, Sao Win has always been at the leading edge of stylus technology. In the FET-10, he goes a step beyond his (and everyone else's) most advanced previous geometry with the longest line-contact footprint ever produced, but without the bottoming and misalignment perils of the Van den Hul and similar designs.

It so happens that our reference MC cartridge of the past few years has also been a Win product, the now discontinued **Win Jewell** (sic). Its last officially listed price was $475.00, just in case you try to locate one (lots of luck); we found it to be distinctly superior to some of the priciest Koetsus and other high-end MC's. The only exception to that may be the **Highphonic MC-D15** ($1500.00), which we never had a chance to compare with the Win in the same system but found well-nigh flawless in an extended listening test. In moving-magnet and moving-iron cartridges, we have a certain respect for the top-of-the-line **Shure** and top-of-the-line **Grado** (also Joseph Grado Signature) products, and that just about does it.

CD players.

We are planning a lot of coverage in this category for coming issues, starting with the next one; here we merely want to go on record in favor of the latest Philips system—16-bit dual D/A converters, digital filters, 176.4-kHz oversampling, unique error-correction IC's, other goodies—in its various European, Asian and stateside-modified incarnations. Which of these will end up as our top choice remains to be seen. Early versions had a least-significant-bit error in the converter; we have no idea whether or not this almost surely inaudible little bug has been removed, but the overall system is still the most sophisticated around.

Whatever you do, stay away from CD players priced over $2000; the technology has not yet reached a plateau, things are changing, and this year's high-end cult favorite may turn out to be next year's electronic paperweight.

Other program sources.

We have no urgent opinions to communicate on the subject of tuners, open-reel tape decks, cassette decks or even DAT decks, although we are desperately rooting for a quick and rational resolution of the insane political imbro-

(continued on page 22)

Landmarks in Power Amplifier and Preamp Design: Tubes vs. Transistors vs. Both

We take a revisionist (or is it just sober?) look at Audio Research's hybrid flagships and then find greater comfort in unmixed circuitry.

It is our pigheaded conviction that a high-fidelity amplifier's output should strongly resemble its input. Let us be more specific. A power amplifier's output should be an exact replica of its input, at an amplitude determined by its gain, into any resistive or reactive load down to a certain minimum impedance, over a certain dynamic range determined by its power rating. A preamplifier's output should similarly replicate its input at a higher amplitude, but modified by whatever intended equalization, filtering and/or other response-shaping characteristics are incorporated in the circuit. All that may amount to no more than coming out in favor of motherhood, the flag and apple pie, but it is surprising how often designers and reviewers ignore, or weasel out of, such truisms. There are even those who believe that totally accurate amplification does not sound good. The fact is that totally accurate amplification reveals the *input* that does not sound good.

A thoroughly knowledgeable designer is able to make the output bear a high degree of resemblance to the input by means of either vacuum tubes or solid-state devices. Tube sound vs. transistor sound may be a legitimate issue where routine (or shall we call it classic?) circuitry is used, but any previously quantified transfer function can be predictably duplicated either way, as we point out at some length in another article, and thus the same sound achieved. The only exceptions to that generalization we can think of are due to tube aging, which can modify the transfer function, and to output transformers, which impose certain limitations at the lowest and highest frequencies. (Output-transformerless vacuum-tube power amplifiers, on the other hand, cannot drive very low-impedance loads, e.g., New York Audio Laboratories' otherwise remarkable Futterman OTL amplifiers.) Since all of the drawbacks, minor as they may be, are on the tube side in a rational comparison, we would always opt for the unlimited flexibility of solid-state circuitry when planning a new design from scratch. That does not mean that a designer who is more comfortable with tubes cannot come up with a superior amplifier.

The widely divergent designs reviewed below represent some of today's strongest statements, credible or not, on how to deal with the above considerations.

Audio Research M300

Audio Research Corporation, 6801 Shingle Creek Parkway, Minneapolis, MN 55430. Model M300 Hybrid Monaural Power Amplifier, $4900.00 ($9800.00 the pair). Tested samples on loan from owner.

A pair of these not particularly handsome invitations to hernia, weighing 110 pounds each, will set you back about the same amount as a 1988 Honda Accord LX sedan. So, when we first set eyes on them, we assumed we would find extraordinary parts under the cover, worthy of a piece of NASA gear. Not so. Everything inside is of commonly good quality; the transformers are huge, of course, as the rated power is 300 watts into 8 ohms, and there is a number of audiophile-brand film capacitors on the board, but we could see nothing in the way of hardware or workmanship that would account for more than half the price of the M300, including all markups. The other half you pay for Bill Johnson's high opinion of his amplifier.

The circuit is called hybrid because it uses FET's only up to the output stage, where eight beam-power tubes (6550's) and an output transformer take over. "Most hybrid power amplifier designs use small signal-input vacuum tubes, then rely on FET's for the output stage," explains Audio Research's blurb on the M300. "Audio Research has chosen instead to eliminate these low-level input tubes—tubes which can be prone to problems with hum, noise, microphonics, drift and, of course, require periodic replacement. The new FET 'front end' is combined with Audio Research's long-famous, patented cross-coupled circuit... [and] with yet another Audio Research patent: an output stage utilizing vacuum tubes and partially cathode-coupled ...but with the screen (or accelerating) grids operating with a signal voltage precisely in phase with the cathode voltage," etc. We buy the criticism of front-end tubes but fail to see, despite further rationales offered by Audio Research, why a much simpler transformerless output stage, using power MOS FET's or other solid-state devices, could not have been designed to achieve the same performance goals.

We suspect that the reason for the use of tubes in the M300 is political; Audio Research decided that the image of their flagship power amplifier must somehow be associated with tubes, and never mind the FET's, because the company's prestige is built on a tradition vacuum-tube components.

Our measurements resulted in a mixed bag of goodies and not-so-goodies. The claimed power output of 300 watts mimimum CW at 8 ohms from 16 Hz to 25 kHz with less than 0.5% THD was confirmed only up to 12 kHz; further up, 15 kHz clipping was observed at 288 watts with 0.68% THD and 20 kHz clipping at 264 watts with 1.2% THD. It is an outside possibility that our line voltage was a little lower than the specified 120 volts, although in the region of 100 Hz to 500 Hz the clipping point was barely below 350 watts. More disturbing than that small discrepancy was the bizarre way the amplifier went into clipping at the higher frequencies, starting at approximately 4 kHz. Instead of symmetrically flattening the sinusoidal waveform, clipping superimposed a large sawtooth pattern on it just before (but not after) each zero crossing. This may be a feedback-related anomaly; we have no way of determining its effect on the sound we heard.

Another cause of raised eyebrows was the frequency-response peak of 1.1 dB at 96 kHz. Undoubtedly due to an output-transformer resonance, it was sufficiently low in Q to spill down into the topmost octave of the audio range, effecting a minuscule treble boost, of the order of 0.2 dB at 20 kHz, equivalent to a tiny RIAA equalization error in a preamplifier. Audible? If so in a preamp, then so in a power amp—right? Output impedance at the 8-ohm tap was measured to be 0.281 ohm, yielding a damping factor of just over 28 and confirming the specification of approximately 30; the amplifier acts as a current source to an ever so slight degree. Hum and noise were negligible.

After a good many hours of warm-up, we did some serious listening. We cannot say we were disappointed, as our expectations were somewhat short of sky-high by then. Yes, the M300 sounded "good" in a very general sense; it is, after all, a reasonably clean and very powerful amplifier. To the critical ear, however, the sound was definitely on the rough and sibilant side, slightly spitty one might even say, and not really pleasant overall. Was it a case of a less than perfect input accurately reproduced? If so, why did the all-tube MESA/Baron M180, reviewed below, sound so natural and so *right* in the same system? Or maybe the M300 needs a five-day warm-up—the kind of tweako ritual that should not be necessary with a good design. That, dear readers, we shall never know. Our listening tests ended much sooner and with considerable finality.

What happened was that, without any provocation, one of the pair of M300's suddenly quit on us. A short from control grid to screen grid in one of the 6550's created some kind of avalanche effect that traveled upstream and took out all the FET's—a catastrophic failure mode apparently endemic to this model. A well-known Audio Research dealer, who must of necessity remain nameless, confessed that all of his M300 customers, without exception, had run into this and similar problems, requiring massive warranty repairs.

The moral? There is no amount of unhappiness in this materialistic world that $9800.00 cannot buy.

Audio Research SP11

Audio Research Corporation, 6801 Shingle Creek Parkway, Minneapolis, MN 55430. Model SP11 Hybrid Stereo Preamplifier, $4900.00. Tested sample on loan from owner.

This is Audio Research's all-time top-of-the-line preamplifier, already canonized by the high-end pontiffs and, one can assume, the input of preference into a pair of M300's. The price is the same as that of a single M300, and again we must point out that we found nothing inside the two chassis (the power supply is housed separately) so obviously costly or exquisitely wrought as to justify more than half that amount, if that much, typical markups included. Bill Johnson certainly knows how to charge; the Light Brigade could have taken lessons from him.

The hybrid circuitry is even harder to rationalize than in the case of the M300; the vacuum tubes are embedded between the FET's within the same gain stages of the SP11, and in such a redundant way that one could bypass the tubes and still have a working circuit. Audio Research seems to have some sort of cookbook philosophy to the effect that tubes in a preamp give you a musical and natural flavor, whereas solid-state devices are for quickness and dynamics; put the two together and *voilà*—the sauce is *magnifique!* Here again, our best guess is that Audio Research's flagship preamplifier simply had to have some tubes in it, regardless of function, for purely political reasons. (We are reminded of a story from the late 1960's about the tyrannical Avery Fisher, who objected to a blank space on the escutcheon plate of a prototype FM tuner and told the engineers to put a button there in the final version. When it was tactfully explained to him that there would be no function for such a button, he snapped, "Find a function!" and stormed out of the lab. They found one.)

The SP11 has a plethora of controls, including a few slightly idiosyncratic ones; their operation has been amply covered in other reviews and need not concern us here. The same goes for all the inputs and outputs. On the laboratory bench the SP11 acquitted itself with distinction in nearly all respects. The phono stage has 46 dB of gain, which is a little scant for very low-output moving-coil carridges, but with the line-stage gain of 26 dB, resulting in 72 dB (i.e., 4000 times) total available amplification, there will be relatively few phono sources that cannot be accommodated. We were impressed by the almost unmeasurable THD of the phono stage, as well as the excellent overload characteristics of both stages. Signal-to-noise measurements were also entirely satisfactory, and for once the RIAA equalization is dead accurate, as close to the standard as we have ever seen. Interestingly, the high-frequency response of the line stage

rolls off to -0.2 dB at 20 kHz and -2.0 dB at 100 kHz, thus compensating fairly exactly for the minutely rising response of the M300. We refuse to speculate whether or not this is deliberate or even marginally significant. Of greater concern is the fact that the input impedance of the phono stage cannot be modeled simply by a resistor in parallel with a capacitor; the complexities of the phono circuit create an impedance requiring a much more elaborate model, and that is not good design practice to the best of our knowledge. (This has nothing to do, by the way, with the switchable resistor values for cartridge loading at the phono input of the SP11.)

Of course, the proof of the preamp is in the listening, and the SP11 sounds very good indeed. After warming up the unit for several hours, our initial listening reaction was much, much more favorable than in the case of the M300, although we cannot say we were transported to a realm of unearthly delights like certain reviewers. We merely found the sound to be open, clean, focused, highly defined, well controlled and quite neutral. Something we could live with. The mystical masochists of the high end, to whom Audio Research has often meant the promise of redemption through suffering, are unlikely to get their five grand's worth of delicious misery out of the SP11, as it seems to be a square-shooting, not particularly temperamental piece of equipment with excellent mainstream performance. Its special piece of bad luck in the course of our listening tests was that, through sheer coincidence, we happened to have temporarily available for side-by-side comparison a reconditioned Citation I, the late Stew Hegeman's more than a quarter-century old all-tube kit preamp.

The SP11, so nice by itself, somehow began to sound a little nasal, rough and strained next to the utterly smooth, unflappable, musically uncontradictable Citation I. The latter is one of the very few designs known to us that does not take the RIAA playback equalization standard at face value but takes cognizance of the fact that, in the record cutting process, the preemphasis characteristic cannot logically rise at the rate of 6 dB per octave to infinity, as the playback standard seems to imply. It has to flatten out at some point, and the ideal playback curve would mirror that flattening out. Although there are as many ways to trim the top end of the preemphasis curve as there are cutter heads and mastering engineers, Stew Hegeman had a very good gut feeling for the typical deviation and adjusted his design accordingly. Is that what accounts for the difference in sound? Possibly, but we also suspect that the elegant all-tube circuit of the Citation I may in some very basic way be superior to the hybrid complexities of the SP11. We are not going to spend sleepless nights trying to resolve the matter because (a) the Audio Research SP11 is not a good buy for the money and (b) the Citation I is extinct except for a few second-hand specimens still floating around.

In all fairness, we should point out to new readers that **The Audio Critic** has never found an Audio Research component to be the absolute best of its kind, not even once. Sorry about that; we just call them as we see them.

Boulder 500

Boulder Amplifiers, a division of Silver Lake Research, 4850 Sterling Drive, Boulder, CO 80301. Boulder 500 Power Amplifier, $2875.00. Tested sample owned by The Audio Critic.

This unique power amplifier has been around for about two years, but not many audiophiles and even fewer reviewers have had much experience with it. It is quite a bit better known in the professional field. We have been using it as one of our reference amplifiers since shortly after its debut, so we are obviously in favor of it and would like to call the attention of our readers to the Boulder story.

