Audio

INTERVIEW
AVERY FISHER

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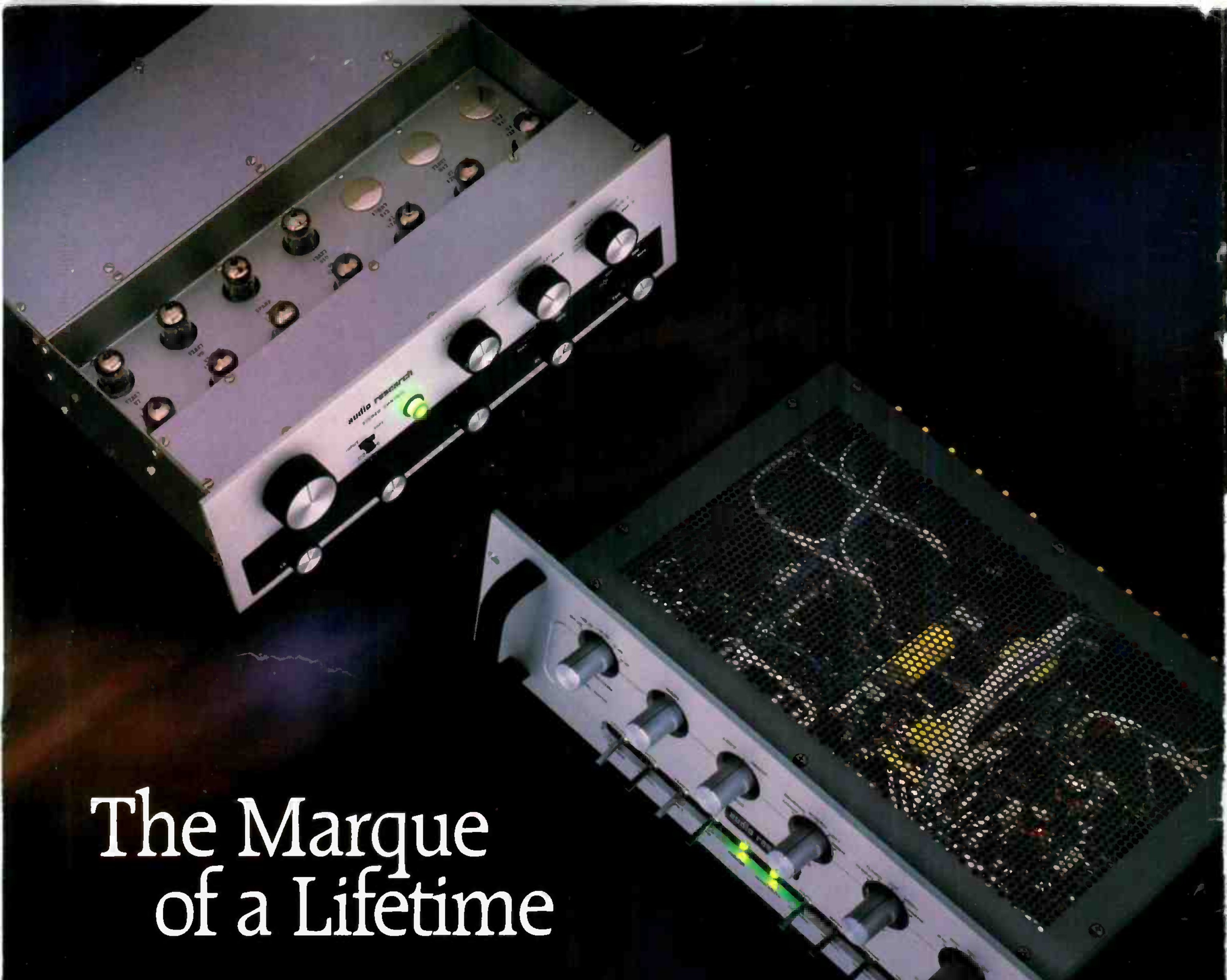

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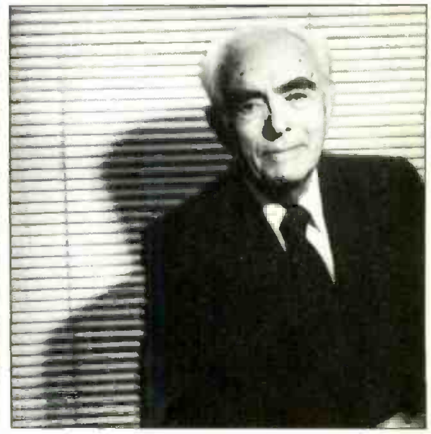
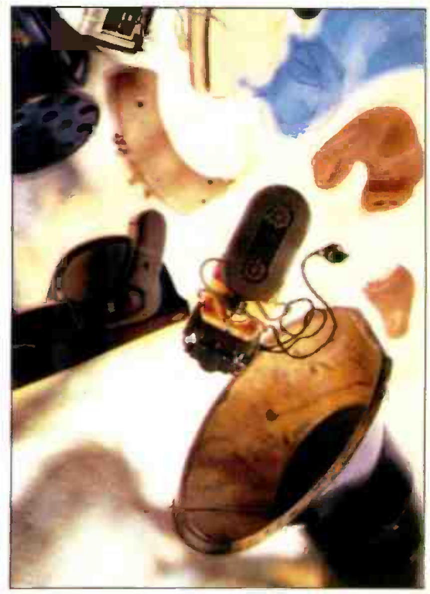
SEPTEMBER 1990 VOL. 74, NO. 9

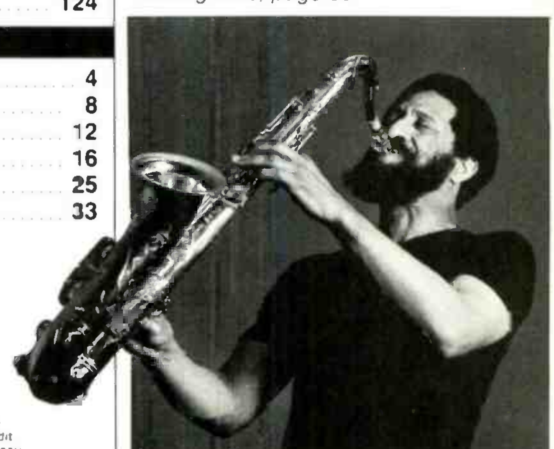
SOTA Turntable, page 58



Avery Fisher, page 48



Hearing Aids, page 38



Sonny Rollins, page 118

FEATURES

EQUIPMENT PROFILES

MUSIC REVIEWS

DEPARTMENTS

The Cover Equipment: SOTA Cosmos turntable, SME 309 tonearm, and Signet OC9 cartridge.
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SIGNALS & NOISE

Congrats on Stats

Dear Editor:

I am writing in response to Herman Burstein's article, "Statistics in A/B Testing: By the Numbers," which appeared in the February 1990 issue.

I am a college student majoring in business and am currently enrolled in a business statistics course. This article opened my eyes to the actual usefulness of statistics, which I began to doubt after a month's worth of boring lectures.

At age 20, I am quite the stereo enthusiast, considering I have already upgraded my entire system. I found your article extremely helpful in showing me that numbers don't necessarily mean anything, unless you can be assured that they are reliable and valid. Thanks for the lesson.

William S. Stranberg
Milwaukee, Wisc.

On Trials

Dear Editor:

I enjoyed Herman Burstein's treatise on statistics immensely ("Statistics in A/B Testing: By the Numbers," February 1990). Thanks to you and to him for the article. His discussion of the differences between a scientifically valid and a statistically reliable experiment has been missing from nearly every other discussion on audible differences and test analysis. However, in discussing sample size, Mr. Burstein implies that the classic A/B/X test is limited to 16 trials and states the procedure was not well studied from an analysis standpoint. That observation does not actually describe the A/B/X method very well.

While 16 trials is suggested as the minimum needed to reduce the probability of Type 1 error to reasonable levels, in actual practice, the magic 16 has been a suggested "session length" and not a "sample size." I compiled a summary of every published double-blind amplifier test, including 16 which employed the A/B/X method (eight from the *SMWTMS Newsletter*, six in *Audio*, compliments of David Clark, and two from *High Fidelity* conducted by Dan Shanefield). Only one contained as few as 16 trials (*Audio*, April 1985). The *SMWTMS* tests ranged from 49 to 253 trials, with an average of 109. The *Audio* A/B/X tests ranged from 16 to 160, with an average of 77. The tests that Dan Shanefield ran for *High Fidelity* each had 40 trials.

One could come to the conclusion from reading Mr. Burstein's article that A/B/X tests are or have been limited to 16 trials. Certainly not so. Most contain multiple listeners or multiple sessions and have both excellent scientific validity and statistical reliability. As in any other experiment, sample size is at the discretion of the experimenter. There is no evidence to support the notion that A/B/X tests have had limited sample sizes and high probability of Type 2 error.

Tom Nousaine
Chicago, Ill.

Author's Reply: It was not my intention to imply that A/B/X tests are or should be limited to 16 trials. It should have been made clearer that larger sample sizes than 16 are desirable and generally used. I had in mind that A/B/X tests are sometimes multiples of 16, such as the same subject tested 16 times on each of two occasions, or several subjects each tested 16 times. Also, it seemed best to deal with a small sample for purposes of illustration. On the other hand, in the section on sample size, I did point out the desirability of larger samples, such as 50 or 32, in examples I gave.—*Herman Burstein*

Gifts with Ribbons

Dear Editor:

I purchased a pair of Bob Carver's Amazing Loudspeakers, a rather difficult achievement considering that top-of-the-line audio equipment does not come cheap. After approximately six months of enjoying these excellent speakers, the ribbons began malfunctioning in the extreme high frequencies. I am sure the loudspeakers could have been repaired, but Bob Carver offered to replace them with brand new loudspeakers. Not only did he replace them, he upgraded them to Carver Platinum Edition Amazing Loudspeakers, which have many improvements and carry a much higher price. "Proudly made in the U.S.A." really means something to Bob Carver and his company.

R. Van Etten
Topeka, Kans.

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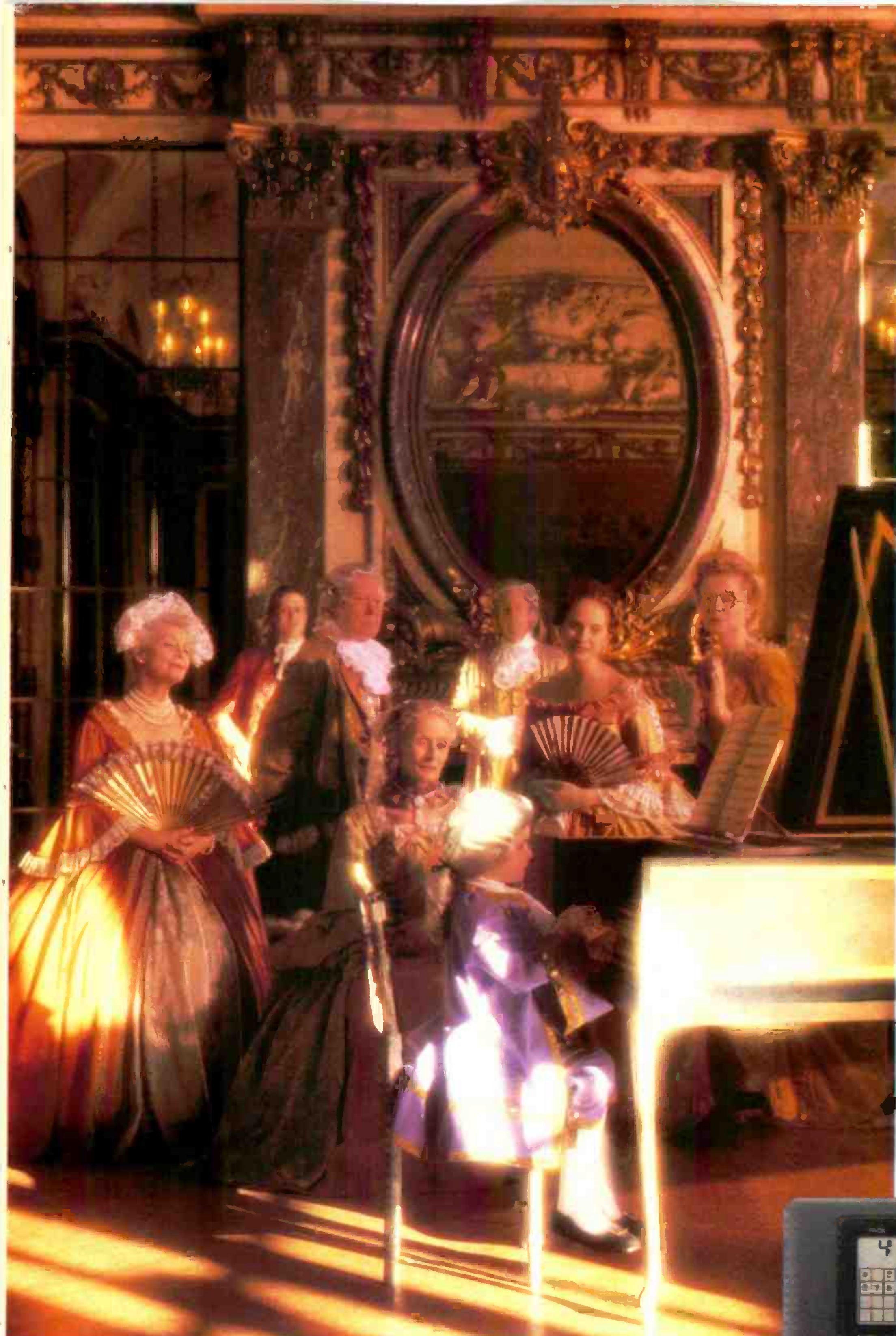

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JOSEPH GIOVANELLI

Duplicating Edison Cylinders

Q. I am in the business of giving talks on the history of recorded music. One question which keeps cropping up is one that I cannot answer: How did the early recording engineers make copies of Edison cylinders? I cannot see where the electroplating process that is used to make modern disc copies could be applied to copying cylinders. Those early pioneers didn't even have electronic amplification to do this with magnetic cutters. —Bill Pollock, Oak Ridge, Tenn.

A. I can shed at least some light as to the manner by which Edison cylinders were copied; there were four methods that come to mind. The first method was for the artist to record every cylinder, one by one. This approach surely didn't guarantee uniformity of performance from one cylinder to the next.

The second approach involved placing a recording horn in front of the playback horn. While playing the master, a second machine was set to record. This is analogous to placing the microphone of a tape recorder in front of the loudspeaker as a recording is played. The results of such a technique are poor, even with flat systems. Can you imagine the problems caused by peaks in the reproducing and recording horns?

The third approach was to use a pantograph: The cylinder was played and the motion of the playback stylus was transferred via leverage to a cutting stylus, which made a copy of the cylinder being played. This system was limited to the number of times the master cylinder could be played, perhaps not more than about 25 times. You can imagine the tremendous loss of highs caused by the mass of the pantograph.

The fourth method by which these cylinders were reproduced was known as the "gold molding" process. The master cylinder was made as usual. Through the use of special molds, the master cylinder was placed within a vessel, and relatively hot wax was poured into a suitable channel. The result was a cylinder which was a copy of the master but with the grooves on its inside wall. The master was then removed. Again, by using a suitable mold, hot wax was poured into this "negative" cylinder. When the wax cooled, it could be separated from the negative. The result was a cylinder which was a "positive"—with grooves on the outside wall, ready for playback. How the master was released from the mold and how the negative was released are steps not known to me; I also have no idea as to how many copies could be made from a single negative or whether the master could be reused. Perhaps some reader would care to shed more light on this.

Digital Outputs

Q. My CD player has a digital output. What do I use it for? I now use the left and right analog outputs, and the player sounds great.—M. Olson, Riverside, Cal.

A. A Compact Disc carries digital pulses that represent the music signal's numerical value at various points in time. The digital signal must be converted to a continuous analog waveform before it can be amplified and played through your speakers. Your player's digital output carries the unconverted signal, while your left and right outputs carry the output from your player's digital-to-analog (D/A) conversion circuitry.

It appears that you have no use for your player's digital output at this time, but you may at some time own components having matching digital inputs that will accept this signal. Such components include stand-alone D/A converters, and preamplifiers and receivers that include their own D/A conversion circuitry. The makers feel that they can produce better converters than are found in most players.

Professional DAT recorders, and the newer home units with SCMS copy-limiting circuits, also have digital inputs to allow direct digital copying from digital sources such as CD. This should provide cleaner sound than first passing the digital signal through a CD player's D/A converter and then passing the analog output of that converter to the recorder's A/D circuit to convert it back to digital form.

Low VCR Audio Output

Q. When I record a program on either of my VCRs and play that recording back through my TV set, the playback level is extremely low, even though the audio levels on the VCRs are set high and are registering high while the programs are being recorded. I have no such problems when I play prerecorded VHS Hi-Fi tapes through my TV set.—G. Lipton, North Woodmere, N.Y.

A. The fact that prerecorded tapes play back fine tells me a couple of things. First, you probably have your VCRs switched to feed the output from the linear audio track, rather than the Hi-Fi tracks, to your sound system. If so, listening to the Hi-Fi output will probably give you more, as well as better, sound.

On most Hi-Fi VCRs, the audio level indicators and the manual level control pertain only to the Hi-Fi tracks; an automatic level control circuit sets levels for linear-track recording. The linear tracks of many prerecorded videotapes are recorded at much higher audio levels than you could get on a home recorder. If your deck does allow manual level control for the linear tracks, try recording with your meters "in the red" and see what happens.

It's also possible that the recording level meters on both VCRs are giving false indications. But with two machines (unless they came from the same batch), that's not terribly likely.

FM Background Noise

Q. I have a two-year-old receiver which has developed a background noise problem in the last few months. This occurs only on FM. The amount of background noise increases the longer the receiver is turned on. The noise is not really loud; in fact, it is only noticeable on "easy listening" or classical music stations, mostly during silences between selections. The noise sounds like a low-frequency "bubbling" or "rumbling." Service technicians have not solved the problem, and some won't admit it's there. Do you have any thoughts regarding this?—Orvis L. Beal, Dallas, Tex.

A. There is no way for me to give you a definite answer as to the source

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

Professional DAT recorders also have digital inputs to allow direct digital copying from a digital source such as CD.

of the background noise. I believe, however, that by answering a couple of questions, you will help find the answer to your problem.

What happens to the background noise if you switch to mono? If there is no way to do this, tune to a station that does not transmit stereophonically. If the monophonic signal also contains the background noise, you will know that the stereo decoder is not the culprit. If the noise is heard in mono, does the signal strength appear to decrease the longer the system runs? If it does, you will know to examine the front-end or the i.f. system. The background noise could be caused by oscillations in either of these. Defective r.f. bypass capacitors could be responsible for this, but poorly soldered connections can't be ruled out. I suppose that the tuner output section could also be defective.

If the background noise does disappear when listening monophonically, we can know with reasonable certainty that the problem lies in the stereo decoding portion of the receiver. It is possible that the tuner is not in step with the 19-kHz pilot frequency. This would mean an incorrect 38-kHz signal, needed to reconstruct the stereo signal. This could cause the background noise. If the frequency error increases as the receiver operates, the background noise will both change in character and increase in intensity.

It could be that all that is needed is to slightly retune the appropriate inductor in the stereo decoder. Caution! Do not turn the inductors in the decoder indiscriminately; obtain a service manual so you can locate where to make the adjustments correctly. Nor should you turn the correct inductor any great amount. Whether or not the noise problem is resolved, you may compromise stereo separation.

Inasmuch as the background sound increases the longer the equipment is turned on, perhaps the value of a resistor is changing as it warms up or the performance of a transistor or IC is deteriorating as it heats up. You may be able to isolate the defective component using sprays designed to cool individual components. After the set has been on for a time, carefully spray individual components. If you spray the defective part, the background noise should decrease as this component is cooled.

You may find that the background noise does not become noticeable with the cover of the receiver removed to expose the electronic components. This is because the components are exposed to the air, and heat doesn't build up. To overcome this, place the cover loosely on the chassis and let heat build up to a point where the noise is obvious. Remove the cover and quickly spray the components, hoping that the noise will continue long enough for the spray, not the fresh air, to silence it.

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TAPE GUIDE

HERMAN BURSTEIN

Parts and Repairs for Old Decks

I've recently received two queries from readers who have old tape decks in need of parts or repair, so perhaps it is time to repeat some recommendations I've given in the past:

- For drive belts and pinch rollers, try Projector-Recorder Belt Corp., Box 176, Route 3, Highway 59, Whitewater, Wisc. 53190.
- For decks or other old equipment requiring other parts or service, help may be available from Acoustatronic Laboratories, which specializes in renovating and modifying old, high-quality audio components. Their address is 140-11A Cherry Ave., Flushing, N.Y. 11355.

Playing Old Tapes

Q. I have a considerable number of recorded cassettes that have not been touched for years and am wondering about their condition. Would the tape layers bond together? Would the oxide chip off? Can you recommend any steps for preservation of my collection?—Tyler Roberge, Prince Edward Island, Canada

A. If your long-stored cassettes have not been subjected to extremes of heat or cold or humidity, chances are that they will perform satisfactorily. It is unlikely that the tape layers have bonded or that the oxide has flaked. However, the tapes may have acquired a physical set as well as developed print-through. Therefore, it is advisable that prior to using them again you put them through fast-wind and rewind or, better yet, operate them in both directions at normal operating speed. For proper protection of a collection, cassettes should be stored on end, kept away from extremes of temperature and humidity, and wound and rewound at least once a year.

Double Trouble

Q. In the past five years, I have experienced the same problem with two cassette decks made by different manufacturers. When recording, all appears normal. During playback, there is static, and the deck's meter display is erratic; sometimes, one channel drops out completely and then pops in again. In the case of one of the decks, pressing hard on some of the buttons causes the static to start and to disappear; probably pressure on the buttons is causing the circuit board to flex. The tapes sound fine when played on other decks. I haven't taken either of my cassette decks to a repair shop because the problem is intermittent and because I have had a few bad experiences with the repair shops in my town.—Chris Pillar, Anchorage, Alaska

A. Apparently, the long arm of coincidence has reached you. My best guess is that there is poor soldering somewhere in the playback circuit or a hairline break in a circuit-board connection. If you are up to this kind of thing, you might visually check the playback circuit board for poor solder joints, which are usually dull and grayish instead of bright and shiny, and resolder them. If you see nothing, you might *carefully* go over all the solder connections in the hope that they are causing the problem. A magnifying glass might help you find hairline breaks.

Binaural Miking

Q. In the March 1986 issue of Audio, an article on the history of binaural recording suggests putting two omni mikes on stands 7 inches apart with a quarter-inch-thick, 4 × 6-inch board between them. Wouldn't you get just mono sound with the mikes so close together? As one mike disappears behind the board when the sound source moves left or right, wouldn't the board chop some frequencies more than others?—Ken Thorberg, Duluth, Minn.

A. The spacing between the two mikes and the board between them are intended to simulate a human head and ears. This will not result in mono sound; it will result in binaural sound, intended to be heard through earphones, with (approximately and hopefully) the same perception of width, depth, and location of sound as human hearing provides. Yes, the board will "chop" some frequencies as the sound comes well from the left or right. But this is the same effect as caused by the human head.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1633 Broadway, New York, N.Y. 10019. All letters are answered. Please enclose a stamped, self-addressed envelope.

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EDWARD TATNALL CANBY

HANDS-ON HISTORY

Illustration: Ed Miliano

And I quote: "Imagine a museum in which almost everything works!" (This is from the June 1989 article by Peter Hammar in the *Journal of the Audio Engineering Society* concerning the John T. Mullin Collection of historical audio, as mentioned last month.) That is the very soul of the museum as it is conceived today—even including the art museum.

By "work" we mean that the object in question gives us a real and vivid idea of its own state of existence in its time. Often this requires restoration. If the original involved motion—the phonograph record, for instance—then the museum's job is to give just that sense, one way or another. Today, the thing must "work," whether it is a painting, a locomotive, or a piece of audio equipment. You must have heard of the enormous flap over the recent restoration of the Sistine Chapel. Problems—there are always problems. But if you look at *National Geographic*, which showed the magnificent and brilliant results, you will understand that the "preservation" of older art exactly *as is*, until the stuff is barely intelligible due to time's destructive forces, is an idea that is over and done with. Almost. There will always be sticklers. Luckily for all of us, they are losing ground. The modern type of museum is much more interesting. That's why I am promoting, as well as I can, a real national Audio Museum and Hall of Fame. Or the same by any other name, if you wish. It's bound to happen, sooner or later, and you may be sure that everything in it will work, as far as ingenuity and expertise will allow.

In my time (as we say when we get to a certain age), I have seen all too much of the opposite. In the early 1920s, when I was a child, I was taken to the Steinert Collection of ancient musical instruments at Yale. It was a typical 19th-century museum, a dingy, musty hodgepodge of all sorts of priceless old machines shown exactly as they had *become*, over centuries of neglect in assorted attics and cellars and back closets. There were harpsichords, clavichords, and virginals, blackened and decayed, with the remains of the strings hanging out loosely. The same for the rest. Just a musical dump, as I remember it. Even at that age, I was shocked—I already had discovered that I liked the sound of keyboard instruments even if I couldn't play them, and I was saddened to see these instruments in such disrepair.

Needless to say, that situation has since been remedied! (*Editor's Note:* See "Enduring Instruments: Treasures from the Yale Collection," written by David Lander and photographed by Robert Lewis, in the February 1989 issue.) I have a feeling that the harpsichordist Ralph Kirkpatrick was in charge of much of the long process of restoration that made this museum "work" in the musical sense. That 1920s jangling jumble of junk would be unthinkable today in any public presentation.

Yet in 1956, 30-odd years later, I paid a visit to the British Museum to pass away a rainy day in London. No doubt that worthy institution is still a scholars' mecca—it dates from the beginning of all museums as such, far back in the 19th century. But what I saw that day in 1956 was even more shocking than the music collection at Yale: Row after row, room after room of dingy, waist-high glass cases filled with what seemed a total mess—hundreds, thousands of bits and pieces of this and that, broken crockery, metal, who knows what. Unbelievable! No *presentation* whatsoever. Just *collection*. Yet it was open to the public. In comparison, the famous Louvre in Paris, also a vast repository of a million works of art, with paintings jammed together from floor to ceiling, still managed to convey a certain realness. The French touch. I enjoyed the Louvre! Or some of it—maybe 5%. After a few dozen rooms, if you have any sense, you quit. And go again another day.

Believe it or not, the idea of a "working" museum, a presentation, is relatively new. New in terms of history. In 1929, I visited Munich, Germany—before Hitler had made himself more than a local phenomenon—and instantly repaired to the Deutsches Museum, an absolutely incredible place where everything, *everything*, worked. If I am right, it was the first of its kind in the world. It covered just about everything German, from mining to music. I remember a whole segment of a working coal mine, through which you could walk or crawl. There were countless exhibits where you could press buttons and make things go, or have a try yourself at, say, a spinning wheel. For a kid this was heaven! My brother and I spent days in that place, detaching ourselves from our father, who had business elsewhere. I remember noth-

ing else whatsoever about Munich. My greatest thrill, in those many hours, came when I casually entered the music collection, and there were dozens and dozens of beautiful ancient instruments, meticulously restored and *playable*. Better still, you, the passerby, were allowed to try them out. That was the first time I ever heard the sound of a harpsichord, so common today. A few years later, I heard the first public recital on Harvard University's newly restored instruments. The "working" idea was spreading fast. I have not yet gotten over my youthful passion for the sound of these old instruments and each new advance. The fortepiano, the piano of Mozart and Beethoven's day, still has me enthralled.

All this, you see, is why I was enthused by the very idea of the Mullin Collection. It is indeed the prototype of what any larger, more public, and more permanently managed audio museum venture should be. Mr. Mullin has done it entirely on his own, as both the owner and the expert engineer and restorer. It's a sort of Murphy's Law in reverse—everything that *can* work, *does*. With the addition of a lot of large-scale exhibits, such as the broadcast studio scene I suggested last month, this is indeed our prototype for an up-to-date historical audio display—authoritative, operating impeccably, open to the public, and intended *for* the public as well as private scholars and researchers.

As for my own audio collection, covering approximately 60 years at this point, it is no better than the British Museum. Or, shall I say, the town dump near my Connecticut home. Indeed, the dump has long been a favorite visiting place for our resident population, and not merely to leave more junk. Those immense piles of flotsam and jetsam (whatever that is), those zany cookstoves sticking their legs out at 45° angles on top of heaps of old lawn mowers, broken shovels, hair curlers—you know the picture—are far more interesting and dramatic than was the British Museum in 1956. (Let us hope it is improved for 1990.) Also more visible, out in the daylight.

My own collection is awful, though I am not ashamed. I am no restoration engineer. You must climb up a rickety folding ladder into the attic to get near most of it, and there is only a crawl space, ill lighted, as you inch around the open chasm abruptly leading to the floor below. Back in the far corners, under the sloping roof, are "priceless" piles of expensive and once-state-of-the-art tonearms, unworkable turntables, half-eviscerated amps, and dingy speakers with notes stuck on here and there: ONE CHANNEL DEAD or TWEETER BUSTED. This entire heap of relics, someday, should be evaluated, pruned, and *restored* for that envisioned audio museum.

Photographs of the Mullin Collection: Courtesy of Larry Zide

Actually, my real "museum" is in my head, sheer memory. I have been "restoring" a great deal of it in these columns over the years, and there's a new gleam in my eye as I look at the list of exhibits in the portion of the John T. Mullin Show (pardon me, Collection) which was bodily transported by the AES to New York back in 1988 for display at Convention time.

Hey, I played around with some of those myself! Imagine it. Maybe I can add some informal and unmuseumlike bits of lore? Nothing like having your hands on a "working" piece of equipment, whether you are amateur, critic, or professional.

Indeed I've already described one item, the unthinkable Webcor (Webster-Chicago) Wire Recorder, and I doubt if any other living person can match my account of *that* utterly frustrating machine (January 1988). Jack Mullin has one. It works, we can assume, though it's hardly worth the trouble. If you read my account, then you'll see why.

Jack Mullin has the Old Original—in a more modern reproduction. I mean, the tinfoil phonograph of 1877. Could this be the spanking new phono that we sported on our cover for that celebrated 100th anniversary? Ask the Editor—he did it. (*Editor's Note*: Actually, the Editor didn't "do it." The unit pictured on that cover was a beautiful reproduction, made by Peter Hillman from a set of plans he purchased at the Edison Monument in West Orange, N.J. Hillman wrote a "review" of his unit, which appeared in December 1977, and when I talked with him a few months ago, he said he still had the model.—*E.P.*) In 1977, I visited the last Edison factory, now a kind of museum, and looked upon another spanking new exact replica, not the original. To my shock (as recounted here at the time), I then discovered the *actual original*, musty and covered with dirt, placed haphazardly in an inconspicuous corner, very much unrestored. There you have the old museum versus the new! I sincerely hope that the Edison people have done something about that by now, 13 years later.

Do I have memories of the Victor Orthophonic Victrola! It was totally acoustic, 1926, but was designed with extraordinary expertise to accommodate the new electrical recordings then being quietly introduced (not to disturb the market too quickly). Everything you hear about that machine was true. For the time, its sound was unbelievable and indeed the very best on the commercial market. The earliest electronic phonographs were opposites of the older acoustic machines—all tubby bass and dismally lacking in treble. The Orthophonic still had the treble, as good as it came, and thanks to an astonishing, folded exponential horn built inside the case, it had a range of bass that was startling after the tinny, older acoustic models, even the fanciest. (I can still hear that shrill little voice coming out of my uncle's big expensive console Victrola of an earlier year.) As previously recounted, we had several of these machines at the prep school I attended, and on them I learned the César Franck Symphony, the Brahms Third, and plenty more, playing them over and over again. I think I still hear them Orthophonically. I missed hearing Mullin's restored Orth-

All tubby bass and dismally lacking treble, most early electronic phonographs seemed opposites of their acoustic predecessors.

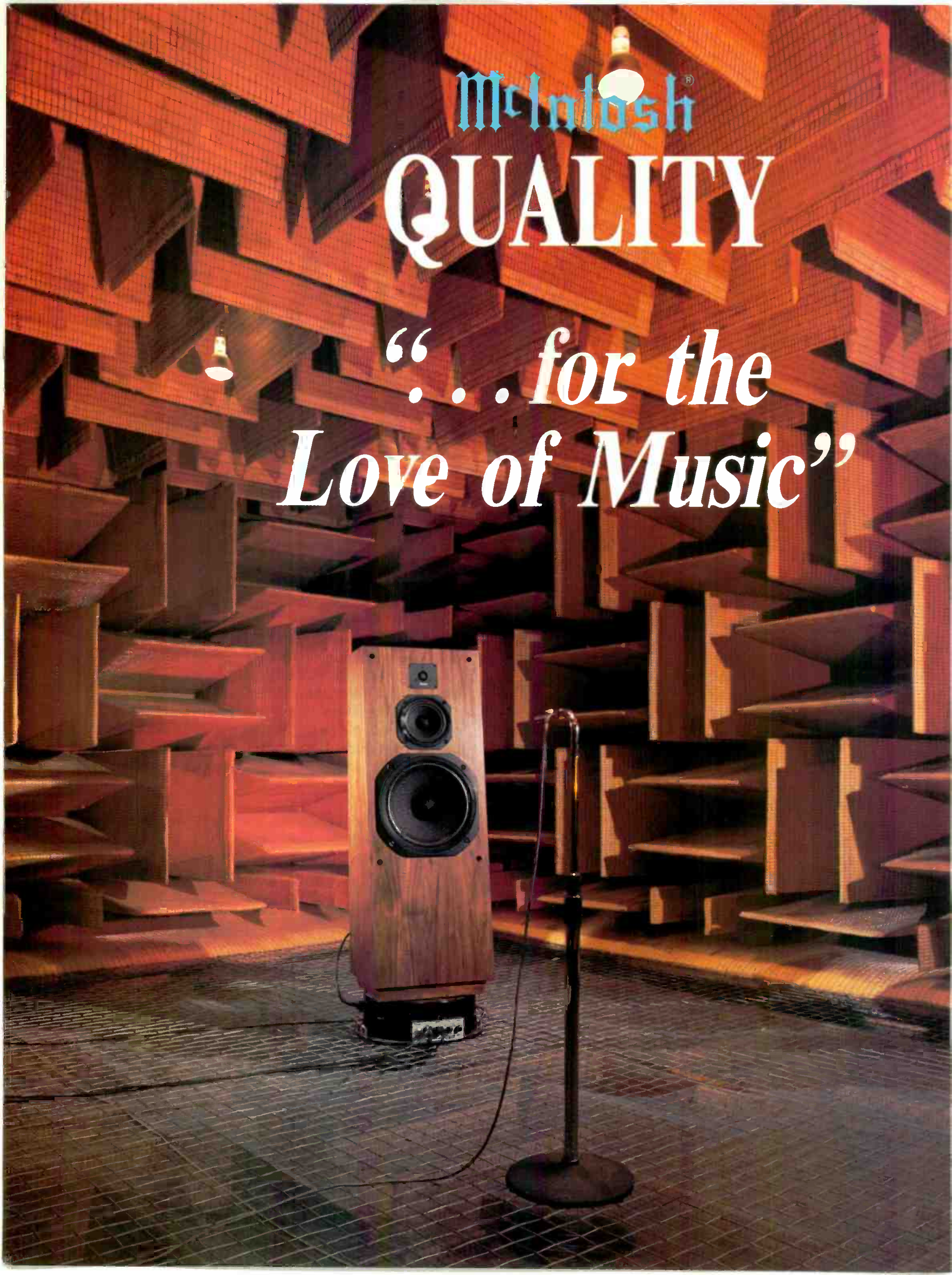
ophonic and would give my wisdom teeth, if I had some, for a good, leisurely listen. I'll bet it "works."

Jack has a Vitaphone recording lathe, same year, 1926, used with 16-inch discs at 33⅓ rpm for the first electrical talking pictures. I heard a very early demo of the Vitaphone less than a year later, in January 1927. It was held in a small improvised theater space at the New Haven Century of Progress Exposition of that year. I seem to disagree with some accounts of that pioneer film—to the best of my knowledge and memory it was old Fritz Kreisler, the hammiest violinist you'll ever see (and one of the best), who played the icky old potboiler "Humoresque" for Vitaphone. Whoever he was, it was a fat, leering figure that I saw on that screen, showing off like crazy as we *looked* at him and simultaneously *heard* him. The whole thing lasted only a few moments—maybe there was more that I forget. So, you see, I heard the very first public talking picture, not yet commercial, in prototype demo. Good start toward today.

Following on that, Mullin has a 1929 Western Electric Radio Transcription Recorder, reorienting the Vitaphone system toward "long play" radio material. Fifteen minutes a side. The speed and size were the same as Vitaphone, and we still have that speed today in the LP, though the ETs (Electrical Transcriptions) are now only in libraries. Or museums. My great exploration of early FM (in 1943 to 1946) found me in the middle of a huge rental collection of those ETs, both laterally and vertically cut, pressed on plastic, some of them on clear red vinyl. Far ahead of the 78 shellac! With the WE 9A reproducer head, wide-range vertical or lateral. The ET reigned supreme in radio until tape came along. Indeed, there was even a brief spate of 16-inch, 33⅓-rpm consumer long-play discs just before the LP appeared. Few remember this—the LP system was so much more suitable for home use and so ingeniously engineered that the big home discs vanished instantly. I might have one in the back of my attic.

I'll postpone a later miracle, the Cook "binaural" (i.e., stereo) disc—boy, did I try that system! It too vanished instantly in the face of the far more ingenious 45/45 stereo LP. Fun to play with, and Mullin has a working system; I have one disc. Must have sent the double arm back to the factory. Earlier, there was the fabulous Capehart console for 78s, automatic play. Everybody who was anybody (i.e., had cash) owned a Capehart because it was expensive, with rare woods, etc. It actually flipped the fragile 78s mechanically and only broke a few, in spite of many a legend. Rolls-Royce? Infiniti? I saw, but never owned. Amen.

Jack Mullin has a Capehart, and it still works. Want some albums for it to chew up, Jack? I have plenty.


McIntosh®
QUALITY
"...for the Love of Music"

XR 240 Walnut

McIntosh® QUALITY

McIntosh Loudspeakers are designed to meet the demands of digital recording. The freedom from the distraction of background hiss, noise, clicks and the purity of the loudest crescendos on the compact disc focuses attention to the pure acoustical events in music. When listening to a compact disc, the slightest non-musical imperfections stand out. Now, truly, the burden of balance, accuracy and clarity rests almost entirely on the loudspeaker. From the softest whisper to the loudest passage, the sound field must be extremely accurate. These Loudspeakers have been designed to meet this need. The systems take up very little floor space and are attractively styled.

The sound field is smooth, not only in front of the system, but also as it radiates both horizontally and vertically. This, and the proper arrival time, enables a stereo pair to track the original sound field created by the music producing artist with all the depth, spaciousness and imaging of the original. Even some older stereo recordings can reveal a spaciousness and clarity not heard before on lesser loudspeakers. The sound stage of these speaker pairs is simply unsurpassed for accuracy.

Crossover network for the XR 240

Performance like this did not develop by accident. Years of painstaking measuring and listening, the ultimate form of measuring, combine to produce these design results.

In each driver design, there are many variables that the loudspeaker scientist must satisfy. The size, mass, stiffness and shape of the radiation surface as well as the suspension linearity and magnetic field flux must all be optimized to work together.

It is the correct combination of these and many other factors that give drivers the lowest possible intermodulation distortion. Absence of intermodulation translates directly into clarity. Without this foundation, the correct reproduced musical information that achieves unparralleled ease of listening would not be possible. The absence of "loudspeaker sound" frees you from the distraction of a "loudspeaker presence" and takes you right through to the recorded musical origin.

The XR 240 and XR 230 are three-way systems that have excellent dispersion. Each has a high power handling woofer, (ten inch in the XR 230, twelve inch in the XR 240), a carefully matched midrange driver and a one-inch tweeter. A complex and extensive crossover accurately blends the drivers together.

Each driver is designed to work best in its frequency range. At low frequencies a woofer with large cone area and long linear excursion is required. The cone must remain rigid and not "break up" into independent modes of vibration. The mass of the

Handcrafted with pride in the United States

The McIntosh XR240 and XR230

Two New Speaker Designs

XR 230 Walnut

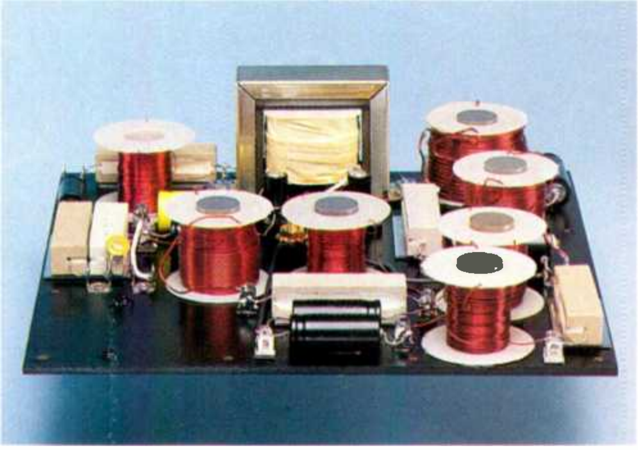
moving parts must be as low as possible, yet constructed in a way that will not allow these independent vibration modes to appear. The magnetic gap must supply the required force at 20Hz, the lowest operating frequency. The upper woofer's limiting frequency is where the woofer's radiation becomes directional.

Above the woofer's operating range, the dividing network transfers the driving power from the amplifier to the 5-inch midrange. The smaller diameter and lower moving mass allow this driver to move effectively without breakup.

Above the midrange the crossover network again transfers the energy; this time to the 1-inch dome tweeter. Its very small relative diameter and extremely small moving mass permits it to efficiently radiate high frequencies up to 20,000Hz.

The three loudspeakers, woofer, midrange and tweeter are all connected by the crossover network. The McIntosh crossover network has these additional tasks to perform: smooth the response in the active pass band of sound for each speaker, minimize the interference between speakers, and present a uniform sound arrival time to the listener. A loudspeaker that can deliver ideal depth, spaciousness and three-dimensional sound space requires a crossover network that is very exacting and meticulous. These measurements are possible only in a FULL SIZE ANECHOIC CHAMBER to assure the exactness of the circuit and component selection. McIntosh Laboratory, in its own acoustical research laboratory, built a chamber in 1979.

The cabinets for the XR 240 and XR 230 are constructed of veneer covered, high density (45 pounds per cubic foot) non-resonant particle board. The exterior is available in three different veneers: walnut, oak, or black lacquered ash. The wood finishes are of an exceptional quality that creates an outstanding blend of sheen, color and depth of grain.



Crossover network for the XR 230

Oak Walnut Black

by dedicated, highly trained craftspeople.

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A New Amplifier Designed For A New Age of Home Entertainment and Commercial Sound.

The MC 2600 stereo power amplifier is the finest amplifier offered by McIntosh. It is the product of more than 40 years of technology and design experience at building the best audio amplifiers. Some of the features which entitle it to be called McIntosh's finest:

- 600 watts/channel stereo or 1200 watts mono continuous average power output—the most powerful amplifier ever built by McIntosh for home entertainment.

- Less than 0.005% total harmonic distortion at any power level from 250 milliwatts to rated power from 20Hz to 20,000Hz—the lowest distortion rating McIntosh has guaranteed for any power amplifier.

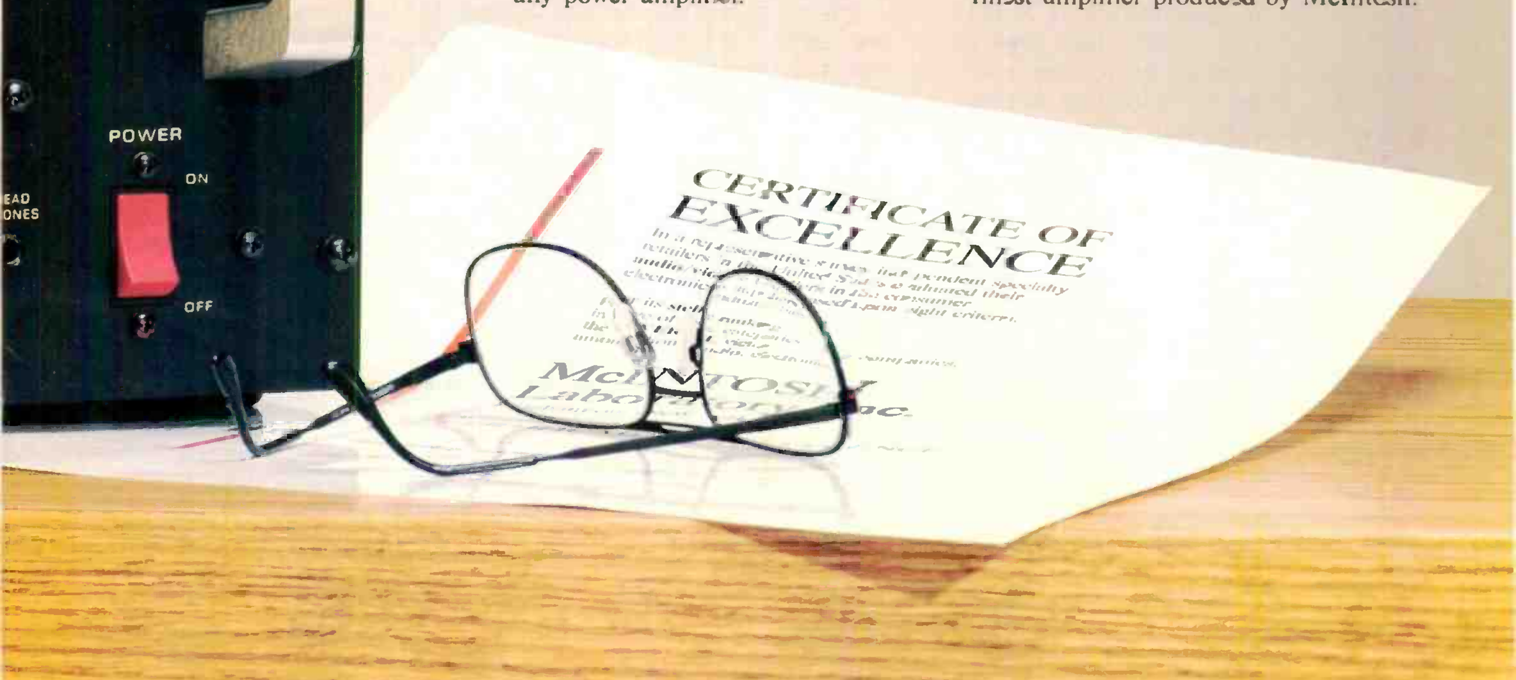
- 2200 watts/channel stereo or 4400 watts mono dynamic power output into low impedance loads (loads of 20% of the rated load impedance)—the greatest power margin ever obtained.

- Over 100 amperes/channel stereo or 200 amperes mono output current (into 0.4 ohm load stereo or 0.2 ohm load mono using dynamic power test method).

- The McIntosh patented exclusive POWER GUARD output circuit prevents amplifier clipping with its undesirable distortion.

- Huge gold plated output terminals will accept speaker cables up to 0.25 inches in diameter.

The distortion free, brute force power of the McIntosh MC 2600 makes it truly the finest amplifier produced by McIntosh.



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JOHN EARGLE

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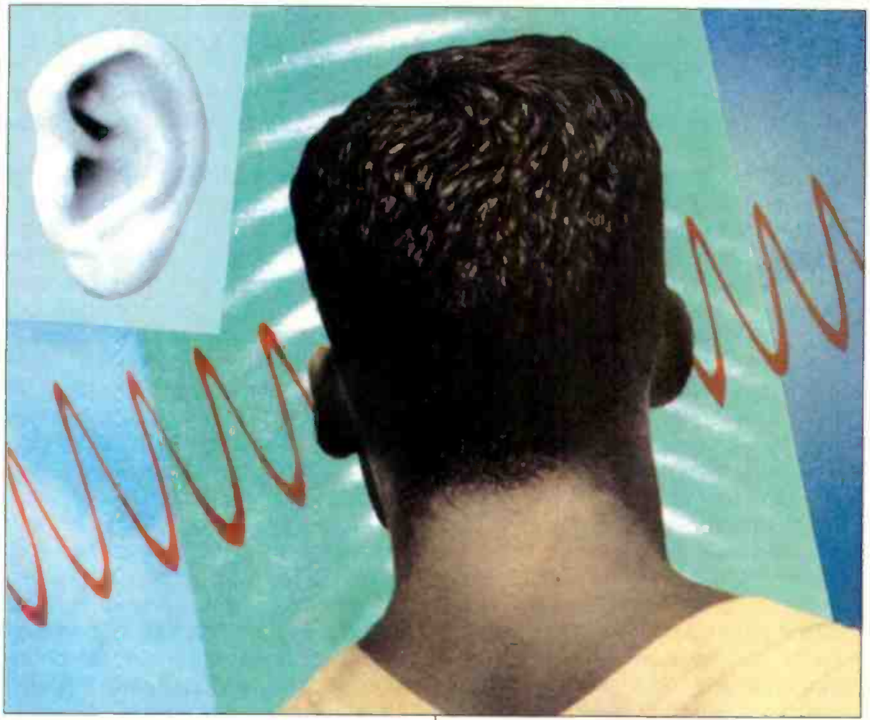

Collage: *Victoria Kann*

The "Sound of Audio" was the subject of the eighth International Conference presented by the Audio Engineering Society this past May in Washington, D.C. Subtitled Perception and Measurement, Recording and Reproduction, the conference covered virtually all aspects of audio technology that bear on our understanding of current and future developments in the field.

The chairman of the conference was Skip Pizzi, of National Public Radio, and the papers chairman was Floyd Toole, of the National Research Council of Canada. Special thanks go to these men for organizing the conference and pulling together facilities, demonstrations, and appropriate distinguished chairmen for the various informative sessions.

One of the ground rules was that each speaker was expected to submit a paper suitable for preprinting. These were duplicated, and a bound set was presented to each of the nearly 200 attendees. The complete manuscripts, with any changes or additions, will be published by the AES later this year and will be available for general sale. *Audio* readers should keep their eyes open for this valuable collection of convention proceedings.

In addition to the seven major sessions, various audio demonstrations illustrated many of the effects and techniques that were discussed during the actual sessions. Some of these point clearly to possible new developments in consumer electronics, while others represent variations on currently available technology.

The first session, chaired by Louis Fielder of Dolby Laboratories, was titled "Perceiving the Sound of Audio." Neil Viemeister of the University of Minnesota began the conference with an overview of psychoacoustics and auditory perception. Viemeister described the nature of hearing sensitivity, and it may surprise readers of *Audio* to learn that the ear responds, at its lowest threshold, to eardrum displacement about $1/100$ the diameter of a hydrogen molecule! The upper limit is some 120 dB greater, representing an intensity ratio of 10^{12} to 1. This is all the more astounding when we remember that the "front-end" of the ear relies on mechanical leverage between the eardrum and the inner ear. Viemeister's discussion continued with the temporal aspects of hearing, pointing out the ears' remarkable ability to sort out timing differences between them on the order of a few microseconds. Viemeister's presentation continued with discussions focusing on loudness and pitch perception.

Frederic Wightman, of the University of Wisconsin, discussed aspects of hearing in three dimensions. The classical aspects of lateral localization with emphasis on arrival time and intensity differences at the ears were reviewed as a prerequisite to a discussion of recent experiments that emphasize the importance of the pinna (the outer structure of the ear) in providing cues for fore/aft and up/down localization of sound sources. Essentially, the convolutions of the pinnae provide significant spectral shaping of sounds as a function of both lateral and vertical angles. Also, the specific frequency shaping is virtually unique to each person, providing a consistent frame of reference by which each person learns to assign directions.

William Hartmann, of Michigan State University, closed the first session with a paper on localization of sound sources in a room. In real-world situations, there are always reflections that both enhance our appreciation of the environment around us and interfere with our localization efforts. For example, it is difficult to localize the source of a sine wave, since small amounts of reflected sound can profoundly alter the phase relationships of that signal at the two ears. On the other hand, the source of a complex signal such as pink noise can usually be accurately localized, primarily by timing information coming from the many microtransients that the signal contains. A good bit of the time, we are only marginally sure of our localization judgments, but this suffices in many listening situations where our attention may be drawn to other aspects of audition. In that sense, our localization techniques are adaptive, providing us an important ability to relearn quickly in difficult environments.

Don Keele, Senior Editor of *Audio*, was the chairman for the second session, "Measuring the Sound of Audio." The first speaker, Richard Cabot, of Audio Precision, discussed audible effects versus objective measurements in the electrical signal path. In a paper noted for its detail and extensive bibliography, Cabot discussed the many forms of both linear and nonlinear dis-

In his slide tour of concert hall design, David Klepper emphasized the various acoustical and commercial trade-offs involved.

tortion that can intrude on the audio signal. The audibility of various types of distortion is dependent on certain thresholds, and of course the annoyance of a given type of distortion depends as well on conditioning and learning. Both audibility and annoyance are subject to a variety of masking effects by the program itself.

David Klepper, of KMK Associates, then discussed the basic relationships between live music and architectural acoustics. Klepper presented a slide tour of modern concert hall design, with emphasis on the many acoustical and commercial trade-offs involved. The balance between reverberation time, early reflections, and ratios of direct to reflected sound are the objective measurements leading to subjective descriptions such as intimacy, warmth, clarity, etc. As halls become larger, and as they are called on to fulfill other purposes, music requirements per se run the risk of being shortchanged. The skillful acoustical consultant is one who can minimize the maximum risk.

John Bradley, of the National Research Council of Canada, discussed methods of quantifying auditorium acoustics. Such terms as *deutlichkeit* (clarity), running liveness, and center time are measurements of clarity and definition of music. All are relatively simple measurements and represent single-number descriptors of the effectiveness of a given hall for the performance of music. Such terms as clarity index, articulation index, and speech transmission index are all objective measures of the effectiveness of speech communication in an auditorium. Again, these are all relatively simple measurements whose accuracy can be borne out in actual syllable articulation tests. Bradley stated that there is a relatively small number of measurements necessary to explain the bulk of subjective assessment of auditorium acoustics. These in turn have led to new parameters which can only lead to more predictable halls for music and speech.

As you can see, the first day was a busy one. But it wasn't quite over. That evening, Floyd Toole moderated a panel discussion on the reviewing of audio products. Panelists included Don Keele, Ed Foster, Julian Hirsch, Len Feldman, John Atkinson, Peter Aczel, David Clark, and David Ranada. In lively interplay with the audience, the reviewers provided insight into their methods of and criteria for equipment evaluation.

At the same time, the demonstration rooms were up and running. Some of the interesting exhibits there included Dolby Surround decoding, Ambisonics, various artificial-head recording methods, synthesizing images over headphones with variable height as well as left-right positioning, and a number of loudspeaker crosstalk cancelling schemes that produced very clear out-of-bounds (to the side) localization for listeners seated on the median plane.

David Clark demonstrated an automotive stereo system which had a delayed center loudspeaker for keeping the phantom center image from collapsing to the nearest loudspeaker. Additional delays from a set of four side and back loudspeakers filled in early reflections one might hear in a typical living room.

The second day got underway with a paper by Floyd Toole on loudspeakers and rooms for stereophonic sound reproduction. His paper, which was actually a continuation of the first afternoon's session, dealt with the many effects of room boundary conditions on loudspeaker performance. In addition to affecting the low-frequency loading on the loudspeakers, the boundary characteristics determine reverberation time and may provide significant discrete reflections. The relative positions of the loudspeakers and the listener can also bring into play profound response aberrations due to the normal, or preferred, low-frequency modes of the room. By way of practical advice, Toole outlined methods for analyzing the mode structure of the room and repositioning the loudspeakers to alleviate the modal problems.

Recordings themselves are a major problem in attaining the ultimate listening experience, since there is such variation between them in terms of spatial relationships and integration of hall (studio) sound with direct sound. A recurring theme throughout Toole's presentation was "to close the loop" between the recording (input) and playback (output) processes by involving the recording engineer and producer in analytical evaluations of the playback process.

Daniel Queen, of Daniel Queen Associates, was chairman of the third session, which was titled "Subjective Evaluations of the Sound of Audio." Floyd Toole presented a paper on identifying and controlling the variables in loudspeaker subjective testing. The following physical variables are significant: The listening room itself, loudspeaker position, the listener position, relative loudness, absolute loudness, program material, electronic imperfections, electroacoustical imperfections, and whether the music is presented in stereo or mono (both are important). He further cited the following psychological and physiological variables: Knowledge of the products, familiarity with the program material, familiarity with the room, familiarity with the task at hand, judgment ability or aptitude, experience, and listener interaction and group pressure. Obviously, the experimental setup must take all these variables into effect and somehow neutralize them so that they do not significantly bias the tests.

Continuing in the same vein, Søren Bech, of the Technical University of Denmark, outlined in great detail the statistical methods used in structuring loudspeaker listening tests so that all undesired variables were equalized out of the tests.

At the conclusion of this session, consultant Tom Nousaine and Stanley Lipshitz, of the University of Waterloo in Canada, gave the audience their reflections on the "Great Debate" of the past decade—the *presumed audibility* of differences between electronics and the *inaudibility* of the same differences when subjected to double-blind tests.

Double-blind testing is a procedure in which neither the listener nor the person administering the test knows which of two amplifiers is which. In the normal testing setup, the two amplifiers appear as A and B on a switchbox. The listener can hear A and B as often as necessary to form a judgment. Then, at the moment of truth, the listener presses a button marked X. X is either A or B, and the task for the listener is to identify which it is. If there truly is an audible difference btween A and B, then the task of identifying X

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Mozart

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In October, we will send you the 12 CD set of **The 41 Symphonies** to audition in your home Free for 15 days. Performed by The Academy of St. Martin-in-the-Fields under Sir Neville Marriner, you will receive "The Jupiter", "The Haffner", in fact, all the glorious symphonic works Mozart wrote (1-41). Each month thereafter, and continuing as long as you maintain your series subscription, we will ship additional volumes, each for your Free 15 day audition. You may cancel your subscription at any time.

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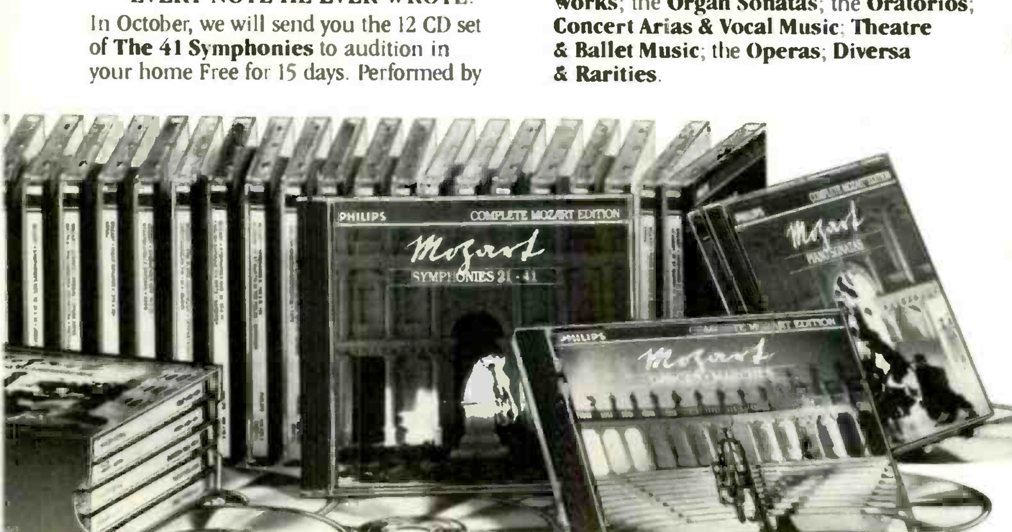

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Demonstration rooms were up and running. Exhibits included Dolby Surround decoding and artificial head recording methods.

should be quite easy. But when two amplifiers are carefully adjusted to precisely the same gain, and both operated within their power limits, it is amazing how little real difference there is.

Ron Streicher, of Pacific Audio-Visual Enterprises, chaired the next session, titled "Recording and Reproducing the Sound of Audio." Sean Olive, of the National Research Council of Canada, spoke on the preservation of timbre, microphones, loudspeakers, sound sources, and acoustical spaces. Olive described the range of aberrations that are to be found in even the best studio microphones and monitor loudspeakers. Taking into account the characteristics of sound sources and the recording space itself, a not so pretty picture of the total transfer process emerges. The ear/brain combination is mercifully forgiving of many things gone wrong, and we should be thankful for that. When you consider that your grandfather listened to acoustical recordings in severely band-limited and distorted mono, we have made great strides. But there is room for improvement still.

I chaired the next session, titled "Recording and Reproducing the Space of Audio: 'Conventional' Stereophony." The aim of this session was to present descriptions of current two-channel recording practice as applied to the mass media: Compact Disc, the cassette, and FM radio.

The first paper was jointly given by Ron Streicher and me, and it dealt with current practice in commercial classical recording. Essentially, classical recording employs fundamental stereo microphone arrays to preserve essential spatial cues. To this are added various accent microphones to correct imbalances and certain acoustical and musical problems. Contrary to what many people believe, both conductors and artists heartily endorse these hybrid techniques, when used with good taste and judgment.

David Moulton, of the Berklee College of Music, described the many techniques that are used in the pop/rock studio to produce music intended for presentation over loudspeakers. Here, there is no acoustical frame of reference, and the studio recording represents the initial creative act.

George Augspurger, of Perception Inc., discussed the many problems of monitoring the recording process in the normal work spaces used by engineers and producers, relating them to typical problems in the consumers' listening environments. He discussed the differences between high-end cone and dome systems and the usual compression driver and horn combinations used in most control rooms. The phantom center image was discussed and compared to the sound that would be produced by a discrete center loudspeaker. Depending on the precise listening angle, a phantom center will exhibit a pronounced null in response at

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The highlight was the discussion on binaural presentation made over speakers and the impact that DSP will have on it.

the ears somewhere in the range of 2 kHz! This is inherent in the slightly differing delay paths from each loudspeaker to both ears. A discrete center speaker does not have this problem.

David Griesinger, of Lexicon Inc., chaired the next session, titled "Recording and Reproducing the Space of Audio: 'Surround' Sound." Roger Furness, of Minim Electronics, described the Ambisonic system of recording and playback, in which the four outputs of a Soundfield microphone can be encoded in two, three, or four channels and decoded into a variety of loudspeaker configurations for accurate reproduction of spatial information. He cited many currently available stereo recordings that have been so encoded.

Tomlinson Holman, of Lucasfilm, presented details of the Dolby Stereo and Dolby Surround systems as currently used in motion picture theaters and in home theater systems. Essentially, the technique encodes center channel information in phase between the two transmission channels, while surround channel information is encoded in opposite polarity. The better matrix decoding systems do a remarkably good job of determining dominant signals and sorting them out with a minimum of artifacts.

Griesinger then gave a paper on continuing experiments in reproducing binaural recordings naturally over loudspeakers. While the problem has been made to look simple over the years, it is in fact quite complex. Binaural recordings are normally made with an artificial head, and when played over headphones the effect is pleasant but not always completely natural sounding. There are often ambiguities between front and back, and up/down cues may be missing altogether. Some listeners experience "in the head" localization effects. What is missing in the recording are the pinna cues, which are unique to each of us. An ideal, but impractical, binaural recording setup would be tailored to each person. The artificial head would have exactly the pinnae convolutions of the person being modeled, and the headphones would be carefully equalized via probe microphones at the eardrums. The transformation from binaural to stereo loudspeaker presentation involves crosstalk cancellation, so that a listener on the median plane of the loudspeakers will receive the left and right signals primarily at the left and right ears, respectively. This must be done for a given subtended angle of the loudspeakers as measured from the listening position.

Griesinger further described Lexicon's efforts to solve the basic problems of binaural presentation over loudspeakers so that it will be effective for a significant fraction of listeners.

Gary Kendall and Martin Wilde, of Auris Perceptual Engineering, Inc., then described their work in develop-

Involving engineers and producers in playback evaluations could "close the loop" between recording and playback processes.

ing a spatial sound processor that takes monophonic sound sources and processes them for three-dimensional presentation over stereo loudspeakers or headphones. Their system is designed for use in music, video, and film production.

The final session of the conference was titled "Frontiers in Sound Reproduction" and was chaired by Marshall Buck, of Cerwin Vega Corp. The first paper, by Wulf Pompetzki and Jens Blauert of Ruhr University, discussed further the ideas of binaural recording for both headphone and loudspeaker presentation. Details were given for signal processing of multiple microphone inputs for binaural presentation.

Jeffrey Borish, of EuPhonics, discussed methods of enhancing normal stereo recordings through simulation of the reflection patterns naturally occurring in concert halls. The characteristics of a hall can be measured, or they can be modeled via an image modeling program. The advantages of the image modeling approach are that the model can be easily changed, or else the listener can "change seats" in the hall.

David Clark, of DLC Design, then discussed in detail the evolution of the autostereo system that had been on demonstration during the conference.

The final paper of the conference was given by consultant Ronald Genereaux on adaptive equalization of loudspeaker systems. The method he described measures the transfer characteristic between a loudspeaker and a given listening position. An inverse filter is then calculated and inserted in the audio path so that many of the adverse effects of the room are cancelled. The technique has wide application in both consumer and professional applications.

The highlight of the conference was the broad subject of binaural presentation over loudspeakers and the impact that digital signal processing (DSP) will have on it. The big problem with that technology is the restriction on listener location. For that reason, the technology will probably find its first broad application in TV stereo, where close stereo loudspeaker placement will work to its advantage. Other applications include the automobile, where speaker and listener are fixed.

BERT WHYTE

MEETING MY YOUTH

A few months ago, I had one of those milestone birthdays—you know the kind I mean—and I realized I was getting a bit long in the tooth. I don't think I am superannuated, but looking back over the years, I am aware that I have led a pretty fantastic life. In remembering things past, what I found particularly fascinating were the twists and turns of fate that interrelate and entwine one's life with events and experiences in other peoples lives.

Music has always been an important part of my life. By the age of 12, I was fairly well grounded in classical music. Our next-door neighbor, in Bay Ridge, Brooklyn, was Thelma Votipka. A Czech mezzo-soprano of imposing stature, she sang supporting roles in Metropolitan Opera productions, especially Wagnerian operas. Madame Votipka taught me a great deal about music, and on Good Fridays at our neighborhood church, this boy soprano joined her in singing Sir John Stainer's "Crucifixion." My father was a fine baritone and used to sing recitals on WJZ, New York, back in the B battery days of radio reception.

Illustration: Vala Kondo

My very musically oriented family owned one of those big Victor Orthophonic phonographs, and I was immediately enamored of the clunky, fragile, monophonic 78-rpm records. Even in those primitive days (electrical transcriptions had been on the market for just about six years), I was very concerned with the sound quality of the recordings. What I deemed the best sounding were the Victor recordings of the Philadelphia Orchestra conducted by Leopold Stokowski. Not only did I like the sound, but I loved the repertoire chosen by Maestro Stokowski and the great playing he got from the orchestra. Thus I revelled in such listening experiences as Rachmaninoff's "Rhapsody on a Theme of Paganini" with the composer as soloist, Brahms' Third Symphony, Scriabin's "Poem of Ecstasy," and the Symphonic Synthesis of Act III and "Good Friday Music" from Wagner's *Parsifal*. No doubt about it, I was as much a fan and disciple of Leopold Stokowski as any wild-eyed rock fan is of The Rolling Stones. Nowhere in my wildest youthful imagination did I ever fantasize that 25 years after hearing these records I would be recording this great conductor as he led the Houston Symphony Orchestra in most of this very repertoire! As a youth I was also fond of big band music and attended concerts by the likes of Benny Goodman and Woody Herman. I certainly never dreamed that I would make the first stereo recordings of these bands in Chicago's Blue Note in 1951 and 1952. These are but two examples of the numerous interrelations in my life involving music, musicians, composers, and conductors.

Stokowski and the Philadelphia Orchestra were certainly one of the fabled synergies of conductor and orchestra in American musical history. The Philadelphia under Stokowski was held in awe as much for the richness of their orchestral color as for the opulence and beauty of their string tone. Although Stokowski encouraged free-bowing instead of unison playing on the strings, he employed a little psychoacoustic trickery: In a diminuendo passage that would ultimately fade into nothingness, he would have the players continue to draw their bows across the strings, even though they were not producing actual sound. The effect was magical!

A friend of mine had the 14-record set of Schoenberg's monumental "Gurrelieder," with Stokowski conducting the Philadelphia Orchestra. This work required a huge orchestra including seven clarinets, 10 horns, and a vast percussion battery which contained a set of large iron chains! These artists, along with choruses and soloists, added up to 554 musicians! I first heard this work in 1934, and needless to say, a work on this grand scale is rarely recorded. The next time I heard it was in 1953, and therein lies a tale.

I have been an ardent devotee of the music of Gustav Mahler ever since 1935, when I heard his Second Symphony, "Resurrection," as recorded by Eugene Ormandy and the Minneapolis Symphony Orchestra on 22 sides of 78-rpm records. I also fondly remember Mahler's Fifth Symphony conducted by Bruno Walter, and Mahler's First Symphony recorded by Dimitri Mitropoulos and the Minneapolis Symphony Orchestra. This recording was transferred to LP, and I believe it was the only Mahler on LP for quite a while. It must be remembered that even in his own time, Mahler's music was considered quite controversial and received a lot of negative criticism. During the period from 1930 to 1958, his music was little known and seldom played in the United States. In 1952, I was at the Chicago premiere of Mahler's Ninth Symphony with Rafael Kubelík conducting the work in Orchestra Hall. The First Movement of this profound work

Not in my youth's wildest dreams did I ever fantasize that one day I would record Leopold Stokowski.

runs up to 29 minutes, depending on tempos. I well remember several people walking out of the hall before the end of the First Movement and Kubelík turning around and giving them a contemptuous glare!

Mahler was acutely aware of all the criticism of his music and was said to have stated, "My time will yet come." This motto was used on the gold Medal of Honor for Mahler, struck by the Bruckner Society of America. I used a reproduction of this medal on the front cover of my Everest recording of Mahler's Ninth Symphony with Leopold Ludwig conducting the London Symphony Orchestra.

Getting back to the "Gurrelieder," in 1953 I received an invitation from the Haydn Society to attend a reception at the New York City apartment of Stella Adler, the well-known acting teacher and drama coach. The occasion was to celebrate the Haydn Society's LP release of "Gurrelieder" conducted by René Leibowitz. The usual crowd of voluble critics wandered about, libations in hand, when someone grabbed my arm and steered me to an attractive older woman and said, "Bert, I'm sure you want to meet Alma Mahler." I was stunned, to say the least! It really was the widow of the legendary Gustav Mahler! She was in her mid-70s, and I could still see the fairness and grace of the woman who was once known as the most beautiful girl in Vienna. She was very poised and self-assured, almost to the point of feistiness. She still retained a charming Viennese accent. I was damn near speechless, but of course I told her how passionately I admired her husband's music. I mentioned the Chicago concert of the Ninth Symphony, and she knew all about it. I told her a prime ambition of mine was to record all of her late husband's symphonies. She asked me which one was my favorite, and I replied that I liked them all but that I found the Ninth very special, along with the First, Second, and Fifth. A little more diverting small talk, and she was gone. Little did I know that five years hence, I would indeed make the first stereo recordings of the Mahler First, Fifth, and Ninth Symphonies.

As for Alma Mahler, this remarkable lady died in New York City in 1964 at the age of 85. Mahler was 20 years older than Alma Schindler, the beautiful music student, when he married her in Vienna in 1902. At that time, Mahler was director of the Court Opera House and already well known for his music. Alma travelled with Mahler on conducting tours in Europe and the United States. He became the conductor of the New York Philharmonic Orchestra, but in 1911, his second controversial season, had to cut his work short to return to Vienna, where he died of a heart attack.