Jeff Nelson and Randy Gill, the two refreshingly unpretentious but extremely competent engineers behind the Boulder line of audio components, come from the world of professional studio electronics and are totally devoid of the usual hi-fi phoney-baloney. Their amplifier technology is based on the work of Deane Jensen, formidable author of some of the most powerful computer programs for electronic design and developer of the JE-990 discrete operational amplifier, the circuit concept at the heart of each Boulder product. The JE-990 op amp is not an integrated circuit but an amplifier module made up of discrete transistors, diodes and other components. It has been in the public domain for seven or eight years and has an almost legendary reputation among professionals, but to our knowledge only Boulder has used it in consumer audio equipment.

The 990 circuit enables the amplifier designer to eat his cake and have it, too. He can eat up harmonic distortion until it is reduced to near-zero levels. That, as we all know, requires large amounts of negative feedback, which in turn will create transient instability, right? Well, with the 990 he can have it, too—*mucho* negative feedback, that is—because the open-loop compensation is so sophisticated that there is sufficient phase margin to prevent all overshoot and ringing. The Boulder 500 stereo amplifier circuit uses two sequential 990 op amps in each of its channels, the first for most of the voltage gain and a second, highly beefed-up one for the power stage. That may sound simple, but the innards of the amplifier look immensely complicated, not only because of the inherent complexity of the 990's but also on account of a whole arsenal of high-tech goodies that would take several pages to do justice to. Balanced and unbalanced inputs, mono bridging, protection circuits without audio intrusion, visual indicators for everything, high-quality input level controls—and the list has hardly begun. With all that stuff in there, we cannot even get too upset about the price; we wish they could have done it for less, say $1995, but the difference is not enough to raise the suspicion of an early retirement fund for Jeff and Randy.

As far as measurements are concerned, the Boulder 500 is very close to a distortionless voltage source. The power supply is not quite the Krell-like beast capable of pumping increasing current into decreasing impedances down to a virtual short circuit, but it is still awfully good; the "500" designation is earned with 250 watts per channel

of totally clean, continuous power into 4 ohms across the entire audio band, 20 Hz to 20 kHz. When we say totally clean, we mean that the THD is difficult to measure with a Sound Technology 1701A distortion meter at that power between those frequencies, the residual distortion of the instrument being 0.0009 % at 1 kHz and a little higher at the frequency extremes. Transient waveforms are also improbably clean; bass response goes below the range of our signal generators because of DC coupling (but there is a very good servo to prevent DC at the output); the output impedance is also hard to measure because it is so close to zero, resulting in an almost perfect voltage source. In effect, over a bandwidth considerably wider than the audio range and within the current capabilities of the power supply, the transfer function of the Boulder 500 approximates very closely that of a straight wire with gain. The question is—how does that kind of transfer function sound?

Well, it sounds undeniably different. Those who are used to the warmth and lushness obtainable with a *soupçon* of second and third harmonic distortion will call the Boulder sound a little dry, or perhaps on the cold side, or even a bit hard or bright. We call it accurate. With the right program material and speakers designed to be driven from a voltage source, the sound is a new experience in transparency and detail, beautifully balanced and controlled from bottom to top, and smooth as silk. If the recording engineers were pushing to punch through anticipated veiling, or if the speaker designers were precompensating for the possibility of slightly current-sourcey amplifiers, the Boulder 500 unforgivingly calls the listener's attention to those practices. The basic statement it makes is, "If you don't like my output, you don't like my input." That is why we like it as a reference. As a bland mediator of varying degrees of audio quality in a record collection it does not quite make it.

You may want to read Jeff Nelson's brief monograph, "Too Many Notes: Harmonic Distortion Analyzed," which is generally included with the Boulder literature. It explains that "an amplifier's harmonic distortion... can easily mislead those with even the best of ears into thinking that they are hearing something closer to the original when, in fact, they are not. The original recording is actually clearer and more distinct than that which a high-THD amplifier is capable of reproducing." We basically agree, but you have got to understand that to Jeff 0.02% THD is high.

MESA/Baron M180 (modified)

MESA Engineering, Inc., MESA/Boogie, Ltd., 1317 Ross Street, Petaluma, CA 94952. Baron M180 Differential Feedback Amplifier (mono), $650.00 without mod (1300.00 the pair). Tested samples on loan from owner.

Ordinarily, we would probably have decided against publishing a full-length review on a discontinued amplifier, especially with a modification that was made only to a few pieces. This is no ordinary case, however; there is a genuine hope of some eventual benefit to our readers and perhaps other audiophiles, so we want to explain the situation as clearly as possible.

MESA/Boogie is a well-established, medium-sized manufacturing company in the highly specialized field of vacuum-tube amplifiers for electric guitars and basses. They have about 60 employees on the payroll, and their annual volume is in the neighborhood of $6 million, including sales in a large number of foreign countries. Thus, even though you may not have heard of them, this is not a case of tweaky amplifiers built by some tube freak in his basement. Randall Smith, the owner, is a musician by training and a tube circuit designer by sheer necessity, he claims, as there are no other designs out there that he finds musically satisfying. When asked why he designs only vacuum-tube amplifiers, he replies that he does what he knows best and what his musician customers like best. No harangues on the overwhelming superiority of tubes over transistors. Equally refreshing is his assertion that no musician in his right mind would be willing to pay much more than $650 per channel for a guitar or bass amplifier; that represents the high end of the market. MESA/Boogie sells directly to the end user at list price, as well as to musical instrument stores at trade discounts that are much smaller than in the audio retail business. So much for background.

The M180 was designed as a monophonic, single-chassis power amplifier for guitar or bass, but suitable also for general hi-fi applications. MESA/Boogie saw in it a possible *entrée* into the quality home-audio market and renamed it MESA/Baron to take away the jive flavor. Not many were sold and it was discontinued some time ago, but not before an audiophile-oriented circuit modification was made on just a few samples. It was a pair of these that we stumbled into by the sheerest coincidence and tested upon the insistence of the owner, before even finding out about MESA/Boogie and Randall Smith. Currently, and somewhat confusingly, the company is marketing with greater success a stereo power amplifier called **MESA Strategy 400** ($1250.00), which is identical to a pair of *unmodified* M180's on a single chassis sharing a common power transformer. More about that below.

The modified M180 we tested looked like a solidly made piece of professional equipment with parts of good quality (Randall Smith goes to great lengths to find the right vendors), giving a totally different impression from domestic-type audio components in the same price range. The circuit uses a differential amplifier as the input stage, feeding a cascode driver stage (which is the mod, not used in the stock version), followed by an output stage of six beam-power tubes (6L6's) in push-pull, going into a very unusual output transformer, plain-looking but amazingly efficacious and clearly the result of prolonged R and D.

If tested as a "black box," without any knowledge of its innards, the amplifier could almost be mistaken for a solid-state design on the basis of some of its measurements. Small-signal frequency response is ruler flat from 10 Hz to 100 kHz, without even a hint of an output transformer.

Clipping, abrupt but very clean in the solid-state manner, occurs under most load conditions in the neighborhood of 220 watts at any audible frequency from 30 Hz up; power bandwidth referred to 220 watts is 20 Hz to 24 kHz. Thus the M180 (viz. 180-watt) designation is quite conservative. At 1 watt into 8 ohms, THD is between 0.02% and 0.06% throughout most of the audio range, rising only at the frequency extremes: 0.2% at 20 Hz, 0.11% at 16 kHz, 0.42% at 20 kHz, all of it strictly second harmonic. At 180 watts into 8 ohms, distortion becomes a mixture of second and third harmonic, typically under 0.15%, but kicking up to 0.46% at 30 Hz and 0.85% at 15 kHz. Square waves look very good, even at 20 kHz. Input impedance is 470K, dropping to 100K at 20 kHz. Output impedance is far from zero; we measured 0.873 ohm at the 8-ohm tap, yielding a damping factor of only 9 (i.e., not a perfect voltage source).

These test results, highly respectable as they are, did not prepare us for the sound of the modified M180. It is simply the best-sounding vacuum-tube power amplifier in our experience, with the possible exception of the utterly impractical NYAL Futterman OTL-1 at close to ten times the price. We had only a few other power amps available for comparison at the same time (see the Audio Research M300 review above), and only a limited number of speakers for testing the audible consequences of the slightly current-sourcey interface, but the results were consistent; the M180 came out on top in every respect, even to our solid-state-conditioned ears. Extremely transparent, totally neutral, beautifully smooth yet sharply defined, never on the verge of coarseness under stress, not really "tubey," either—the sound simply raised no problems and gave eminent satisfaction. We wish we had been able to compare the almost straight-wire-like Boulder 500 or one of the unshakable Krells with the M180; the contrast might have helped to bring out the all-tube *Gestalt* more clearly. The high output impedance remains puzzling; could *that* be what we really liked? Regardless of anything else, the quality-to-price ratio of the amplifier is truly astonishing and an embarrassment to the high-end tube scene in the audiophile market.

There remains the $64 question (or perhaps the $650 question) of whether or not the matter is academic, since the modified MESA/Baron M180 is not in production. Well, we bring you glad tidings. Randall Smith has assured us that he is willing to resurrect the design, even repackage it in any form that audiophiles might prefer, if he perceives some kind of demand for the product out there. He has the parts, the tooling and the production facilities; it would take him only a month or two, he claims. Our recommendation is that you write to him at the above address if you are seriously interested. As we said, MESA/Boogie is a real, grown-up company with worldwide distribution, so you will not be merely fueling the fantasies of some amateur genius looking for tweaky custom business. You could also look into the alternative of the MESA Strategy 400, which is immediately available, but without that far from trivial cascode modification we cannot see how it could possibly sound identical to the pair of amplifiers we tested. ◊

Where We Stand

(continued from page 17)

glio that has been stifling the DAT medium. A ray of sunshine through that cloud is vaguely discernible now that the decision regarding the audibility of the copy-code chip rests in the hands of the National Bureau of Standards.

Speaker wires and audio cables.

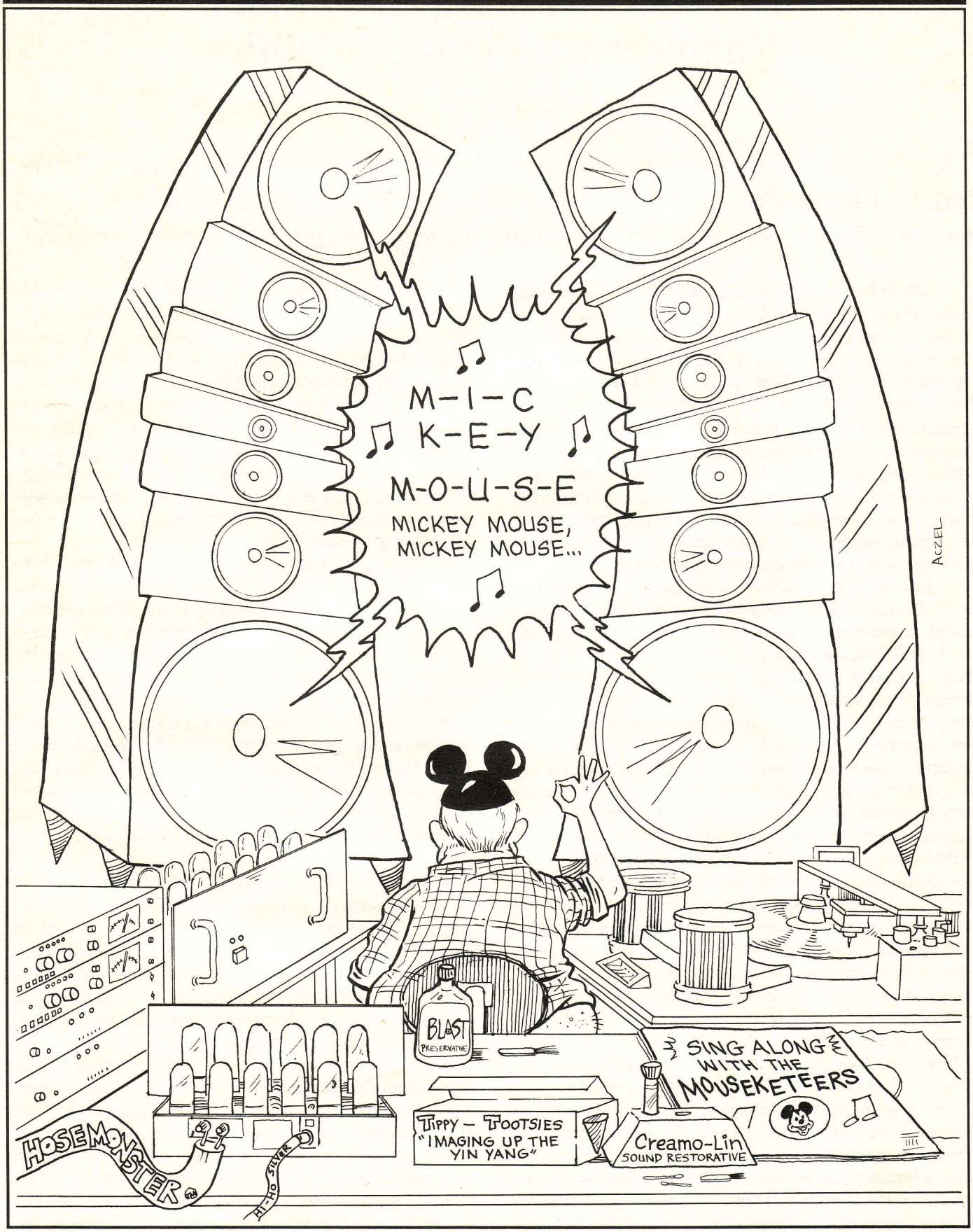
We have not changed our mind on this subject since our 1979 article. Audible differences between various types and brands do exist, but in every case they are explicable in terms of resistance, capacitance, inductance, dielectric, shielding, RFI, diode effects (i.e. rectification) and other known electrical phenomena. Any connection between two pieces of audio equipment can be analyzed as a network and is subject to all the laws of network theory. Furthermore, the output and input impedances interfacing through the connection are every bit as important to such an analysis as the network characteristics of the connection itself. Without specifying a signal source, a signal and a termination, a connection cannot by itself be described as good or bad. Most wire and cable advertising is therefore superficial hype if not outright nonsense. Some advertisers seem to think they are addressing the microwave business, not audio.