Alma married architect Walter Gropius in 1915 and divorced him in 1918. (In later years, Gropius designed the Pan-Am Building in New York City.) While still married to Gropius, Alma met writer Franz Werfel and had a son by him. She moved in with Werfel and married him in 1929. Talk about your soap operas! Werfel and Alma fled Nazi Germany in 1939 and settled in California in 1940. These experiences resulted in Werfel writing his well-known book, *Song of Bernadette*. Werfel died in 1945, and Alma moved to New York City in 1952. Alma Mahler-Werfel freely admitted she was attracted to geniuses and had love affairs with many who fit that description. One was the famous Russian pianist Ossip Gabrilowitsch, who later became the conductor of the Detroit Symphony Orchestra and ultimately married Mark Twain's daughter.

It has been said that Alma Mahler-Werfel was a brilliant and creative composer whose talents were suppressed by Gustav Mahler. Listed in the CD catalog, under Alma Mahler-Werfel, is *Complete Piano Songs*, a program for soprano with piano accompaniment. It is on the CPO label (distributed by Koch International).

A harrowing story concerns the aforementioned Ossip Gabrilowitsch, Leopold Stokowski, and Stokowski's wife, pianist Olga Samaroff. The Stokowskis were guests in Gabrilowitsch's Munich home in 1914 when the First World War broke out. German troops arrested Gabrilowitsch, but Stokowski, his wife, and two friends were able to flee the country. Stokowski had tucked a copy of the score of Mahler's Eighth Symphony, "Symphony of a Thousand," in his suitcase. It's quite a tale, but you'll have to wait until the next issue to read about it! *A*

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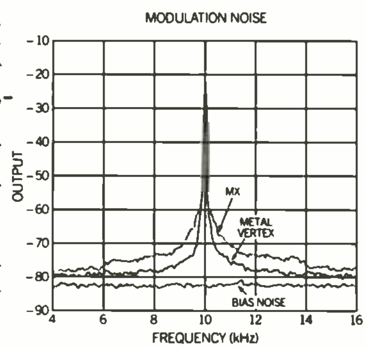

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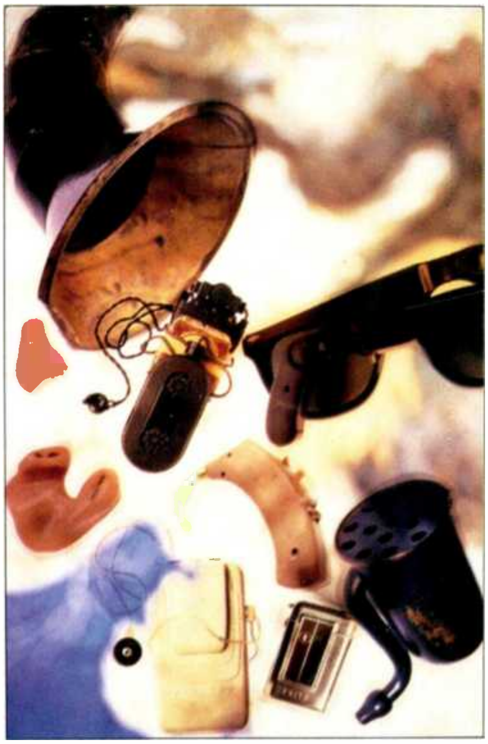


PHOTOGRAPHS: DAVID HAMSLEY

In 1977, when consumer awareness of digital audio was still almost nil, a seminar on the subject aroused widespread interest in another part of the sound industry—that relatively small segment concerned with meeting the needs of the hearing impaired. The seminar, held in West Berlin, was part of an annual international meeting of industry people known as the Congress for Hearing Professionals, where a number of papers were read concerning the application of digital audio technology to hearing aids. The topic has more recently begun to excite those involved in consumer audio—namely digital signal processing (DSP).

DSP, it was assumed at the time, would provide the key to precise and independent calibration of all performance parameters relating to compensating amplification of sounds in the environment. Gain, frequency response, and output level in hearing aids could be manipulated within the digital domain—presumably—with no noise penalty, and with none of the artifacts that inevitably accompany analog signal processing. With so much power and flexibility at his disposal, the dispensing audiologist could provide each patient with the very best fit, and could apply truly selective amplification, thus eliminating the problems of unnaturally loud background noise and uncomfortably intense transient reproduction which have plagued hearing aid wearers since the dawn of electronically amplified aids more than 60 years ago.

In 1977, such discussions were purely academic. The electronic devices available then were far too bulky and inefficient to permit the construction of a digital hearing aid of reasonable size, and, in any case, the techniques of digital encoding in use at the time were still, in some measure, experimental. But the promise was there, and the need was certainly there also.

In the past two years, the promise has begun to be fulfilled as the first digital aids have appeared on the market. Today digital audio circuitry seems likely to effect as big a revolution in the hearing aid field as it has in consumer audio, though the course and the impact of the digital revolution in hearing aids is and will be very different from what occurred in the music industry.

The hearing aid field is one segment of audio electronics that most of us who are involved in music production usually forget. As a group we tend to pride ourselves on our hearing acuity, and the phenomenon of hearing impairment involves the unthinkable, the loss of our ability to make extremely fine aural discriminations. And yet the very large majority of us will suffer noticeable hearing impairment in time, not because it is the human condition to suffer loss of hearing—for surely it is not—but simply because we live in environments where our ears are continually insulted. And, of course, those of us who make our living in some area of the music business are doubly at risk, since we are frequently exposed to high intensity sounds in the normal course of practicing our professions, very often by our own hands.

Hearing aid technology—audio prosthetics if you will—offers those of us afflicted with the unthinkable at least a partial solution. It also offers us food for thought, because audiologists have often been far in advance of consumer audio manufacturers in conducting meaningful psychoacoustic research. Hearing aid researchers were discussing transient distortion in the early 1950s and the effect of outer ear structure on localization back in the '70s. For the hearing aid specialist, such matters were literally health issues, and the insights these researchers gained on human hearing, both normal and impaired, should be of interest to anyone involved in audio. Moreover, the current and future involvement of the hearing aid industry with DSP will surely have ramifications touching on every area of the audio industry.

Why Digital?

The appeal of digital audio to the manufacturers of hearing aids is quite different from that which digital exerts on the three other segments of the audio industry where it has become established, namely consumer audio, recording, and telecommunications. In both music reproduction and telephony, digital encoding is attractive chiefly because it protects the signal against losses during transmission. In the hearing aid field, on the other hand, electrical signal losses are not especially significant. A hearing aid is, in essence, nothing more than a miniature P.A. system with microphone, amplifier, and speaker (see hardware sidebar). The amplifiers in use today in hearing aids are of high-fidelity standards in regard to noise and distortion. Digitizing the signal at the amplifier stage would have little effect in lowering the residual noise floor of the circuitry. The real reason behind the push for digitization is the hope that by powerful digital analysis and signal processing, hearing aids can be made to do a better job in compensating for hearing loss. This statement implies that analog aids have serious limitations in performance, and indeed they do. Simply stated, the conventional analog aids of today do not produce a good approximation of normal hearing in even mildly hearing-impaired persons.

The hearing-aid industry agrees that hearing aids, by and large, do not restore hearing losses nearly as successfully as, for example, contact lenses compensate for simple myopia. Indeed, the analogy of corrective lenses is so unflattering to the hearing-aid industry that a more proper comparison would be to artificial limbs—both better than nothing, but not truly equivalent to the normally functioning natural organ.

Here, I am describing the typical nondigital, nonprogrammable hearing aids generally in use today, not the handful of digital or hybrid aids just now appearing on the market, which may be seen as challenging and superior to the conventional aid. I would stress that current analog aids, for all their limitations, are highly sophisticated devices and are the culmination of nearly 70 years of continuous research and engineering. The analog microphones, amplifiers, and earphone transducers available today in hearing aids are superbly linear but aren't likely to become significantly better. Indeed, an audiologist from the 1940s would feel that most of the long-term design goals of the pioneering hearing-aid engineers have been met by current designs. Yet a high proportion of hearing-impaired persons cannot adapt to conventional hearing aids, while most successful wearers complain of poor speech intelligibility at times and difficulty in localizing sounds.

To understand why conventional aids fail, it is necessary to understand something about the problems they aim to correct. The majority of persons seeking relief through electronic hearing aids suffer from simple sensorineural losses, the same liability that afflicts nearly all of us to some small degree. The cause of the hearing loss is the destruction of some of the cilia in the middle ear through progressive exposure to traumatic noise levels (see sidebar on hearing loss and hearing aids.) The trauma-inducing stimulus could be a few gunshots at the practice range, years of working in a noisy factory, or playing music in a band. But whatever the cause, a common cluster of symptoms tends to manifest itself.

DSP FOR THE HEARING IMPAIRED

First, the losses tend to be frequency dependent, with the more severe losses generally occurring in the upper frequencies. Second, the dynamic range of sounds tolerable to the individual is compressed. For example, the person may have a 20 dB loss at 4 kHz which entails a 20 dB higher threshold of audibility at that frequency, yet the maximum intensity level the person can tolerate remains the same as before—let's say 105 dB. All told, the individual's effective range of perception has been cut by 20 dB in that frequency range—a phenomenon known as recruitment or "accelerated growth of loudness" as Edgar Villchur describes it. A third common symptom is an inability to follow a conversation in the presence of background noise when a hearing aid is being used. Finally, most of the sensorineurally impaired have problems in localizing sounds, particularly when they are using their aids.

It is easy to conclude from the briefest examination of the problems of the hearing impaired that the design model of the hearing aid as a miniature P.A. system is wholly inadequate. A P.A. system ideally is linear in both frequency and gain. All frequencies get the same boost, and loud input signals are amplified just as much as soft ones. Such linearity does not meet the needs of the individual with mild to moderate sensorineural losses. He hears all loud sounds and most soft sounds perfectly well. He only has problems in a certain frequency range, though it happens that that range is generally where the voiced consonant sounds occur, and consequently he tends to have problems understanding speech. A linear frequency response restores the high frequencies for consonants, but at the price of overwhelming bass and midrange, while a linear gain amplifies quieter sounds but makes ordinarily loud sounds into excruciatingly loud ones.

Historically, hearing-aid manufacturers were slow to address these problems with appropriate signal processing, but almost all hearing aids made today use at least some form of signal processing, broadband equalization and single-band compression at the most basic level. Even with this technology, most hearing-aid wearers still experience problems—problems that appear to be beyond the solution of simple tone controls and wideband compression, thus the interest in DSP and extensive individual programming options.

Self-Contained Amplification and Signal Processing

If digitization is relatively new to the hearing-aid field, sophisticated circuit design and penetrating investigations into psychoacoustics are not. Hearing aids have always presented extraordinary design challenges to their manufacturers, and throughout the history of the device, engineers and audiologists have responded by employing the most advanced audio technology available at the time.

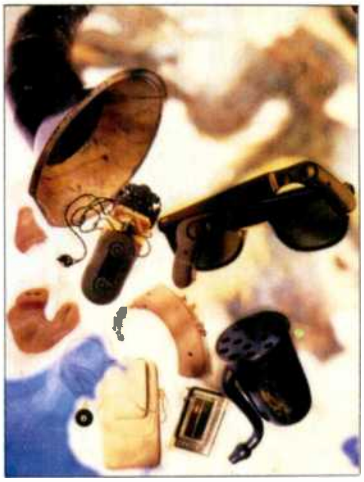
Electric hearing aids, themselves, are just about as old as the century. But before 1900, the hearing impaired might resort to hearing trumpets—large, clumsy horns that could provide only marginally better acoustical coupling of the eardrum to the atmosphere, but no practical prosthesis existed.

Early electrical hearing aids were essentially adaptations of the telephone. A carbon microphone modulated an electrical current within a battery-powered circuit, and the current in turn activated an earphone that used an electromagnetic transducer. No amplification occurred within the electrical circuit, so the transduction process resulted in a net loss of energy. Furthermore, the carbon transducer was highly nonlinear, and overall frequency response was extremely peaky. And yet, the tightly fitting earpiece did transfer acoustical energy very efficiently to the eardrum, and carbon hearing aids provided up to a 50-dB increase in acoustical pressure at the eardrum in the midrange.

This carbon aid was, by modern standards, a cumbersome device, with separate external microphone, battery pack, and earphone, but it did provide some slight relief to mildly hearing-impaired persons, and its superiority to the hearing trumpet was undeniable. It was also relatively cheap, a factor that kept it on the market until the late 1940s, long after more advanced technology was widely available.

Shortly after the carbon aid appeared—in 1906, in fact—Lee DeForest invented the triode amplifying tube, ushering in the electronic age. In less than a decade the triode would be widely used in radio transmission, and engineers in other areas of communications technology were beginning to explore its potential as well. Hearing aids represent one of the very first consumer applications of the triode amplifying tube, and the earliest vacuum tube hearing aid was developed in 1921 by Earl Hanson. Several others were available by the end of the decade.

DIGITIZED AUDIO CIRCUITRY SEEMS LIKELY TO EFFECT AS BIG A REVOLUTION IN THE HEARING AID FIELD AS IN CONSUMER AUDIO.



Early electronic aids were really not portable, and were limited to desktop use. The amplifying circuitry alone occupied a box the size of a table radio. The pressure for miniaturization in other areas of electronics eventually led to smaller tubes and batteries and the introduction of truly portable electronic aids in the late-'20s. The first wearable electronic aids were still quite bulky by present standards, requiring two separate cabinets—one for the batteries and another for the microphone and amplifier. The cabinets were not concealable but were worn externally like camera equipment. A single earpiece took the output of the amp. Such hearing aids were known as "body aids" because the housings containing the guts of the systems were generally worn on the upper body, or alternately carried in a coat pocket. At the very end of the decade, a few aids appeared with battery and amp in one housing—the form almost all hearing aids would retain until the 1960s.

Ungainly acoustic horns, in a variety of shapes and sizes, provided 10 to 20 dB of gain—and required no batteries.

Prewar electronic aids were expensive, and in the depression-ridden '30s they did not sell in large numbers. Indeed, prior to World War II most electronic hearing aids produced were essentially experimental and appeared in small pilot runs. But in the aftermath of World War II, the electronic hearing-aid industry exploded.

During the war years, the U.S. military—perhaps inevitably—evinced little concern for protecting the hearing of its troops, and thousands of young men returned from the war with premature hearing losses from the effects of explosions and aircraft engine noise. Veterans' benefits provided these men with the means of paying for the still expensive electronic aids, and the Veterans Administration undertook an extensive research program on hearing loss and the means of treating it. The tube-amplified body aid came into its own.

World War II itself had given tremendous stimulus to vaccum tube technology, and a number of ultraminiature tubes had been developed that proved godsends to the hearing-aid industry. (It is no accident that in the aftermath of the war both high fidelity and musical instrument amplifiers developed rapidly as well.) But the effects of war-related hearing research were equally important to the development of the hearing aid, and they were to some extent detrimental.

Early research studies published by the Veterans Administration and Harvard University stated that linear amplification was preferable to compensatory equalization, and

Even without tubes or transistors, the amplification of carbon-microphone aids, and their tight coupling to the ear, effectively increased average sound pressure at the ear by anywhere from 10 to 50 dB.

PARALLEL

UNIVERSES

that bilateral aids provided no performance advantage over monaural. Current studies have come up with sharply different results in both areas, and a couple of reasons may be given for the discrepancies. The cues by which persons localize are better understood today than in the '40s so more appropriate tests can be devised. Also, modern researchers are able to evaluate an aid's real response at the eardrum—not just its acoustic output in free air. At any rate, during the '40s and '50s, most audiologists accepted as valid the findings of the Harvard and government research.

The general acceptance of the findings of the Harvard and Veterans Administration researchers can certainly be explained by the prestige of the bodies sponsoring the research. But the lack of any vigorous dissent is still somewhat puzzling because by this time hearing aid manufacturers, as well as dispensing audiologists, were well aware that hearing loss is nearly always frequency dependent and that recruitment poses a serious problem for a good portion of the hearing impaired. In fact, both compression and equalization were offered in a few hearing aids of the early '50s in spite of a lack of solid research to support such measures, and in spite of the extreme difficulty in executing the signal processing circuitry with vacuum tubes contained in a cabinet the size of a deck of cards.

The fullest development of signal processing lay in the future, however, and before hearing aids could incorporate the hundreds of electrical components necessary to execute sophisticated signal processing, the transition from vacuum tubes to transistors would have to occur. Interestingly, this transition would take place within the hearing aid industry almost as soon as production transistors were available. Indeed it occurred before transistors were used to any extent in computers, and also long before they appeared in consumer audio components. The first hybrid transistor hearing aid appeared in 1952, and the first fully transistorized unit followed a year later. By the mid-'50s tubes were passé. The heat, size, and inefficiency of tubes were simply unacceptable in the hearing aid field. The attraction of transistors was irresistable, not only by virtue of their greater efficiency, but because they were much smaller and were much less conspicuous.

For a period of about 20 years from the early '50s, when transistors first appeared, to the early '70s, the hearing aid manufacturers concentrated their energies on reducing the size of the physical plant, and secondarily on improving transducers. Signal processing was generally given short shrift.

The very first transistors were relatively bulky components with pins and sockets like miniature vacuum tubes, and their primary appeal was on the basis of their higher efficiency, not their size. But by the late '50s, when the first integrated solid-state circuits were developed, hearing aid manufacturers could begin to contemplate an inconspicuous substitute for the traditional body aid.

The miniaturization of hearing air circuitry was a gradual process, and the first ICs did not permit the production of hearing aids that could be concealed in the ear canal as has been achieved in some present-day designs. The first nonbody aids instead took the form of eyeglass hearing aids with the circuitry and microphone concealed in the frame of a pair of false eyeglasses and an earphone extending from one of the arms. Later, behind-the-ear aids appeared with the circuitry contained within a molded enclosure that fit directly in back of the external ear. Still later, in-the-ear aids were developed that put everything within an earmold fitting into the opening of the ear canal. In-the-ear-canal aids, the last to appear, represent the ultimate in miniaturization and concealment.

As a matter of interest, in-the-ear aids are the dominant type at present. The more recent in-the-canal aids push miniaturization to the limits of present technology and suffer from a tendency to feedback which miniaturization alone cannot solve.

In the meantime, as transistors and ICs got smaller, transducers and amplifiers improved at a steady pace.

As we have seen, early hearing aids used carbon transducers, but these were later replaced by electromagnetic devices. By the early-'50s, the balanced armature type earphone had become the industry standard and remains so to this day. Modern balanced armature transducers have a frequency range of roughly 50 Hz to 10 kHz, while greatly exceeding the efficiency of the moving-coil transducers used in consumer headphones. (Balanced armature driver elements may in fact approach 80% efficiency.) Electret transducers are generally conceded to offer slightly better fidelity, but their low efficiency has ruled out their use in practical consumer products.

HEARING IMPAIRMENT IS ONE SEGMENT OF AUDIO THAT MOST OF US INVOLVED IN MUSIC REPRODUCTION FORGET ABOUT. FOR US IT IS UNTHINKABLE.

Microphones in modern high performance hearing aids are almost invariably of the electret type and have been since the late-'60s. In some cases, the capsules are of the same type used in music recording. Most authorities on hearing aid design feel that current microphones are very highly developed, and that extreme improvements in performance are unlikely in the foreseeable future.

Hearing aid amplifiers, for the most part, are of the same general design as those used in high-fidelity applications. Several stages of voltage amplification are used, followed by a power-output stage that runs in AB mode. Class A hearing-aid amplifiers have been made, but low efficiency has militated against their general adoption. Experiments have also been conducted with floating power-supply rails and Class D operation, both proven techniques for improving efficiency over AB operation. Etymotic Research's new K-Amp chip, manufactured by Knowles, uses a Class D power amplifier.

Signal Processing: The Focus of Current Research

Hearing aids, like high-fidelity systems for the home, are ultimately assemblages of components. Transducers are bought from one manufacturer, amplifiers from another, signal processing circuits from still another. The parts are then assembled by the company whose brand name the final product bears. A few companies supply the raw components used in hearing aids, but many companies compete in the market. Not surprisingly, a similar level of performance tends to be encountered at specific price points.

Nevertheless, the hearing aid field is competitive, and most of the competition and innovative research among manufacturers tends to center on signal processing circuits. This, as we have seen, is where digitization comes into play.

Generally, high-performance hearing aids, however complex their circuitry may be, use only five kinds of signal processing—variable gain, equalization, compression, limiting, and steady-state noise reduction. Since only the last involves what might be termed intel-

The Basics of Hearing Aid Hardware

At the most fundamental level, modern hearing aids may be regarded as miniaturized public address systems (perhaps "private address system" would be an apt term). With the singular exception of the cochlear implant aid, all hearing aids consist of the following: A microphone to pick up the sounds in the listener's environment and convert them into electrical impulses, an electronic amplifier, and a loudspeaker. An internal battery is included to power the unit.

Except in the case of the bone conduction type (see below), a custom-made earpiece seats the loudspeaker in the ear canal. In most modern aids, the earpiece holds the amplifier and microphone in addition to the loudspeaker. If the earpiece (containing all of the hearing aid components) extends into the external structure of the ear, the aid is called an in-the-ear aid, while if the earpiece is contained entirely within the ear canal, it is an in-the-ear-canal aid.

In hearing aid nomenclature, the loudspeaker is referred to as a receiver, or, more rarely, as an earphone. A couple of types of hearing aids do not use receivers in the usual sense. Bone conduction hearing aids use a special type of transducer to excite vibrations in the skull behind the ear. Bone conduction aids exhibit poor frequency response and fidelity, and are only used with patients with deformities of the outer ear or severe ear canal drainage problems.

Cochlear implants are surgically implanted devices that do not amplify sound at the eardrum but function almost as surrogate ears. Electrical impulses generated in the device stimulate the auditory nerves directly, bypassing the organs of the middle and inner ear. Cochlear implants are only recommended for patients with profound hearing loss verging on total deafness and must be regarded as palliatives at best. The device itself was developed by 3M, which still controls the market for cochlear implants.

Most present-day hearing aids are compact units with all components contained within the earpiece. Less common are behind-the-ear aids where the electrical circuitry is placed in a curved module located directly behind the ear, while the microphone and receiver reside in the earpiece. A variant on this approach is the eyeglass aid where the electronics are placed in the frame of a pair of false eyeglasses (this type has practically disappeared from the market). The oldest and least popular form of hearing aid today is the body aid where electronics occupy a small box worn against the body. Progress in chip design has rendered the body aid almost obsolete with the one significant exception discussed in the text. —*D. S.*

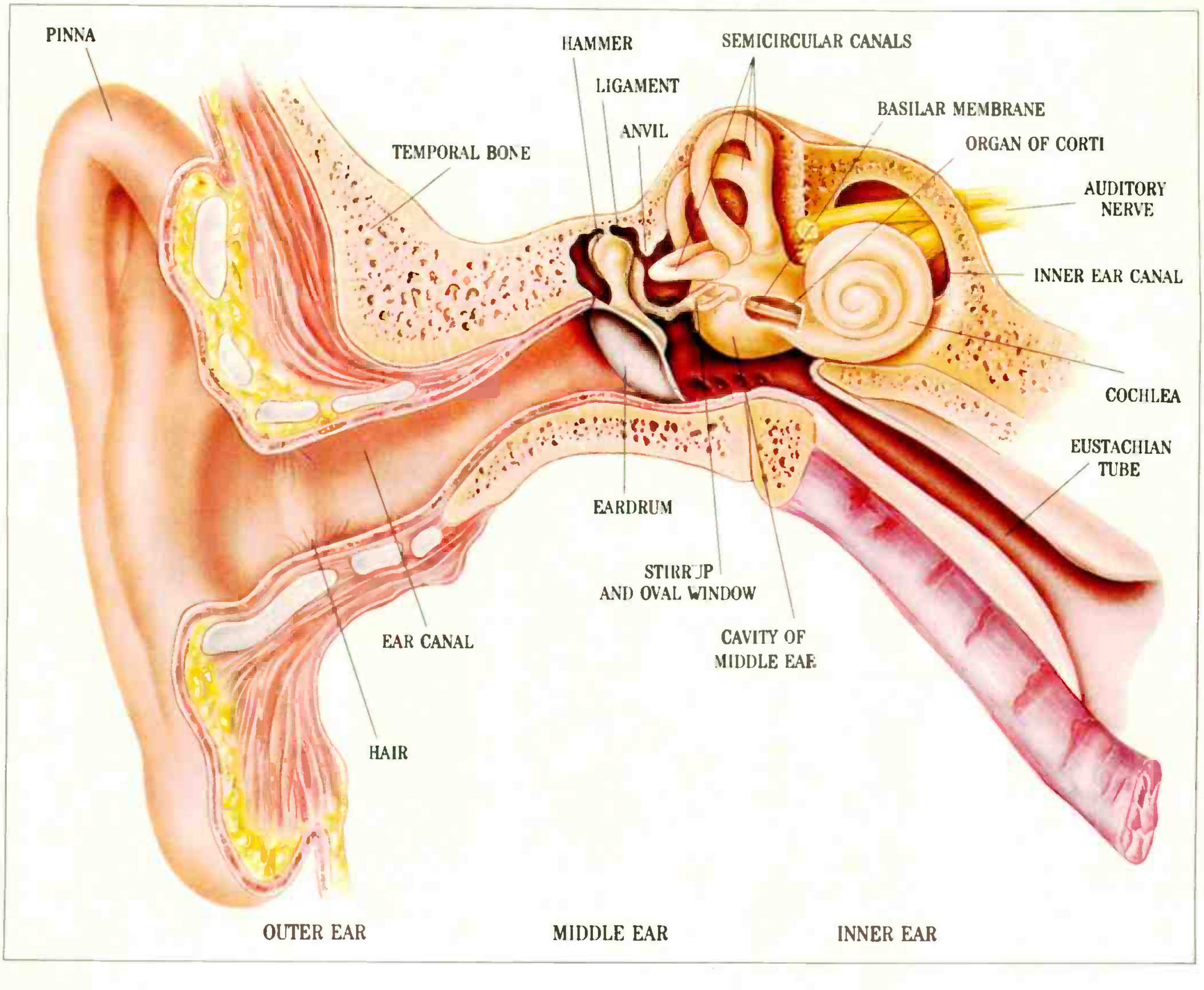


Illustration: ©1988, Judith Glick

ligent circuitry, the question arises as to why digitization would be deemed necessary or desirable, especially inasmuch as DSP circuitry requires more power to operate than analog signal processing electronics.

In fact, only one hearing aid on the market, the Nicolet Phoenix, actually converts the main signal into a digital code. Several other high-performance aids are of the hybrid type, however, using digital circuits to exercise control functions on the analog signal. These include the Audiotone/Miracle Ear Dolphin System, the Ensoniq Sound Selector, the Maico/Bernaphon PHOX (Programmable Hearing Operating System), the Resound Personal Hearing System, the 3M Memory Mate, and the Widex Quattro. The filters that perform the signal processing in these devices are purely analog, but the circuits that vary the filter parameters are digital.

There are several reasons behind the move toward digital control circuits. The first is a matter of sheer physical space. The chief benefit in offering a hearing aid with highly flexible signal processing is the achievement of better individual physical fitting. Such flexibility in turn entails a multitude of controls. There's simply nowhere to put a multitude of controls on a modern hearing aid, and so the programming of the hearing aid necessarily has to be done remotely, and almost certainly by digital means.

A second reason for digitizing control functions is to tie them in with the diagnostic process. Most hearing aid manufacturers touting sophisticated signal processing advocate the use of combined testing and fitting programs run on a personal computer. The program interprets patient response and prescribes compensatory adjustments on the aid itself. Digital control circuitry within the aid can interface easily with the diagnostic computer. Futhermore, digital control circuits commonly exceed the precision of analog trimmers, enabling the dispenser and the patient to calibrate the aid very accurately.

Finally, the programmable aid makes refitting very easy. Most analog aids have a very limited range of tone controls, and the basic equalization curve is set at the factory per the dispenser's recommendations. If the setting proves problematic, the aid must be sent back to the factory. On the other hand, a programmable's equalization setting can be changed with a few key strokes.

EARLY ELECTRONIC AIDS WERE NOT REALLY PORTABLE. THE AMPLIFYING CIRCUITRY ALONE OCCUPIED A BOX THE SIZE OF A TABLE RADIO.

The tube-amplified aids of the 1940s (left) quickly gave way in the '50s to more compact, transistorized models (right).

Signal Processing Strategies

Compensatory equalization, a component of every digitally programmable system in use today, appears to have been the first signal processing technique applied to hearing aids. Shelving filters limiting gain in the lowest frequencies have been available since the late '40s. Later, simple, broadband tone controls appeared, and these still characterize most aids today. But the manufacturers of programmable, digitally controlled aids generally offer considerably more flexibility.

The most sophisticated hearing aid equalizer in the industry is currently offered by Ensoniq, a company until now active chiefly in the musical instrument field. Ensoniq's equalizer allows remote calibrations from a diagnostic computer. The equalizer has thirteen bands, with third-octave equalization in all but the two lowest bands where whole-octave equalization is provided.

The equalizer developed by Ensoniq is the product of an extensive research program and reflects the company's position that precise equalization is the key to restoring hearing losses prosthetically. According to Christine Christy, an audiologist employed by the company, Ensoniq's own research has demonstrated that with correct equalization little further signal processing such as compression and noise reduction is necessary, al-

though the Ensoniq aid does include single-band 2:1 compression. Ensoniq further claims that its hearing aids can be made virtually transparent to persons with normal hearing, a claim also put forth by Etymotic Research, a company with a very different philosophy of signal processing.

No manufacturer of programmables places total reliance on equalization, nevertheless all programmables currently on the market do afford the user some degree of frequency shaping. Typically, only broadband equalization is used, but corner frequency of the bands is generally adjustable, and, in some cases, slope. Most of the programmables also have a single narrow preset filter to cope with the ear canal's natural resonance which occurs at roughly 3 kHz.

Compression and limiting are also very commonly used signal processing techniques among the programmables. These processes allow compensatory amplification while not exceeding a certain absolute sound pressure level, thus tailoring the signal to the dynamic limitations of the recruitment sufferer. Recall that recruitment entails a rise in the individual's threshold for intelligibility with no corresponding rise in the threshold of discomfort. Compressing the sound to fit within the narrow window of comfort and intelligibility is the obvious answer.

The need for compression was seen as early as the '30s, but the circuitry for accomplishing it in a relatively unobtrusive manner was extremely bulky. Very few of the vacuum tube aids of the early '50s used true compression. Most relied instead on the crude limiting provided by designing the amplifier to have no headroom. A true compressor reduces gain above a certain threshold level and does so only when the threshold is exceeded for a certain predetermined duration. To avoid unnatural pumping and breathing effects, most compressors are provided with release times that are considerably longer than the attack times. The distinction between compressors and limiters has become rather hazy, but according to Mead Killion, president of Etymotic Research, any device with more than a 4:1 ratio should be considered a limiter rather than a compressor—at least in the context of the hearing aid industry.

A compressor is a rather sophisticated device, and while the circuitry can be, and has been, executed with vacuum tubes, an integrated circuit is an altogether more practical proposition. High dynamic range compressors with 2:1 compression ratios were introduced to the hearing aid industry in the late '60s by an engineer named Hyman Goldberg. Such compressors, termed AGCs (automatic gain controls) in industry parlance, began to become commonplace in hearing aids in the '70s.

The ubiquity of AGC in modern hearing aids is testimony to its effectiveness, but many users complain of unnatural effects from the circuit's operation. Automatic gain control circuits are typically broadband in their operation, and thus they compress dynamic range in the lower frequencies where the aid may provide little or no gain. According to Edgar Villchur, another problem with single band compressors is that they're prone to locking up in the presence of a high-intensity level at a single frequency. Keith Wilson of 3M notes a further defect: Vowels tend to be compressed more than consonants, and due to the slow release characteristics of the compressor the vowels can swamp the voiced consonant sounds. Compressions also tend to do little to improve speech intelligibility or to mitigate the effects of background noise.

Recently, two companies, both of them manufacturers of programmable aids, have introduced aids with dual band compression in an effort to overcome some of the limitations of wideband compression. Dual band compression provides for two separate compressor circuits, the more powerful of which is intended for the upper frequencies where recruitment is ordinarily manifested more strongly.

The two companies currently offering dual band compression are Resound and 3M. (3M combines dual band compression with highly flexible equalization.) A third company, Etymotic Research, has designed a chip that combines single band compression with level-dependent high-frequency boost, which is said to provide the same benefits as true dual band compression.

The idea of dual band compression itself is not new. Bell Labs and Edgar Villchur, the holder of numerous patents relating to high fidelity, did basic research on multi-band compression in the '70s, but the circuitry of the period did not permit practical implementations. Modern

Hearing Loss and Hearing Aids

Hearing impairment arises from a multitude of causes, but generally impairments can be placed within two broad groupings—conductive losses and sensorineural losses. The former are mechanical in nature and include deformities of the outer ear and the ear canal, traumas to the eardrum, tissue growth between the inner and outer ear, abnormalities of the bones of the ear, and fluid and wax in the ear. Many types of conductive loss are treatable and are at least partially reversible.

Sensorineural losses, on the other hand, are usually permanent and irreversible. These most commonly involve breakages in the cilia, the tuned hair cells of the inner ear that trigger nerve impulses in response to sound-induced movements in the fluid of the inner ear. Such breakages are generally the result of progressive noise trauma, and over a lifetime the loss in hearing acuity can be considerable.

Generally, victims of sensorineural losses are considered to be better candidates for hearing aids than those persons suffering from conductive losses, because the malformations or lesions in the outer ear, often present in conductive losses, preclude the fitting of an earpiece. In contrast, sensorineural losses are beyond the scope of even the most advanced microsurgery, but they do not in themselves involve any abnormalities of outer ear that would preclude aids.

Diagnosing hearing disorders and fitting the hearing impaired with selective amplification are extremely involved and cannot be described in even the sketchiest fashion here, however one rather common misconception can be dispelled. Correctly fitted hearing aids do not match every decibel of hearing loss with one of gain. For slight to moderate losses the general rule is to counter the losses with one-third gain, while for the most severe losses, the gain ratio may be increased to two thirds. —*D. S.*

chip technology does. Both Villchur, who has consulted for Resound, and Killion feel strongly that appropriate compression rather than flexible equalization is the key to effecting broad-gauge improvements in hearing aid performance. Villchur (in a phone interview with the author) opined that dual band compression also ameliorated the "cafeteria effect" where the hearing impaired have difficulty following a single conversation in the presence of background noise.

"People with hearing loss simply receive fewer cues than the rest of us for distinguishing conversation from background noise," says Villchur. "Multi-band compression helps restore those missing cues."

But not all researchers agree. Intellitech attacks the background noise problem more directly with a circuit known as the Zeta Noise Blocker. Intellitech is not a hearing aid manufacturer per se but a small engineering and research company that sells the Zeta Noise Blocker chip to other manufacturers. The Zeta Noise Blocker is a hybrid device. It utilizes analog circuitry exclusively in the signal path, but the monitoring and control circuits are digital and the processes performed by them may be rightly termed digital pattern analysis.

Although the Zeta Noise Blocker is probably the most sophisticated signal processor used in a hearing aid to date, its actual mode of operation is fairly straightforward. The device consists of a group of interrelated circuits. In aggregate these circuits distinguish background noise from conversation and remove noise from the audio signal.

In its first stage the Zeta Noise Blocker divides the signal into a number of frequency bands and then scans the signal content within each band for abrupt changes of amplitude. Typically, speech directed at the listener will exhibit rapid variations in amplitude whereas background noise, including background conversation, will show a more gradual variation in level, and will tend to approach a steady-state condition. The Zeta Noise Blocker identifies the signal content whose envelope appears to represent noise and attenuates the signal level in the frequency bands where noise is apparent. A variable corner frequency is provided for each band to tailor response more effectively. The Blocker monitors the incoming signal continuously, and in the absence of a predetermined noise threshold, the audio signal is not processed.

PARALLEL

UNIVERSES

With ICs, entire aids could be built into eyeglass frames or hooked behind the ear. This placed the microphones near the user's ears, where head diffraction and head motion could provide binaural listening cues.

Because it identifies noise by means of relatively long-term fluctuations in signal level, the Zeta Noise Blocker is ineffective in suppressing impulsive noise. On the other hand, it can separate direct speech from background conversation because the latter tends to exhibit less amplitude variation, though because the two occupy the same frequency bands, the Beta Noise Blocker cannot remove background speech entirely without interfering with direct speech.

The Zeta Noise Blocker, while unique in its approach, is not the only digital noise suppression system. The Nicolet Phoenix, the world's only fully digital aid, also includes a circuit for suppressing background noise.

The Environmental Approach

The primary purpose of programmability is to improve individual fitting, but digitization brings another significant benefit as well, namely the ability to store in memory more than one tuning. Several of the programmables, including the Resound Personal Hearing System, the Widex Quattro, the 3M Memory Mate, and the Nicolet Phoenix, have this capability. The Nicolet Phoenix goes furthest in this regard in that it is provided with three memories storing diagnostically determined equalization, noise reduction, and gain settings for different environments. The user, by taking advantage of the body-worn control module, can change settings at the push of a button.

Such flexibility is impressive, but hearing aid engineers are looking

beyond predetermined settings to an adaptive digital hearing aid with enough on-board software to be able to analyze the environmental noise characteristics and recalibrate the aid from moment to moment to maximize speech intelligibility. Considerable progress in both chip design and psychoacoustics will have to take place before hearing aids of such sophistication can even be made in prototype but the benefits of such technology, if it can be perfected, could be inestimable.

The latest chip technologies allow microphones and electronics to be mounted in the ear, so spectral-directional cues from the wearer's pinna and concha are included in the amplified sound.

Programmable Prospects

Some industry analysts, such as William J. Mahon, Editor of *The Hearing Journal*, suggest that programmable aids will become the norm sometime in the early '90s, but so far market acceptance has been limited.

Part of the problem is high price. The programmables represent new technology and embody a great deal of proprietary research. The companies who have developed programmables obviously have to charge more to recoup initial development costs.

Another problem has been size. All of the first generation instruments excepting the PHOX were behind-the-ear only. The Phoenix, the only fully digital unit, also utilized a body-worn cable-connected control module. Most of the newer programmable aids will be in-the-ear types while Starkey, a leading hearing aid manufacturer, is developing a programmable in-the-canal hearing aid.

But customer resistance to size and pricing aren't the only factors in limiting programmable acceptance, nor do they appear to be the most important. Dispensers themselves are in many cases reluctant to stock programmables because of the high costs of the diagnostic equipment that must be used with them and because of the lack of compatibility between brands. The dispenser who sells a programmable must purchase the unique computerized test equipment and interfaces required for each brand. This effectively restricts him to a single programmable model which puts him at considerable risk if the manufacturer decides to abandon the programmable market.

WITHIN THE NEXT FIVE YEARS, RAPID ADVANCES IN HEARING AID RESEARCH AS WELL AS ENGINEERING SHOULD BE ACHIEVED.

Some solutions to the last problem may be at hand, however. In Europe, a number of hearing aid manufacturers including Siemens, Philips, Hansaton, Phonak, and Rexton have formed a consortium to develop a mutually compatible programming system to be known as the PMC (programmable multichannel system). The PMC is not intended to be truly universal but will only operate with systems developed according to PMC standards by participating companies.

Gennum, a Canadian company which is a leading supplier of hearing aid ICs, is currently at work on a universal "learning" external programmer that can be used with any digital aid, and this promises to provide the ultimate solution to the compatibility problem.

The gradual implementation of industry standards in programmability will undoubtedly give more dispensers the confidence to offer such aids to their patients. At that point the competing theories as to optimal equalization, compression, and gain characteristics will be tested in the marketplace. Academic studies will begin to supplement proprietary research, and eventually one theory will prevail leaving one or two companies to dominate the digital aid market. Undoubtedly the hearing-impaired consumer will benefit, because the programmable aids do indeed offer a level of signal processing and individual tailoring that isn't possible with the established all-analog technology.

Unfortunately, as in other areas of audio, electronics engineering outruns understanding of the way that human beings process signals with the ear/brain, and the execution of solutions is often clearer than the identification of the problems. The next five years should signal very rapid advances in the hearing research as well as engineering, and perhaps by the mid-'90s the "high-fidelity hearing aid" presumptuously advertised by a number of current manufacturers will actually exist. ▲

THE AUDIO INTERVIEW

Avery Fisher

The Gift Of Music

Do we credit coincidence or some celestial casting agent with the fact that Avery Fisher could play himself on stage? The urbane, handsome hi-fi patriarch and patron of the arts is the very image of distinction.

In the October 1946 *Fortune* magazine, a lengthy article explored the hobbyist phenomenon called high fidelity in great detail. It was the first time many Americans so much as heard the term, and the piece thrust Fisher, the only manufacturer to earn rave reviews, into the spotlight. Products from the era's major console makers comprised a comparatively tuneless chorus, but the two radio-phonographs built by Fisher Radio were virtuoso performers. "Best of the post-war radio combinations in price and performance," the *Fortune* writer stated unequivocally.

The idea of incorporating high-performance components in a commercially available console was just the first of many remarkably astute moves from this groundbreaking manufacturer. Combining preamp, amp, and tuner on a single chassis to create the first hi-fi receiver (an innovation as important in our field as the sandwich proved to food) ranks as another. By the time Fisher sold his company to Emerson Electric Co. for $31 million in 1969, the list of achievements had lengthened considerably.

In 1973, Fisher donated more than a third of the pretax proceeds from that sale to New York City's Lincoln Center for the Performing Arts, which in return renamed its major concert hall in his honor. The grant, about $12 million, was unusually sophisticated: A portion was set aside for housekeeping, necessary if mundane, and other monies are held in trust for the benefit of deserving young performers, 48 of whom have since been award recipients.

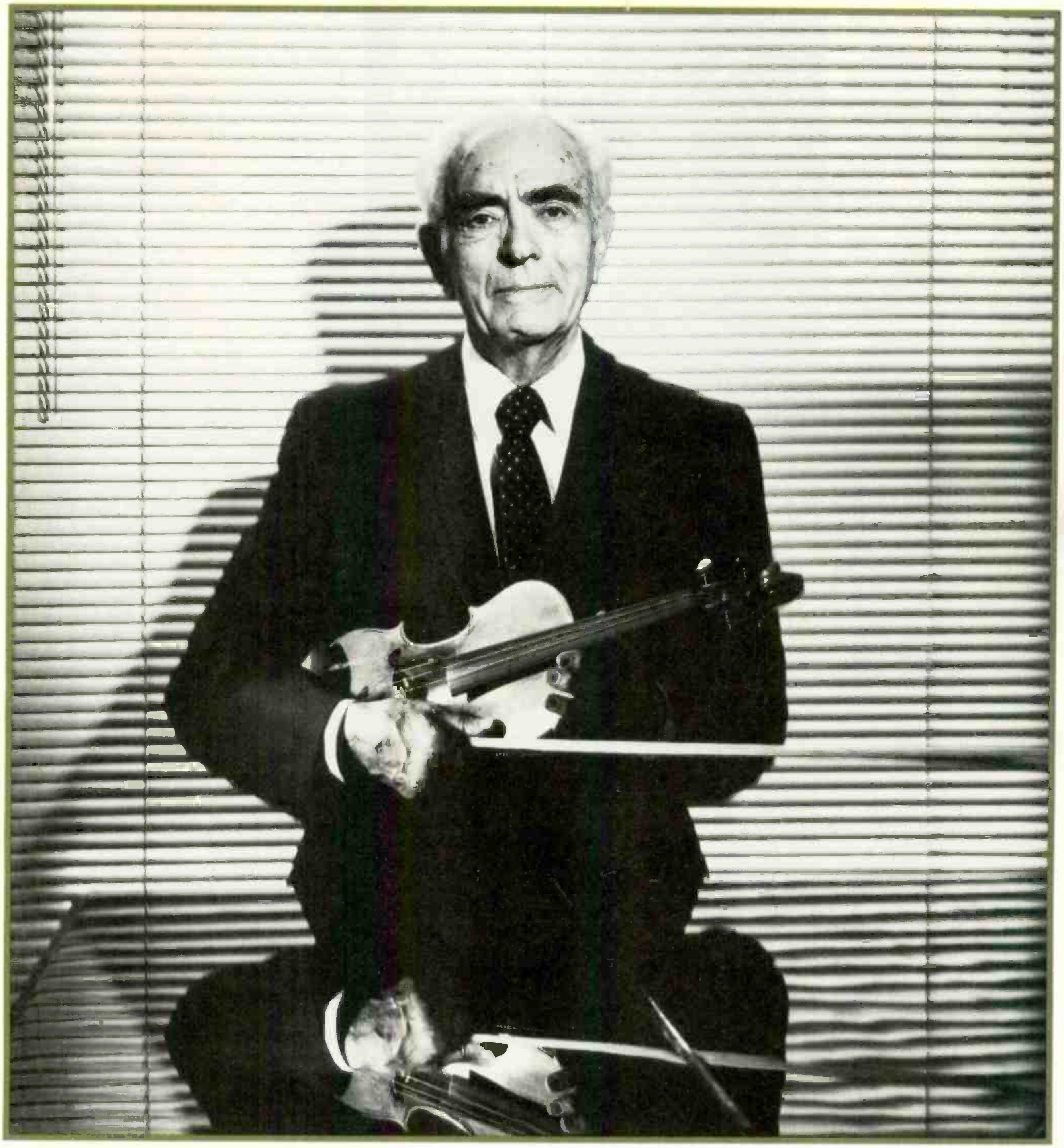
> Fisher justifies his grant to Lincoln Center in the simplest of terms: He was merely giving something back to the music world.

Fisher justifies that extremely generous grant in the simplest of terms; he was, he has explained, merely giving something back to the music world. Music, he has stated, is the wellspring, the sine qua non of high-fidelity hardware; without music, Avery Fisher once remarked to me, everything he had manufactured over the years would be piled up in basements.

Avery Robert Fisher was born in Manhattan, New York, on March 4, 1906, just three years after his parents had emigrated from the Russian city of Kiev. Educated at the city's public schools and New York University, he grew up in a musical household only blocks from the upper East Side apartment where he now resides. His father, Charles, collected early cylinder recordings, and all six Fisher children were given the chance to learn instruments. Young Avery's choice was the violin, and the boy was instilled with a profound love of chamber music that has remained an important part of his life to this day.

The conversation that follows took place in the apartment the Fishers have occupied for more than 30 years, in the living room where equipment destined to carry his name once underwent listening tests. With a 7′4″ Bösendorfer grand piano standing near one wall and a library of string quartet literature shelved against another, it was an ideal setting to discuss a hi-fi legend's long and passionate involvement with music. *D.L.*

DAVID LANDER



PHOTOGRAPH: KEVIN KNIGHT

Winners of Avery Fisher Artist Awards celebrate the 10th anniversary of the program as well as Fisher's 80th birthday in March '82. Mr. Fisher is seated with Richard Stoltzman; also present were, from left, Emanuel Ax, Lynn Harrell, Horacio Gutiérrez, Richard Goode, Murray Perahia, Elmar Oliveira and Yo-Yo Ma.

Susanne Faulkner Stevens

What did your father do for a living?
My father was in the clothing business. He had a store—not too far from here, as a matter of fact—for many years. It became very well known. He was a linguist—he could speak German, Russian, English, and French, so new arrivals who had difficulty with the English language enjoyed coming there. They could always make themselves understood.

You've mentioned his avid interest in music and record collecting. Was he also a musician?
He didn't play an instrument himself, but he saw to it that every one of his children—there were six of us—was given an opportunity to learn to play. All the rest were pianists; I was the only one who studied violin, which in later years I realized was a very nice thing because that gave me access to string quartet playing. For many years my wife and I had chamber music in our home every Friday night. That, I would say, is the single most significant musical experience for me, that exposure to chamber music. I have a pretty comprehensive chamber music library right up on those shelves. At the time I started playing it in my apartment, if you'd mention the phrase "chamber music" people would ask, "What is that?" It was a foreign language to them, but for me it's a gold mine. There's no bottom to this mine. You keep digging for as many years as you want to, and there's always something new or the rediscovery of something. We're very fortunate that a number of outstanding professional musicians are very good friends of ours, and they love to play in this room. We don't have a mob scene. We just have the musicians and a few friends—their friends, ours—and a nice meal afterwards. Anything they want to play, I can pull it off the shelves if we have it here. We have a very fine piano here. So that's a very enriching experience for me.

Do you still play?
No, I don't play anymore. My wife will tell you, if you ask her, that I stopped playing in response to popular demand. [laughter] A string instrument is something you've got to keep at every day, at least a half-hour of exercises, scales or whatever, or you lose it fast. No, I haven't played for some years. I'm the librarian now.

I remember running into you at Lincoln Center—perhaps 10 years ago—after [violinist] Ani Kavafian gave her Fisher-award-winning performance. I went to the Green Room with a few friends to say hello to her, and you were standing outside holding a violin case in your hand.
It may have been the Strad that I loaned her.

You own a Stradivarius. Do you own other instruments as well?
No, just that one. It's enough for me.

How old is the violin? What's its provenance?
It's from 1692. It was owned by one of the prominent female violinists in England. It was in her family for 75 years, which means it wasn't knocked around on tour and is in excellent condition.

But you loan it out to performers?
I loan it out for special occasions. Not for long term because it becomes a cruelty. They fall in love with it, and then at some point you have to take it back because you're not going to make them a gift of it.

No. An instrument like that is incredibly valuable today.
I bought it at an auction in London 12 years ago for $60,000, and it was recently reappraised for $500,000. That's what's happened, and that, in a sense, tells you the tragedy of being a string instrument player on his way up who hasn't got the funds to get the best possible instrument to pursue his profession. It's a terrible situation. These youngsters sign away their income for the next 15 or 20 years just to be able to own a good instrument.

You've helped a number of young performers, and I want to get back to that subject. First, I'd like to ask you about the early days of hi-fi. One of the original breeding grounds for the species was the collection of radio parts stores on Cortlandt Street in downtown Manhattan. You have a favorite Cortlandt Street story about a radio you bought there for your parents. Do you recall how old you were at that time?
Oh, I guess I was in my late 20s. Cortlandt Street was known as Swindle Street, as you know. I went down to Cortlandt Street, and they had two d.c. models, six tube and eight tube, and I erroneously thought the extra tubes meant extra quality of some sort. So I bought the one with the eight tubes and gave it to mom and dad. They were living in an apartment with direct current; they didn't have a.c. Several years later, that neighborhood was rewired for a.c., and I took their radio down to the service department of Lafayette Radio, which had those facilities, to be rewired for a.c. The man at the counter took the thing apart and took a look and then said, "I'd like to show you something." Those two extra tubes were not even in a circuit; all they did was light up. My other favorite comment on Cortlandt Street: There was a place that sold used tubes, and a slogan in the window said, "Our tubes are guaranteed for life." In other words, the minute they failed, that was the end of the guarantee. [laughter]

You never studied engineering, though I believe your brothers did. Like so many of those instrumental in making hi-fi a business, you started out as a hobbyist.

Yes, my two oldest brothers were engineers, a mechanical engineer and chemical engineer. They were in no way an influence on my activity. I represented the meticulous hobbyist who wanted to get the best possible results. I started delving into [audio] when sound movies came along. Theaters in the early days of sound movies were playing the sound off a 16-inch disc synchronized with the film in the projection booth. Of course, the movie theaters had terrible problems with lip synchronization. Then along came Western Electric with their system, called Mirraphonic, which recorded the sound track on one edge of the film. [The theaters] went into the Western Electric systems, and they got rid of their amplifiers, which were called Photophones—that was the RCA system. I used to pick those up for a song from the theaters. To them it was junk, but they were very good amplifiers. I think they had a type 50 audio tube that was the size of a pint milk bottle. I used those to build up phonographs, and they were pretty good. I started really as a hobbyist. When I had to get design work done, I had it done by electronic engineers, but I was the guy who stated the features that were wanted by the public I thought was out there—the convenience features and the performance features.

When and why did you decide to make hi-fi your profession? Prior to starting your first company, Philharmonic Radio, you had been a book designer.

That's how I started to make a living when I got out of college. I worked with a publishing house, Dodd, Mead and Company—to whom I owe everything when you get right down to it. I worked at Dodd, Mead and Company for the single most cruel person I have ever met in my lifetime—and I'm not exaggerating. This man was only a year older than I. He was the boss's son, and I think he sensed my apprehension about having a job at all. I went to work there in 1933, having been in the advertising agency that handled their account before that. That agency closed when the banks closed in 1933, and I was out of work for about six months. In the fall of that year, I went to Dodd, Mead asking if they could use my services, and they hired me for $18 a week. After about six months, perhaps out of guilt or something, they gave me a two dollar raise. I was doing the same work there that I was doing for them at the agency, and the agency used to charge them $100 to design a [promotional] brochure. I used to turn out two or three of those a week, and I still was getting only $18 or $20.

In 1937, I noticed that the advertising department of Dodd, Mead was buying their photo engravings from one source and their book manufacturing department was buying from another. If they combined both those purchases and bought from one source, their quantity discount would save them just under $10,000 a year. I went to my superior, Ed Dodd, and told him about it. He said, "That's a great idea, Fisher." He never called me by my first name—always by my last, you know, like a deckhand. He said, "I think I'll do something about it." And they did. And I said, "By the way, I'd be very grateful if I could have a five dollar raise." He could have said, "Well, not right now." But instead he said, "Well, no. We probably could get some young Yale boy in here to do your work for less than we're paying you." That day, I said to myself, "I've got to get out of here one way or another," and I started putting [radio-phonograph] sets together for friends. I was moonlighting, and I did that for a number of years before I was in a position to get out and really spend full time on this. By 1943, I'd built up my company, Philharmonic Radio, to the point where I could draw enough money from it to earn a living. By that time I had a wife and child. So I owe them [Dodd, Mead] everything. Because I really loved my work as a book designer, and I turned out some very fine stuff, which won prizes. One of the books I turned out was called *Grassroot Jungles*, which became one of the 50 best books of the year for graphic design—this is out of 40,000 titles—and Ed Dodd never let me put my name in a book for credit as the designer. Now this is a long answer to your simple question, what got me into hi-fi. It was an act of desperation—and also of love, because I really enjoyed hearing good equipment.

Where was Philharmonic Radio based?

54 West 21st Street. I shared a loft that had an area of about 750 square feet. Half was a showroom and the other half was the production area. In those days we were assembling a tuned radio-frequency receiver, and the object was to get the best possible reproduction of the local stations and best possible reproduction of recordings. We were not interested in short wave, which was a sort of national craze at the time. Consumer's Union ran a report on what we were doing, and that was the first big boost we had in becoming known.

What did Philharmonic Radio do during the war?

During the war, we were working on subcontracts for the Navy. We were turning out IFF equipment, which is Identification, Friend or Foe. It was a transponder, so you could tell whether an aircraft was one of ours or one of theirs. You'd send out a beam, and you had to get a signal reply back. We also designed the first instrument landing system used at LaGuardia Airport for the Civil Aeronautics Administration in Washington. In 1943, we didn't have enough money to finance the contract work we were able to get, so the company was sold to American Typefounders, who needed an electronic division. I stayed on 'til the end of the war, at which time [1945] I resigned and start-

There's no greater pleasure than hearing chamber music in your own living room. There's an intimacy about it that can't be matched.

Kevin Knight

ed Fisher Radio. After the war, a lot of GIs came back with some electronic exposure, and they were part of our clientele. We also got a writeup in *Fortune* magazine in October, 1946. That article was the watershed for our company internationally. We started getting orders—it was amazing who was buying from us; it was literally a Who's Who of American industry, education, and government, top people. And as a result of that, I met some really wonderful people who happened to be interested in music but who also wanted very good equipment to reproduce it in their homes. Some of them became very good friends. These are the wonderful things that happened as offshoots of my basic business, making hi-fi equipment. I met some marvelous human beings.

Well, you were always very attentive to your customers.

That's true, absolutely true. I felt that anybody who bought something from me deserved my attention—if it came to that. I used to go to work on Saturdays at my Long Island facility. The place was closed, but I had the first line plugged into my office so I answered the phone. It was not atypical for a customer to call up and say he needed some service. I asked what the trouble was and wrote it down and said, "Somebody will call you on Monday to set up an appointment because there's nobody here." [And the customer would say] "By the way, who is this? I said, "This is Mr. Fisher." And he would say, "You're kidding!" And anybody who called during the week and had a complaint got me. I never ducked anybody. I felt, if they had been disappointed by somebody lower down, they deserved my attention.

Kevin Knight

Didn't you in fact take calls from consumers up until the time you sold your company?

Oh, sure. As long as I was in my company, I was accessible to anybody.

You also had a retail store for a while.

We had a little store at 41 East 47th Street [opened in] September of 1945. We kept it there for a few years. At that time, we had no dealer distribution. If you wanted Fisher equipment, that's where you went.

When you decided to sell through other dealers, who were they?

Well, most of them were Capehart dealers. That's where we got our basic start with dealers. Capehart was unable to produce a trouble-free set that could handle LP records. The heavy shellac records gave the machine something to get a grip on, but even those [players] used to break. Then they had trouble with their cabinets; sheets of veneer would fall off. That left it open for somebody to come in with a high-priced radio-phonograph. The dealers turned to us. We were the only ones who could produce what they were looking for.

One of Fisher's customers was Jack Kennedy. Another was Truman, who gave a Fisher radio-phonograph to the King of Siam.

You once told me that a number of customers at your 47th Street store paid you in cash.

My favorite cash customer was a dentist who came in on a Saturday afternoon to pay for his set, and he paid me in cash. I didn't want to leave that cash in the store over the weekend so I took it home. My wife said, "What's that funny smell?" I said, "From what?" She said, "Coming from your drawer." It seemed the smell was camphor. The doctor had camphor balls in his cash to make sure the mice didn't eat it.

I believe your customer list also included a couple of U.S. Presidents.

Oh, yes. My favorite, of course, was Jack Kennedy. We not only set up hi-fi equipment in the private quarters of the President in the White House, which he used all the time, but we put together a radio-phonograph in segments that fit into aluminum cases that accompanied the President on Air Force One. We made a special set for him with multi-voltage facilities so, no matter where he was, he could enjoy his equipment. And President Truman—when he wanted to give a gift to some potentate, he would give him a Fisher radio-phonograph. When the King of Siam [now Thailand], Phumiphol Adundet, got married, President Truman had the State Department come to my little shop on 47th Street and order a radio-phonograph to be shipped to Thailand. They brought with them [an inscribed] silver plate, and we were instructed to nail that to the top of the set with silver nails so the King would never forget where it came from. [laughter]

What did the postwar Fisher line consist of?

We had two basic models as far as receivers were concerned. We had a variety of loudspeaker arrangements—that's where we had our variety. And also tonearms. Some people wanted to go into the very expensive stuff, and we used to supply them with Western Electric tonearms—the Model 9A—which was what the broadcast stations used. And also Western Electric turntables. That was the top of the line. There were customers for whom price was no object, and we supplied them.

You didn't build your own speakers in those days.

No. We didn't get into making speakers until later years. For the top of the line, we used Western Electric, two of which I have in this room. I used to enjoy impressing people by having a little table radio, which probably had a one or two watt output, and switching it into these speakers. They couldn't believe that much sound was being generated by this $10 piece of junk.

Weren't your prices so high that, in effect, you were competing with the television manufacturers of the day?

In a sense, I guess we were. People would come in, learn the price and say, "Well, wait a minute. For that kind of money I can get a radio-phonograph *and* television." I had to point out to them that the audio side of that comprised a six-inch speaker instead of a 15-inch [woofer] and high frequency speaker, and a very small amplifier, perhaps three or four watts, because we were selling them 50-watt amplifiers. I had to educate the public because of that price differential.

How did you see yourself in relation to the major audio companies?

The big companies, in my specialized market, were at a great disadvantage. Their decisions on what models to bring out were usually created in committees, and the bottom line was that division had to produce a profit. Their decisions were understandably based on what would generate the most volume, not essentially what a few hi-fi bugs would like. So that left that field for me. And conversely, I was not in the position to turn out volume radio-phonographs at a low price. I was just not set up for it. So we were both specialists in a way, they in mass-produced, moderate-priced equipment and I in limited production and high quality.

Did you ever consider moving downmarket—lowering the quality and cranking up the volume?

It never even entered my mind because I had no personal interest in it. No model we ever turned out was even brought anywhere near production before prototypes were brought into this home, this room as a matter of fact, and lived with for a while. That was true also of loudspeakers; I always matched prospective speaker systems against my Western Electrics, which were my standard.

A distinction I often make between art and business is that the former is driven by love and the latter money. Were your contemporaries in the early days of hi-fi more interested in the art of music reproduction than they were in making a lot of money?

They were dedicated people. I'm sure they wanted to make money, but their primary motivation was to turn out a quality product. There's no question about it—and, where possible, I used that quality product.

You had some Fisher products built in Japan.

Later on, yes. But we were not one of the first to rush over.

When did you first come into contact with the Japanese?

When I first took notice of what was going on, I decided to go over and see for myself. In the early '60s, I went to Japan. That first trip was an eye-opener for me. I was going over to buy material—loudspeakers. We were also interested in tuning meters for our receivers, center-of-channel and signal-strength meters. I took my chief engineer over with me. Now as far as the speakers were concerned, I was shown through these assembly line [areas]. The first thing that struck me was that, here I was, a strange person in this environment, a lot of young people on an assembly line, and I never once caught them looking at me. I'm sure they saw me. They were all busy with whatever it was they were doing. One of the companies we visited was a meter manufacturer. My chief engineer gave them samples of what we were looking for—we were buying perhaps five or ten thousand at a time—and he gave them to the manager, who was taking us on a tour of that facility. I don't think we were there more than an hour and a quarter, maybe an hour and 20 minutes. When we were saying goodbye, his aide came over. They had already fabricated samples of the meters that we were interested in. That's the Japanese.

Guitarist David Starobin and Fisher. Starobin is the only guitarist to be honored with a Fisher Career Grant.

Susanne Faulkner Stevens

Did you participate in the first public hi-fi shows, the ones run by Harry Reizes?

Yes, we were in every one of them. As a matter of fact, I was one of the instigators of the Institute of High Fidelity Manufacturers [a trade association later renamed Institute of High Fidelity; it has since been absorbed by the Electronic Industries Association]. We felt that the industry was important enough in and of itself to be able to run its own shows.

The early shows introduced a lot of people to the phenomenon known as high fidelity. They were important to you and your colleagues in other ways as well, weren't they?

Sure. We wanted to be in touch with our clientele. We learned a great deal from them. We didn't have to send out a bunch of college boys with questionnaires to find out what we should be making. I was able to speak to the actual consumers, or potential consumers, to find out what they liked about our present products and what they would like to see in our future products. And conversely, for them to be able to come into our rooms and talk to the man whose name was on the product meant a great deal to them. They felt they were talking to headquarters, and they were. I enjoyed meeting these people. They were not only helping me make a living, but they were great people. They were interested in music, and I've found over the years that people who love music are special somehow. They're usually very decent people. I'm not saying there aren't some devils among them but, generally speaking, the nicest people I've met in my lifetime are music lovers and musicians. They are very special.

Well, in the light of your exceptionally generous donation to Lincoln Center, your feelings about musicians are a matter of record. Let's talk a bit about that. Why did you decide to make the grant to that particular organization?

I wanted an organization that could also administer the Avery Fisher Artist Program, and Lincoln Center had the personnel to do exactly that. I don't know where else I could have gone to have that set up on a permanent basis, with the right people running it. That's been one of the most enriching experiences of my life, that program.

How are the monies allocated? At the time you made the grant, the press noted that the program you set up was very sophisticated in that it helps cover such unglamorous but essential things as housekeeping.

The basic endowment goes to the operation and maintenance of Avery Fisher Hall—20 percent of that goes to the support of the Avery Fisher Artist Program. That additional income means that they don't have to raise ticket prices as much as they would have to if they didn't have the income from that endowment. That helps the New York Philharmonic, which pays part of the operation and maintenance of the hall.

And, of course, some of the money was used to redo the hall acoustically in the mid-'70s. But explain the Avery Fisher Artist Program.

It operates on two levels. One is the Avery Fisher Prize, which carries with it a $25,000 stipend. It goes to an established musician who has made an important contribution to music. To give you an idea of who the recipients of the prize have been: In 1975, [cellist] Lynn Harrell and [pianist] Murray Perahia, in 1978, Yo-Yo Ma, cellist, 1979, Emanuel Ax, pianist, in 1980 [pianist] Richard Goode, 1982, Horacio Gutiérrez, pianist, and in 1983, Elmar Oliveira, violinist. These are the established people.

In addition to that, on another level, we have the Avery Fisher Career Grant, which has a $10,000 stipend. There have been over 40 beneficiaries of that. These are talented musicians who are ready for a major career and who need a break of some sort. I've been told by a number of them that, although the money is very good and they appreciate it, what meant even more to them was the fact of being chosen for this program. Now mind you, the way it works is we have about 120 members of a recommendation board that includes educators, musicians, managers—people in a position to spot the talent. They send in their nominations to Lincoln Center, where we have an executive committee, and that executive committee makes the final choice. These musicians have told us that the imprimatur of that committee meant more to them by way of bookings than anything we could possibly have done for them. Their careers usually took off at that point. So it's become a very important endorsement. Now each year, we award only one prize, if there is somebody suitable for it. But we also award up to five Career Grants of $10,000 each, depending on eligibility of musicians. Now they can use that $10,000 for any purpose that furthers their careers; it could be for a recital, it could be to put a deposit down on an instrument.

Kevin Knight

The Avery Fisher Prize of $25,000 has gone to such musicians as Murray Perahia, Richard Goode, Lynn Harrell, Emanual Ax, and Yo-Yo Ma.

At the time your donation was announced, Lincoln Center's major concert hall was renamed Avery Fisher Hall. You've always maintained that was not your idea.

It was not my idea—it was mind-boggling when it happened. It was uncomfortable in the beginning. I try to think of myself as a low-key person. But they felt I had done enough for them to warrant that sort of thank you. It's been a very amusing experience in ways, you know. People who have their names on concert halls are supposed to be dead. But today there are two concert halls in New York—Alice Tully Hall and Avery Fisher Hall—where the people involved are still around. It's not unusual for me to go to a department store and want to charge something; I'll put down my name, Avery Fisher, and the clerk will look at me and say, "Are you the hall?"

I see some LPs on your shelves. Do you have a very extensive collection of records?

The major part of my record collection is not here, but up in [a weekend residence in] Connecticut, where I have facilities that are really something to see. In Connecticut, I have a bass speaker cabinet with two 15-inch woofers. These are horn-loaded, Lansing. And on top of that, I have two 594A Western Electric drivers with four-inch voice coils. The voice coil assembly and magnet weighs something like 31 pounds, so you can be sure there's plenty of gauss in there. These feed into a model 26A Western Electric multi-cellular horn, the kind used in theaters. It's 37 inches wide and 26 inches high and has 15 cells. That's mounted on top of these two 15-inch woofers. The whole assembly stands 7 feet tall, and it fits right into a closet in our hall, which is just ideal. I like to tell my friends that, when I brought this monster into the building, I first arranged with one of the local doctors to give my wife general anesthesia so she wouldn't throw me out of the house with the speakers.

It really is amazing how far the art of music reproduction has advanced in your lifetime.

Don't forget I started my career in hi-fi by being the youngest member of my family. We had a hand-crank phonograph. It was spring wound, and I was the one who had to crank it up after every record. You know, it only ran four minutes.

If you had it all to do over again, what would you change?

Well, I wouldn't go to work for Ed Dodd, but that would be the only thing I would change. For me it's been a very enriching life, not only in the area of fine reproduction equipment, which brought happiness to a lot of people, but being able to listen to great music by fine musicians—some of whom are very dear friends who have honored this house by coming here to play. No matter how great the concert, there's no greater pleasure than hearing chamber music in your own living room. There's an intimacy about it that can't be matched in a concert hall. ▲

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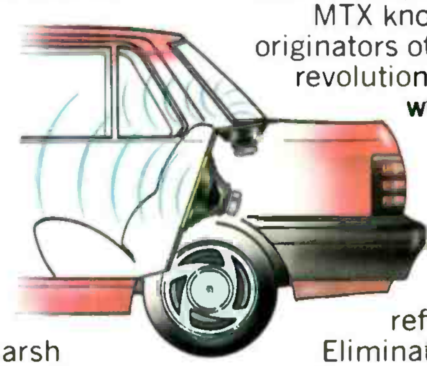

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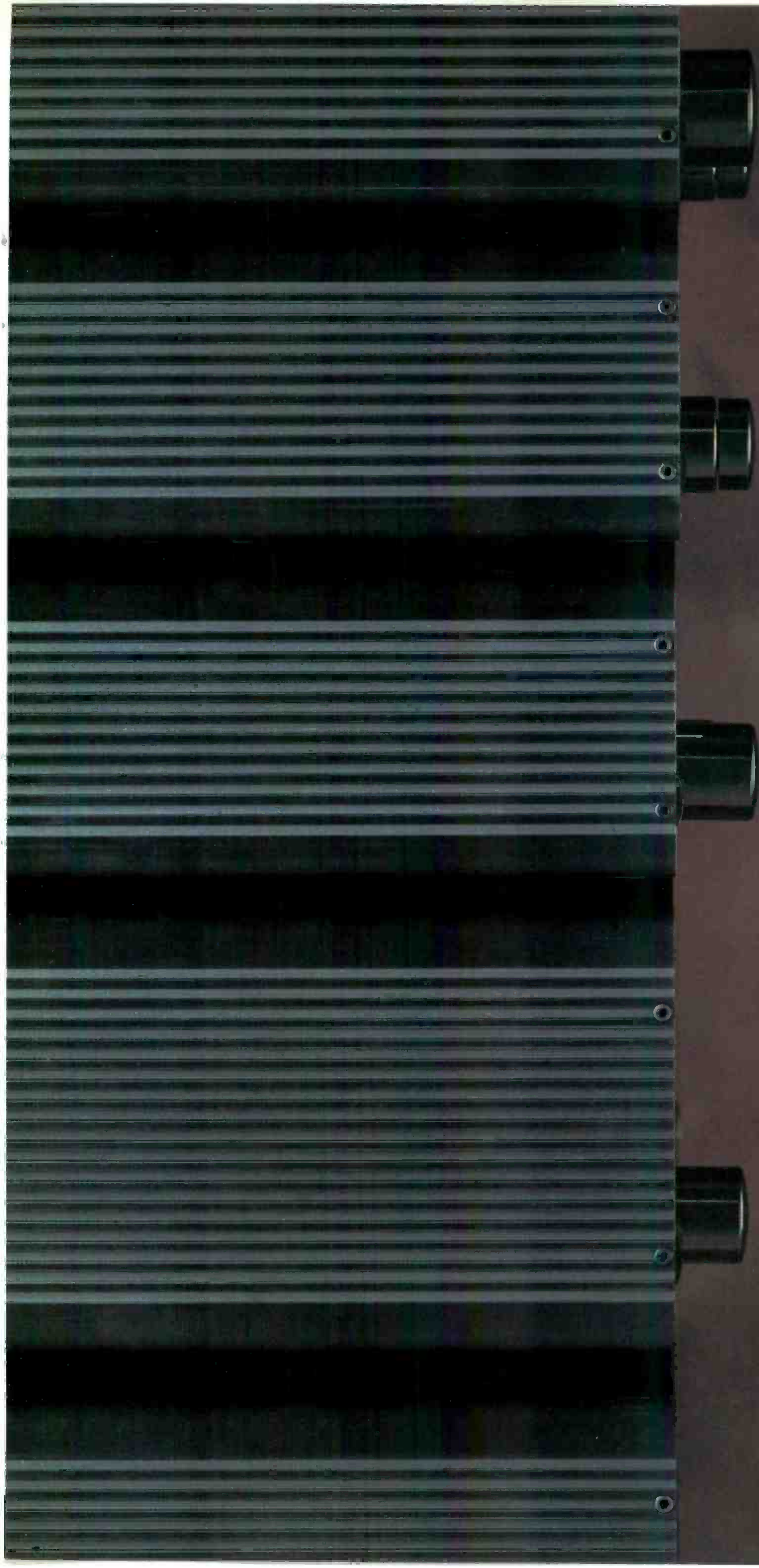


SOTA COSMOS TURNTABLE

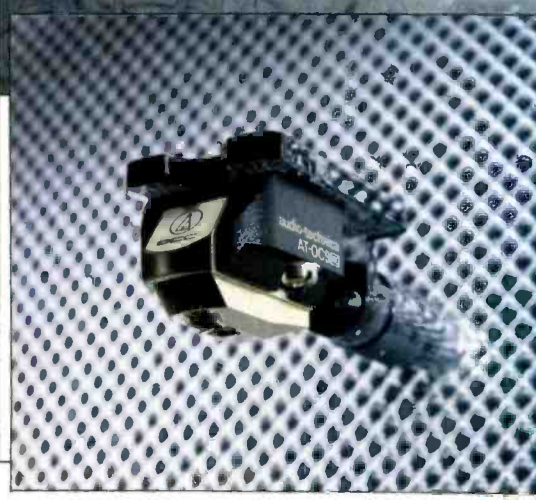
Manufacturer's Specifications
Speeds: 33⅓ and 45 rpm.
Speed Stability: 0.1%.
Wow and Flutter: 0.1%, DIN wtd.
Rumble: Unweighted, −60 dB; weighted, −75 dB.
Dimensions: 20¼ in. W × 16 in. D × 7½ in. H (51.4 cm × 40.6 cm × 19.1 cm).
Weight: Turntable, approximately 60 lbs. (27.2 kg); vacuum pump, 15 lbs. (6.8 kg).
Price: $4,000 in black matrix finish; $4,500 in high-gloss acrylic.
Company Address: 954 86th Ave., Oakland Cal. 94621
For literature, circle No. 90

"The turntable is not dead! Long live the turntable!" This seems to be what SOTA is saying with their introduction of the Cosmos turntable. In fact, the Cosmos is not just a statement in favor of the turntable as a viable source of pleasure to those of us who enjoy listening to our record collections; it seems to be SOTA's way of saying, "There are subtle nuances and details on your favorite records that you haven't yet enjoyed; we want you to be able to hear them." How well they have succeeded is the subject of this report. In the June 1986 issue of *Audio*, I reported on the SOTA Star Sapphire turntable, which featured a vacuum system to hold the record firmly against the turntable platter; SOTA has applied a further refined version of this system to the Cosmos turntable. The purpose of this uncommon feature is to increase the transfer of mechanical energy from within the plastic record material to the platter surface, where it can be dissipated harmlessly and not re-enter the playback system as delayed energy. This energy, which is generated by the interaction between the stylus and the record groove, can smear and obscure subtle details in the recording.