In nearly all cases, a direct connection between two audio components, with little or no wiring, can be assumed to represent the theoretical ideal. For example, a mono amplifier can be lined up behind a speaker in such a way that the amplifier output and speaker input terminals almost touch. You can then make a connection with an inch or two of bus bar or braid. If your favorite loudspeaker cable sounds better than that, you are in deep trouble, amigo. The same goes for plugging, let us say, a CD player into the high-level input of a preamp by means of a pair of a male-to-male phono connectors without cable. Do the makers of zillion-dollar silver cable believe they can improve on that sound? The only high-end wire and cable company known to us that openly admits these realities and accepts a direct connection as the ultimate sonic standard is **Straight Wire**; how well their products maintain that credibility in actual performance comparisons with competitive brands will be reported in a forthcoming review. Here we shall restrict ourselves to the confession that we are currently using the somewhat plebeian **Mogami Neglex 2477** low-inductance cable between our power amplifier and speakers—and like it. The high-end police will be knocking on our door any night now.

One more thing...

We trust our former readers remember and our new readers will realize that the quickie equipment survey above is not our reviewing style. At the risk of being repetitious, we want to emphasize again that these capsule observations are offered *faute de mieux* as a necessary stopgap. Check out the few full-length reviews in this issue for a better idea of how **The Audio Critic** goes about its business. ◊

In Your Ear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TIPPY – TOOTSIES
"IMAGING UP THE YIN YANG"
Creamo-Lin
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HOSEMONSTER
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The Fourier Loudspeaker Story: Engineering, Finance, Politics

The first speaker designed to the specifications of *The Audio Critic* led to half a dozen others, plus several dozen rumors and a lot of *succès d'estime*. Here are the facts, straight from the horse's mouth.

Let us begin at the end, for the sake of clarity. The loudspeaker company introduced in the last full-length issue of **The Audio Critic** circa December 1980, Fourier Systems, Inc., is no longer in operation. There was no bankruptcy, but the Yonkers, New York factory was shut down as of December 31, 1986, and the small remaining stock of speakers sold out in the first half of 1987. At present the company is a paper entity, without a production facility, without employees, without inventory, without sales and without assets other than its so-called intellectual property. Your Editor, although still engaged in loudspeaker R and D as a private pursuit, is no longer active in the company in any capacity and is deriving no income from it.

Now we can go back to the beginning. We wrote the original article approximately two months before it actually landed in the hands of our readers. At the time of writing, the Fourier situation was still quite vague. There was a finished speaker design, ready to go into production, with several preproduction samples built and tested; there was a company named Fourier Systems, about to be incorporated over a lawyer's signature; there was a laboratory (ours) but no factory; there was no working capital to speak of and no idea who would end up owning the company by coming up with the capital. Thus the disclosures made in the article regarding the involvement of **The Audio Critic** and its Editor in the Fourier project were as complete and forthright as the few established facts of the case permitted. A small, and soon insufficient, amount of capital became available in mid-1981, a good many months after we had ceased to publish; the factory was opened a few months after that; your Editor did not derive an income from the company until the last quarter of 1981 and became President of Fourier Systems only in the spring of 1982; more capital was finally obtained in 1983, and after all the shuffling and reshuffling 45.5% of the Fourier stock issued ended up in the name of Peter Aczel, the rest in the hands of various investors.

We are citing this chronology to squelch poisonous and paranoiac rumors, persisting to this very day, that it was our fraudulent scheme from the start to take money from subscribers, leave their subscriptions unfulfilled and use the money to bankroll Fourier. Come on, good people, Eleanor Roosevelt may have been a card-carrying member of the Communist party, and it was probably Lyndon Johnson (or did you say J. Edgar Hoover?) who had the Kennedy brothers assassinated, but about this one you have your facts all twisted. The facts are that we stopped publishing at a particularly cash-poor point in our subscription renewal cycle; that the first trickle of capital into Fourier's coffers came at a considerably later and unrelated time; that the amount of money divertible at any time from a publication such as ours is pitifully inadequate to finance a manufacturing operation; and that only a simpleton unfamiliar with the elementary realities of business would consider such a scheme to be a viable fraud.

The only factual overlap between **The Audio Critic** and Fourier Systems was the design of the original, first-generation "Fourier 1" loudspeaker, which started out as an editorially conceived engineering exercise to verify certain technical desiderata and complaints we kept bringing up in our reviews. As far as this alleged "conflict of interest" is concerned, we happen to believe in every red-blooded Hungarian-American boy's birthright to critique other people's speakers and at the same time work on the development of better designs. Same subject, same capabilities. Those who had a problem with that philosophy were free to disbelieve the critiques and/or ignore the new designs, since they had been told of the connection. Enough of such nonsense.

The evolution of the Fourier product line.

The **Fourier 1**, as many of our readers will recall, was a floor-standing three-way design with a 10-inch woofer. Its aforesaid *Ur-* version came on the market in mid-1981 at the retail price of $1325.00 but was discontinued as of the end of that year. Although it satisfied the basic specifications we had set for it, some driver-related problems that had eluded our attention in the laboratory made its interface with certain rooms unpredictable. A new midrange driver with an in-house modification and a new off-the-shelf tweeter were substituted; the Fourier-designed woofer, the cabinet and the QB2 crossover network remained the same, as did the price; and in this second-generation version the speaker became the standard Fourier 1, sold throughout 1982 and 1983, with one eventual price increase to $1549.00. Early in 1984 the third-generation **Fourier 1L** ($1675.00) replaced the

plain 1. The L stood for an unprecedentedly sophisticated fourth-order Linkwitz-Riley crossover network that distinguished the new model from its predecessor. The network consisted of 26 specified values of L, C and R, computer-optimized to the point where, among other benefits, the summed response of the interacting filters and terminations was dead flat—meaning close to ±0.0 dB. There would have been no way on earth for the classic, cut-and-try loudspeaker designer (with the dangling cigarette and hot soldering iron) to arrive empirically at such a network, which represented Fourier's progress over the years in computer-aided electroacoustic engineering. The seamless crossover, in addition to the computer-optimized 32-Hz vented box common to all Fourier 1's, made the 1L good enough to earn grudging, how-did-you-do-it compliments from rival speaker designers whose names you would recognize and whose products cost a great deal more.

Two smaller speaker system were meanwhile introduced in 1983. They were the **Fourier 8** ($799.00), a fat bookshelf-size two-way system with 8-inch woofer, and the considerably smaller **Fourier 6** ($499.00), also two-way, with 6-inch woofer. Both woofers were Fourier-designed, and the crossover networks, although of slightly earlier vintage and not quite as advanced as that of the 1L, were very elegant computer-aided solutions to the problem of matching fourth-order low-pass and high-pass sections. The Fourier 8 underwent an early crossover update, and in that second-generation version became the monitor speaker of choice for top-of-the-console placement in some of the most prestigious professional recording and mastering studios, as well as the portable monitor speaker preferred by a number of well-known recording engineers and producers. It seems it had the right combination of accuracy, efficiency and bass for the pros. The Fourier 6 was a no-sweat, piece-of-cake design that stayed in its first-generation version throughout its life span; it was cordially received by reviewers and sold in fair quantities in audio retail stores. In 1985 the little **Fourier 44** ($349.00) was added to the line; it had two 4 1/2-inch almost-full-range drivers, a tiny tweeter to fill in the top octave, a computer-optimized vented box just like the other Fourier speakers—and sound that was a little better than it had the right to be but not much. A few pros found use for it as a minimonitor but it never took off in the stores.

The end was approaching when the company's most advanced product, the **Fourier 8e** ($1095.00), was introduced in mid-1986. This was a three-way system for which a new and better 8-inch woofer had been designed; the somewhat larger than bookshelf-size cabinet was exceptionally handsome, in rosewood and black lacquer without a grille; the speaker's chief claim to fame, however, was its unique crossover network based on a proprietary design technique called CAMF, the acronym standing for Computer-Aided Matrix Fitting. CAMF comes closer to approximating the appearance of a single-driver crossoverless wave launch out of several drivers than any other method known to us, but the drivers must have extremely well-behaved top-end rolloffs to begin with, otherwise the method is not applicable. In this particular case, CAMF resulted in an ouput that more nearly resembled the input, over a larger solid angle of radiation, than we had ever measured in our tests of electrodynamic box speakers. How that sounds is known only to a small group of Fourier 8e owners, mostly professionals, who grabbed a pair before it was too late. Let us just say that the speaker redefines the generally assumed quality-to-price and performance-to-size ratios, and that a few highly distinguished audio practitioners have chosen it as their reference speaker, regardless of price.

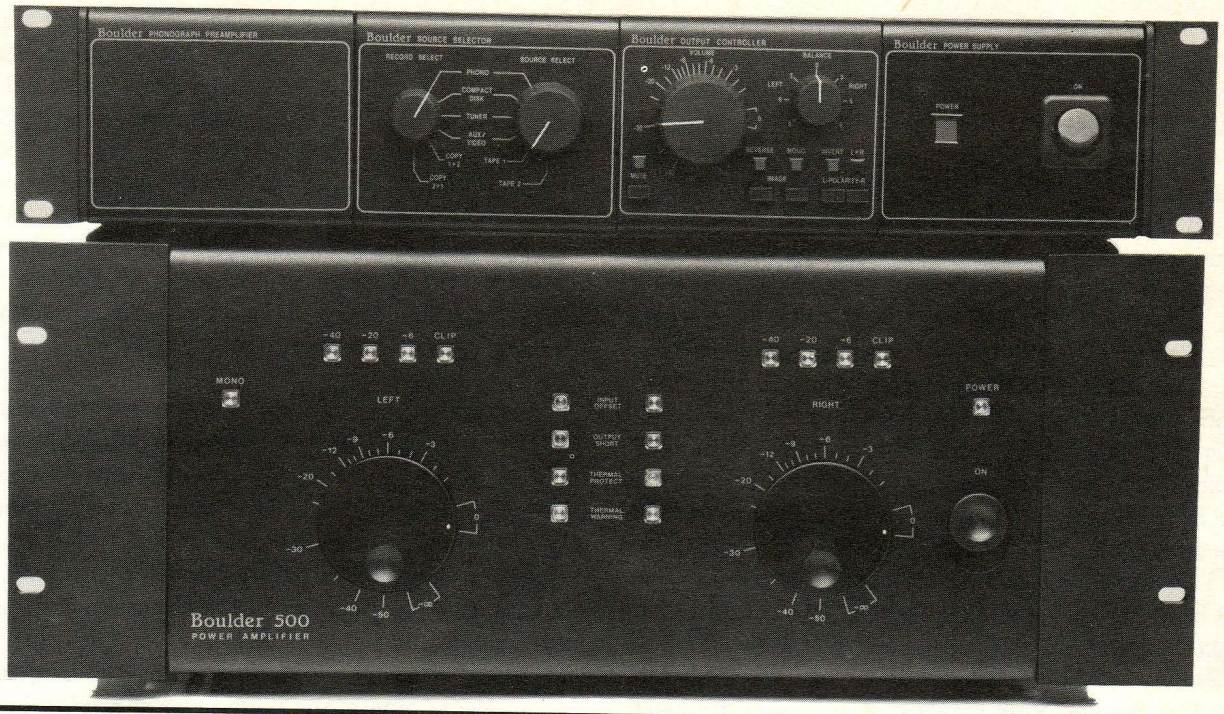
The triumph of market forces over sound quality.

All of the above is strictly of historical interest, of course, since none of the speakers discussed is in production or even available from leftover stock. What happened was a good demonstration of the inadequacy of "We Have the Best Sound" as a marketing plan. Advanced engineering, superior sound and the high opinion of professionals were not enough to obtain for Fourier a retail marketing base of sufficient size and stability to make the company profitable.

Every month, for 66 months in a row, there was a small, one might even say trivial, net operating deficit. Belts were tightened, waste was eliminated, sales increased, the deficit shrank, but a little bit of red ink always remained on the bottom line. It took only simple arithmetic to figure out that 66 times a small number is a big number, and the moment came when the plug had to be pulled. To be sure, there are other small loudspeaker companies that operate at a steady deficit, but the owners or outside backers keep pouring in new money in hopes of a turnaround. Fourier ran out of such hopes.

In the 1970's, the product would probably have drawn to itself an adequate network of dealers without the need for a major marketing effort. In the incomparably more competitive 1980's, the company suffered greatly from the lack of a financially committed marketing partner with heavy experience (or at least great talent) in manufacturer-to-retailer selling. Sales managers on salary and reps on commission turned out to be self-serving and lazy. It takes special skills and determination to persuade a dealer to take on a new line of loudspeakers in a market surfeited by too many brands. A typical reaction by store owners was: "These are great speakers. They're probably better than anything I have in the store. And you know something? I'm not going to carry your line. Why not? Because I have a warehouseful of other stuff I must sell first. And besides, why should I stick my neck out pushing your unknown speakers when people come in here asking for these other speakers by name?" A top-notch retail marketing man might have been able to handle that. Fourier did not have one. The dealer network never became as large as was minimally needed.