The Cosmos is a completed design. In most turntables, there is still something that can be improved; sometimes, these improvements appear in later designs. The Cosmos is different in that, given SOTA's design philosophy over the years, it seems that nothing can be significantly improved. For example, when trying to adjust the vertical tracking angle of the cartridge stylus, the record should be down flat against the turntable platter. The fact is that without the vacuum system operating to pull it down against the platter, the record would be sitting up on the soft rubber vacuum-sealing lip around the periphery of the turntable platter. But if you turn on the power so that the vacuum system will operate, the turntable will rotate, making the VTA adjustment very difficult. SOTA has the answer to the problem: The power cord from the power-supply/vacuum-pump box is unplugged from the turntable and terminated in a female DIN plug (supplied). This fools the system into supplying vacuum even though the turntable is not rotating. These little details add up to a well thought-out total design. It is almost embarrassing to see a product like this because one of the reasons for this type of report is to point out failings as well as good points. Here, failings were hard to find.

From the standpoint of engineering and construction the Cosmos is impressive; the smooth, glossy, salt-and-pepper finish, the rounded surfaces, the black record mat with its integral soft rubber lip that seals the record to the platter, and the small half-round a.c. power and speed change buttons are unlike any I have ever seen before. They are unmarked, as on previous SOTA turntables, and have the same salt-and-pepper finish as the turntable

Continued on page 60



SME 309 ARM & SIGNET OC9 CARTRIDGE

Manufacturer's Specifications

Tonearm

Type: Tapered aluminum tube with detachable, clamped headshell.

Pivot-to-Stylus Distance: 232.32 mm (9.15 in.).

Pivot-to-Spindle Distance: 215.35 mm (8.48 in.).

Offset Angle: 23.204°.

Overhang: 16.98 mm. (0.67 in.).

Linear Offset: 91.54 mm (3.6 in.).

Tracking Error: 0.013°/mm max.; 0° at 63.62 mm and 119.46 mm from record center.

Vertical Tracking Force: 0 to 2.5 grams, at minimum cartridge weight.

Cartridge Weight Range: 6 to 17 grams.

Effective Mass: 9.5 grams.

Wiring Characteristics: Internal wiring, 15 pF/channel, 0.54 ohms/ conductor; external audio lead, 140 pF/channel, 0.15 ohms/ conductor.

Weight: 717 grams (1 lb., 9.3 oz.).

Price: $995.

Company Address: c/o Sumiko, P.O. Box 5046, Berkeley, Cal. 94705.

For literature, circle No. 91

Cartridge

Type: Moving coil.

Stylus Assembly: Elliptically polished, nude, miniature diamond on gold-plated beryllium cantilever.

Tip Dimensions: 0.2 x 0.7 mil.

Frequency Response: 15 Hz to 50 kHz.

Tracking Force: 1.25 to 1.75 grams.

Channel Balance: Within 1.0 dB.

Output Level: 0.4 mV at 1 kHz.

Recommended Load Impedance: 20 ohms.

Mounting: ½-inch centers.

Weight: 7.8 grams.

Price: $395.

Company Address: 4701 Hudson Dr., Stow, Ohio 44224.

For literature, circle No. 92

The range of SME tonearms has expanded once again. In the June 1986 *Audio*, I reported on the SME V tonearm, which remains the flagship of its maker's range of tonearms. After the Model V reestablished SME as the preeminent maker of precision tonearms in the world, and a subsequent, cost-reduced version (the Model IV) was introduced, SME turned its attention to the redesign of the famous 3009 III tonearm. This arm had been refined over the years to a point where it had become the most popular and versatile universal tonearm of all time. It was universal in that it was designed to accept an extremely wide range of high-compliance, low-mass cartridges and bring out their best performance capabilities. The 309 tonearm has many features that result from the experience gained during the design of the Models V and IV. The 309 tonearm is designed to appeal to a greater range of users and to be more afford-

Continued on page 70

I try hard not to be swayed by the looks of the products I test, but the SOTA Cosmos turntable makes it hard to keep one's head.

Continued from page 58

MEASURED DATA

PARAMETER	CLAIMED	MEASURED	COMMENT
Speed Stability	0.1%	±0.20%	Excellent
Wow, DIN Unwtd.		0.18%	Very Good
Wow, DIN Wtd.		0.09%	Very Good
Flutter, DIN Unwtd.		0.10%	Excellent
Flutter, DIN Wtd.		0.04%	Excellent
W & F, Unwtd.		0.23%	Very Good
W & F, DIN Wtd.	0.1%	0.13%	Very Good
Long-Term Drift	±0.02%	±0.10%	Excellent
Rumble, Unwtd.	−60 dB	−67.6 dB	Excellent
Rumble, Wtd.	−75 dB	−87.8 dB	Excellent
Suspension Resonance		2.9 Hz	Well Damped

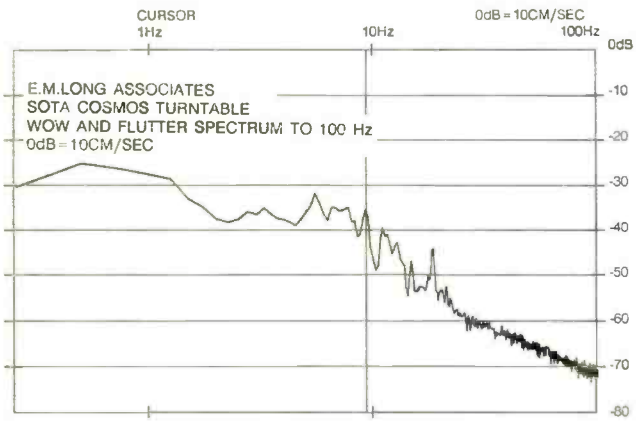


Fig. 1—Wow and flutter spectrum, from 0 to 100 Hz. Most of the output is at 9.5 Hz, the tonearm/cartridge resonance, and is not due directly to the turntable itself.

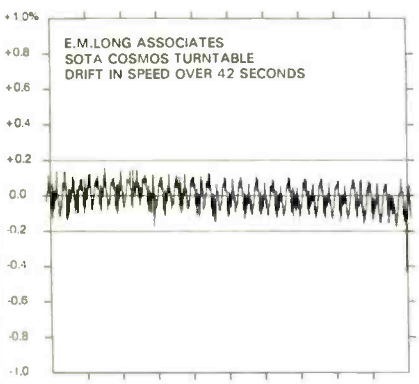


Fig. 2—Speed drift over 42-S period.

base. So, while the Cosmos is obviously related to the previous SOTA offerings—the Sapphire and the Star Sapphire turntables—it differs in significant ways. I try very hard not to be swayed by appearances when I evaluate products, but I must admit that products that look as good as the SOTA Cosmos turntable make keeping one's head a bit difficult.

The Cosmos has a vacuum system like the Star Sapphire's but with some added refinements. The Star Sapphire vacuum system relies on a timing circuit to apply two levels of vacuum to the turntable platter and record interface. The first is applied to purge the air line and to achieve a good seal between the record and the turntable platter; the second is at a lower level, just enough to maintain the vacuum seal. This allows the motor of the vacuum pump to operate at a much reduced level of vibration, thus lowering the noise level.

The Cosmos' vacuum system is more refined than that of the Star Sapphire turntable. It incorporates a sensor that monitors the amount of vacuum in the line connected to the turntable platter; this sensor provides a signal to an electronic circuit which, in turn, controls the vacuum pump. The first level of vacuum is high enough to cause a good seal between the record and the turntable platter. As soon as the sensor determines that a good seal has been made, the vacuum is reduced to about 2 inches of mercury. If for any reason the vacuum is reduced, the sensor causes the vacuum pump to increase the vacuum and try to pull the record tightly against the platter surface. The vacuum hose and the fittings are also much better on the Cosmos turntable; the ends of the hose have solid, twist-lock connectors that mate with the fittings on the turntable and auxiliary control box. If your listening environment is extremely quiet, it is possible that you might hear the vacuum pump running, even though it produces very little vibration in its normal operating mode. Just in case, SOTA supplies a generous amount of vacuum hose, allowing you to locate the auxiliary box containing the vacuum pump away from your listening environment.

The Cosmos is supplied with the SOTA Reflex Clamp, which also holds the record down against the platter at the center and helps to maintain the integrity of the vacuum seal. The Electronic Flywheel power supply, which stabilizes the rotational speed of the turntable during a.c. power-line voltage fluctuations, is no longer an option as it was with the Star Sapphire but has been upgraded and combined with the Cosmos vacuum system in one auxiliary box. The Electronic Flywheel power supply for the turntable motor and the power supply for the vacuum pump have separate power transformers, so the different functions are well isolated from each other.

As I mentioned previously, there are two buttons on the left, forward portion of the turntable base—one for power, the other for speed change. (The Cosmos can operate at either 33⅓ or 45 rpm.) A knob on the rear of the turntable allows the speed to be adjusted to obtain exact pitch for records that might be slightly off. The exact speed can be reset at any time by adjusting this knob while looking at the appropriate pattern on the strobe disc that comes with the turntable. This speed-adjusting pot is a high quality Mil-Spec type.

The tonearm mounting board is a sandwich construction that dissipates unwanted energy that would otherwise blur sonic details.

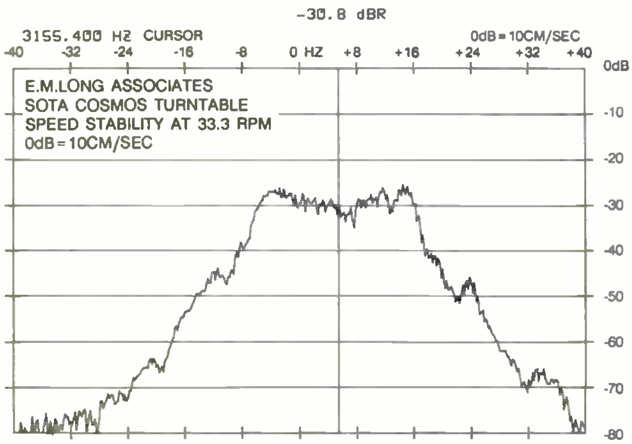


Fig. 3—Speed stability, referenced to 3,150-Hz tone on B & K 2010 test record. The cursor is at 3,155.4 Hz, the center of the speed variation; see text.

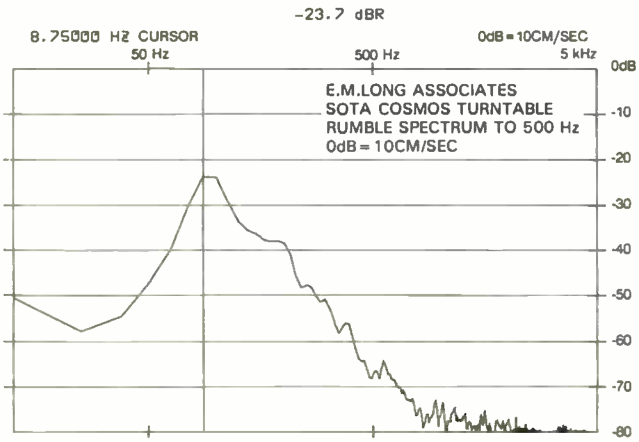


Fig. 4—Rumble spectrum. Most of the output is at the tonearm/cartridge resonance; the rumble is very low above and below this frequency.

The turntable platter is not removable and is locked by two transit screws to protect the main bearing during shipping. These screws must be removed before you can operate the turntable, but I suggest that you tape them to the underside of the turntable base because you should reinstall them if you need to move or ship the turntable any appreciable distance.

The Cosmos turntable, like previous SOTA turntables, uses four springs to suspend the main platform. The weight is equally distributed, with the tonearm being part of this weight-distribution system. When you order the Cosmos, you should decide which tonearm you will be using so the dealer can set it up for you and add the proper amount of extra weight. SOTA provides a bag of lead shot to balance the system. The heaviest combination of tonearm and tonearm mounting board is the SME V and the Cosmos laminated tonearm board. If you order the Cosmos with this combination, you will not need any additional weight because the Cosmos tonearm board is designed to be balanced with this combination installed.

I tested the Cosmos turntable with the SME tonearm and the Cosmos tonearm board, which is constructed as a six-layer lamination. The top layer is 0.1 inch of polished black acrylic, followed by a ⅛-inch layer of clear acrylic, a ⅛-inch layer of black acrylic, a 1/16-inch layer of lead, another ⅛ inch of black acrylic, and finally, at the bottom, ⅛ inch of aluminum.

This sandwich of different materials dissipates a great deal of unwanted mechanical energy that might otherwise be reflected back to the phono stylus and blur musical detail. Such blurring is a result of the delay caused by the transit time of the energy from the stylus down the tonearm tube to the base and back up the tube and to the stylus.

The bottom of the tonearm board is machined out and it can be ordered for the SME type base and the Eminent Technology linear tracking tonearm. SOTA "Composite" arm boards are available for all other tonearms, many of which are pre-drilled. The Cosmos tonearm board has three countersunk mounting holes and the aluminum subchassis of the turntable is threaded to accept the screws that are provided. These screws are 2½ inches long, which gives some indication of the thickness of the tonearm board and subassembly.

The turntable base is an integral part of the system, not an afterthought. It measures 20¼ inches wide, 16¼ inches deep, and 4 inches high including the three adjustable feet. These feet allow you to balance the turntable while using the bubble level supplied. The bottoms of the feet are recessed to allow special conical isolators, also supplied, to be inserted if you want to use them.

The subchassis, which is suspended by four counter-wound springs, is a carbon-fiber honeycomb. The rear of the turntable base has an elongated opening (3⅝ x 1⅛ inch) for a plate on which are mounted the five-pin DIN power connector, the vacuum connection, the speed adjustment knob, and a knurled grounding post. This ground is connected to the main subchassis and although I did not need to connect it to my system ground to reduce hum, I found that it was necessary for draining the static charge that builds up when playing vinyl records.

The motor is a Pabst servo type specially modified by SOTA for the Cosmos. The control electronics supplies 400 mA of current to bring the motor up to speed quickly, then switches to 30 mA for normal running. This lowers the vibration and allows the motor to be mounted directly to the subchassis. Because of this arrangement, the main bearing and the drive motor are at a constant fixed distance from each other and are unaffected by any motion of the subchassis caused by vibration of the springs. This means that the belt is always under a constant tension and remains unaffected by outside vibration, making the speed very stable even during earthquakes (very important here in California where we like to hear exciting music during our movies and earthquakes).

The listening panel rated the Cosmos very highly on piano reproduction, one of the most revealing tests for wow and flutter.

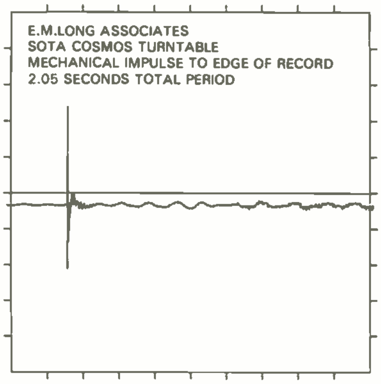


Fig. 5—Output vs. time for a mechanical shock applied to edge of a stationary record, with stylus resting in groove near the middle of the disc.

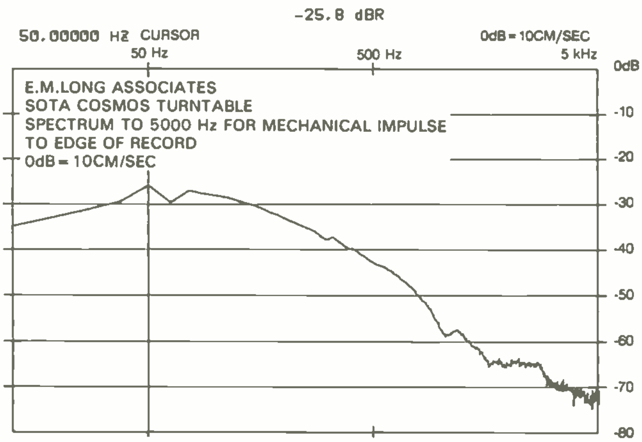


Fig. 6—Spectrum to 5 kHz of output from a series of 16 mechanical impulses (averaged) applied to edge of a stationary record, with stylus resting in groove. The smoothness of the spectrum indicates that the platter's energy absorption is uniform and will not color the sound.

The Cosmos turntable mat is also unusual; it is a multi-layered casting that takes 10 days to make because of the curing times involved in its fabrication. The top layer is a proprietary material chosen because its mechanical impedance is close to that of the type of vinyl used to make records; this allows a much greater transfer of mechanical energy from the record into the mat than if the impedance were different. The next layer is a damping layer in which the energy is dissipated; the last layer is chosen to interface with the turntable platter and act as a barrier. An optional dust cover is available, and threaded inserts are already at the rear of the base to accept its hinges. The one-piece, thermo-formed, smokey brown cover provided with the Star Sapphire was exceptionally good at reducing and absorbing airborne vibrations, but apparently dealers and customers are enamored by the solid, clear-acrylic, multi-piece covers of other turntables, and SOTA has followed suit.

Measurements and Listening Tests

I used the SME V tonearm and Talisman Virtuoso Boron cartridge for the technical measurements and listening evaluations. I made all of the setup adjustments and technical measurements before the listening evaluations so that I could be certain that everything was functioning correctly. The absolute polarities of the reference system and the SOTA Cosmos system were determined and all of the recorded selections were marked for correct absolute polarity. Some people might think that worrying about the absolute polarity of a system and the program material is carrying things a bit far but, believe me, when you are evaluating such high-quality systems, capable of revealing every tiny and subtle detail, then I assure you that absolute polarity is a definite factor in determining how you will perceive the system's reproducing qualities. Each of the listening panel members was given a form allowing them to rate the reference system and the SOTA Cosmos turntable from 0 to -5 for each musical selection. If a system were perfect, it would receive a 0 rating, while a really poor system would receive a rating of -5. Without being told which system was which, the panel members are asked to judge system "A" versus system "B" and rate them; written comments about the perceived quality of the sound were encouraged but panelists were asked not to talk or make any outward sign during the playing of any selection. If a panel member asked to hear something again (which can happen when the two systems being tested are very close in reproducing quality) I replayed the selection.

Since the quality of sustained tones is affected by the speed stability of a turntable, a very low amount of wow and flutter is quite important. Figure 1 shows the wow and flutter spectrum of the SOTA Cosmos. I have always felt that this spectrum reveals much more about wow and flutter than a simple number does. Since the resonance of the tonearm and cartridge can have a great influence on that number, seeing its contribution is very enlightening. If this resonance is great, it can give a higher wow and flutter value than the turntable deserves. The output of the SME Series V tonearm and Talisman Virtuoso Boron combination is very low at their combined resonant frequency of 9.5 Hz. It therefore contributes very little to the wow and flutter meter readings in my "Measured Data" chart. When reproducing piano (one of the most revealing instruments with respect to wow and flutter), both the reference system and the Cosmos were given very high ratings by the panel members.

Figure 2 shows the drift in speed of the turntable over a 42-S period. This excellent performance shows that the Cosmos is capable of sustaining the musical pitch of a piece of music over a long period. The speed stability is presented another way in Fig. 3, which is a graph of the variation in the frequency of the 3,150-Hz wow and flutter test tone of the B & K 2010 record averaged over sixteen

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Vibration control is a major theme of the Cosmos design, including its vacuum system, suspension, arm mounts, and drive.

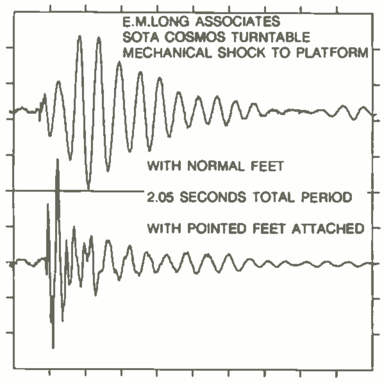

Fig. 7—Output vs. time for a mechanical shock applied to the platform on which the turntable base rested, with the stylus resting in a stationary groove. Note the difference between output with the standard feet (top trace) and with the pointed feet added (bottom trace).

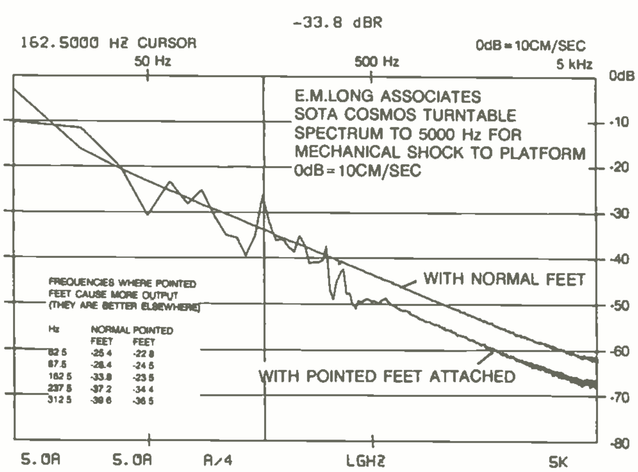

Fig. 8—Averaged spectrum to 5 kHz of vibrations caused by 16 mechanical impulses applied to turntable platform with stylus resting in a stationary groove. Again, note the difference made by addition of the pointed feet.

samples. The deviation is ±8 Hz, representing a variation of only ±0.254%, which is excellent. No adverse comments were made by any panel members that would correlate to speed variation in either the Cosmos or the reference system. I did find a correlation between the peaks of the variation curve and the tonearm resonances. Although it isn't shown in Fig. 3, when I changed to another tonearm and cartridge combination, which has a higher Q at resonance, the plus and minus points, rather than being flat as shown in Fig. 3, actually peaked up in a very pronounced manner. When I listened to this other tonearm and cartridge combination, the variation in pitch for a steady test tone was more obvious than with the SME V and Talisman Virtuoso Boron. This tells me that when testing or listening to a really high-quality turntable, the choice of tonearm and cartridge has a much greater effect on the wow and flutter than one might assume.

The spectrum of the rumble for the SOTA turntable is in Fig. 4. The rumble is most pronounced at the tonearm and cartridge resonance; this shows that the choice of tonearm and cartridge also plays a major role in the measured and perceived rumble of a turntable like the Cosmos. Some panel members commented that the rumble from the Cosmos was slightly less than that from the reference system.

Figure 5 shows the output versus time for a mechanical impulse applied to the edge of a stationary record with the stylus of the cartridge resting in a groove near the middle of the record. The mechanical energy is well damped and dissipates quickly. The spectrum produced by a series of 16 mechanical impulses, applied to the edge of the record and averaged, is shown in Fig. 6. The importance of this graph is not in the absolute level of the output, but in the shape of the spectrum: It is very smooth, without any peaks or dips. The presence of peaks and dips would tend to color the perceived sound. The turntable's three-layer, laminated mat is not only very effective in removing mechanical energy from the record but it does it in a very uniform way without favoring any particular band of frequencies. This is not a trivial engineering task, as anyone who read the report I did on turntable mats in the April 1988 *Audio* should realize. I commend SOTA for solving the problem. But how does this relate to the perceived sound? Well, the acid test is how well a rapid series of musical notes, particularly a piano arpeggio, is delineated. Can each note be distinguished clearly, or does one note tend to blur into the next? When such a musical selection was presented to the listening panel, their rating of the SOTA Cosmos was the highest they had ever given to a turntable—exceeding the reference system, which has always been given high marks in this regard. If you are looking for clarity of detail, you will find it in the SOTA Cosmos.

The graph of the output from the Talisman Virtuoso Boron cartridge with its stylus resting in a stationary groove near the middle of the record, when a mechanical shock was applied to the solid platform upon which the turntable was resting, is in Fig. 7. I conducted this test both with and without the pointed insert feet which come with the SOTA Cosmos. The top trace shows the output without the pointed feet and the bottom trace is with them inserted between the normal turntable and the platform upon which the turntable

There are more expensive turntables, but I think that the SOTA Cosmos is as good as they get.

rested. As I mentioned before, the normal flat turntable feet have recesses which accept the pointed inserts, and it appears from this test that these pointed feet are very effective in reducing the amount of mechanical energy that can reach the turntable. The spectrum of this output, for 16 shocks, applied and averaged, is shown in Fig. 8. There is a decrease in energy transfer across most of the range except for a few frequencies, particularly 162.5 Hz. The SOTA Cosmos is immune to outside mechanical vibration with or without the pointed inserts. Electing to use them may be more dependent on whether you want to risk scratching the surface where you would place the turntable.

The panel members rated the Cosmos slightly better than the reference system for voice, strings, acoustic guitar, double bass, drums, and piano. The sound of violin was perceived to be a bit smoother and more detailed with the Cosmos, and the sounds of the strings being plucked on an acoustic guitar were more precise. The sound of the double bass was full and yet very tight and well defined. The drums were reproduced with just a bit more realism. The Cosmos and the reference were rated equal for brass, full orchestra, and the ability to reproduce a sense of openness and space. Both systems were rated equal in presenting a stereo image that allowed panel members to point at the location of specific instruments. (I should mention that the loudspeakers are hidden from view behind light colored, acoustically transparent drapes, which allows panel members to concentrate on the stereo presentation without being distracted by the physical location of the loudspeakers.)

Conclusions

Here we are at the point of this report to which everyone, including me, looks first! As anyone who has ever written a report of any kind knows, the opening and the closing are always the hardest. In the case of the SOTA Cosmos turntable it is particularly hard because I am tempted to use a "boiler plate" ending—you know, the kind that says, "This is a wonderful (type of product). The (name of product) is the best I have ever heard. You owe it to yourself to rush out and hear it." The trouble with cliché endings is that they don't really tell you anything, and the SOTA Cosmos doesn't deserve that. It is really a super turntable and I admire all the work that must have gone into its development. I might however, question the sanity of David Fletcher and Robert Becker, who obviously have placed a quest for phonographic perfection above economic reality. I don't mean that the Cosmos isn't worth its price, because it certainly is to anyone who is looking for the best turntable he can find. There are turntables that are more expensive but I think that the SOTA Cosmos is as good as they get. I only wish that more people could enjoy the pleasure of hearing their favorite records with a turntable like this. *Edward M. Long*

Continued from page 59

able than the Models V and IV. (If you want to see how the 309 compares with the original 3009 III, my test report on that arm appeared in the May 1981 *Audio*.) If you would like a little more background on SME, there is also a videotape featuring Alastair Robertson-Aikman, the managing director of SME, which was made by Sumiko, Inc., the importers of this British-made tonearm. If you are interested in seeing the tape, you can contact Sumiko and they will let you know more about it.

Signet was started about 12 years ago, offering high-quality cartridges through specialist audio dealers. It is a completely separate division of Audio-Technica U.S., Inc. I mention this affiliation because although the OC9 moving-coil cartridge is a Signet product, it is made for them by Audio-Technica in Japan and has Audio-Technica markings. At this point in time, Signet has decided to make the OC9 available in limited quantities and with the Audio-Technica markings and packaging, as this will allow them to keep the price reasonable. The original price for this cartridge was to be $700, but since its introduction it has sold well enough around the world that the increased production has allowed economies of scale; this has allowed Signet to offer the OC9 at a more reasonable $395.

Audio-Technica U.S., Inc. was begun in 1972 by Jon R. Kelly, who had been the phono-cartridge and microphone product manager for Electro-Voice, Inc. in Buchanan, Mich. At that time, the Japanese Audio-Technica company had been working with JVC on the CD-4 discrete four-channel phono system. This system used a very high frequency carrier (about 50 kHz), which was modulated with the rear-channel information. The requirements of this now-defunct system had a great effect on phono cartridge and stylus research. The first of the new generation of high-performance cartridges was the direct result of the requirement that they be able to trace high frequencies well above the normal 20-kHz limit of the audio band. We are still enjoying the benefits of the extended-bandwidth techniques applied to the cartridge designs and the elliptical and fine line-contact stylus shapes that were developed in this era.

Although Audio-Technica of Japan is a very diversified company that makes laser pickups, bar-code readers, microphones, and headphones, it is interesting that they not only continue to produce phono cartridges but are still engaged in advanced research on cartridges and styli.

The tapered tonearm tube of the 309 is a single piece of drawn aluminum similar in appearance to the magnesium tonearm tube of the Model V; aluminum is less expensive and easier to work than magnesium, which helps to reduce the cost while still providing excellent characteristics. When I performed the tap test on the tonearm tube, which features the same internal, constrained-mode damping as the model V, I found that it had very little sound of its own and that the character of this sound was very difficult to describe. Near the headshell the sound was like "tuck;" in the middle it sounded like "tick," and near the tonearm pillar the sound was like "tug." The sound was difficult to characterize because there seemed to be more sound coming from the metal tapping tool I use than from the tonearm tube. What all this means is that any resonances in the tonearm tube are very well damped and should contribute very little coloration to the reproduced sound.

When I grasped the tonearm tube in one hand while holding the arm pillar firmly in the other hand, and tried to push, pull, and twist the tonearm tube, I found absolutely no

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MOL is indicated by the curve at the top of the analyzer's monitor; bias noise is indicated by the curve at the bottom. The vertical distance between any two points on these curves is the measure of an audio cassette's dynamic range at that particular frequency.* The greater the distance, the greater the dynamic range. And the greater

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Removable headshells can ordinarily reflect energy that colors the sound. But the SME's shell is firmly locked by a nut and bolt.

looseness or play in the bearings, which is a good sign; loose bearings can cause much coloration in the sound.

The SME 309 is finished in matte black and satin aluminum and appears to be designed and manufactured with great care and attention to detail. The base mounting requires the famous SME elongated slot, which allows the necessary stylus overhang to be adjusted very precisely using a rack-and-pinion system in the base.

I looked for a serial number on the body of the Signet OC9 cartridge but I couldn't find any. The sample that I received for evaluation did not have an amplitude-frequency response graph, although the listing for the OC9 in the October 1989 *Audio* magazine directory indicates that one is normally supplied. The stylus is not user-replaceable so the cartridge must be returned to Signet should the stylus need to be replaced. I am not certain what this costs but, since the cartridge is reasonably priced, I assume that it will be of commensurately low cost. A snug-fitting stylus guard may seem like a minor thing, but I appreciated that it did not fall off easily. Many of the more expensive cartridges seem to lack this little refinement and offer loose-fitting stylus guards that seem more like afterthoughts than planned designs.

Features

As a replacement for the venerable 3009 tonearm, the 309 is more than an improved version; it is a complete redesign. One of the main features of the 309 is its removable headshell. Most modern tonearm designs have eschewed removable headshells because they tend to cause sonic coloration due to the poor mechanical connections to the armtube. Such connections can cause energy to reflect back to the stylus, where the delayed energy is reproduced as a blurring to the sound. The SME 309's headshell is firmly locked to the armtube by a bolt and captive nut which seems to be very effective in solving this problem. Changing cartridges mounted in different headshells is not a quick process, as you'll see from the following description. The armtube has a slot that lines up with the bolt, which must be removed from the headshell and then reinserted when the headshell is pushed against the spring-loaded gold pins at the end of the armtube. This assures that the headshell is firmly in place and that good contact is made both electrically and mechanically. There is a slight amount of rotation available so that the exact stylus azimuth can be adjusted. The SME booklet suggests using a mirror to set the stylus azimuth.

The SME booklet, a model for all other product set-up booklets, contains step-by-step instructions with 40 close-up photos detailing every aspect of installing and adjusting the 309 tonearm. It begins with specific information on the use of the supplied templates for drilling and creating the slot in the mounting board. If you are interested in buying an SME 309 tonearm, this booklet might persuade you that the people at SME really know what they are doing; ask the dealer to let you see it.

The SME tonearms provide a unique way to adjust the stylus overhang. Overhang is necessary to compensate for the tracking error introduced by playing records made by a straight-line cutting lathe with a pivoted tonearm. The over-

MEASURED DATA

SME 309 Tonearm

Pivot-to-Stylus Distance: 9.14 in. (232 mm).
Pivot-to-Rear-of-Arm Distance: 2.375 in. (60.3 mm).
Tracking-Force Adjustment: 0 to 2.5 grams.
Tracking-Force Calibration: None (use calibrated tool provided).
Cartridge Weight Range: 6 to 17 grams.
Counterweights: One (154.2 grams).
Counterweight Mounting: Locked to rear of tonearm after adjustment.
Sidethrust Correction: Knob on extension from arm pillar.
Pivot Damping: None.
Lifting Device: Damped lever near pillar.
Headshell Offset: 23.5°.
Overhang Adjustment: Sliding base.
Bearing Alignment: Excellent.
Bearing Friction: Less than 40 mg, vertical and lateral.
Bearing Type: Ball and race, vertical and horizontal.
Lead Torque: Very low.
Arm-Lead Capacity: 10 pF, each channel.
Arm-Lead Resistance: 0.12 ohms, each channel.
External-Lead Length: 3.9 feet (1.2 meters).
External-Lead Resistance: 0.9 ohms, each channel.
External-Lead Capacity: 90 pF, each channel.
Mounting: SME rack and pinion.

Signet OC9 Cartridge

Coil Inductance: Less than 100 µH.
Coil Resistance: Left, 11.6 ohms; right, 11.7 ohms.
Output Voltage: Left, 0.10 mV/cm; right, 0.093 mV/cm.
Tracking Force: 1.75 grams.
Cartridge Mass: 8.0 grams.
Microphony: Very Low.
Hum Rejection: Excellent.
High-Frequency Resonance: 28.5 kHz.
Rise-Time: 11 µS.
Low-Frequency Resonance: 7.0 Hz.
Low-Frequency Q: 2.6.
Recommended Load Resistance: 20 ohms or greater.
Recommended Load Capacitance: Unaffected by up to 500 pF.

VDAT IS HERE

8 hours of CD quality on a $3 VHS tape

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Since the PCM 44.1 just copies numbers, there is no need to set recording levels, bias, equalization or Dolby.

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How VDAT Works

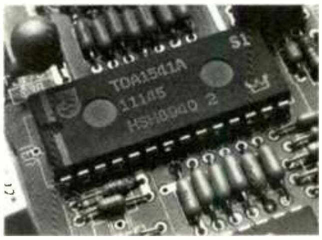
VDAT works the same way as professional digital master tape recorders: by transforming the digital signal from your CD player into a video signal that your VCR can record. VDAT has more powerful error correction than traditional studio recorders, enabling the use of inexpensive VHS units at the EP (8-hour) speed.

Just connect either the coaxial or optical digital output from your CD player to the PCM 44.1, and the PCM 44.1 to your VCR. With the touch of a button, make a flawless digital recording of 8 CDs (or more) onto a single video cassette!

On playback, use your VCR's address or index search system to go straight to any spot on the tape. The PCM 44.1 automatically lays down a control track while recording so that you can access any of hundreds of songs using your VCR's remote control.

Audiophile Sound

Upon playback, the video signal from your VCR passes back through the PCM 44.1. The PCM 44.1 adheres to the VDAT standard for error correction, which provides full data recovery even if there are dropouts on the tape. Correct data is fed to the best Philips 4x oversampling D/A conversion chip set available. The PCM 44.1's ouput stage contains only the highest quality analog components and regulated power supplies.

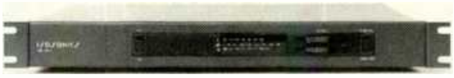


The PCM 44.1 features the Philips linearity-selected TDA-1541A-S1 -- the world's lowest distortion audio D/A converter. It is the same chip found in Philips' $4000 LHH 1000 Reference Series CD Player.

The sound is so good that you will probably end up using the PCM 44.1 as an outboard D/A converter even when you aren't recording.

Won't Steal Your VCR

The PCM 44.1 only needs your VCR when you want to listen to music. When you're not using the PCM 44.1, your VCR records and plays back movies as usual.



64X Oversampling A/D

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Instead of just slotting the cartridge mounting holes, SME uses a unique rack-and-pinion base for overhang adjustment.

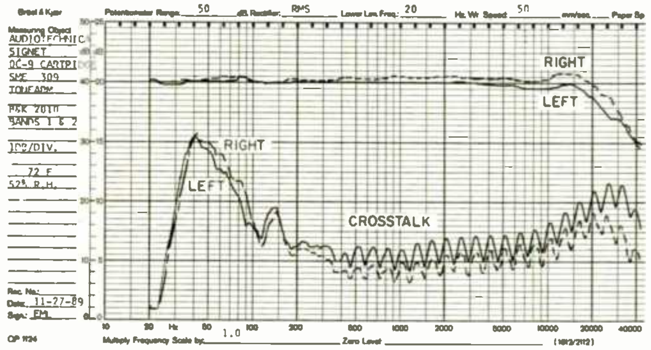

Fig. 1—Frequency response and interchannel crosstalk of the SME arm and Signet cartridge. The crosstalk increase at low frequencies is an artifact of the B & K 2010 test record.

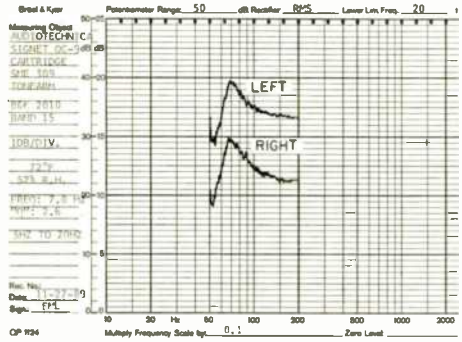

Fig. 2—Low-frequency arm-cartridge resonance is at 7.0 Hz with a Q of 2.6.

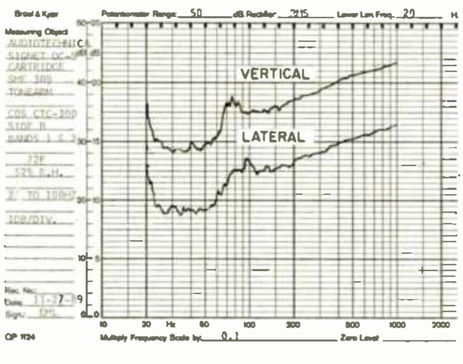

Fig. 3—Response to a slow sweep from 2 to 100 Hz to check for lateral and vertical modulation.

hang refers to the fact that, if you swing the tonearm so that the cartridge is placed directly above the turntable spindle, you will notice that the stylus "over-hangs" the spindle by a small amount, usually about 15 mm. Most tonearms feature a pair of slots in the headshell to allow the cartridge to be slid back and forth until this overhang is set correctly. SME uses, instead, a rack-and-pinion system as an integral part of the arm base mounting; a special tool is provided to allow you to slide the whole tonearm back and forth until the correct overhang nas been achieved. A template is included with all SME tonearms so you can make this adjustment easily. When the correct position has been found, the tonearm pillar can be locked securely by tightening two clamp bolts on either side of the tracks. A fingerlift can be installed on the headshell, but I opted to rely on the damped lever, located near the tonearm pillar, to raise and lower the arm.

A swivel-mounted output socket at the bottom of the pillar accepts the five-pin DIN mating plug on the output leads that are terminated, at the other end, with gold-plated phono plugs. Three separate grounding wires are provided; one is attached to the body of the tonearm while the other two are connected to the separate cable shields. The shell of the phono plug is not connected to the ground wire, thus providing a balanced output for the signal. The internal tonearm wiring and the external cable use oxygen-free copper.

A special, calibrated tool is provided to set the tracking force. It has a ball-shaped hexagonal end that can be inserted into a screw on which the counterweight is mounted; turning this screw moves the counterweight and allows the tracking force to be set. After the desired tracking force is set, the counterweight should be locked firmly to the rear of the armtube by tightening another screw. A sidethrust or "anti-skating" adjustment is provided by a calibrated knob mounted on the same assembly supporting the damped tonearm-lifting system.

It seems that the relatively low cost of the Signet OC9 moving-coil cartridge is the result of applying some of the mass production techniques commonly used during the manufacturing of moving-magnet cartridges. While I realize that the assembly of moving-coil cartridges is a bit more complicated than the assembly of moving-magnet cartridges, I have often wondered why they couldn't be produced at a more reasonable cost than we are used to seeing. I also know that smaller quantities usually cause greater manufacturing costs, but I have often wished that the benefits of wide-band design could be enjoyed by a greater number of people. Since the requirements of moving-coil cartridge design result in a relatively low coil inductance and source impedance, this type of cartridge seems ideal for wide-band design. This doesn't mean that moving-magnet cartridges cannot provide wide-band response, but since they do not require small, light coils, they are usually designed to provide high output. This means that the coil inductance, which limits the high-frequency response, is higher because the coils have more turns of wire. The coils of the Signet OC9 MC cartridge have very low inductance and resistance. Their inductance is so low that I found it impossible to make a measurement that I considered reliable; this was partly due to the very low resistance of the coils, which lowered the Q and swamped the inductance.

By applying techniques used in making moving-magnet cartridges, Signet reduced the moving-coil OC9 from $700 to $395.

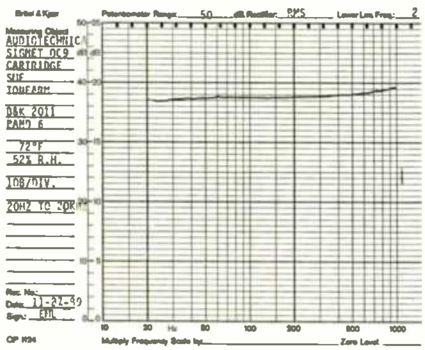

Fig. 4— Slow sweep from 20 Hz to 1 kHz to check for system resonances; see text.

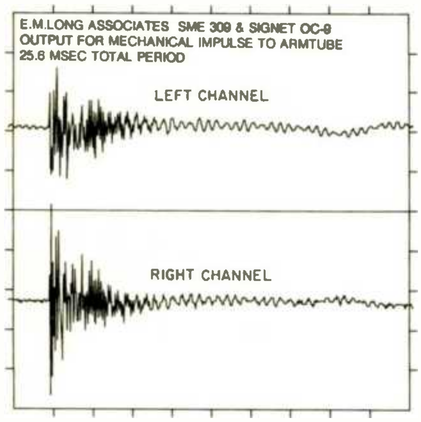

Fig. 5—Output vs. time of arm/cartridge when mechanical impulse was applied to armtube. Ringing is apparent, but the higher frequencies are damped quickly.

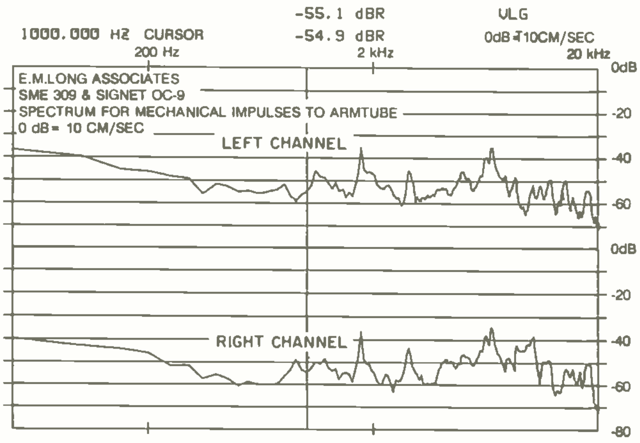

Fig. 6—Spectral output (average) of arm/cartridge due to 16 mechanical impulses applied to armtube.

Normally, coil resistance as low as the OC9's would mean the cartridge's output would be very low because there were few turns on the generating coil. If ordinary magnets had been used, this would be true; however, since the OC9 uses samarium-cobalt magnets, whch produce a very strong magnetic field, its output is relatively high. Still, the output of the OC9 is lower than that of some high-output moving-coil cartridges, and Signet therefore recommends the use of a step-up transformer or pre-preamp between the cartridge and the phono input of a preamplifier or receiver. I found the output acceptably high without the use of either device; all of the technical measurements and the listening evaluations were conducted with no step-up device.

Measurements and Listening Tests

The measurements were made before the listening panel members were assembled to audition the SME 309 tonearm and Signet OC9 cartridge. I always make the technical measurements and calibrate the system before the listening sessions because too many things can cause problems in a phono playback system if it isn't set up and adjusted correctly. The listening evaluations were conducted by comparing the sound of the Signet OC9 cartridge with the sound of a reference system most of the panel members have listened to in past evaluations. While it is of exceptionally high quality, this system is used merely as a reference, to which panel members may compare the sound of the device being evaluated. Sometimes, as you will see later, a panel member will make a written comment that although the sound of "A" may be in some respects superior to "B," he or she still would prefer the sound of "B" for certain types of program material. By the way, all comments are written and no discussion is allowed during the listening evaluations. Discussions take place after the listening sessions have been concluded.

Figure 1 shows the amplitude versus frequency response and the interchannel crosstalk for the Signet OC9 cartridge mounted in an SME 309 tonearm. The response holds up well above 20 kHz, and the slope is mainly that inherent in the B & K 2010 test record. There is a definite indication that the high-frequency resonance is at 28.5 kHz, which I verified by using another measurement technique. One of the characteristics that made moving-coil cartridges so well liked by audiophiles was their lack of the swaybacked response, in the range from about 2 to 5 kHz, which many moving-magnet cartridges exhibited; this smoother response made the sound more forward and realistic. The better moving-magnet cartridges of the present era have also eliminated this swayback response and are very smooth through this range, but I think that the acceptance of the moving-coil cartridge had much to do with making this a design goal for moving-magnet cartridge designers. If anything, the SME/Signet combination has a more pronounced output in this range than the reference system, which also features a moving-coil cartridge. Comments such as "more up front" and "sharper images" made by listening panel members correlate well with the response characteristic shown in Fig 1. The crosstalk of the SME/Signet combination is excellent; the rise in the lower frequency range is an artifact of the B & K test record. (By the way, for those who


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You may not need step-up transformers or pre-preamps with the OC9. Its output is relatively high because of its powerful magnets.

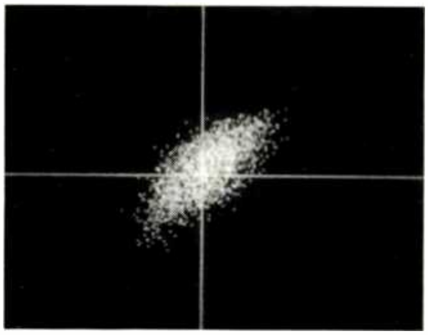


Fig. 7—Interchannel phase difference, using pink noise from B & K 2011, band 7.

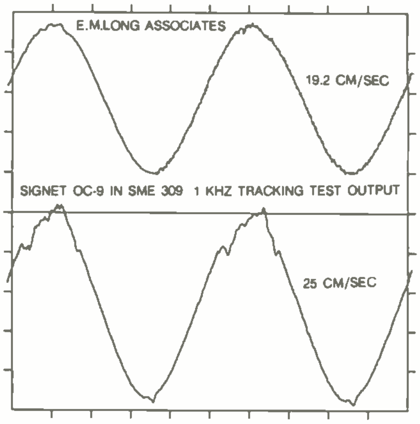


Fig. 9—Tracking of arm and cartridge with 1-kHz test tones at 19.2 cm/S (top) and at 25 cm/S (highest level on B & K 2010, bottom). Signs of mistracking are apparent at the higher signal level; see text.

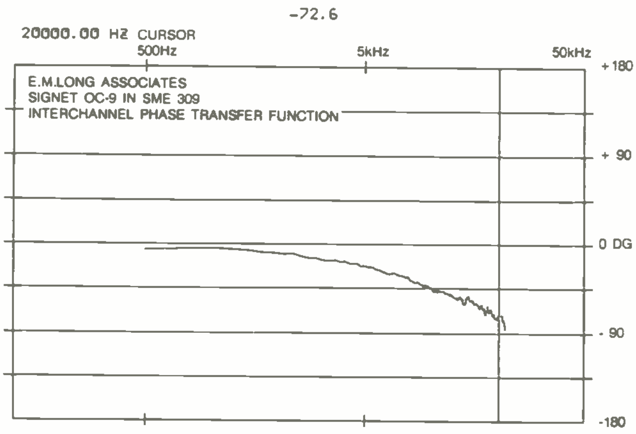


Fig. 8—Interchannel phase difference vs. frequency for same track as Fig. 7. Phase difference at 20 kHz is -72.6° (10.1 μS).

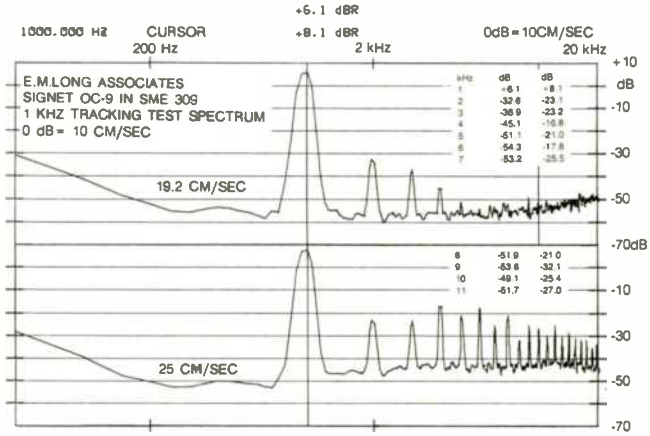


Fig. 10—Spectrum of cartridge output when reproducing the 19.2-cm/S and 25-cm/S signals of Fig. 9. The third harmonic is -39.8 dB (1.0%) for the 19.2-cm/S signal and -22.3 dB (7.7%) for 25-cm/S. Note the increase in the even harmonics at the higher signal level.

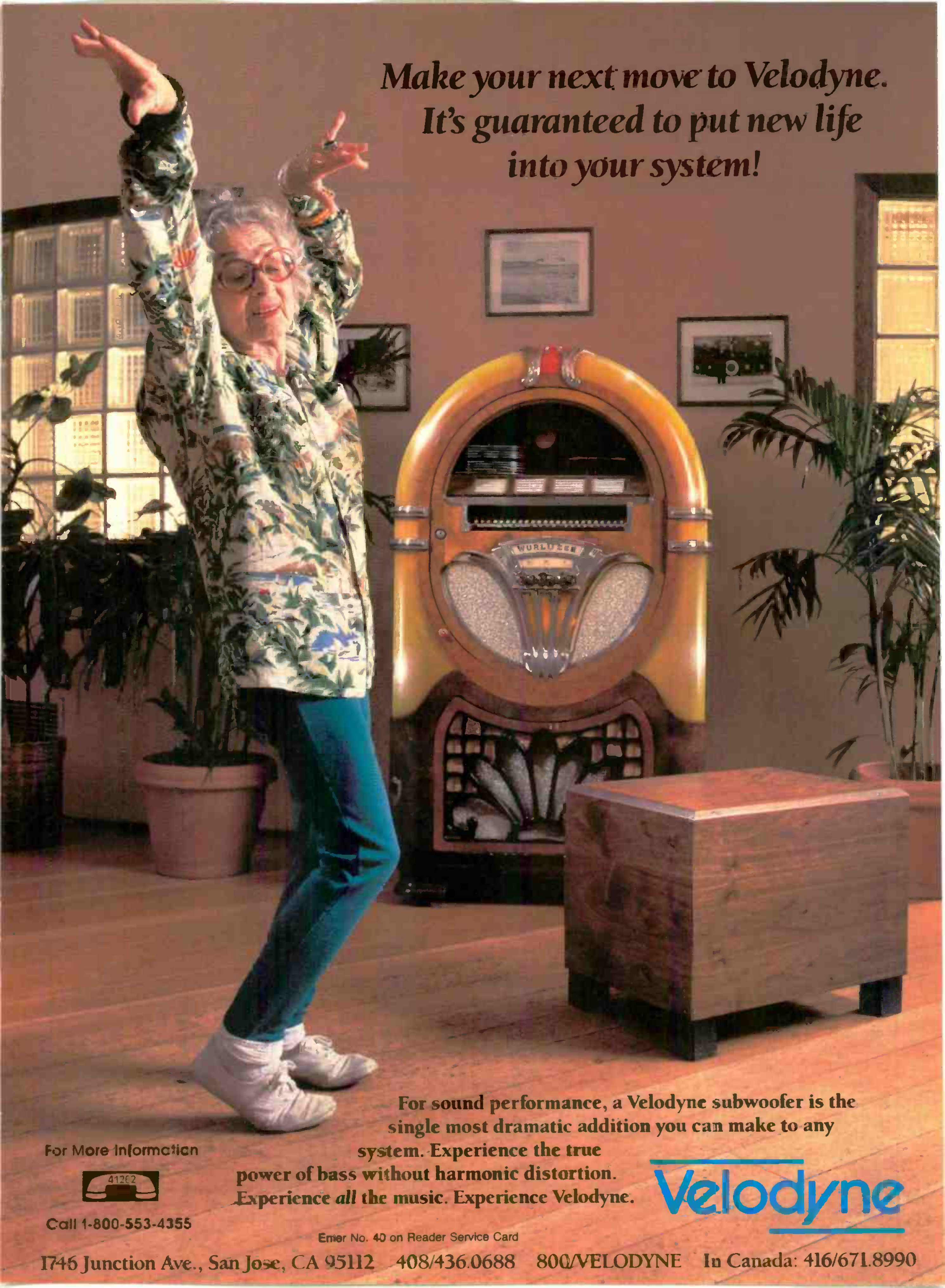
might wonder, crosstalk means leakage of signal from one channel into the other, not that the channels are mad at each other.)

The low-frequency resonance due to the compliance of the Signet OC9 cartridge and the effective mass of the SME 309 tonearm is shown in Fig. 2. It occurs at 7.0 Hz but the relatively low rise in response at this frequency is due to the desirably low Q of 2.6. Comments by some of the panel members about the sound of double bass and kick drum rated the OC9 as being "slightly less rounded" and "less full" than the reference system, while other comments were "very close" and "hard to choose between A and B."

Figure 3 shows the low-frequency resonance in the vertical and lateral planes for the Signet OC9 cartridge mounted in the SME 309 tonearm. They are very similar, which indicates that the compliance of the OC9 and the mass of the SME 309 are fairly evenly distributed between the vertical and lateral modes; they make an excellent combination from this perspective.

The combination of the SME 309 tonearm and Signet OC9 exhibits a very smooth response for the slow sweep of frequencies between 20 Hz and 1 kHz (Fig. 4). There are no glitches that would indicate structural discontinuities. This is exceptional for a tonearm with a detachable headshell.

The output of the SME/Signet combination for a mechanical impulse applied to the armtube is shown in Fig. 5. The gain of my digital storage oscilloscope had to be set quite high to obtain this graph as the actual output is really very low. The fact that the constrained mode-damping within the SME 309 tonearm does an excellent job is apparent from the low output as well as the rapidity of the decay in energy, especially at the higher frequencies.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The SME's constrained-mode damping does an excellent job, as shown by the low output and rapid decay of impulses to the arm.

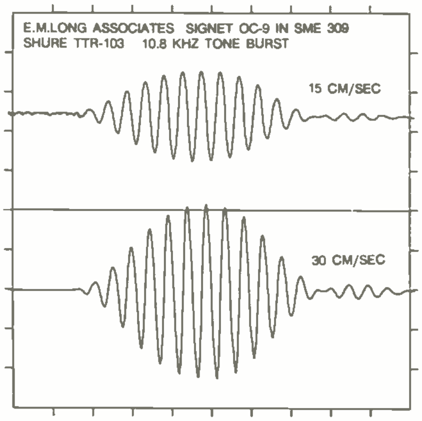

Fig. 11—Output from 15- and 30-cm/S, 10.8-kHz pulse test, Shure TTR-103 test record.

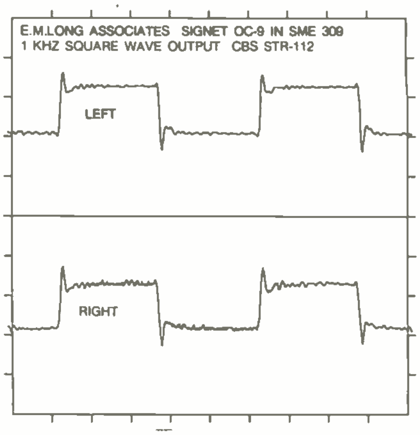

Fig. 13—Output from 1-kHz square wave, using CBS STR-112 test record. The ringing is at 28.5 kHz.

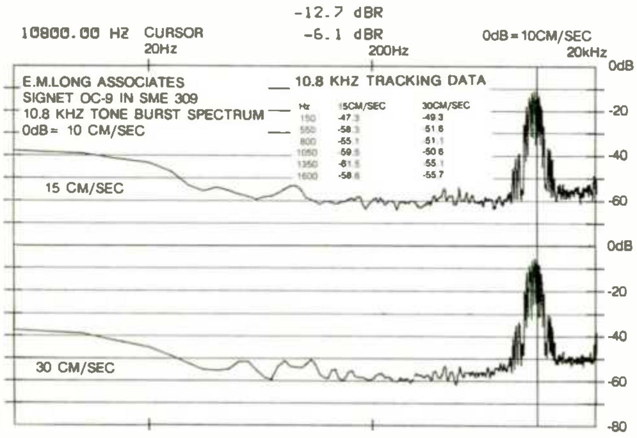

Fig. 12—Spectral analysis of distortion products from signals shown in Fig. 11. This is excellent performance.

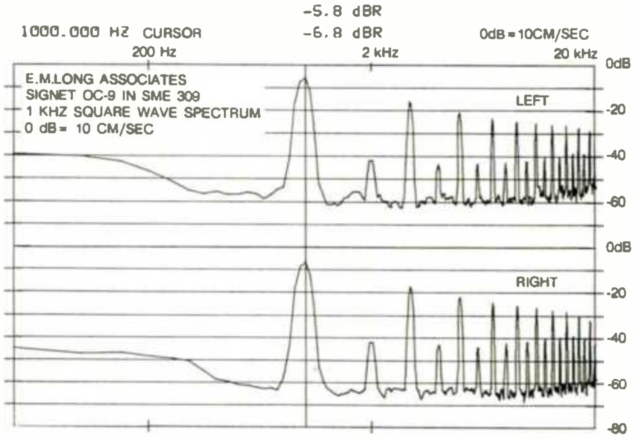

Fig. 14—Spectral analysis of the 1-kHz square waves shown in Fig. 13. The response to a complex signal is excellent.

Figure 6 shows the spectral components due to a series of mechanical impulses applied to the arm tube. While there are peaks at 1,750, 2,850, and 6,650 Hz, they are at a very low level. It is possible that these frequency components could add a slight brightness and enhance the forward quality of the sound.

Figure 7 is the output of the left versus the right channel for wide-band pink noise. If the channels were perfectly identical, the result would be a straight line at a 45° angle. Figure 8 is a graph of the interchannel phase-transfer function, which indicates a slight phase difference between the left and right channels. The time difference between the channels is 10.1 μS at 20 kHz. The panel member comments that might correlate with this phenomenon concerned image stability and the sound of bells and cymbals. They were "slightly less precise images" and "cymbal sounded bigger."

Figure 9 indicates that the OC9 has very good and consistent tracking capability. It shows signs of mistracking at the 25-cm/S velocity but showed no signs of groove-jumping at this extremely high level. The OC9 cartridge was rated as being "slightly more gritty" during high-level drum and cymbal passages than the reference, but "more mellow" and "more refined" on moderate-level passages of string, brass, and acoustic guitars. In fact, for the brass ensemble passages one panel member commented, "B [SME/Signet] was a bit muffled compared with A [reference system] but B was more pleasing to me." Figure 10, the

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The SME 309 is a good value and the Signet 309 can introduce you to the wonders of MC cartridges without breaking the bank.

spectrum of the output of the OC9 for the 19.2- and 25-cm/S levels of the B & K 2010 test record, also indicates that the distortion increases rapidly at the higher level but that the increase is greater for the even harmonics. An increase in even-order harmonics like this usually causes a perception of mellowness and body in the sound. One panel member's comments were right on target for the louder guitar passages; this listener found the passages to be "full-bodied" and "mellow."

Figure 11 shows the output of Signet OC9 cartridge for the 10.8-kHz shaped tone burst of the Shure TTR-103 test record. The symmetry is excellent and Fig. 12, which shows the spectrum due to the output shown in Fig. 11, reveals little change between the 15- and 30-cm/S bands of the test record. This can be correlated to comments by various panel members, such as "the bells and triangle sound very real." The performance of the Signet OC9 in this area is excellent.

The square-wave output of the Signet OC9 is shown in Fig. 13, while the spectrum of this output is shown in Fig. 14. The overshoot and slight ringing indicate that some phase shift is occurring at higher frequencies. Panel-member comments such as "less spaciousness" and "less depth" may be related to this because the reference system has less phase delay in this range; I would still rate the OC9 cartridge very highly, regardless of these comments, because the reterence system the listening panel was comparing it to is excellent in this regard.

Conclusions

The SME 309 is a good value and provides many of the features of the more expensive SME tonearms. It is an especially good choice for anyone who has more than one phono cartridge, because it has interchangeable headshells. I think that the Signet OC9 cartridge is an excellent value. Both the 309 and the OC9 have their strong points and their weak points as this report has shown.

If you went out right now and bought the SME 309 tonearm and the Signet OC9 moving-coil cartridge, I don't think you would be disappointed; each is offered by a company that has been specializing in its particular products for many years and each has earned its excellent reputation by producing excellent products. Make certain, however, that your preamplifier or receiver phono input has enough gain, or you will have to buy a step-up transformer or pre-preamp. All of my testing and the listening evaluations were done without a step-up device, because I think that "less is better" and the normal 47-kilohm phono input worked just fine with the Signet OC9. If you have been using a run-of-the-mill moving-magnet cartridge, the Signet OC9 will introduce you to the wonderful world of moving-coil cartridges without breaking the bank.

Edward M. Long

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2

LAZARUS H-1A AMPLIFIER

Manufacturer's Specifications

Power Output: Stereo, 50 watts per channel into 8 ohms (Class A), 100 watts per channel into 4 ohms, 200 watts per channel into 2 ohms; mono, 200 watts into 8 ohms, 400 watts into 4 ohms, 400 watts into 1 ohm.

THD at Rated Output: 0.2%.

Full-Power Bandwidth: 5 Hz to 80 kHz.

Input Impedance: 47.5 kilohms.

Polarity: Stereo, inverting; mono, inverting or non-inverting at user's option.

Power Requirements: 117 V a.c., 250 watts (idle) to 1,500 watts peak.

Dimensions: Front panel, 19 in. W × 3½ in. H (48.3 cm × 8.9 cm); chassis, 17 in. W × 3½ in. H × 15 in. D (43.2 cm × 8.9 cm × 38.1 cm).

Weight: 35 lbs. (15.9 kg).

Price: $1,920.

Company Address: 8130 Coldwater Canyon, North Hollywood, Cal. 91605.

For literature, circle No. 93

Lazarus Electronics of North Hollywood, California, produces a number of all-tube and hybrid preamplifiers along with several hybrid power amplifiers. The Model H-1A is a two-channel hybrid power amplifier rated at 50 watts per channel into 8 ohms and is said to operate in Class A into this load. Rated power into 4 ohms is 100-watts per channel. The unit can be bridged to produce 200 and 350 watts into 8- and 4-ohm loads, respectively. Additionally—and this is really unusual for a solid-state output stage—the amplifier's channels can be paralleled for operation into loads below 2 ohms!

Physically, the unit is of reasonable size for its Class-A rated output power. Front-panel dimensions are 3½ inches by rack width (19 inches). Depth is about 16 inches. Located on the front panel are two pushbuttons (one to switch between "Standby" and full operation, while the other is the main "Power" on/off switch) and two LEDs (a green one for "Bias" and a red one for "Power"). Most of the rear surface is taken up by heat sinks. An area between the heat sinks, some 3½ inches square, holds the two Tiffany input phono jacks, a female XLR connector for balanced input in bridged mode, two sets of five-way binding posts for load connection, a power cord, and a line fuse. A hole just under the output binding posts allows the insertion of a nonmetallic tool to operate the stereo/mono switch. Space is tight but, with reasonable dexterity, large speaker wires can be connected. The hot terminals of the output are at the outside ends of the line of four five-way output binding posts. This makes the use of dual banana plugs impossible for speaker connection in the mono mode. This is just as well, as these plugs do degrade the sound, I believe.

Within the amplifier, the front half is taken up by power supply components; the rear part of the space holds the amplifier circuitry, mounted on a large p.c. board. There are actually a number of power supplies in the H-1A—one for the output stages and several for the tube front ends. The large toroidal transformer at left front and the filter capacitors in the middle front are for the output stages, while the smaller transformer and the p.c. board with lots of smaller capacitors are for the front-end circuitry. The six MOS-FET output devices per channel are mounted to ¼-inch aluminum L brackets; the device leads are soldered to the p.c. board under these brackets. The other leg of each L bracket is coupled to the inside of the rear panel. Heat is transferred to the heat sinks through the rear panel metal.

Circuit Description

As hybrid power amplifiers go, the H-1A has about the simplest signal circuit I've seen (Fig. 1). The input stage is a cascode-connected 6DJ8 dual triode with a plate load resistor of 39 kilohms and an unbypassed cathode resistor of 475 ohms. In the stereo mode, each channel's cathode resistor is grounded. All of the circuit's voltage gain comes from this tube stage. Output from the tube front-end is coupled via two separate capacitors to the gates of a pair of complementary MOS-FET drivers which, in turn, drive the MOS-FET output devices. Both driver and output devices are connected as source followers. The output stage is composed of three N-channel and three P-channel MOS-FETs wired in parallel in two groups.

There is a bias-spreading network made up of two N-channel J-FETs wired in series. The lower device is wired as a constant-current source for the upper device, which is connected as a source follower. A variable resistor is connected between the lower device's drain and the upper device's source. These respective ends of the bias-adjust rheostat are connected to the P- and N-channel driver gates through 1-megohm resistors. An inverting servo compares the amplifier's output d.c. potential to ground (or 0 V d.c.) and applies the greatly amplified error to the gate of the upper J-FET device; this causes the amplifier's d.c. offset to approach 0 V d.c. The J-FETs are operated from the same zener-regulated supplies that power the servo op-amp. This servo and its connection with the J-FETs make up a neat design that I haven't seen before. No overall feedback loop is used in the Lazarus H-1A.

Another clever aspect of this design is the way it switches between stereo and bridged-mono modes. As previously mentioned, the cathodes of the input stage's lower tubes are connected to ground through their respective cathode resistors. These resistors are tied together, and are grounded through one pole of the mono/stereo switch when it is in the stereo position. Also connected to the junction between the two cathode resistors is an additional resistor, on the order of 10 kilohms, whose other end is connected to a −90 V d.c. supply. When the H-1A is switched to bridged mono mode, the junction of the three resistors is ungrounded and voila! we have a differential amplifier formed from the two input stages. Whether either signal input is fed alone, or both are fed a balanced push-pull signal, the two hot terminals of the outputs will now be out of phase with each other and the mono load is to be connected between the hot output terminals.

In stereo mode, the H-1A's two channels both invert signal polarity. In mono mode, the signal will be inverted in whichever channel is fed a signal but will be uninverted at the output of the other channel. The amp will therefore

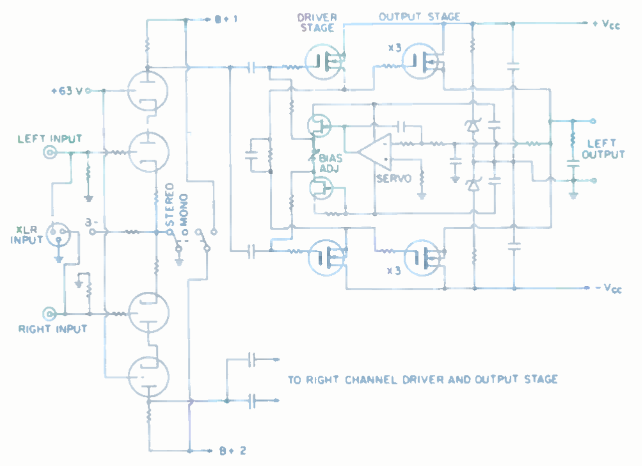

Fig. 1—Simplified schematic, showing left channel and input stage of right channel; see text.

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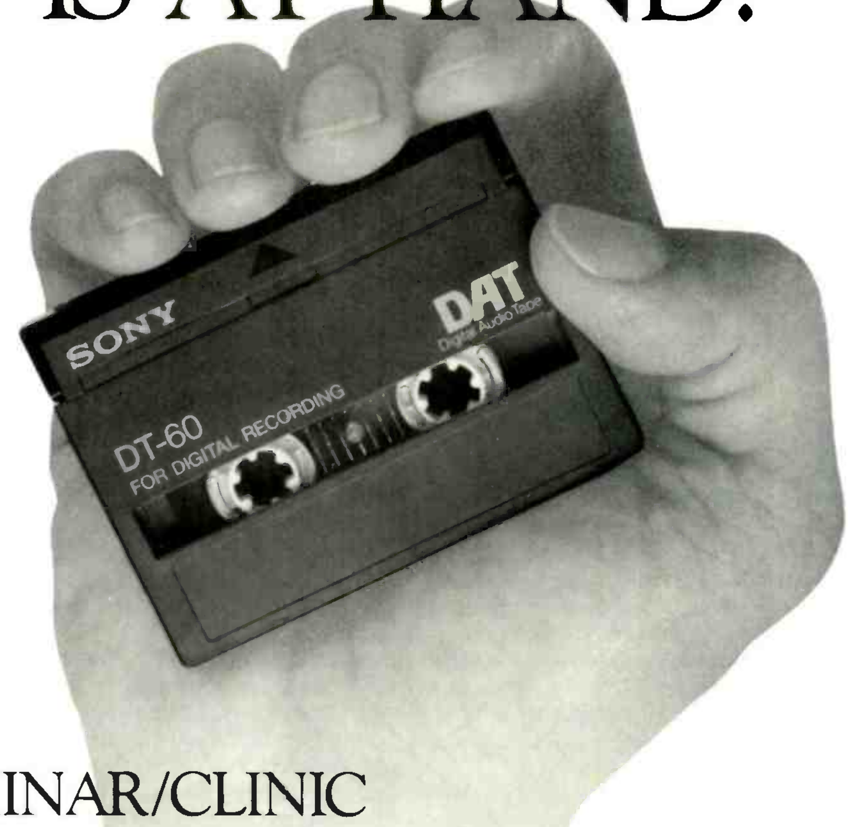

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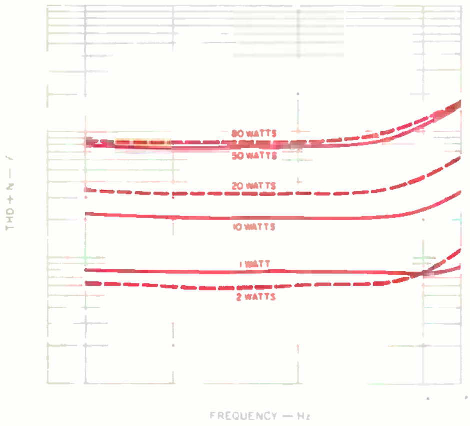

Fig. 2—THD + N as a function of frequency and power output for 8-ohm loads (solid curves) and 4-ohm loads (dashed curves).