And then, in February 1986, a huge fire two floors above the Fourier factory resulted in the loss of the entire inventory through water damage, courtesy of the Yonkers fire department. There was stock insurance but no work-stoppage insurance. That was the beginning of the end. ◊



The Boulder family includes configurable preamplifers and switchable mono/stereo power amplifiers.

Our Modular Preamplifier System maximizes the Boulder 500's sonic clarity.

Boulder Amplifiers continues the tradition of providing professional 990 amplifier stages in a preamplifier / power amplifier combination designed especially for the music lover's home.

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Because the Phono Preamp, Selector Switch, Output Controller, equalizer and effects modules are separate, you can add features in the convenience of your home or at your dealer.

Optional gold 3 pin connectors drive long lines to the balanced inputs of the Boulder 500 power amplifier without any signal degradation.

The Boulder 500 power amplifier, now in its third year of production, continues to offer its unique two stage design - the first (a 990 amplifier) for voltage gain, the second (an enlarged 990) for high output current.

The uncompromised sonic clarity, electronic durability, and rugged mechanical construction ensures that the Boulder Modular System and Power Amplifiers will be wise investments for years to come.

To find out why Boulders are the choice of professionals and home music lovers alike, call or write for a brochure and dealer nearest you.

The Boulder 500 power amplifier delivers 150 Watts stereo or 500 Watts mono into 8 Ohms. $2875 suggested list. Your investment in the Boulder Modular Preamplifier System varies according to the modules you select.

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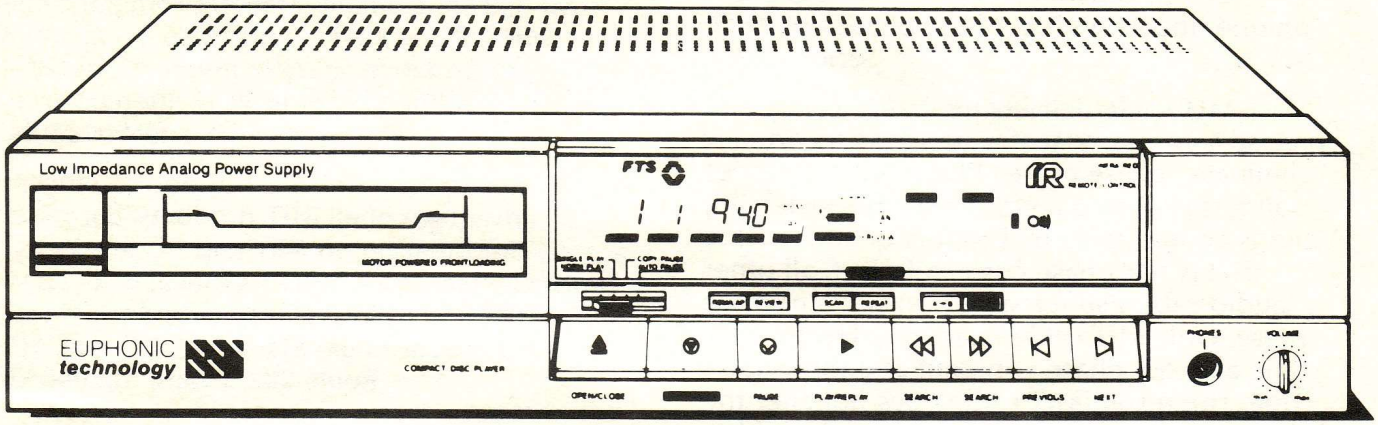

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MIT cable delivers *neutrality, clarity* and *precise focus* because it is designed to virtually eliminate "phase noise". Phase noise includes all forms of frequency and phase instability, and is an inevitable by-product of audio cable that is not phase correct. In fact, all other audio cables suffer significantly from phase noise. Only MIT cable is designed to be truly time aligned, phase coherent and thus, noise free. The result: MIT cable does not alter the sound as do other audio cables.

In a dramatic comparison of MIT's superiority, MIT ran head-to-head tests of one-meter lengths of MIT MI-330 vs. solid-core straight wire, employing a sequence of music tone bursts. Despite past regard for straight wire, and some observers actually recommending its direct application in audio cable, comparable lengths of straight wire simply cannot compete with MIT cable on crucial phase noise performance.

These test graphs, which illustrate only one of a series of music tone bursts, provide visual proof of MI-330's overwhelming phase noise superiority. From the instant each music tone is retriggered, MI-330's defined transmission is obvious. Equally important is what occurs *before* each succeeding music tone is retriggered—a time segment which is supposed to be absolutely quiet (note exploded view of the pre-trigger time segment).

MI-330 is essentially quiet before each music tone is retriggered, as audio cable must be for sonic accuracy. The length of straight wire, like other cables which are not phase correct, is noisy when it should be quiet. It is victimized by phase noise—stored energy residue which is being released at the wrong time! By comparison, MI-330's *quiet* passages and *clearly defined step waveform* mean that the music starts and stops when it is supposed to, yielding a more holographic sound stage, intertransient silence and minimal distortion.

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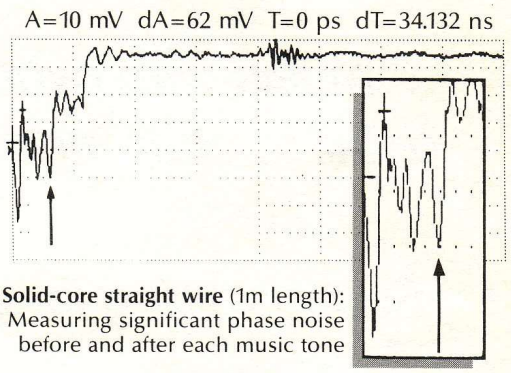
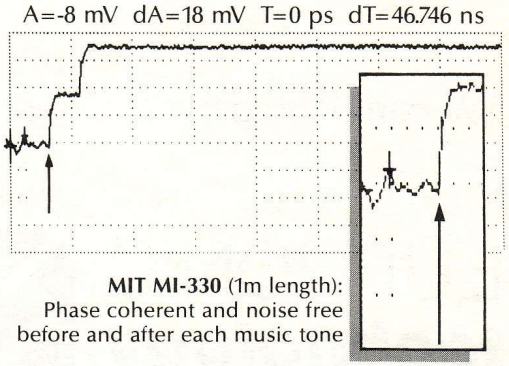


Solid-core straight wire (1m length): Measuring significant phase noise before and after each music tone



MIT MI-330 (1m length): Phase coherent and noise free before and after each music tone

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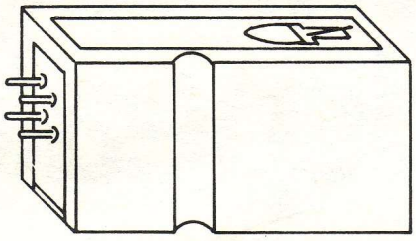

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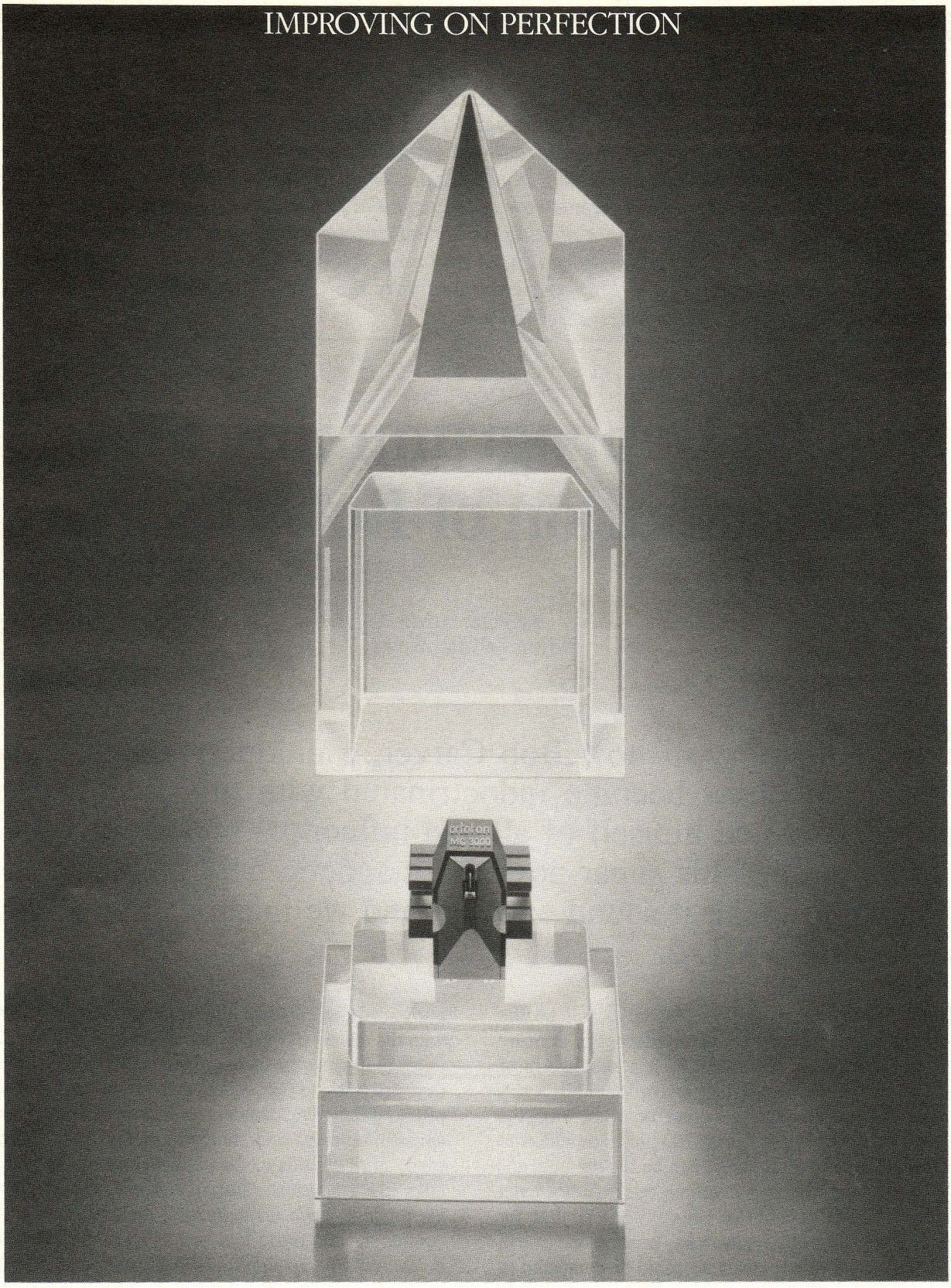

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The article that follows was standing in type in January 1983, along with other parts of an almost complete issue, when the Carver Corporation asked for, and was granted, permission to preprint it and circulate it. The issue itself, which was to reach its readers almost simultaneously, never made it to the printing press. In the same spirit as a man might marry a mistress of long standing "to make an honest woman of her" (an old-fashioned notion, admittedly), we are making an honest article of this widely discussed, some would say notorious, piece by officially publishing it here and now. All editorial comment about the ravages visited upon the belief system of the high-end community by the Carver preprint will be found in the follow-up article that appears immediately after this one.

The Deprogramming and Reformation of Bob Carver

By Peter Aczel
Editor and Publisher

The amazing story of how Bob Carver, a uniquely gifted inventor who had somehow become indoctrinated with mid-fi notions and practices, divested himself of all bad influences under our watchful eye and modified his super-powered magnetic field amplifier in our laboratory to make it sound exactly (and we mean exactly) like the Mark Levinson ML-2.

Bob Carver, who is not yet 40, may well be the oldest continuing paradox on the audio scene. For as many years as most of us can remember, he has been the most original and innovative audio designer of them all. Every piece of equipment the man has come up with, from the earliest version of the Phase Linear 700 power amplifier to the late-1982 Carver TX-11 tuner, can be legitimately and literally called a new idea, something that had not even occurred to his peers. It could be plausibly argued that, for sheer invention and creativity, there has been no one else in home entertainment electronics who could be compared to him since the days of Edwin Armstrong. On top of it, he is a perfectionist, so obviously dedicated to the do-it-right philosophy that he made the cover of the December 29, 1980 issue of *Fortune* magazine as a prime exhibit for a feature article on "Things Made Well."

And yet, here is the major paradox: the Carver name has so far acquired no status among upper-echelon audio purists, golden ears and high-tech fanatics. Popular as he is with the editors of the big, commercial hi-fi slicks, Bob has failed to impress the underground audiophile journalists and their disciples; in fact, on the extreme tweako/weirdo fringe of the "alternative" audio press he has recently come under spiteful, repeated and childishly unfair attack. One could easily attribute this to the particular image he projects: he talks like a physicist rather than a cultist or mystic; all of his products have made money; the mainstream business community has made him one of its minor celebrities; he comes on like an apple-pie American optimist; he is a heterosexual—you get the picture. But that still does not resolve the contradiction inherent in extraordinary engineering renown without some sort of elitist support. Only the Carver product itself can provide the explanation.