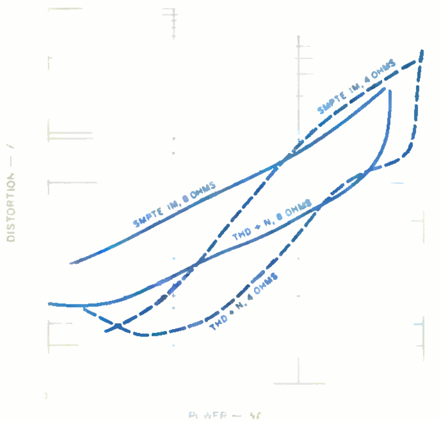

Fig. 3—SMPTE IM and THD + N vs. power for a 1-kHz signal into 8- and 4-ohm loads.

provide push-pull outputs from the input differential amplifier regardless of which input receives the signal. The intended mode for mono operation, however, is for a balanced signal to be fed through the XLR jack. When this is done, the situation remains the same as when one phono jack is fed: The positive-going input still produces a negative-going signal at that channel's output. The way to connect one's speakers for overall noninverting operation in mono mode is to wire the speaker's positive terminal to the output of the channel that received the negative-going input signal.

The power supply for the H-1A, as already mentioned, uses two power transformers. The output-stage power transformer is a relatively large toroidal unit that seems appropriate to the unit's output power. Filter capacitance is quite high for an amp of this size and power output. Two 53,000-µF, 50-V units are used. Instead of the usual single full-wave bridge rectifier for both positive and negative d.c., the H-1A uses separate full-wave bridges with each of the two secondary windings to produce separate, full-wave-rectified d.c. supplies—an interesting twist. These two d.c. supplies are connected in series via the usual common connection for the output stage. The designer feels that this helps to reduce unbalanced flux in the power transformer core for high power outputs at frequencies below 60 Hz.

The smaller transformer powers the tube front-end circuitry only. A time-delay/muting circuit is powered from the positive rail of the output-stage supply. Both the front-end and output-stage power supplies come up when the main "Power" switch is turned on. After the turn-on delay time has elapsed, pushing the "Standby" button (assuming it has not been pushed already) energizes a pair of two-pole relays. These relays' contacts are normally closed, shorting both MOS-FET driver gates to ground, which ensures that turn-on surges from the front-end circuitry won't get through to the speaker output and keeps the output stage biased off. Energizing the relays opens their contacts, biasing the output stage and enabling the unit to pass signal. If the "Standby" switch is pushed in at the same time that the main power switch is engaged, the amp will start playing immediately after the turn-on delay. For best sound, one should keep the "Power" switch on at all times and switch to "Standby" when the amp is not being used.

Returning to the front-end supply arrangement, we see that a full-wave bridge connected to the high-voltage winding of the small power transformer feeds two separate RC filter networks that provide the B+ for each tube input stage. Each of these B+ outputs feeds current through separate resistors to a zener regulator diode that supplies about +63 V to the upper front-end tubes' control grids. The output from another secondary winding goes through a full-wave rectifier and RC filter to supply the −90 V for the front-end cathode resistor that is common when the unit is operated in the mono mode.

Another pole of the stereo/mono switch ties the two separate front-end tube supplies together in the mono mode. This interesting twist tends to cancel any signal voltage at these points, as the B+ ends of the plate load resistors are out of phase in the mono mode. The output of the last secondary winding goes through a full-wave rectifier and a capacitor input filter before being applied to the two front-end tube heaters, which are wired in series.

No protection circuitry seems in evidence in the H-1A other than the line fuse. How's that for confidence!

Measurements

The standard FTC preconditioning tests at one-third power are interesting with a real Class-A amplifier, in that the output stage's current dissipation under those conditions is less than at idle. Incidentally, this unit's heat-sink temperatures get quite high at idle, when the power dissipation is on the order of 100 watts per channel. The unit had no trouble with one-third power into 8-ohm loads, and its heat-sinks were definitely cooler than they were at idle. When I tested

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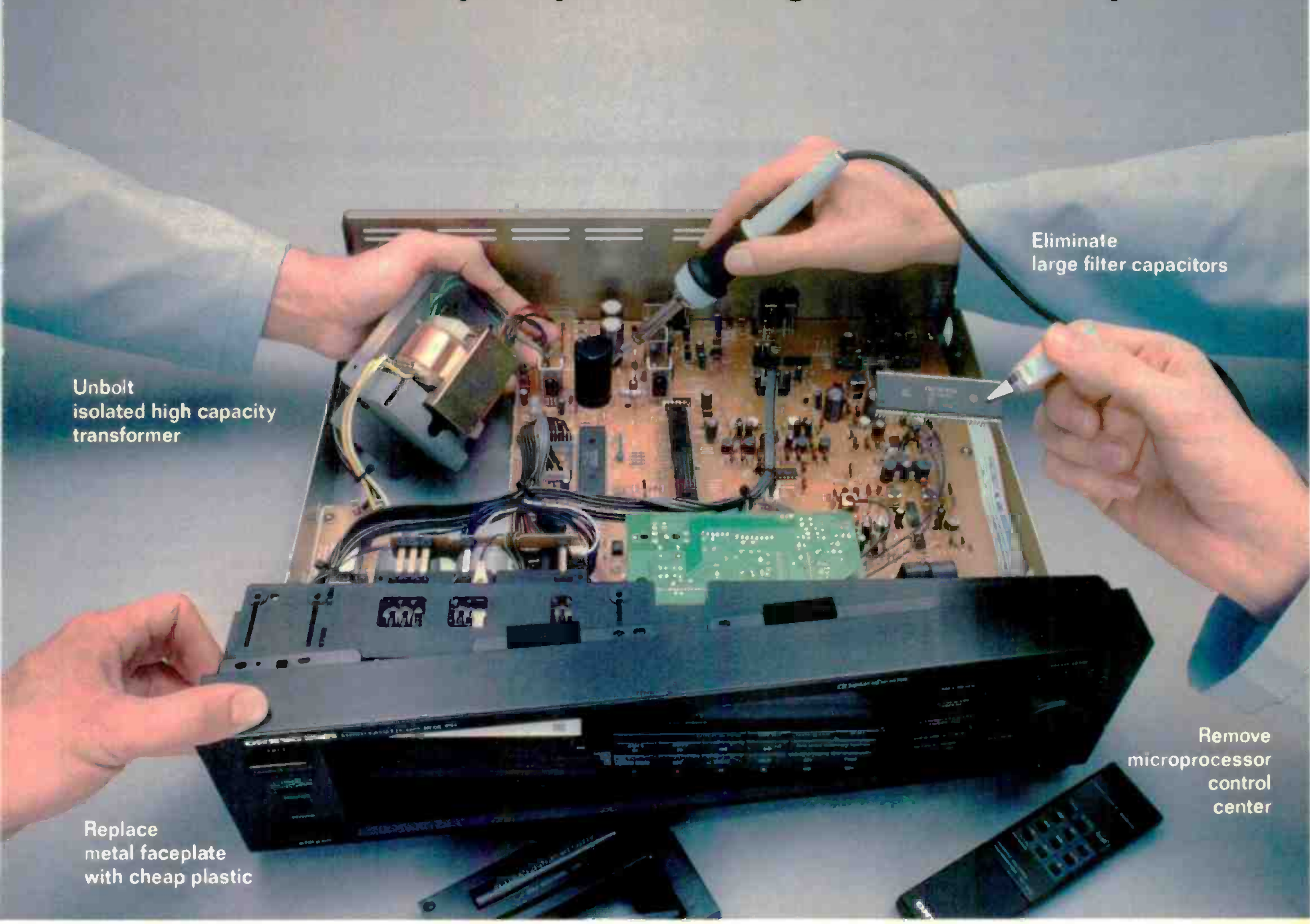

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First, we'd remove our specially isolated transformer, bolting a cheaper replacement directly to the chassis. This would result in vibrations that mask some of the musical detail. Nothing important, just little things like instruments and vocals.

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Of course, the custom designed microprocessor would have to go, taking the Real Time Counter with it. After all, isn't it more exciting to watch the song and tape race to see which finishes first?

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At most output power levels, THD rises only moderately as the frequency goes up, and treble distortion doesn't rise at all for 1 watt out.

Fig. 4—Distortion residues and 1-kHz signal. For 10 watts into 8 ohms (upper residue trace), THD measured 0.062%; for 20 watts into 4 ohms (lower residue trace), it was 0.095%.

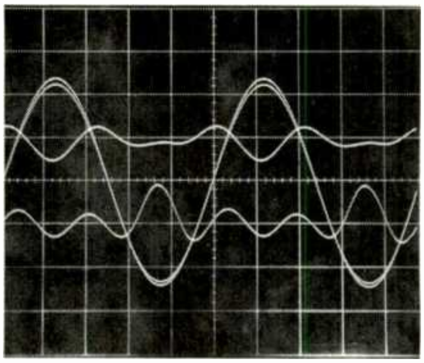

Table I—THD + N for 1-kHz signal, in stereo and bridged mono modes. Stereo figures are with 8-ohm loads; mono figures are with 16 ohms, an equivalent load (see text).

Stereo			Mono	
Watts/	THD + N, %			
Channel	LEFT	RIGHT	Watts	THD + N, %
1	0.07	0.1	2	0.024
3	0.12	0.17	6	0.038
10	0.2	0.285	20	0.115
40	0.53	0.6	80	0.54

Table II—Output noise. The IHF S/N ratio was 83.5 dB for the left channel and 94.0 dB for the right.

	Output Noise, µV	
Bandwidth	LEFT	RIGHT
Wideband	520	850
20 Hz to 20 kHz	330	740
400 Hz to 20 kHz	195	200
A-Weighted	190	192

the H-1A at a third of the rated power (i.e., 33.33 watts) into 4-ohm loads, the heat-sinks got hotter than they did at idle, but otherwise the hour passed uneventfully.

Voltage gain for the H-1A measured 29.7 dB. The IHF input sensitivity was 93.5 mV.

Total harmonic distortion plus noise is shown in Fig. 2 as a function of power, load, and frequency for 8- and 4-ohm loads. The two channels behaved similarly; the results shown are for the left channel. As can be seen in the figure, distortion rises only moderately at the high-frequency end of the audio range. (The reviewed unit carried no channel identification, so I applied my usual convention of identifying the channels as seen from the front of the unit.) Figure 3 shows THD + N for a 1-kHz signal, and SMPTE-IM distortion, as functions of power output for 8- and 4-ohm loads. As shown, distortion at 100 watts per channel into 4-ohm loads is rather high. Visual onset of clipping into 4-ohm loads was about 88 watts per channel. Into 2-ohm loads, visual onset of clipping was at some 132 watts/channel, quite a distance from the claimed power output of 200 watts per channel.

Figure 4 shows typical harmonic distortion residue for a 1-kHz signal for 10 watts into 8 ohms and 20 watts into 4 ohms. The figure shows results for the left channel where, as can be seen, the dominant distortion is a combination of second and third harmonics. With 4-ohm loading, the right channel's THD residue was mostly odd-order.

To look at distortion characteristics in the mono mode, I constructed a low-distortion phase inverter that would allow me to drive both channels in push-pull with one channel direct from my Soundtech oscillator and the other driven from the phase inverter. Since the distortion in stereo mode at low power levels was mostly lower-order even harmonics, I expected to find less overall distortion at equivalent power and loadings in the mono mode, due to push-pull cancellation of even harmonics. (In mono mode, the equivalent to 8-ohm loading in stereo is 16 ohms between the hot output terminals. Also, the equivalent power is twice as high; this is because the voltage is doubled and the power is then equal to the square of this voltage divided by the doubled load impedance.)

Table I shows some selected power and distortion figures for stereo and mono operation. As expected, distortion at low power levels was lower in bridged mono mode with the 16-ohm load because the even-order distortion products cancel out. At higher power levels, however, as the third harmonic starts to dominate, the distortion amounts are similar in both stereo and mono modes. There was little or no distortion with an 8-ohm load in mono, less than there was with 4-ohm loads in stereo because the distortion with these loads was mostly odd-order, and odd-order distortion doesn't cancel in push-pull topologies.

We have a winner here in the contest for flattest output impedance versus frequency. It can't get much flatter than this: Damping factor was 25 for the left channel and 24.2 for the right channel, from 20 Hz to 20 kHz. The output impedance is rather high, though, approaching that of many tube amplifiers. This means that the delivered frequency response to speakers whose impedance curves show wide variations will vary more than it would with amplifiers having lower output impedances.

Interchannel crosstalk as a function of frequency was also measured. The output level for the driven channel was 10 V rms, and the undriven input was terminated in 1 kilohm. Results were within a dB or so of being symmetrical, and were around −80 dB between 20 and 300 Hz, increasing to −76 dB at 1 kHz, −66 dB at 5 kHz, and to about −55 dB at 20 kHz. These numbers are for the slightly worse, right-to-left direction, with the driven channel loaded by 8 ohms. As with many amplifiers I have measured, this one had somewhat less crosstalk when the driven channel was unloaded, on the order of 6 to 10 dB, which means that the crosstalk level is somewhat load-dependent. Output noise for different bandwidths and IHF signal-to-noise ratios are given in Table II.

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The Lazarus H-1A's space, air, and dimension are quite good, and its bass extension and power are downright impressive.

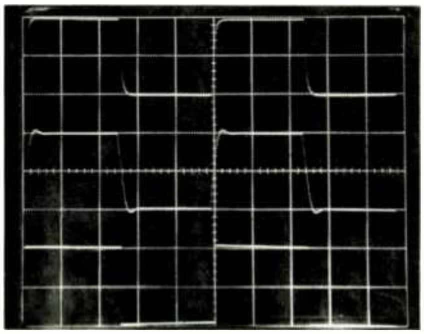


Fig. 5—Square-wave response. Top trace is 10 kHz, with 8-ohm load; middle trace is same signal, with 2-μF capacitance across the 8-ohm load; bottom trace is 40 Hz into 8 ohms. (Scales: Vertical, 5 V/div.; horizontal, 20 μS/div. for 10 kHz, 5 mS/div. for 40 Hz.)

Dynamic headroom in stereo mode with 8-ohm loading worked out to about 0.22 dB. With 4-ohm loading, the attainable power was less than the rated 100 watts (with no distortion spec) and the headroom number comes out at −0.4 dB. Clipping headroom was +0.17 dB with 8-ohm loads, but was −0.56 dB with 4-ohm loading. With only one channel driven, output was about ±20 amperes into a 1-ohm load.

Frequency responses, for 1-watt output with 8-ohm loading and for 2 watts into 4 ohms, were flat down to my low-frequency measuring limit of 10 Hz, and were about 2 to 3 dB down at 100 kHz. The two channels had slightly different roll-off curves, with the right channel being down more than the left. The difference between 8- and 4-ohm loading was slight. Rise- and fall-times at ±5 V into 8 ohms were 2.8 and 3.2 for the left and right channels respectively. 'Scope photos of square-wave performance are displayed in Fig. 5 where the top trace is for 10 kHz with 8-ohm loading, the middle trace is for 8 ohms with an added 2 μF of capacitance, and the bottom trace is for 40 Hz into 8 ohms. The unit has a small amount of ringing with the added 2 μF; the small amount of tilt in the 40-Hz waveform indicates extended response below the audio band.

The regulation of bias, or quiescent current, with temperature is overstable, meaning that as the unit heats up the current decreases. This is most likely due to the negative temperature characteristic that the Hitachi MOS-FETs exhibit at the currents used. The a.c. line draw was about 2.5 amperes when the amp was cold and about 2.0 amperes when warmed up. How perfectly Class A is the amplifier into 8-ohm loads? I couldn't easily measure output-stage current, as there were no source feedback resistors in the output stage, and I don't have a current probe. Judging by a.c. line draw as a function of output power into 8 ohms, however, the H-1A is pretty close to being Class A all the way up to clipping: The a.c. line draw rose only slightly, from 2.0 amperes at idle to about 2.5 amperes at 50 watts per channel.

Summarizing the measured behavior of the H-1A, on the plus side of the ledger are its low-order harmonic distortion, flat output impedance with frequency, and its lack of slewing distortion. On the not-so-hot side are the relatively high distortion at high power levels and the fact that the amp does not really make its power spec into low-impedance loads with sufficiently low distortion.

Use and Listening Tests

Equipment used to evaluate the H-1A power amplifier included, as signal sources, an Oracle turntable fitted with a Well Tempered arm and Spectral Audio MCR Select cartridge, a Magnavox CDB-560 CD player feeding a Wadia 2000 decoding computer, a Nakamichi 250 cassette deck, and a Technics 1500 open-reel recorder. Preamps used were my Cook-King reference unit (which combines a phono preamp with a passive selector switch and stepped attenuator) and an Illusion No. 8 tube preamp. Other power amps used were my reference EAR 519 tube units and VTL Compact 100s and de Luxe 120s. Speakers used were Siefert Research Magnum IIIs.

(An aside on the Wadia 2000. I have been using one of these wonderful devices for 2 to 3 months courtesy of a loan by Wadia to *Audio* for evaluation purposes. I have to agree with all the accolades it has received in various reviews. My own experience is that it drastically opens up the space and depth in CD reproduction and generally reduces irritation levels in the high-frequency region. Also, the bass quality is killer.)

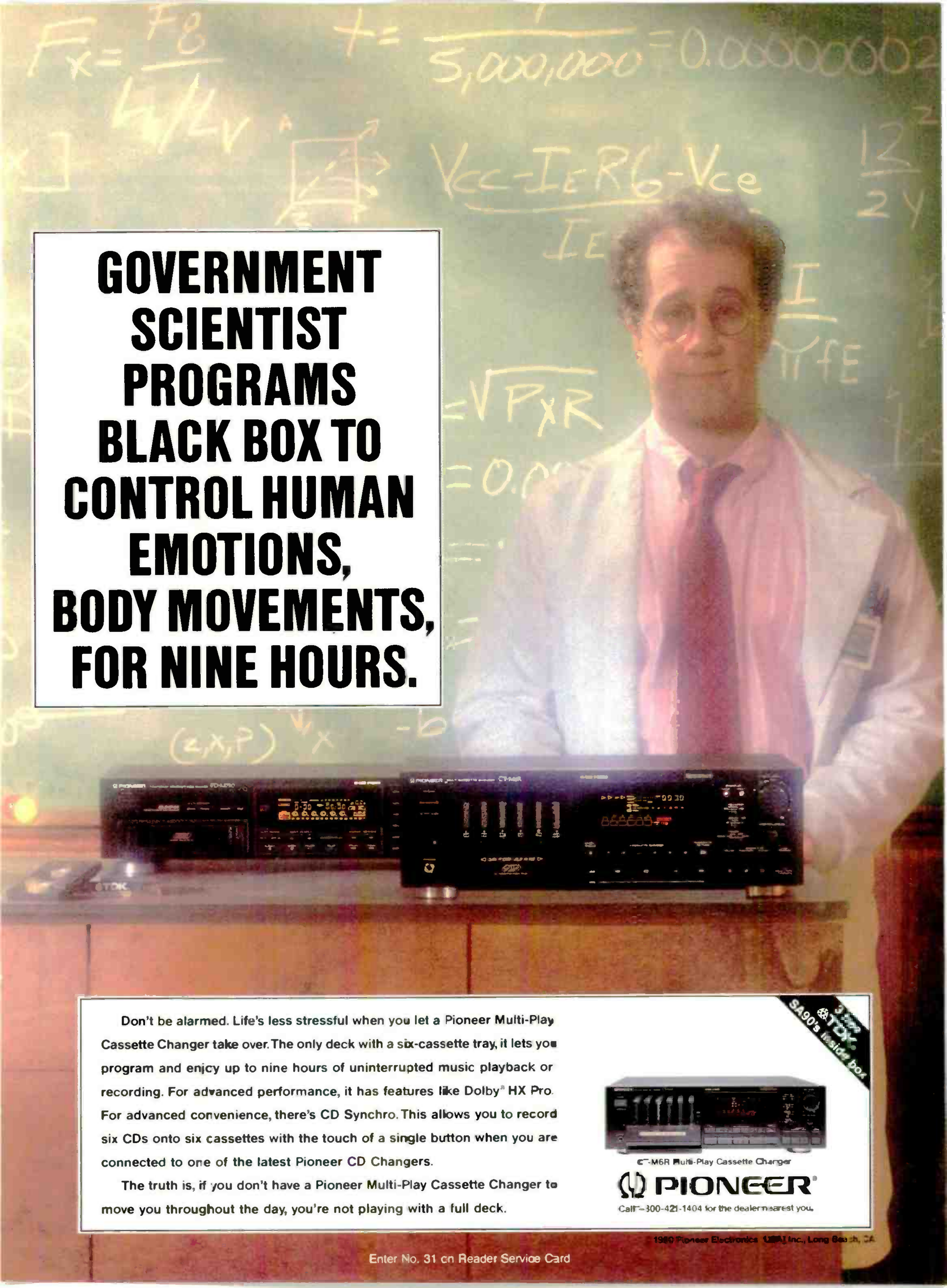
Before receiving this updated sample for review, I had an earlier H-1A which, judging by the newer sample, may not have been representative of Lazarus's actual production. I did not like the earlier unit's sound, which was harsh, closed in, and generally irritating.

Ah, but the unit I reviewed! Much to my surprise and delight, I now have another amplifier in residence that I enjoy listening through. Spectrally, the sound of this amp seems to be tilted down over the audio range, with the bass elevated and the treble reduced. The resultant sound is highly listenable and non-irritating. Bass extension and power are downright impressive. Space, air, and dimensions are quite good. (However, when I go back to my reference EAR 519s, the overall sound is more open and believable.) As with other Class-A designs, the H-1A sounds louder than its rated power might indicate and plays plenty loud for me.

Operationally, the H-1A worked flawlessly. The delay/mute circuitry worked with nary a click or pop. I left the main power switch on all the time I was using the amp and flipped the "Standby" switch to listen to it. When operated this way, optimum sound occurs in about 15 minutes. From a cold turn-on, optimum sound takes much longer.

Summing up, I think the H-1A is a very good sounding power amplifier and I certainly recommend giving it an audition. I certainly enjoyed its stay at my house.

Bascom H. King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PRECISE MONITOR 10 SPEAKER

Manufacturer's Specifications
Type: Three-way, bass reflex.
Drivers: 10-in. (25-cm) cone woofer; 6½-in. (16-cm), polymer-laminated cone midrange, and 1-in. (2.5-cm) dome tweeter.
Frequency Response: 20 Hz to 35 kHz.
Sensitivity: 90 dB SPL at 1 meter for 1 watt input.
Crossover Frequencies: 200 Hz and 2.5 kHz.
Impedance: 4 ohms.
Rated Input Power (DIN): 100 watts.
Maximum Input Power (EIAJ): 250 watts.
Recommended Amplifier Power: 50 to 250 watts.
Dimensions: 44¼ in. H × 15⁹⁄₁₆ in. W × 13⅜ in. D (112.4 cm × 39.6 cm × 34 cm), including grille.
Weight: 70.5 lbs. (32 kg).
Price: $1,500 per pair.
Company Address: Precise Acoustic Laboratories, 200 Williams Drive, Suite B, Ramsey, N.J. 07446.
For literature, circle No. 94

The Monitor 10 is the top model in a line of five loudspeakers made by Precise Acoustics, a division of Onkyo U.S.A. created to design, build, and market high-quality loudspeakers in the United States. While the Model 10 is currently built in Japan, it will soon be made in the U.S., as the other four models already are, and all five were designed in the U.S.A. The principal design work was done by Keith O. Johnson, who is probably more widely known for his work for Reference Recordings, where he has been responsible for some very impressive audiophile recordings. Years ago, Johnson built his own tape deck and invented a method of recording the highest audio frequencies deep into the magnetic tape, rather than near the surface, which is the conventional way; he called this "focus gap recording." The technique called for the use of a special recording head and the use of a very high bias signal, in the megahertz range. It is still used today for high-speed cassette duplicating systems.

More recently, Johnson has come up with another innovation, this time one that applies to loudspeaker design. The technique, called Differential Mode Stress Analysis (DMSA), is used to investigate the modal behavior of loudspeaker diaphragms. This may sound very complicated but it really isn't. Loudspeaker diaphragms, whether they are flat, conical, domed, etc., all tend to have complex vibration patterns that can be set into motion by the music they are trying to reproduce. These modes of vibration must be controlled, otherwise they will add their own output to the total sound and cause it to differ from the original.

Finding these modes, or vibration patterns, on a loudspeaker diaphragm is not an easy task. In the past, two methods have been used. The first utilizes a fine powder, which is sprinkled on the diaphragm; when certain frequencies are applied to the loudspeaker from a signal generator, the powder will migrate to the areas of the diaphragm that are not vibrating. The second method also requires the use of a signal generator, but this time a stroboscopic light is used to illuminate the diaphragm. (The strobe light is similar to the kind used by auto mechanics to set the timing of an automobile engine.) The frequency of the strobe light's flashes is adjusted to match the various vibration patterns of the diaphragm, allowing them to be seen. The DMSA technique can be used with music signals; this sets it apart from the other techniques, which always require a pure sine-wave tone as the input signal to the loudspeaker. The key ingredient in DMSA is a tiny differential microphone that Johnson designed and built. The mike is placed close to the diaphragm and moved across it while the diaphragm is reproducing sound. The output from the microphone can be connected to instrumentation and perhaps to a pair of headphones. The two elements of the differential mike pick up the sounds from separate but adjacent points of the diaphragm. When the two adjacent areas of the diaphragm are moving together, as they should be, there is no output from the microphone. If, however, the diaphragm is breaking up into modal patterns, there will be output from the microphone because each element in the microphone picks up a different output from the diaphragm. The material and treatment of the diaphragms used in the Precise Monitor 10, as well as the other models in the Precise line, were designed and developed using Johnson's ingenious technique.

The first thing that I noticed about the Precise Model 10 was that it was very well constructed and beautifully finished. The system consists of two cabinets, one on top of the other. The bottom enclosure is finished in oak and is a ported bass system, with a 10-inch bass driver on the front baffle and the port opening on the rear of the enclosure. A smaller enclosure, which has the 6½-inch midrange driver and the 1-inch treble driver, sits on top of the bass cabinet; it is finished in matte black with smoothly rounded corners. The treble driver is mounted on a front panel, which is set back from the midrange driver. This mid/high enclosure is detachable but cannot be used separately from the bass system, as I found out during my technical measurements. A socket on its bottom fits into a pin that sticks up from the top of the bass cabinet; this locates it on top of the bass enclosure and allows it to be turned right or left about 30°. A detachable hood, covered with black grille cloth, fits over the smaller box; it is held in place by four pins which mate with sockets in the top of the bass enclosure. The input to the system is on the back panel of the bass enclosure; the smaller, mid/high enclosure is connected to the bass enclosure by two pairs of wires that come from the top of the larger box. For those readers who like to rap their knuckles on enclosures and tap cones, the "knuckle test" indicates that the enclosure is solidly constructed, with no peculiar sounds, and the "cone tap" test elicits nothing unusual in the way of strange sounds.

The bass cabinet is 12⅝ in. deep × 15½ in. wide × 29½ in. high. The cabinet appears to use inch-thick panels except for the baffle, which is 1¼ inch thick. The volume of the bass enclosure is about 3,945 cubic inches, which is 2.28 cu. ft. The input plate features large, gold-plated terminals with holes suitable for thick loudspeaker connecting cables; these terminals are mounted at an angle to make them easier to use. Inside the bass enclosure, the input terminals are connected by heavy wires to a crossover board that is mounted by plastic fasteners to a diagonal brace at the bottom of the enclosure. This board carries two chokes, three capacitors, and three resistors. The output from this network feeds a separate bass-control circuit.

The bass-control circuit does not use a p.c. board; its parts are mounted on a piece of particle board that is fastened to the right side of the cabinet. This circuit includes one large choke, two back-to-back electrolytics, and two large resistors. These parts are connected to the bass switch, which is mounted on the input plate on the back of the bass cabinet and allows the bass to be increased or decreased 2 dB from its normal setting.

MEASURED DATA

Type: Three-way bass reflex with separate mid/high enclosure.

Frequency Response: 40 Hz to 20 kHz, ±4 dB.

Sensitivity: 76 dB SPL at 1 meter for 1 V input.

Efficiency: 85 dB SPL at 1 meter for 1 watt input.

Amplifier Power: Recommended, 50 to 250 watts per channel; maximum, 300 watts.

Harmonic Distortion: At 90 dB SPL, less than 1.0% second or third harmonic above 100 Hz; less than 6.3% second or third harmonic below 100 Hz.; at 100 dB SPL, less than 2.0% second or third harmonic above 100 Hz, less than 7.1% second or third harmonic below 100 Hz.

Minimum Impedance: 2.4 ohms.

Absolute Polarity: See text.

Low-frequency Resonances: 27 and 40 Hz.

Crossover Frequencies: 120 Hz and 3 kHz.

Controls and Switches: Three-position toggle switches for bass and treble.

Input Connections: Bass, five-way binding posts, gold-plated, with large holes; mid/high, four banana sockets, gold plated.

Enclosure Material and Finish: Bass, 1-inch medium-density fiberboard, oak finish; mid/high, ¾-inch medium-density fiberboard, black finish.

Enclosure Dimensions: Bass, 29½ in. H × 15½ in. W × 12⅝ in. D; mid/high, 13⅜ in. H × 9¼ in. W × 7⅝ in. D.

Weight: Total, 75 lbs.; bass, 57 lbs.; mid/high, 14 lbs.; hood, 4 lbs.

The magnet for the treble driver is the same size as that used for the woofer; this is quite exceptional.

Two pairs of wires, with gold-plated banana plugs at their ends, exit the bass enclosure from the top near the rear, and plug into gold-plated banana jacks on the small mid/high enclosure. (These jacks appear to be five-way binding posts, but actually are designed to accept only banana plugs.) One pair of wires feeds the tweeter crossover network, which is inside the small enclosure; the other feeds the 6½-inch driver directly from the crossover inside the bass enclosure; this is why the small cabinet cannot be used separately.

The crossover for the 6½-inch driver carries three chokes, seven capacitors, and seven resistors and is securely mounted inside the back of the bass cabinet by five threaded stand-offs and five nuts. The treble crossover, inside the small enclosure, is also mounted on a p.c. board and carries two inductors, three capacitors, and five resistors. The crossovers in the two enclosures therefore consist of 8 inductors, 15 capacitors, 18 resistors, and 2 switches—a total of 43 parts.

The treble switch, which is mounted on the input plate of the mid/high enclosure, has its own p.c. board for easier connection of the Monitor 10's large-diameter internal wires. Soldering these large wires directly to the small switch terminals would be too difficult. The treble switch allows the high-frequency range from 3 to 20 kHz to be boosted or cut by 2 dB from the normal setting.

A thin felt rectangle, 12½ inches wide and 16½ inches high, is fastened to the front of the bass cabinet and surrounds the bass driver. A separate, detachable grille panel covers this felt rectangle and is mounted by four plastic pins that lock into the plastic inserts on the front of the cabinet.

The 10-inch bass driver has a slightly curved cone of rather soft material, with a diameter of 7⅝ inches. This type of material can provide good dissipation of unwanted vibrational energy that would color the sound. Eight holes, each 3/16 inch in diameter, surround the cone near the apex. These holes relieve the pressure under the 3⅝-inch-diameter solid paper dust cap and reduce the possibility of noise that would occur if the dust cap were allowed to vibrate. A half-roll annulus of synthetic rubber is attached to the periphery of the cone, allowing the cone to move back and forth at least ¾ inch. The bass driver's magnet is a ferrite type, 4¼ inches in diameter and 11/16 inch thick.

As I mentioned before, the bass system is a ported design and the port tube is 4½ inches in diameter; a plastic elbow connection allows the initial, short section of the port tube to make a 90° turn where it joins with another section about 18 inches long, which is braced to the inside of the enclosure. Pads of thick felt material are placed strategically inside the bass enclosure and fastened by large staples.

The mid/high enclosure also uses the same felt material to absorb energy and damp resonances. The bottom of the mid/high enclosure has four rubber feet to protect the finish of the bass enclosure and hold it in place. The 6½ inch mid/high driver has a slightly curved cone, 4⅝ inches in diameter, whose rear surface is treated to control resonances. The annulus is a synthetic rubber half roll which absorbs unwanted energy and allows quite a bit of cone excursion. The midrange-driver has a very large magnet that measures approximately 3¼ inches in diameter by 11/16 inch thick. The voice-coil former, which is 1½ inches in diameter, has a series of vent holes around the top to release air that would otherwise be trapped under the 2-inch diameter plastic dust dome; this trapped air could cause the dust dome to deform and cause noise.

The treble driver's 1-inch dome is of woven material which is impregnated and sealed. Its magnet is the same size as the bass driver's; this is quite exceptional. The steel top plate, which provides the outside part of the magnet gap, is thinner than that used for the bass driver. A large plastic mounting plate is fastened to this top plate by four screws. The treble driver is set into the front of the enclosure so that it is flush with the baffle. Its top part of the front baffle is set back from the bass driver baffle by a step about 1 inch deep. This step delays the signal from treble driver by about 74 μS for a listener seated in front of the system. The resulting 1-inch ledge below the treble driver is covered by an inch-thick piece of felt to absorb any reflections and reduce diffraction effects.

All of the drivers (which are made by Onkyo in Japan) and the input plates are sealed to the enclosures by foam gaskets. The drivers are mounted by screws and tee nuts. The mounting hole cut in the inch-thick baffle for the 6½-inch driver is not circular, but irregular in shape, to break up reflections from the rear of the cone. The proper polarity of the connections to each driver is assured by the fact that they each have a small and a large terminal and the two wires that supply the signal to them each have a large and a small connector. The wire to the large connector has a red stripe to assure that the right connector is attached to it during assembly of the wiring harnesses. To me, this kind of thing indicates the thoroughness of the Precise Monitor 10 design.

The grille hood is solidly constructed and is covered by a seamless sock of quite acoustically transparent cloth. An insert board, covered by the same grille material, is held to the top of the hood by Velcro. The hood measures 15⅜ in. wide × 14½ in. high × 11½ in. deep at its bottom; because its upper portion slopes back, the hood is 8½ inches deep at the top. I measured a slight difference in response with the grille in place, so I left it off during the listening sessions.

The Precise Monitor 10 is covered by a limited warranty that extends for five years on parts and labor, and a list of service stations is included with the instruction manual.

Measurements and Listening Tests

The results of my technical measurements of the characteristics of the Precise Monitor 10 loudspeakers are presented along with comments made by listening panel members when appropriate. In this way I hope to correlate the measurements with the subjectively perceived attributes of the Monitor 10 systems. The panel members listened to various classical and contemporary musical selections that included both small and large vocal and instrumental ensembles as well as many different types of instruments. The panel members were also asked to complete forms rating the reproduction quality of the Monitor 10 systems, from 0 to −5. They were also encouraged to write comments about the speakers' characteristics but were asked not to make any audible comments while auditioning the systems.