That product, in our opinion, has consistently offered unexpected and highly convincing user benefits as well as solid value for the money, quite aside from uniqueness of

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concept and unusual engineering elegance. The *sound*, however, when judged by the purist on a black-box basis and without regard for the price, has always left something to be desired. The ultimate transparency, openness, neutrality and detail have not been Carver hallmarks. Even if the Mark Levinson or Audio Research level of sonic performance were absolutely unachievable within the price structure set by a company like Carver (an article of faith we never quite shared with the high-end religionists), there are at least half a dozen small manufacturers who have tried and occasionally succeeded to obtain a good approximation of the high-end type of sound in a moderately priced component. Past issues of **The Audio Critic** provide some outstanding examples. The Carver sound, on the other hand, has not even nudged this select category until now.

How we got involved.

Ever since we had the pleasure of meeting Bob Carver a number of years ago and having extensive discussions with him on a variety of audio subjects, this paradox has been bothering us a great deal. It was clear almost from the start that this boyish, apple-cheeked technologist knew a great deal more about the physics, mathematics, psychoacoustics, and just plain nuts and bolts of audio design than nearly all of the various practitioners who were producing better sound! Something was decidedly askew somewhere.

It took us a while to sort out the probable causes of this baffling and obviously unnecessary situation, but after several highly interesting dialogues with Bob we had a pretty good list of tentative conclusions. Namely: (1) he did not listen quite as critically as the fussiest audiophiles and his expectations were ultimately not as high; he used unnecessarily large amounts of negative feedback in his amplifier circuits for purely cosmetic reasons, to make his distortion figures come out low enough to be "competitive" with all comers; (3) he specified output filters for his power amplifiers, mainly in apprehension of weird speaker loads that might conceivably destabilize the high-feedback circuitry, but also to reduce THD readings even further; (4) he tacitly accepted the cynical old engineering maxim that a resistor is a resistor and a capacitor is a capacitor, so that he tended to turn his back on premium-quality parts that in some cases would have cost only pennies more. All in all, it appeared to be the case of an inherently puristic and uncompromising mind that had been gradually programmed, under the pressure of its commercial environment, to tolerate certain insidious mid-fi compromises. To save that mind for the immaculate audiophile cause, it was clearly necessary to expose Bob Carver to some new influences. We decided it would be worthwhile to keep bugging him about these matters with some regularity. And we did, as attested by monstrous phone bills, New York to Seattle.

Our efforts were eventually successful beyond our wildest dreams, otherwise this article would not have been written and published here. But it happened in stages, not all at once. The first concrete result after innumerable long-distance calls and one brief visit by Bob to New York in March 1981 was the unannounced modification of the M-400 magnetic field amplifier, also known as the Carver Cube, which had been already reviewed in **The Audio Critic**. At some point in mid-1981, the amplifier began to come off the production line with the M-400a designation silk-screened on its front panel and substantial circuit changes inside. These included considerably reduced negative feedback, more nearly class A operation of the linear amplifier section, different input impedance characteristics, and a milder filter at the output. The sonic improvement over the original M-400 was immediately noticeable; the M-400a came almost within striking distance of the kind of amplifier sound expected by the audio purist. In our opinion there was still something lacking in the rendition of the sound stage and the refinement of inner detail, but a number of high-end oriented audio professionals commented favorably on a special version without output filters that we played for them in our laboratory.

The next positive development was an entirely new Carver magnetic field power amplifier, launched early in 1982 and designated as the Model M-1.5. It was an incredible souped-up version of the cube, rated at 350 watts per channel into 8 ohms and capable of brief 600-watt bursts, but no longer in the cubic format. Instead, it was packaged in the shape of a conventional low-silhouette preamplifier or tuner with standard 19-inch rack panel, weighing about one-and-a-half times as much as the cube at 16 pounds. Some shoehorning job—75 watts into every pound! The M-1.5 made obeisance to most of the high-end design trends: fully complementary topology from input to output, the latest and fastest transistors, almost pure class A biasing of the basic linear amplifier, relatively little (though still too much) negative feedback, relatively little (though still too much) filtering at the output—all this, of course, within the framework established by the utterly original Carver high-output amplifier circuitry. The sound was definitely a step up from that of the M-400a, very respectable even by fairly critical standards (especially at the eminently reasonable price of $799) but still not quite in the same category with the most exalted high-end brands. Conceptually the amplifier was so brilliant, so right, that anything short of the ultimate sonic performance affected us as a letdown, regardless of price, and we made no bones about our frustration to Bob Carver, although we had to admit he was moving in an audiophile direction.

It was at this point that he reiterated in greater depth a challenge he had made to us several times before: "Give me an amplifier, any amplifier at any price," he said, "and I'll make my amplifier sound exactly like it by duplicating its

transfer function." Now, depending on how you interpret it, this is either the most daring or the most simplistic and redundant statement an amplifier designer can make. The transfer function of an amplifier is the exact mathematical relationship of its output to its input. In the most elementary terms it is the output divided by the input, so that the transfer function of a totally perfect amplifier would be 1 X gain (i.e., the theoretical "straight wire with gain"); in practice, however, it is the approximation of an immensely complex expression that would implicitly specify each and every separately measurable deviation from linearity, such as amplitude changes, phase shift, THD, IM, clipping, ringing and all the rest. It is entirely possible for two "black boxes" of different internal design to have exactly the same transfer function, in which case they would have to sound absolutely alike *by definition*, since a given input would undergo exactly the equivalent processing inside each box by the time it reaches the output. If Bob meant that he would strip his amplifier down to the chassis and then build something inside that would duplicate the transfer function of any other amplifier, his statement was nothing more than a tautology. That, of course, was not what he meant. He had sufficient faith in the basic quality of his signal path and his unique power supply to feel that he could implement his challenge with relatively minor modifications, without changing the circuit board or redesigning any part of his amplifier from scratch. That being the case, the challenge was both meaningful and irresistible.

"Okay," we said, "make the M-1.5 sound exactly like a Mark Levinson ML-2 with more power." We could have said Octave Research or Krell or Futterman (by New York Audio Laboratories) or Electrocompaniet or Bedini, but we were convinced that the ML-2 was the right choice. Not because it was clearly "better" than the top-of-the-line models of the other brands (in fact, the Octave Research was our reference) but because it represented the worldwide gold standard in high-end transistor amplifiers and had undergone constant refinement by a solidly established company over a period of more than five years. We had a chance to test the latest version in August 1982 (just before the Carver challenge) and found it utterly clean and musical, both measurably and audibly the equal of any power amplifier known to us and our staff, although not necessarily "the winner by unanimous decision."

Bob immediately agreed to let his challenge stand against the ML-2 and also to complete the necessary work in the laboratory of **The Audio Critic**, so we could observe exactly what he was doing and act as his technical assistant as well as occasional devil's advocate. At this point we still suspected him of believing that he could turn the trick with minor changes in bandwidth and amplitude response; if we were right, we never found out just where in the process he abandoned that pious mid-fi tenet, since he certainly knew better by the time we were through.

A word about the Carver power supply.

We would not have gotten so deeply involved in this rather unorthodox project if it had not been for our convictions about the Carver magnetic-field power supply. Regardless of the sonic limitations of the M-400, the M-400a and the original M-1.5, their power supply (as distinct from their audio signal path) represented by far the most advanced and most successful design approach in our judgment, at least for the amplification of music. Contrary to untutored opinions expressed by audio-store cowboys, jealous manufacturers and/or tweaky reviewers, the Carver power supply does not constitute a compromise. It does not give up anything in exchange for its astonishingly small size, light weight and cool operation. Whatever the largest conventional power supplies in the costliest and most venerated high-end amplifiers can do, thanks to their two-ton transformers and beer-keg-sized capacitors, the little Carver power supply does just as well. It is not "slower," nor does it cause "less bass impact"—such perceptions, if at all valid, relate to the behavior of the rest of the amplifier.

Even the various highly laudatory write-ups of the Carver power supply design in the large-circulation audio magazines missed the essential principle, the basic insight embodied in the circuit. Energy storage in the magnetic field coil is not it, although important to the total process. The breakthrough idea was the *demand utilization*, as dictated by the audio signal, of nearly the entire sine-wave cycle of the 60-Hz power line, as distinct from the wasteful operation of conventional power supplies that store the energy from the 120 peaks per second and in effect throw away the rest of the cycle. The so-called Triac conduction switch and the magnetic field coil work in conjunction to accomplish this, enabling a quantum jump in size and weight reduction. The Carver power supply is one of the very few genuine inventions in the history of electronic amplification, and a number or people whose job it is to recognize such things have missed that point entirely.

The juxtaposition of the Carver M-1.5 and the Mark Levinson ML-2 presented a dramatic contrast in power supplies. The latter has a magnificent power supply of the old school, large enough to provide the required current for pure class A operation into very low-impedance loads.The ML-2, as most of our readers know, is a mono amplifier; a stereo pair costs $6300, even though the maximum continuous power output into 8 ohms is only 35 watts (it used to be 25). The current reserves are sufficient, however, for twice that power into 4 ohms and proportionate increases into even lower impedances. The M-1.5 looked very puny by comparison, although in other respects it exhibited some coincidental similarities in design, including a relatively modest amount of negative feedback and an almost-class-A

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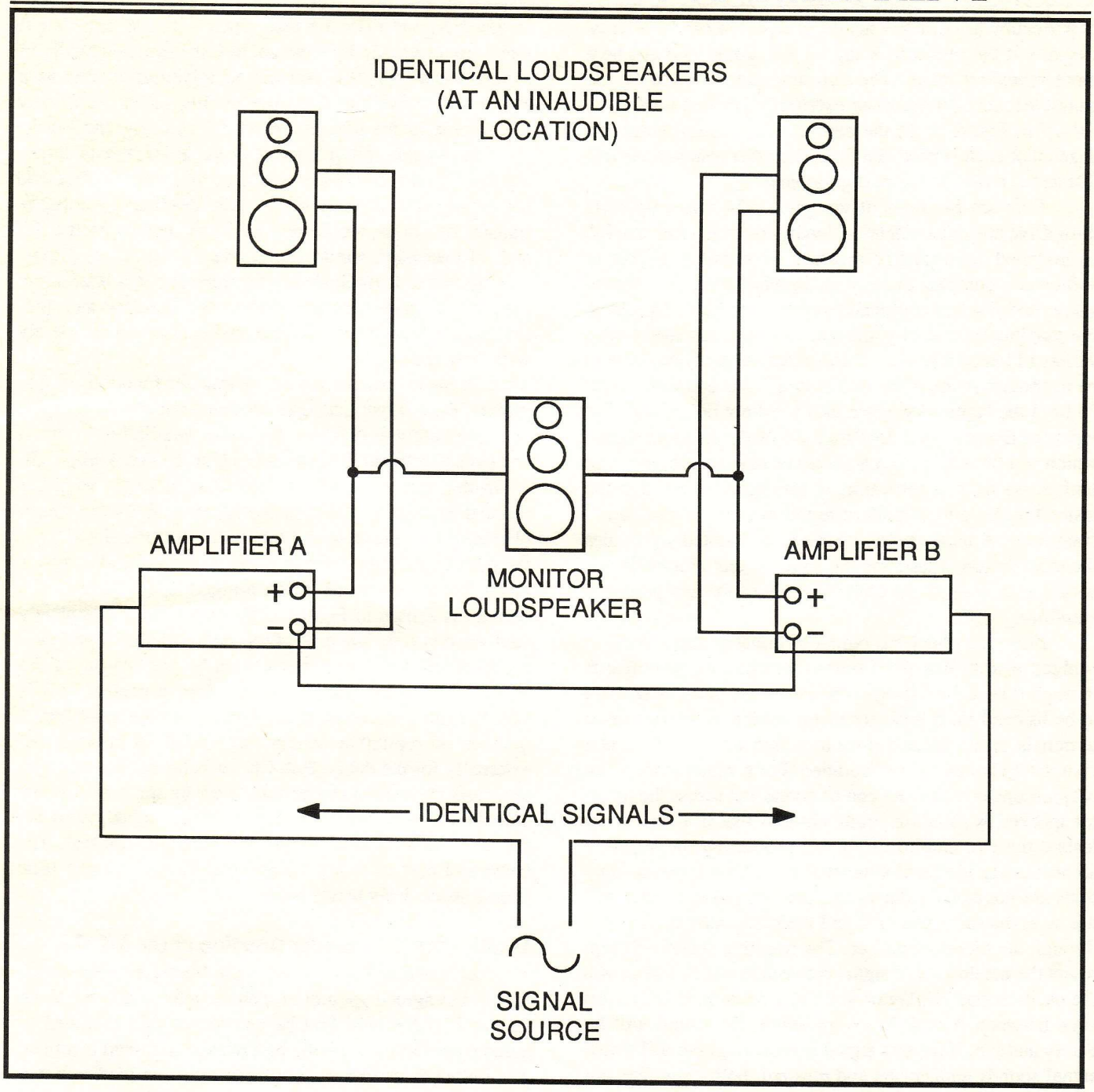

Figure 1: Block diagram of the Carver null test. If the monitor loudspeaker remains silent on all program material, then A – B = 0, and A = B.

35-watt amplifier at the core of the 350-watt-plus demand-modulated configuration. Perhaps these and other marginal similarities made it easier to duplicate the transfer function of the ML-2; a tube amplifier like the Futterman or a totally different solid-state amplifier like the Octave Research might have proved to be a harder nut to crack, although the basic principle of duplication would have remained the same.

The Carver null test: absolute proof.

The utter confidence Bob Carver appeared to have in his ability to turn the M-1.5 into a sonically identical twin of the ML-2 was based on a very powerful laboratory tool, a test that could prove beyond argument the similarity or dissimilarity of the transfer functions of two amplifiers. He had discussed the test with us before, but even he himself had not been able to implement it to quite the same degree

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of perfection as he subsequently achieved in our laboratory. He calls it the null test; bridging test would perhaps be a more revealing name. The two amplifiers, A and B, are simultaneously driven in an externally bridged hookup as shown in Figure 1. In the case of stereo amplifiers, one channel of each is used at a time; the other channel remains idle and is tested on the next go-around.

Here are the rules of the game. The two amplifiers must drive absolutely identical loads, preferably two carefully matched loudspeaker systems or possibly a pair of sufficiently complex dummy loads, simulating both the resistive and reactive components of real-world loudspeakers. For maximum reliability, the test should be repeated with a variety of loads. If actual loudspeakers are used, they should be in another room, at the end of long leads and well isolated from the laboratory, since they must not be audible. The inputs of the two amplifiers are fed exactly the same signal, which can be music from a phono or tape source, white or pink noise from a generator, or any other signal that the tester fancies and considers representative of real-world conditions. A large variety of music undoubtedly provides the most thorough test, and the signal levels should also be varied, almost up to the clipping point of the less powerful amplifier.

Now, the plus (red) output terminal of amplifier A is bridged to the plus (red) output terminal of amplifier B through a third loudspeaker, which is the monitor speaker to be listened to. It does not matter which of the two input terminals of the speaker goes to A and which to B; it is a completely balanced configuration. For a visual reading, an oscilloscope or voltmeter can be connected across the monitor speaker. It should be quite obvious that if at any given instant the two amplifiers are not processing the signal in an absolutely identical manner (i.e., if their transfer functions are not exactly the same), the two red terminals will not be at the same potential and therefore current will flow through the monitor speaker. The resulting sound will represent the net difference signal between A and B, and so will the oscilloscope display or voltmeter reading. If the difference between A and B is very small, the sound will be barely audible; if the test signal is music and the difference signal sounds undistorted and *musical*, both amplifiers are at least reasonably linear though different. If the difference signal sounds ugly and garbled, like a mistuned FM station, then at least one but possibly both of the amplifiers must have a nonlinear transfer function. The test is extremely sensitive.

Here comes the most beautiful part: if the monitor speaker indicates a null by remaining *silent* as the test is repeated with a variety of amplifier loads and inputs, amplifiers A and B are proven beyond a shadow of a doubt to have identical transfer functions, at least above normal thresholds of audibility. They must therefore *sound* identical in any rigorous listening test, since with the same input their outputs are totally identical in waveform and totally in synchronism. We beg you not to misinterpret this as a claim that subjective listening quality is now precisely measurable in the laboratory; on the contrary, the Carver null test bypasses all qualitative or value judgments, focusing strictly on proof of difference or sameness. In fact, two identically terrible amplifiers, with identically nonlinear transfer functions, would null perfectly against each other and, of necessity, would sound exactly the same, namely equally and indistinguishably terrible. The test is absolute precisely because it lumps together all differences and similarities, desirable or undesirable, and concerns itself merely with their existence.

In his measurements of the transfer functions of amplifiers, Bob Carver also uses another nulling test, not quite as indisputably conclusive but more qualitative in thrust and already referred to in previous issues of **The Audio Critic**. In this test the input and output of a single amplifier channel are nulled against each other to establish the resemblance of the output to the input and thus the linearity of the transfer function. The amplifier is loaded and driven in much the same way as in the bridged A/B null test. The hookup is shown in Figure 2. We were never completely sold on this test, since the time delay of the signal as it passes through the amplifier cannot be washed out of the input/output comparison and therefore a perfect null is unobtainable regardless of the linearity of the amplifier. A number of reputable testers have tried to compensate externally for the delay; Bob Carver believes that this contaminates the results and prefers to try for the best possible null without any extra processing of the signal, allowing the delay to remain a known limitation of the test. The latest and best of today's amplifiers have relatively little front-to-back delay in any event.

Duplicating the transfer function of the ML-2.

Before Bob even looked at the Mark Levinson amplifier, it was agreed upon our recommendation that the stock Carver M-1.5 would first be cleaned up and modified to agree more closely with the best current high-end practices. The output filter was excised. The negative feedback was reduced to approximately 15 dB. All capacitors in the actual signal path were replaced with a very high-quality German brand of metallized self-healing polypropylene film capacitor. The one 470-microfarad electrolytic for which there existed no film capacitor substitute was replaced with a much higher-grade electrolytic and then bypassed with a small polypropylene. With just these quickie mods, the M-1.5 immediately began to sound like a genuine blue-blooded high-end amplifier. Perhaps a wee bit zippier than the ML-2 or the Octave Research and not quite as fine-grained, airy and transparent, but in the same general class and not far

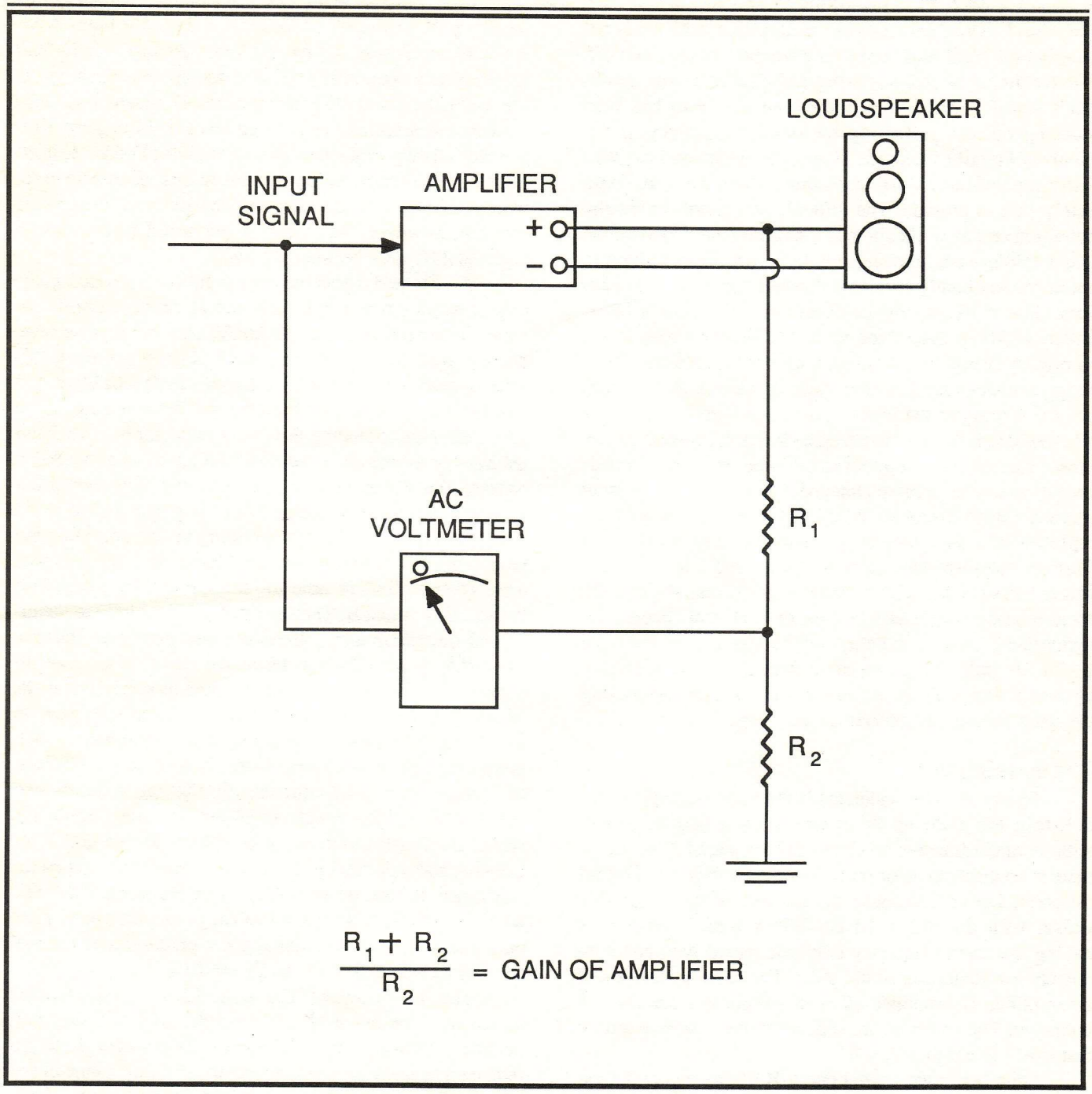

Figure 2: Block diagram of the input/output null test. An oscilloscope may be used instead of, or in addition to, the voltmeter. As explained in the text, this null test cannot be entirely conclusive unless the amplifier propagation delay = 0.

behind them. Even without the considerable improvements that were to come, an amplifier with this kind of sound and the M-1.5's virtually unlimited power would have been an outrageous success among serious audiophiles, especially at $799. We had finally made our point to Bob; he was now 100% in our camp.

Next, the Carver null test was set up to see how close we were, for openers, to the transfer function of the latest Mark Levinson ML-2. Big disappointment. The difference signal was not only fairly loud but quite distorted. The improved M-1.5 obviously needed a lot more improvement before it would track with the ML-2.

This is where Bob began his measurements of the ML-2 and the procedure of copying its transfer function into

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the M-1.5. The Mark Levinson amplifier was analyzed strictly on a black-box basis; its cover was never taken off. The technique of characterizing and duplicating an amplifier's transfer function is something that Bob has been working on and perfecting for more than two years; it involves literally hundreds of measurements and requires fairly sophisticated instrumentation, which we were fortunately able to provide. The difficult part is not the precise definition and quantification of the differences between the two amplifiers but knowing step by step what to do next to cut down and finally eliminate those differences. It requires very clear thinking, lots of experience and quite a bit of patience. We played Igor to Bob's Frankenstein at the laboratory bench for 48 hours, with very little time off for eating and sleeping, before the two amplifiers tracked each other perfectly. In the process, the open loop of the M-1.5 was retailored, the negative feedback was readjusted several times, various transistors were rebiased, the input impedance characteristics were changed, lower-resistance wiring was substituted in crucial places, but no active devices were replaced and no changes in basic topology made. The German polypropylene capacitor was used wherever new values had to be inserted. When it was all done, the monitor speaker remained dead silent on the null test (except for minuscule ground-loop hum) and the instruments indicated a –74 dB null! Yes, two amplifiers of totally different electronic design and physical construction now had exactly the same transfer characteristics from input to output.

The listening tests.

To anyone who understands the basic principle of the null test, the amazing thing would be if two amplifiers with identical transfer functions did *not* sound alike, since there is no mechanism or process whereby they could sound different. Let no one make the mistake of confusing this truism with the old pop-tech fallacy that all amplifiers having the same frequency response, equal gain and adequately low distortion sound alike. The transfer function of an amplifier incorporates *all* of its parameters, known and unknown. The entire matter reduces to the simple assertion that if A – B = 0 then A = B.

Thus, when we started our A/B listening comparison of the modified Carver M-1.5 and a pair of Mark Levinson ML-2's, we were not at all surprised that they appeared to be sonically indistinguishable, as long as we did not exceed the ML-2's dynamic headroom. For the listening tests we used the **Fourier 1** three-way dynamic speaker system, which had been developed in the laboratory of **The Audio Critic** for precisely such applications (see follow-up article in this issue). It is the only single-box, single-amped speaker known to us that (1) goes down to an honest 32 Hz, (2) is efficient enough to be used successfully with low-powered amplifiers and at the same time capable of handling the power of a blockbuster amplifier like the M-1.5 without distress, (3) has the required accuracy in both the frequency domain and the time domain for critical listening evaluations, and (4) presents a simple, untemperamental load to the amplifier at all frequencies. Both amplifiers sounded equally clean and open through the Fourier 1, leaving little or nothing to be desired in spatial information, clarity of detail and sheer musicality; our overriding concern, however, was whether we could hear even the slightest difference between the two.

We decided it was too easy to fall into the audiophile trap of hearing nonexistent differences simply because we were challenged to do so and knew, after all, that we were dealing with two very different amplifiers. So, on Bob's recommendation, we set up a relatively foolproof blind A/B test for a small panel of experienced listeners, including your Editor but excluding Bob, who could not be considered unbiased under the circumstances (and besides was needed to operate the equipment). A randomized A/B switching sequence, unknown to the panelists, was established by 15 tosses of a coin, heads corresponding to one amplifier and tails to the other. Before the blind test began, the panelists were given unlimited time to familiarize themselves with the sound of A and B. They had every opportunity to identify and memorize any differences that may have existed. Then they were asked to leave the room, allow Bob to connect A or B, come back and mark their scorecards while listening. Before every switch they had to leave the room to avoid any possibility of latching on to nonmusical cues, body language or whatever. When the test was completed, the scorecards proved conclusively that the panelists had absolutely no idea which amplifier was the Carver and which the Mark Levinson, even though in the course of listening some of them had claimed to have zeroed in on the difference. In fact, the overall scores were worse than what would have resulted on a statistical probability basis from pure guessing. The theoretical sonic prediction of the null test was therefore experimentally verified.

The "Levinsonized" Carver M-1.5 was then subjected to the input/output null test, in order to make sure that between 35 watts and 350 watts its transfer function remained as linear as it was within the dynamic range of the ML-2. This investigation resulted in one more small modification of the Carver, a slight downward extension of the open-loop bandwidth, which eliminated a tiny phase shift at 20 Hz copied from the Levinson. The two amplifiers still nulled perfectly on musical program material, but the input/output null of the modified M-1.5 was reduced to –64 dB, an amazing figure considering that there was no compensation for the time delay between input and output. This was the final version that Bob duplicated for us a little more neatly, starting with a fresh sample of the stock amplifier (yes, the copy nulled perfectly against the prototype),

EXACT TEXT OF THE 1983 PREPRINT

and the one that came to be called the **t-mod** of the M-1.5 (t for transfer function) or more formally the **Carver Model M-1.5t.** We now have it almost permanently connected to our laboratory Fourier 1's and consider it to be the equal of any power amplifier in transparency, focus and smoothness, and of course far ahead of any other we have tested in sheer gut-shaking power and dynamic range. We especially enjoy hearing spatial detail, instrumental definition and completely natural dynamics on familiar records to a degree we did not know was extractable from the grooves when we listened through lesser amplifiers. At this level of sonic performance, the astoundingly small size, light weight and cool operation of the M-1.5t become the icing on the cake, rather than the main attraction.

What the future holds.

Bob Carver informs us that the t-mod has replaced the original M-1.5 in current production, so that the M-1.5t should be in the stores by the time you read this. The price remains $799, despite the somewhat higher cost of parts. According to Bob, the production version is identical to the prototype he took back to Seattle from our laboratory and nulls perfectly against it in the bridging test. He has also acquired a pair of the latest Mark Levinson ML-2's and is using them as his quality-control standards against which every M-1.5t is nulled. That means you can now buy the ML-2 kind of sound at less than one-eighth the price and with ten times the power.

Mind you,we are in no way suggesting that the ML-2 has ceased to have a reason for its existence. It is incomparably more beautiful than the Carver M-1.5t, more solidly constructed, more likely to provide decades of uninterrupted service, much more of a jewel for an oil sheik's equipment rack. On the other hand, the Carver M-1.5t symbolizes with great poignancy the end of the high-end boom of the 1970's, the era in which *only* the Mark Levinson or Audio Research type of manufacturer understood what the audio purist really wanted. (See also the reviews of the New York Audio Laboratories NCP-1 and the Phœnix Systems P-10 in this issue, not to mention the Fourier 1.)

We are also aware that this article will create tremendous antagonism in certain high-end audio circles, wherever there is a financially or emotionally vested interest in very high-priced equipment in general and Mark Levinson components in particular. That cannot be helped; we are merely reporting certain irreversible facts of life. But for heaven's sake, let no one make an ass of himself by indignantly declaring that the ML-2 does *so* sound better than the M-1.5t. The two have been proved sonically equal with the same rigor as two triangles are proved congruent in plane geometry. What has not been rigorously proved is that either one of them is "better" than other amplifiers. So if you hate both of them, you still retain some credibility. Or you can love both of them, as we do.

Bob is also working on a t-mod of the Carver Cube and claims that he will eventually be able to make it null against the M-1.5t and the ML-2. It may require a new complement of transistors and some changes in topology, however, to get to that point.

It should be added in conclusion that Bob is a changed man as a result of the t-mod project. His reformation is so complete that he simply cannot understand why he had not come to the same conclusions years ago and acted accordingly. It takes courage, of course, to admit past mistakes and omissions freely, without excuses, and to allow one's present work to stand as the severest critic of previous efforts. For this, as much as for the quality of his engineering mind, Bob Carver has earned our sincerest admiration. ◊

Truth is a river that is always splitting up into arms that reunite. Islanded between the arms, the inhabitants argue for a lifetime as to which is the main river.

— CYRIL CONNOLLY

The Carver Amplifier Controversy Four and a Half Years Later (Will They Never Learn?)

The debate on Bob Carver's transfer-function duplication (t-mod) claims, techniques and results, originally started by a 1983 preprint of the article on the preceding pages, has recently been rekindled by his M-1.0t power amplifier and is eliciting some characteristically undisciplined and inane commentary in the "alternative" audio press.

It is assumed that readers of this article have read and digested our original, notorious Carver t-mod article, either in the preprint form that has been circulating since January 1983 or as reproduced in this issue. Without a reasonable grasp of what transfer-function duplication is and what it is not, the recently renewed controversy about Bob Carver's favorite sport is devoid of meaningful content.

Aftermath of the first Carver t-mod.

Soon after the January 1983 Consumer Electronics Show in Las Vegas, where Bob Carver first announced the "Levinsonized" t-mod of his top-of the-line amplifier and started to circulate our article, the outraged yelps of the high-end cultists began to be heard. The hue and cry was of a different sort, however, than we had expected; we had obviously overestimated the intelligence of certain sectors of the audiophile press. We had expected attacks on (1) the very concept and feasibility of transfer-function duplication, (2) the validity and completeness of Bob Carver's methodology, (3) the theory and practice of our blind A/B tests, and possibly (4) the lack of corroboration by independent observers outside the project. We had airtight arguments against all such attacks, but they never took place.

Instead, the press reaction consisted mainly of moral indignation. Their message was that it is not ethical to mimic the sound of somebody else's amplifier (why can't Bob Carver come up with his own sound if he is such a genius?) and that it is similarly unethical to circulate an article that has not appeared yet in the publication it was written for. We were flabbergasted to see the audio pundits miss the main point, namely that *there is no inevitable connection between the ultrahigh-end sound and the ultrahigh price*, and we were tempted to rephrase Samuel Johnson's famous aphorism to read "moral righteousness is the last refuge of an incompetent critic." (If Adolf Hitler stated on a rainy Tuesday morning that 2 + 2 = 4, then on that subject the morally warped, inhuman monster was 100% right and cannot be faulted by an intelligent observer. As for the ethics of copying a famous amplifier's sound, is it equally reprehensible to copy a top home-run hitter's stance at the plate or a beautiful movie star's shade of red hair or Henry Kissinger's accent? Maybe we should have assembled an interfaith committee consisting of a priest, a minister and a rabbi to give us pastoral guidance before we braved the moral complexities of the t-mod project.)

A couple of the aforementioned lightweight reviewers did end up auditioning the production version of the Carver M-1.5t and reported that it sounded okay but not nearly as good as the Mark Levinson ML-2. Was the latter available to them for side-by-side comparison? Nope. Their exquisite hearing and phenomenal aural memory made that small inconvenience unnecessary. More about one of these gents further below.

Our own follow-up of the M-1.5t story was not particularly thorough, since **The Audio Critic** had sunk into limbo, but we did have the opportunity to examine two or three samples of the production version in 1983 and early '84 that satisfied us as being exact duplicates of the hand-wired t-mod Bob had left with us in our laboratory. Considerably later, in mid-1984, we came upon a sample that did not sound right, but we were unable at the time to investigate what was wrong with it or whether it was in any way typical of Carver's then current production. It is possible for the design parameters of an amplifier to "migrate" after months or years of manufacture if they are not rigidly controlled against a calibrated prototype (or in this case the ML-2 standard), but we have not the slightest evidence that such was ever the case at Carver and, frankly, we doubt it. More about that subject, too, further below.

Segueing now to 1985-87, we come to the currently unfolding chapter of the Carver t-mod saga. As many of our readers know from other sources, Bob has done it again and

this time with an added touch of virtuosity, using a very high-end tube amplifier as his reference and copying its transfer function into a Carver solid-state amplifier.

A Conrad-Johnson in Carver's clothing.

In 1985, Bob Carver made the same challenge to *Stereophile* magazine as he had made to us three years earlier ("give me an amplifier, any amplifier at any price,"etc.). He did not mention to them that he had already done the whole thing once before for **The Audio Critic** and, astonishingly, the Publisher, Editor and staff of *Stereophile* had never heard of the first Carver t-mod project or of our article, despite the preprint with a circulation well into six figures and the ensuing press commentary. Those golden ears were apparently not kept to the ground. No wonder, then, that they took up the challenge as eagerly as we had, and luckily they introduced an interesting new wrinkle by designating the Conrad-Johnson Premier Five mono tube amplifier ($3000 each, $6000 a pair) as Bob's target.

An 8-page article by J. Gordon Holt in the October 1985 issue (Vol. 8, No. 6) of *Stereophile* relates in detail what happened next and provides excellent insight into the high-end audiophile subculture's primal anxieties on the subject. First of all, the policymakers of the magazine decided to withhold the identity of the target amplifier; they would not even divulge that it was a vacuum-tube unit with an output transformer or that it cost more than ten times as much as the second-from-the-top Model M-1.0 that Bob selected from the Carver line to "Conrad-Johnsonize" into the M-1.0t. We soon found out from our own sources that the amplifier they used was the C-J Premier 5 (we try hard to keep *our* golden ears to the ground), but the hemming and hawing and rationalizations in the article to explain away the concealment of that enormity are quite depressing. It all comes down to their tacit but clearly evident belief that the whole truth is bad for business. To compensate for such equivocation, the article addresses with ecclesiastical gusto and without the slightest intellectual embarrassment the nonsense moral issue of mimicking other people's sound.

In all fairness, we must go on record here that, in our opinion at least, Gordon Holt has one of the keenest ears in the business, understands the technical aspects of audio quite thoroughly and is 100% honest. Those parts of the article that are politically untrammeled, such as the account of Bob Carver's t-mod procedures and the reporting of the listening tests that followed, can be unhesitatingly taken at face value. Our own, earlier article was a somewhat more rigorous tutorial on the physics and logic of transfer-function duplication, but Gordon's story is basically the same: Bob toiled and tested, there were a few temporary setbacks, but in the end a -70 dB null was obtained between the two bridged amplifiers (in our case it had been -74 dB) and after long-suffering back-and-forth comparisons the two were found to be "sonically identical." We could say, "What else is new, Gordon, baby?" but in fact there were some significant differences between the two t-mod projects and they are worth noting.

To begin with, tube-to-solid-state transfer-function duplication is undoubtedly a greater feat than solid state to solid state, as we already speculated in our first article, and we feel that *Stereophile* deprived Bob Carver of full credit on that count by concealing such a key element of their project. We have always maintained that a truly competent designer who understands tubes and transistors equally well can in a given situation achieve equal black-box results with them, although with very different techniques inside the black boxes. Here was a perfect test of that tenet, but apparently it was impolite to bring it up.

On the other hand, the Conrad-Johnson unit has its own characteristic shortcomings that limited the scope of the exercise; there is no mention in the *Stereophile* article of the input/output null test that figured prominently in the first Carver t-mod project because the results with the C-J would have been quite poor. The output of this amplifier, with its vacuum-tube circuitry and output transformer, does not resemble the input closely enough to produce an impressive input/output null; the amplifier is in effect a mild signal processor rather than "a straight wire with gain" and preferred by certain audiophiles for that very reason. (See the power amplifier recommendations in this issue for our own views on the subject.) Gordon Holt reports that in the penultimate phase of the transfer-function duplication the two amplifiers sounded absolutely identical, except that the Carver unit had better bass definition; Bob had to muddy up the bass of the modified M-1.0 a little bit to make it sound totally indistinguishable from the Conrad-Johnson! Not surprising when you take into account the difference between direct coupling and an output transformer, but too damn bad—because the production version of the Carver M-1.0t incorporates the exact C-J Premier 5 transfer function, warts and all. Bob would not have it any other way; he wanted to prove a point, not give the world a better Conrad-Johnson.

The most amusing difference between the two Carver t-mod projects, however, is that the success of the first gave us a great deal of intellectual gratification, since it was a celebration of the laws of physics and the dictates of common sense, whereas the *Stereophile* people were obviously and miserably unhappy about the success of the second, perceiving it as a deadly blow to the high-end mystique. Every paragraph of Gordon Holt's article exudes a feeling of we-all-wish-it-weren't-true, but he is honest enough and hears well enough to admit that it is indeed all true. With all that resistance to simple truth (not so much by Gordon, as we read it, but by the front office and their cohorts), something eventually had to give, and that brings us to the current state of the Carver amplifier controversy, which is the main reason for this follow-up article.

It's bad for high-end audio, therefore it isn't true.

A long letter by our old friend Harvey Rosenberg (the Tube God of New York Audio Laboratories) in the February 1986 issue (Vol. 9, No. 1) of *Stereophile* sets the tone of subsequent commentary on the subject. Harvey is a with-it guy and immediately points out that **The Audio Critic** was

the first to do a t-mod project with Bob Carver, but then he goes on to state that the production Carver M-1.5t does not sound like the Mark Levinson ML-2, without making it clear (perhaps deliberately) whether or not this perception is based on an A/B listening comparison. He questions Bob's "reformation" as reported by us, brings up once again the ethics of copying somebody else's sound and circulating an unpublished article, challenges Bob to "give us your [own] state-of-the-art stuff if you've got it," and expresses strong doubts about the feasibility of duplicating any experimental Carver amplifier in production. Most significantly, his deepest fears are betrayed when argues that an inexpensive Bob Carver clone of one his tube amplifiers, if it could be done, would actually be good for business. Talk about Don Giovanni inviting the statue to dinner...

A brief answer to a reader's letter in the January 1987 issue (Vol. 10, No. 1) strongly hints at the emerging new *Stereophile* party line: the production Carver M-1.0t does not appear to sound like the laboratory prototype; tests are under way. The denouement comes in the April/May 1987 isssue (Vol. 10, No. 3), where some 14 pages are devoted to the production M-1.0t, including reports by Gordon Holt, John Atkinson and Publisher Larry Archibald, plus a lengthy reply to these by Bob Carver. The gist of the reviewers' message is that the production M-1.0t is sonically distinguishable from the original target amplifier, with some difficulty according to Gordon, easily according to John and necessarily according to Larry. They now admit that the target amplifier was a top-of-the-line vacuum-tube unit (without revealing that it was the C-J Premier 5), which gives Bob the opportunity in his reply to nail them on fundamental procedure.

What happened was that the reviewers compared only two amplifiers, the production M-1.0t and the original C-J, when the scientifically correct procedure would have been to compare three amplifiers, the third being the orginal hand-wired Carver t-mod. The latter had been found one and a half years earlier to sound indistinguishable from the C-J, with a -70 dB null on the bridging test, whereas the production Carver appeared to sound at least slightly different and nulled only an average of -28 dB against the C-J. Even a novice equipment tester should have concluded at that point that there were two distinct possibilities: (1) the production Carver was not a perfect duplicate of the hand-wired prototype or (2) the C-J amplifier was not a perfect duplicate of its older self because of tube aging over a period of one and a half years, a widely known phenomenon. Nothing would have been simpler than to test both possibilities, since Bob had sent the prototype back to the reviewers, but they never touched it, preferring the self-fulfillment of their prophecy of production variations. Bob quietly seethes over this in his letter but remains a gentleman; Larry Archibald has the last word in a postscript that admits the omission and then makes light of it, not very convincingly.

Two issues later (August 1987, i.e., Vol. 10, No. 5), *Stereophile* tries to retire the subject with six letters from readers and a final editorial summation by John Atkinson. One letter is a foul exudation of petty ill will, ignorant disparagement, and provable untruths (who let that one past the wastepaper basket?); the other five are reasonable but not always to the point. John Atkinson does a choplogic postmortem on the key issue of the two-way versus the three-way comparison, takes a gratuitous potshot at Bob's trustworthiness, and then with perceptible irritability declares the matter closed, with Carver advertising thenceforth barred from the pages of the magazine "in response to Carver pressure with respect to the editorial content of *Stereophile*." From reluctantly acknowledged wizard to banished undesirable in 22 months—such was the meteoric rise and fall of Seattle Bob in New Mexico.

All this, in our modest opinion, added up to pretty lightweight audio journalism, quite lacking in credibility no matter what the ultimate truth turns out to be, although we are certain that the project was originally undertaken by the magazine in good faith. Somewhere along the line somebody got cold feet, the *raison d'être* of the high-end business appeared to be threatened and a cop-out mentality crept in.

Meanwhile, in the March/April 1987 issue (Vol. 12, No. 46) of *The Absolute Sound*, the staff member listed as Senior Editor, one John Nork, also reviewed the production M-1.0t. By sheer coincidence, he happens to be one of those prodigies of aural memory referred to above who in 1983 found the M-1.5t inferior to the Mark Levinson ML-2 without needing to listen to both at the same time. By even more remarkable coincidence, he is a former Carver dealer from Indianapolis with a widely reputed grudge against the Carver Corporation. In his M-1.0t review, he magnanimously admits the theoretical possibility of duplicating a highly dissimilar amplifier's sound in the laboratory but then goes into the familiar song and dance about the hopelessness of doing the same in production. Although he, too, seems to have found out that the target amplifier was the Conrad-Johnson Premier Five, he makes no attempt at a comparison, contenting himself with some approved clichés about imaging and soundstaging, after which the M-1.0t emerges as a surprisingly decent amplifier for the money ("substantially better" than the M-1.5t—again strictly from memory) but not really world-class.

We could walk away from this sort of subjective expertizing without comment, since it is exactly on the level of suburban restaurant reviewing, but there are some bitchy remarks in the review about **The Audio Critic**, obviously believed by the author to be mute and incapable of retaliation after all these years, which prompt us to disabuse him of that belief. He refers to our 1983 article on the first Carver t-mod as "the last great journalistic burp from Peter Aczel" and, having established himself with that polished phrase as a literary stylist and *arbiter elegantiarum*, he goes on to characterize the long subhead of that article and another sentence from it as "some of the most narcissistic prose ever to adorn an audio periodical." It appears that John Nork is incapable of recognizing the posture of tongue in cheek (at least when it is your own tongue in your own cheek) and is innocent of rhetorical devices such as hyperbole and

irony, which are not commonly used in either the T-shirted or the polyester-suited retail circles of Indianapolis. We shall have to look elsewhere for stylistic guidance.

What it all adds up to.

Getting back to the basic issue of transfer-function duplication as practiced by Bob Carver and its impact on the world of high-end audio, let us sum up and bring up to date our own observations, insights and conclusions.

First of all, the validity of the t-mod concept remains unassailable. Copying even the most esoteric amplifier's transfer function, and therefore its complete voiceprint or sonic signature, into another, totally dissimilar amplifier is not only "theoretically possible," dear high-end cultists; it is today a common, garden-variety reality. Bob Carver has done it many more times than has been reported in any publication; for example, a year and a half before the M-1.5t project, he did a quick t-mod for us on his old M-400 cube to make it sound like the Bedini Model 25/25. It was not done with the rigor of the later t-mods but it worked, and it was not his first such effort, nor was the Conrad-Johnson job his last.

There are, however, certain common-sense limitations to the Carver t-mod technique that should be understood. The power supply of an amplifier cannot be beefed up in the available space simply by means of some new component parts or a few circuit trims and tweaks. Therefore, for openers, the amplifier to be modified must have a power supply as good as, or better than, that of the reference (or target) amplifier. For example, if the *Stereophile* people had been smart enough to designate the Krell KMA-200 mono amplifier ($8800 a pair) as the reference unit in the Carver amplifier challenge, Bob would have had to throw in the towel in the first round. His amplifier and the Krell are both rated at 200 watts into 8 ohms and 400 watts into 4 ohms, so that the stated conditions of the challenge would have been satisfied. The Krell, however, can deliver 1600 watts into 1 ohm and is not bothered by a load of 0.1 ohm, thanks to Dan D'Agostino's extremist doctrines on power-supply design. The Carver magnetic-field power supply, ingenious as it is, gives up the ghost quite a bit sooner. Even if Bob had been able to make the two units null against each other on the bridging test when driving typical speaker loads at high power levels, an exceptionally nasty low-impedance load (like one of the early Apogee ribbon speakers) would probably have interrupted the null reading from time to time and made the monitor speaker burp. The t-mod would have remained incomplete, and a keen-eared listener would almost surely have heard some sort of difference between the two amplifiers under the above conditions. Does that hypothetical scenario prove anything? Only about power supplies, not about the basic concept of transfer-function duplication.

In general, the amplifier on which the t-mod is being performed must not have any intrinsic, unchangeable design features that limit its maximum performance in comparison with that of the target amplifier. For example, it would be futile to try to copy the transfer function of a DC-coupled amplifier into an amplifier with one or more transformers in its signal path. On the other hand, the DC-coupled amplifier could be easily made to mimic the transformer-coupled unit. The t-mod is not necessarily a two-way street.

Another issue that comes up repeatedly in connection with the t-mod is the "genius" of Bob Carver—that he is so gifted with unique and arcane skills that under his hands the miracle of transfer-function duplication really does take place in the laboratory, but only as a single, isolated, one-time-only occurrence. What rubbish! Bob's highly original and trenchant intellect is more evident in inventions such as the magnetic-field power supply or the asymmetrical charge-coupled FM detector than in the relatively straightforward t-mod procedure, which requires mainly hard work, meticulous attention to detail and iron logic, rather than extraordinary creativity. Bob has expressed to us more than once his astonishment that during all these years of controversy nobody but **The Audio Critic** ever asked him exactly how he does a t-mod. If they had asked him they would have found out, as we did, that it entails little more than a tedious cycle of measure-modify-verify, repeated over and over again many hundreds of times and involving every quantifiable amplifier parameter. No magic, no master-strokes. Needless to say, Bob's complete understanding of electronic circuit behavior and his depth of experience in the t-mod technique enable him to proceed very quickly and surefootedly. He knows exactly how to nudge a circuit a step closer to the desired measurement and he makes few, if any, false moves. Any well-educated engineer, however, should be able to learn his methods and achieve comparable results, even if a bit more slowly and haltingly.

As for the question of the laboratory prototype versus the production model, everybody seems to be missing the main point once again. Let us suppose, just for the sake of argument, that the M-1.0t units coming off the production line do not sound exactly like the hand-wired prototype. If that is the case (which no one has really proved), then what would it take to correct the situation? How about a quality-control engineer whose sole responsibility is the M-1.0t? Let us also give him a crackerjack technician who works for no one else. Now let us upgrade the key component parts in the signal path to audio-cultist brands. Finally, let us "burn in" the finished production units for a solid week. Get the picture? Can we expect the production amplifiers to be exact duplicates of the prototype at this point? Okay, now let us raise the suggested retail price of the M-1.0t so that, in the quantities sold by the Carver Corporation, the additional production costs will be fully covered. We start with the current price of $599. Shall we raise it by $100? By $200? Surely, if we raise it by $401 to end up at $1000 (an absurd idea from the marketing point of view), all extra costs will be doubly and triply amortized. The point is that, even in a *reductio ad absurdum*, we only get to $1000, which is very far from the $6000 price tag of a pair of Conrad-Johnson Premier Fives. So, regardless of Carver's current production standards and practices, the overriding principle remains:

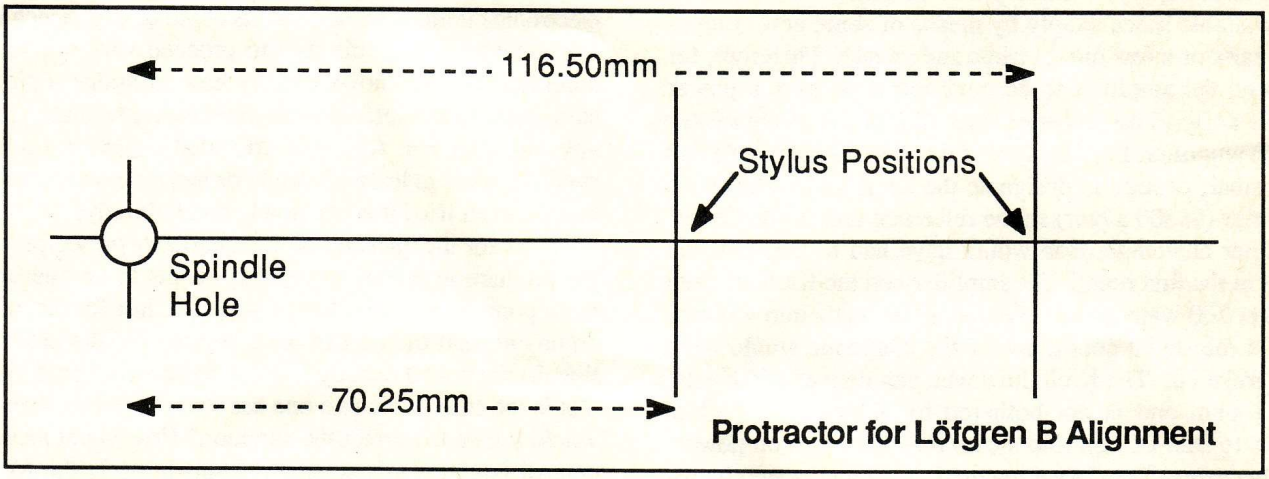
When you buy an amplifier for many thousands of dollars, what you pay for is not the sound. You pay for status, pride of ownership, cosmetic appeal, possibly mechanical ruggedness and long-term durability, in some cases easy servicing and tender loving care by the manufacturer, but not what you actually hear. That is achievable for a lot less money.

Such a conclusion, inevitable as it is in our opinion, should not be hysterically interpreted as undermining every article of faith of the high-end community. Judging from the level indignation in some circles, even mounting to undisguised hatred here and there, Bob Carver is perceived as sending a message of "Who needs you?" to designers and manufacturers of very high-priced amplifiers and "Sucker!" to their customers and admirers. That, of course, is the rankest nonsense. Before there was a Carver M-1.5t, there had to be a Mark Levinson ML-2; before there was a Carver M-1.0t, there had to be a Conrad-Johnson Premier Five; the order could not have been reversed, and there also had to be some brave and well-heeled purchasers of the high-end product, otherwise the issue could not even have arisen. Bob is the first to admit all that. Equipment of this caliber always originates as a concept in sound, valid or not, without any restrictions on the cost of implementation; the problem starts when the makers and owners of the equipment stake off some sort of exclusive claim to that sound by virtue of the price tag. Bob's real message is that there is no such exclusivity because nobody owns, and money cannot buy, a transfer function—and the transfer function *is* the sound.

So where's the review?

One more thing. Since the Conrad-Johnson Premier Five is not our cup of tea, having been engineered as a subtle signal processor to suit certain tastes rather than as a totally neutral conduit, we are not particularly interested in reviewing the Carver M-1.0t. To us it is primarily the proof of a principle, although to lovers of the "tube sound" it appears to be an almost unbelievable windfall. Let them listen to it, argue about it and have fun with it. ◊

See pages 6 to 9.



Protractor for Löfgren B Alignment

This is a bonus filler for those who may be a little bewildered by the article on the "Löfgren B" alignment for optimum lateral tracking geometry and are wondering where to begin the fabrication of a protractor. The above diagram is drawn to scale but not printed accurately enough to be used as a cutout. Make it from scratch out of reasonably stiff cardboard and lay out very accurately the two null radii marked by the "cross hairs." Dimensions are rounded off to the nearest 0.25 mm.

12/17/87

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We report our tests of some of the latest CD players and probe the reasons for the sonic differences, if any.

Our still-remembered objective/subjective reviews of speaker systems are resumed, with particular emphasis on full-range ribbon loudspeakers.

We review the radically new Win phono transducer system in which the stylus directly drives a FET.

An "ultimate" power amplifier, overdesigned and overpriced almost to the point of parody, is reviewed, along with some more reasonable amps, preamps, etc.

We revive our "Records&Recording" department; we introduce a new column that monitors technical misstatements in the audio press; and more features.