The thoroughness of the Precise Monitor 10's design is indicated by such things as the precautions taken to ensure correct wiring.

I had previously determined, by measurements I made on both loudspeakers, that they were almost identical. I did find a difference in output at frequencies between 4.5 and 6.5 kHz, but only of about 2 dB; the systems tracked within 0.5 dB elsewhere. Since their characteristics were so close, I made detailed measurements on only one system of the pair.

Figure 1 shows impedance magnitude versus frequency, from 10 Hz to 20 kHz, for all three positions of the bass and treble switches; the solid curve represents impedance with the switches in the "0-dB," or normal, position. The listening evaluations were made with both switches set to this position. Precise specifies the Monitor 10's nominal impedance at 4 ohms, and this appears to be a good choice. The minimum impedance occurs at about 80 Hz, where it drops to 2.4 ohms. Since most program material has a lot of musical energy at or near this frequency, any amplifier chosen to drive the Monitor 10 should be able to supply sufficient current without overloading. This should be no problem since most modern amplifiers and receivers have this capability, at least at moderate levels. The undulations in the impedance versus frequency curve indicate the complexity of the crossover.

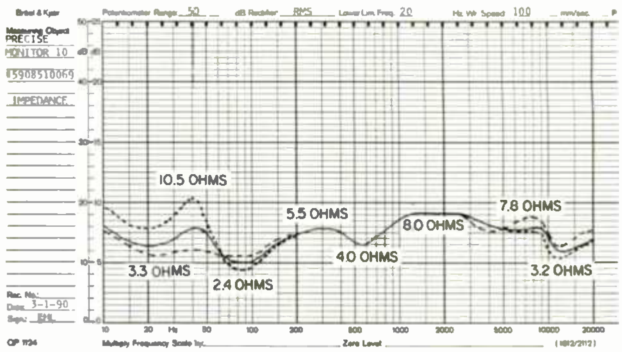


Fig. 1—Magnitude of impedance, with bass and treble switches set to the normal, "0 dB" position (solid line), to "+2 dB" (dotted line) and to "−2 dB" (dashed line).

The complex impedance is shown in Fig. 2. This is essentially an X-Y plot, with the resistive component of the impedance on the X-axis and the reactive component on the Y-axis. Notice that the Y-axis shows both positive and negative values for the reactive component. This indicates that the impedance will have an inductive characteristic when it is in the upper half of the chart, a capacitive characteristic when it is in the lower half, and appears to be merely resistive when it is right on the zero line. The complex impedance of the Monitor 10 is not unusual for a system with the impedance variations of three drivers plus a complicated crossover having a total of eight inductors and 15 capacitors. The vertical scale has been expanded to show more detail so, even where the impedance appears capacitive, its magnitude is not as large as it might appear and should not cause problems for any reasonably good amp.

Fig. 2—Complex impedance, showing reactance and resistance vs. frequency. The vertical scale has been expanded to show detail.

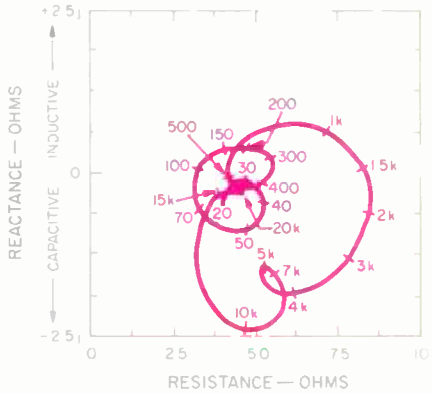
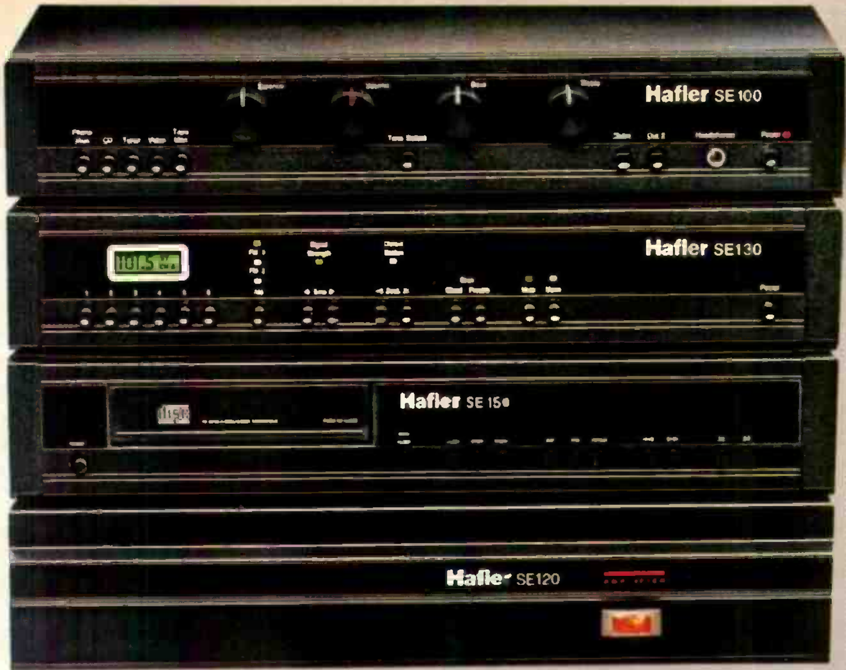


Figure 3 shows the magnitude and phase of the acoustic output of the Monitor 10 measured with a microphone 1 meter in front of the system and between the 6½-inch and 1-inch drivers. The 10-inch bass driver is also contributing output but, since the lower range of the measurement was limited to 200 Hz, its contribution is not significant, especially up in the midrange. The droop in the midrange is caused by the fact that the 6½-inch and 1-inch drivers are not in phase through this range, where both are contributing significant output; the phase plot for each driver shows this clearly. Since the Monitor 10 is designed to place a seated listener on the same plane as this measurement, this can cause problems in the perceived sound, as will be seen later. Since the 1-inch driver is physically mounted behind the 6½-inch driver, on a separate baffle plane, it appears that an attempt was made to cause the output from the two drivers to be presented in phase to a listener in front of the system. Figure 3 indicates that such is not the case.

The energy/time measurement shown in Fig. 4 is another method of indicating how well the energy from the two upper drivers is synchronized; this also reveals that the treble energy arrives ahead of the energy from the midrange. The bass driver was also operating during this test, but its output is insignificant since, as was the case for the measurement of Fig. 3, the lower range of energy is limited to that above 200 Hz.

Figure 5 shows the 3-meter room response of the Monitor 10 measured with the microphone at a height of 42 inches, about ear level for a seated listener. This also put the microphone in the same plane as it was for the 1-meter measurement of Fig. 3, which is directly in line with a point between the two drivers on the mid/high enclosure. I measured the response of the Monitor 10 from 200 Hz to 20 kHz at 0° and 30° off the axis, to simulate what a listener would hear if seated directly in front of the system or off to the side in a common stereo setup. The response changes very little for the different angles but does show a large dip in the midrange for either position. The panel members were seated during the listening evaluations, so their comments, which were sprinkled throughout the evaluation forms, verify this lack of midrange energy. For the sound of stringed



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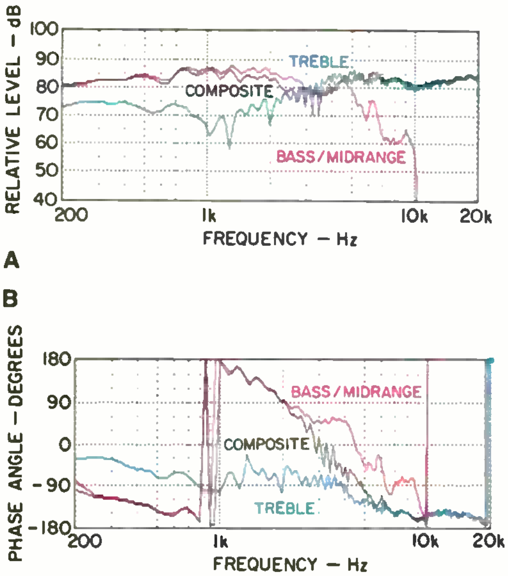

Fig. 3—On-axis frequency response (A) and phase response (B) for bass/ midrange and treble drivers, separately and together. Although only response above 200 Hz is shown, there is some contribution from the bass driver. The phase differences are sufficient to cause some cancellation of output in the crossover region; see text.

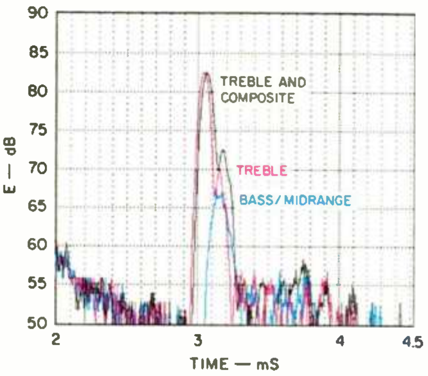

Fig. 4—One-meter energy-time curve, with grille off, showing bass-midrange, treble, and composite output. The treble output has two peaks, the first and larger of which overlaps that of the composite output and arrives about 95 µS before that of the bass/ midrange.

instruments, such as violins, the comments were: "Good highs but not much midrange" and "bright but lacks articulation." For guitar, comments were: "Lacks middle range" and "nebulous sound." And for full orchestra, comments were: "Muted sound", "lacks preciseness," and "no detail."

Figure 6 shows the same response range as Fig. 5, for positions directly in front of the Monitor 10 at microphone heights of 42 and 62 inches, to simulate what a standing listener would hear as compared to the sound heard by a seated listener. The results indicate that a standing listener would probably make entirely different comments about the sound quality, since the Monitor 10 radiates much more midrange energy upward. Since I knew about this difference from my measurements, I asked two members of the panel to briefly compare the sound from seated and standing positions for two selections; I did this at the end of the listening sessions. Their comments verified that the difference was easily perceptible. The most interesting comment for the standing position was that "the imaging and sense of depth is much better when I stand up."

The manner in which the Monitor 10 produces output at various angles around the system is shown in Figs. 7 and 8. In Fig. 7, comparing the output at 1.9 kHz to that at 900 Hz shows that the 6½-inch driver is becoming more directional at the higher frequency, which is quite normal. The treble driver is also becoming directional at 18 kHz, which is certainly normal. At 3.5 kHz, however, where the output in front of the system is reduced by the tendency of the 6½-inch and 1-inch drivers' outputs to cancel each other, there is actually an increase in output at 60° to each side. Remember that the actual output at 3.5 kHz is not as great as shown here, because the curve is "normalized" to the output at 0°. If you refer to Fig. 3 or Fig. 5, you will see that the output at 3.5 kHz is down in level from that at 900 Hz, 1.9 kHz and 18 kHz. The main thing Fig. 7 indicates is that the Monitor 10 does not radiate its midrange output uniformly in the horizontal plane around the system. Because I was aware of this, I conducted multiple listening sessions, with only two listeners at each session, and made certain that they were seated so that each speaker was facing directly toward them. The vertical polar radiation patterns for the same four frequencies are shown in Fig. 8. It is clear that the on-axis position, directly between the two upper drivers is not the best. At 3.5 kHz most of the output is radiated above and below the zero-axis position. A standing listener will receive an entirely different impression from that of a seated listener, with the standing listener hearing much more midrange energy. When you listen to a loudspeaker system, it is a good idea to do it from various positions, especially the seated position, which is how you will do most of your listening once you take the speakers home.

Figures 9 and 10 show the second- and third-harmonic distortion for average sound pressure levels of 90 and 100 dB SPL respectively. The distortion is very low at the 90-dB level—which is higher than the average level maintained during the listening sessions I conduct, because it is too loud for reliable results from extended evaluations. The distortion at the higher, 100-dB average SPL is still very reasonable, with the second harmonic increasing and the third harmonic remaining respectably low. The intermodula-

The Precise Monitor 10 has interesting design features, is solidly constructed and carefully built, and uses quite good drivers.

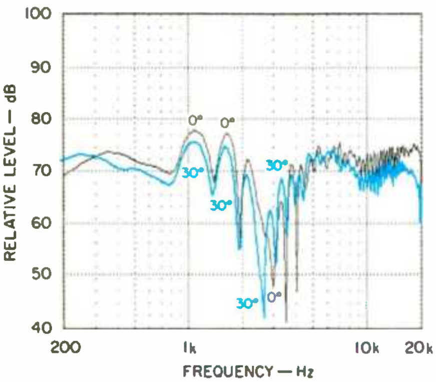

Fig. 5—Three-meter room response, measured on axis and 30° off axis, with the microphone 42 inches above the floor and the system on a 3-inch base.

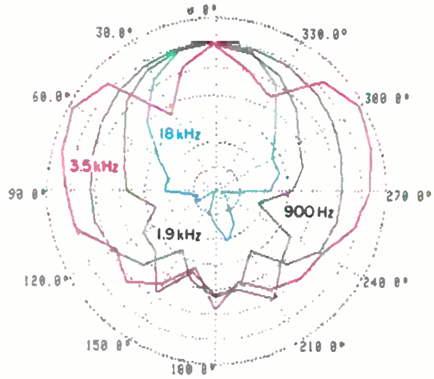

Fig. 7—Horizontal polar responses, with the speaker facing the top of the graph. All curves have been normalized to their 0° values, and hence show relative directionality, not relative output, at different frequencies; see text.

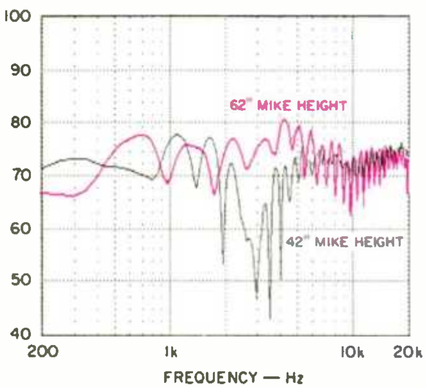

Fig. 6—Three-meter room response, on axis, at microphone heights of 42 and 62 inches, approximating seated and standing listener positions.

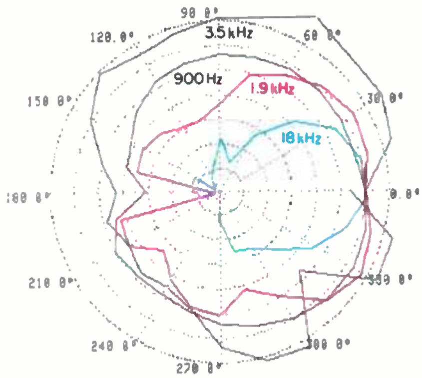

Fig. 8—Vertical polar responses, with the speaker facing right. The 3.5-kHz curve shows the cancellation in the 0° (forward) direction and the tendency to beam more energy above the speaker's axis.

tion distortion was also very low because the bass and midrange are handled by separate drivers.

Figure 11 shows how the Monitor 10 reproduces square waves at 350 Hz and at 1, 4.5, and 7 kHz. I like to use square waves for testing because they are complex signals, each consisting of a fundamental and its harmonics in a definite relationship, much the same as musical sounds; the only musical sounds I can think of that are close to pure sine waves are whistles and "sweet potatoes." The fact that the treble energy precedes the lower frequency energy is evident from the small vertical spike in the 350-Hz and 1-kHz square waves. Various checks that I made showed that, at a listening position in front of the Monitor 10, the treble energy arrives about 95 µS before the lower frequency energy, which represents about 1.3 inches of offset. The high-frequency overtones of complex sounds will precede the fundamental and lower harmonics; this can cause the sound of instruments like solo guitar to be heard as "lacking attack on the plucked strings" although this comment might also be caused by the lack of energy in the midrange.

Figure 12 shows the output for the polarity test signal, which is a positive-going pulse. While the initial energy is negative, the output undulates from positive to negative twice before finally returning to zero; this probably explains why determining the correct absolute polarity for actual program material proved to be very difficult. There was a perceived change in brightness when the polarity was switched, but neither position of the polarity switch provided a sound more realistic than the other. Because of this, I could not list an absolute polarity in my Measured Data.

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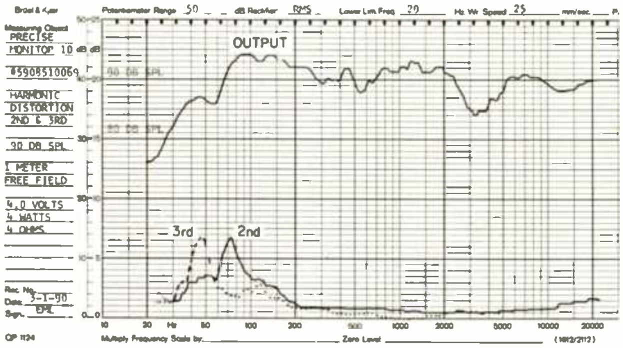


Fig. 9—Output (top) and second- and third-harmonic distortion for 90 dB average SPL, measured in free-field (anechoic) environment at 1 meter. Distortion is less than 1% over most of the range, rising to 3.2% second harmonic at 74 Hz and 6.3% third harmonic at 47 Hz. Bass output would be greater in a normal room. The input was 4 V (4 watts).

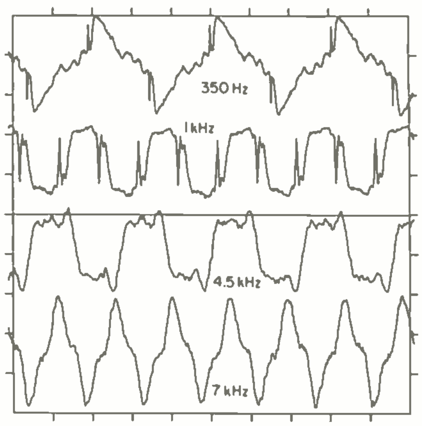


Fig. 11—Square-wave response at 1 meter.

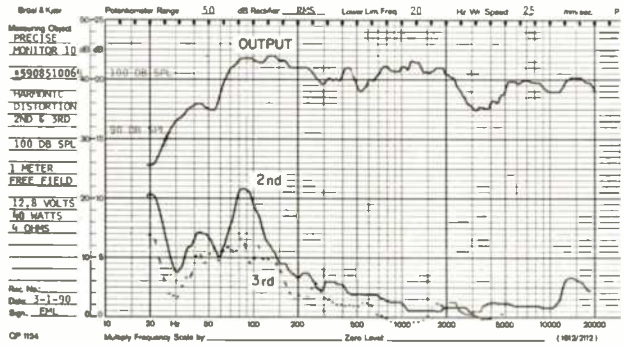


Fig. 10—Same as Fig. 9, but for 100 dB average SPL. Distortion is still below 1% for most of the range, rising to 7.1% second harmonic at 74 Hz; the third harmonic remains very low at this high SPL. Input was 12.7 V (40 watts).

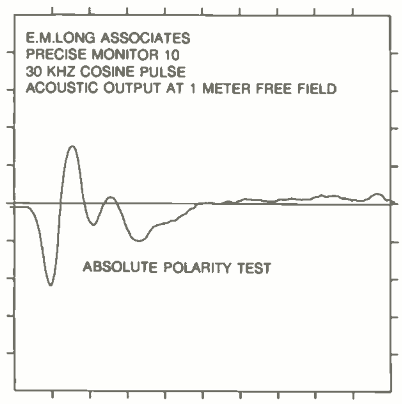


Fig. 12—Absolute polarity, measured at 1 meter in free field; see text.

Figure 13 shows two interesting things about the bass system of the Monitor 10. The first is that the slope of the low-pass crossover network is very gentle and allows the bass system output to extend well into the midrange. Some designers opt for steep roll-off of the upper frequencies, but I have found that a smooth and gentle roll-off characteristic, like that of the Monitor 10, yields a better, more coherent blending of the sound from the bass and midrange drivers. The second thing Fig. 13 shows is the bump in the output at about 80 to 100 Hz. Some panel members made comments that can be directly correlated with this measured response characteristic—the sound of the double bass was "tubby" and the sound of a kick drum was "thumpy."

The effect of the bass output switch is shown in Fig. 14. This measurement was made with the microphone close to the cone of the 10-inch bass driver. The bass output switching scheme is certainly ingenious, and the ability to change the output in the bass range is almost never found in loudspeaker systems using passive crossovers. This can be helpful in adjusting the bass output to the characteristics of different size rooms. The build-up of output around 80 Hz is also evident in these curves, as it was in Fig. 13.

A comparison of the output versus frequency curves from the bass driver and the port is shown in Fig. 15. I first placed the microphone close to the cone of the 10-inch bass driver and ran a curve of the output. Then I placed the microphone at the mouth of the bass port and ran another curve. I changed the signal drive to the system when I made the second curve, so that the output from the port was at about the same level as that from the bass driver, to make it easier to see how they blend together.

Figure 16 shows the acoustic output from the 10-inch bass driver and the port for a single positive-going, 100-Hz pulse. The microphone was placed in the same positions

The Monitor 10's bass output control, a very rare feature in speakers that have passive crossovers, helps adjust bass to suit the size of the room.

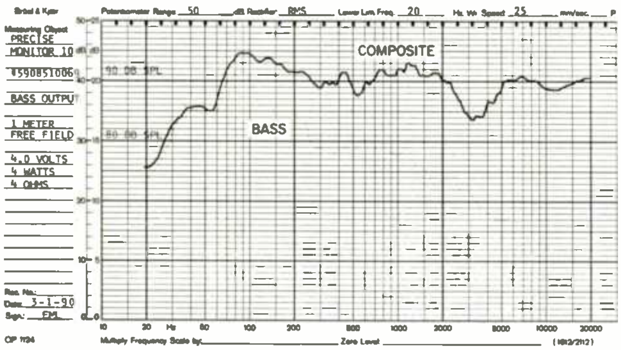


Fig. 13—Output of bass driver and of complete system (including port and bass/midrange driver), measured at 1 meter in free field. Note the gentle crossover slope in the bass-driver curve.

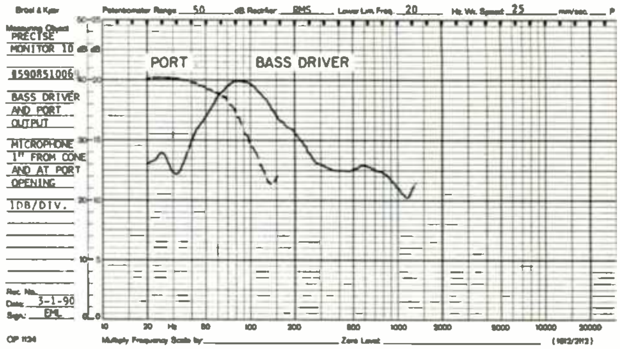


Fig. 15—Output from bass driver and port, each measured at microphone distance of 1 inch. The output levels have been adjusted to blend the curves; see text.

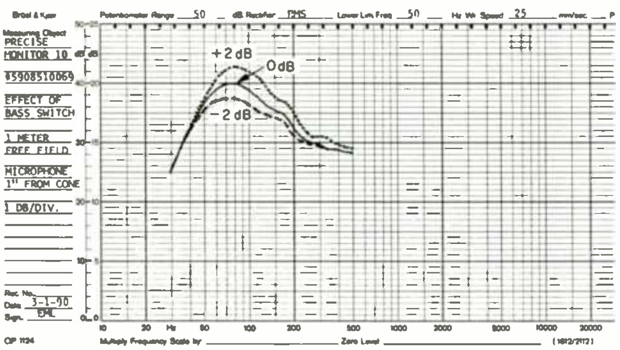
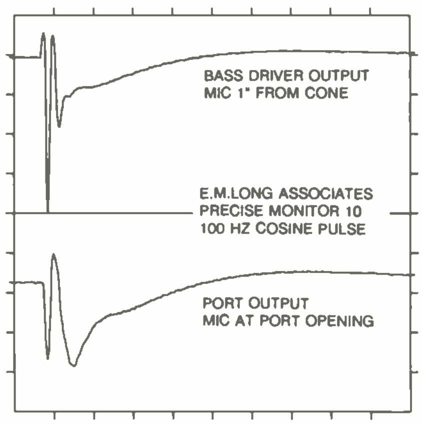


Fig. 14—Effect of bass output switch at all three settings, measured with microphone 1 inch from cone of bass driver.

Fig. 16—Response of bass driver and port to 100-Hz positive cosine pulse. The polarities of the driver and port are 180° apart, as they should be. The port takes longer to recover, since it is tuned to a very low frequency; see text.



that I used for the curves of Fig. 15. The initial response of the bass driver is positive and the initial response of the port is negative, as they both should be. The bass driver shows considerable output in the negative direction after the input pulse has ended, and there is a considerable recovery time for both the port and the bass driver. The "tubby," "thumpy" quality of the bass is probably increased by the fact that the bass driver and the port both continue to produce output after the pulse has ended. The output from the bass driver is also at about 80 Hz, which is about the frequency of the lowest note of a guitar.

Conclusions

The Precise Monitor 10 is a complex system that includes a number of interesting design features. It is solidly constructed and carefully built. The individual drivers making up the system are quite good—especially the treble driver, which exhibits a very smooth response both on and off axis, with very low distortion. If the midrange output on axis (which is in line with a seated listener) had been more uniform, I think the perceived quality of the system would have been much higher. The quality of the bass is unexceptional for an enclosure of this size, consisting mostly of upper bass around 80 Hz. The listening panel members found the overall sound of the Precise Monitor 10 to be very average; one comment, which says it all, was: "Not exceptional sound." If you have an opportunity to listen to the Precise Monitor 10, please do so; after all, you might like the sound. At least you will be better able to judge what we say about other systems.

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POETRY INTO MUSIC

Dvořák: Complete Symphonic Poems, Opp. 107-111; "My Home" Overture, Op. 62. Scottish National Orchestra; Neeme Järvi, conductor.
Chandos CHAN 8798/9, two CDs; DDD; 111:11.

Even those of us who are old enough to know better tend to think of "good taste" as a timeless ideal. Yet what were rejected as execrable Victorianisms 40 or 50 years ago are now afforded the same sort of respectful study as the Parthenon or Rembrandt's chiaroscurro. During my formative years, for instance, program music was deemed fit only to introduce kiddies to the sound of the symphony orchestra. Even Beethoven's "Pastoral" Symphony was viewed with misgivings by some musicologists. But the tide, as King Canute astutely noted, has turned.

What once seemed fussy and overblown now passes for charmingly naive in music that tells a story. The erstwhile pastiche of literal descriptors speaks to us with a directness that is lost in much of the music of our own time. We envy the childlike simplicity of that directness—however elaborately achieved—and marvel at its freedom from the constraints of fugues and tone rows and much of the other formalistic baggage of abstract music.

This set contains all of the symphonic poems that Antonín Dvořák based on the Czech folk-tale poems of Karel Jaromír Erben—"The Water Goblin," "The Noon Witch," "The Golden Spinning Wheel," and "The Wood Dove"—plus the relatively nonliterary "The Hero's Song," which was composed immediately after the Erben pieces and was, in fact, Dvořák's last orchestral composition. The filler overture, "My Home," was composed as incidental music to a biographical play about Josef Kajetán Tyl. It is of particular interest at this moment of new-found Czechoslovakian independence because one of its themes is a tune (to which Tyl wrote the words) that has since been adopted as the Czech national anthem.

The folk tales themselves (and they are central to this set) are every bit as morbid as the stories most of us were brought up on: Aesop, Andersen, Grimm, and company. They are very unpalatable if taken too literally. One trusts that Erben's poetry kept them at a suitably stylized distance; Dvořák's beguiling instrumentation certainly helps. The tone poems are, in fact, engrossing pieces that can be fully understood only if you follow the story lines that give them shape and point. "The Hero's Song" has no story and is the least engaging of the five.

At this late date, it should come as a shock to nobody that the Scottish National Orchestra is a world-class performance organization or that Järvi is an exceptional conductor who specializes to some extent in the music of central and northern Europe. Here, as recorded in Henry Wood Hall in Glasgow in 1986 and 1987, they sound as remarkable as ever—except in loud tuttis, where the textures lose transparency. All in all, this is a valuable recording of unusual and intriguing repertoire—and, as such, a typical Chandos product. *Robert Long*

The Sea Hawk. National Philharmonic Orchestra, Charles Gerhardt.
RCA Victor 7890-2-RG, CD; ADD; 70:05.

Film scores have always been a very specialized form of music composition. Composers of the eminence of William Walton, Serge Prokofiev, and Dmitri Shostakovich have made memorable contributions to this genre. Needless to say, these composers are more noted for their works in the mainstream of classical music. Yet of the composers who concentrated on writing movie music, none epitomizes this group better than Erich Wolfgang Korngold. On this CD, you can enjoy some of Korngold's most memorable scores from such films as *The Sea Hawk*, *Of Human Bondage*, *Between Two Worlds*, *The Sea Wolf*, *The Constant Nymph*, and *Kings Row*.

This music was transferred from analog recordings made between 1972 and 1974 by RCA Victor. Charles Gerhardt (who was a colleague of mine when I was Music Director for RCA Victor Red Seal) conducted the "National Philharmonic Orchestra," which actually is a recording orchestra Gerhardt put together from the cream of London's symphony orchestras.

Gerhardt wisely chose as his engineer the legendary Ken Wilkinson, who made so many wonderful recordings for Decca Records. The music was recorded in the flattering, warm acoustics of Kingsway Hall in London. Wilkinson has made countless recordings

Illustration: Rick Tulka

The seasoned performers of the Cleveland Quartet deliver a model for a fine record and a true musical experience.

there (no longer usable because of traffic noises), and his mastery of it is evident. The recording is very high in level, finely detailed, with great projection and presence.

Korngold's imperial brass fanfares, lush romantic strings, and all elements of his epic scores are stunningly vivid in this outstanding recording. Yes, all of the music is very much heart on the sleeve and highly programmatic, but if you liked those old movie classics, this recording faithfully reproduces their stirring music. *Bert Whyte*

Ravel: "Chansons madécasses;" "Sites auriculaires;" "Frontispice;" Sonata for Violin and Cello. Jan DeGaetani, mezzo-soprano; Paul Dunkel, flute; Isidore Cohen, violin; Timothy Eddy, cello; Donald Anderson, cello; Gilbert Kalish, piano; Paul Jacobs, piano; Teresa Sterne, (fifth-hand) piano.
Nonesuch H71355-2, CD; AAD; 42:39.

If you think of Debussy and Ravel as the Tweedle-Dum and Tweedle-Dee of musical impressionism, you owe it to yourself to listen to this recording. No—to *buy* it; you won't be sorry.

The most celebrated of its contents probably is the "Chansons madécasses," (Madagascar songs) scored for mezzo-soprano (Jan DeGaetani), flute (Paul Dunkel), cello (Donald Anderson), and piano (Gilbert Kalish) in an ensemble (not soloist-accompaniment) relationship. The piece is challenging to players and auditors alike: Brutal and sensual by turns, slashing, petulant, earthy. It makes *Mélisande* sound like "Little Bo-Peep." This is a fine performance and a treasurable memorial of the late and much-missed Jan DeGaetani.

The two-piano pieces that follow are played by Paul Jacobs and Kalish. The first group, Sites auriculaires, comprises the relatively familiar Habanera plus Entre cloches—early pieces that foreshadowed genius. They are followed on the disc by Frontispice, in which Teresa Sterne (for years, the energetic and inventive driving force behind Nonesuch Records) provides the required fifth hand. A bit of Debussy can be glimpsed here. So can a bit of Milhaud and more than a bit of Satie.

But the best is yet to come: The sonata, marvelously played by Isidore Cohen and Timothy Eddy. It is an astonishing work, suggesting the Bartók string quartets more than anything else that comes to mind. The exquisite colorings of impressionism play no part in its elemental writing which, in reexamining the stuff that music is made of, piles one discovery on another in what amounts almost to a frenzy of creation. Fauve, perhaps, but certainly not Impressionist.

Maurice Ravel

Not only does the record contain exciting music excitingly played, but it creates an exceptionally satisfying listen through the textural and stylistic contrasts and the pacing created by the sequencing of the pieces involved. I do find the top end of the frequency range in this CD transfer slightly muffled on my equipment, but otherwise it is a triumph. *Robert Long*

Borodin: Quartet No. 2; Smetana: Quartet No. 1, "From My Life." The Cleveland Quartet.
Telarc CD-80178, CD; DDD; 56:46.

America still has everything—including performances of European music both good and atrocious. Here we have the really lovely and atmospheric playing of two highly European Romantic works, each redolent of that eastern area of the European tradition, from Russia, from Czechoslovakia (more properly Bohemia at the time). They are remarkably similar in quality, these two: The Borodin all fresh, lovely melody, as always with him, and wonderfully expressive harmonies; the Smetana of sterner stuff but forever dissolving into dance tunes of the most catchy sort. And the Cleveland Quartet, a longtime association of seasoned performers from right smack in the middle of the Middle West, plays these two works admirably. A model for a fine record and a true musical experience. Not a thing more need be said.
Edward Tatnall Canby

Henry Litolff: Concerto Symphonique No. 4 in D Minor; Trio in D Major. Monte Carlo Opera Orchestra, Edouard Van Remoortel; Gerald Robbins, piano; The Mirecourt Trio.
Genesis GCD-101, CD; ADD; 69:15.

Franz Schreker: Vorspiel zu einer grossen Oper "Memnon"; "Romantic" Suite.
NOe. Tonkunstler Orchestra Vienna, Uwe Mund.
Marco Polo 8.220469, CD; 49:05.

Even before CD, our reactivated interest in things Romantic began to flush all sorts of composers out of the musical bushes where they had hidden throughout the period of "modern" music, between the wars, and the continuing neoclassical era. Some were

John Eliot Gardiner gets a presentation from the English Baroque Soloists close to what Mozart might have heard.

older; their music went out of style. Others were still composing, unable to get away from the big Romantic idiom they had taken up in the past; they, too were out of style. Now, CD is bringing dozens of these Romantics, early and late, to the fore—interestingly, if perhaps not always for very long. Few of them are Brahmses, Tchaikovskys, Griegs—whose music never left our concert stages or our recordings.

Here are two such—one old, one much later—both composing on the most expansive level of Romantic big-time virtuosity. Litolff, born in 1818, is the more popular-minded composer and, oddly, the better of the two. Schreker, Jewish and stripped of his important positions in Vienna by the Hitler tide, is the tragic one, both in life and in his obstinately huge music composed at the height of neoclassicism. (The projected opera, "Memnon," got as far as its enormous overture in 1934, shortly before the composer died of heart failure.)

Litolff—the name was only vaguely familiar to me—is astonishing. A remarkably accomplished writer for orchestra and piano in the top mid-19th-century bravura manner, his big "super concerto" is flashy, beautifully composed, and remarkably easy to listen to if a trace (only a trace) on the superficial side. One segment you will instantly recognize as a popular and catchy "encore"-type movement that is often heard where an extra bit of time needs to be filled with a brilliant piece for a super-pianist. As for the trio, it is considerably earlier and shows an equal mastery of the three-instrument technique. To me, the work reeks of Robert Schumann. Interestingly, it was composed while that famous man was still at work himself.

The Genesis recordings were made in the 1970s and were first issued on LP (Van Remoortel died in 1977). You need not worry, the sound is excellent.

The then-young pianist, Gerald Robbins, has waves of hair on display and looks to be around 19 (he was older). He is generally fleet and brilliant and also musical, though a few very tough passages get to be hard and poundy—as well they might, considering the difficulties.

Franz Schreker is just one more of the great school of late-Romantic Jewish musicians who flourished in Vienna as the Nazis appeared—all of whom were forced out, escaped, or died. It is a heart-rending story; the only trouble is that Schreker's music, vastly serious and on a huge late-Romantic scale, is just not as big as it sounds. Too many rather crude borrowings from more fluent and original composers, both in the early "Romantic" Suite (turn of the century) and the very late and extremely ponderous "Prelude to an Opera." It's full of Wagner and Strauss and at times gets to be murderously long-winded. Sorry—he was, in any case, a fine teacher and influential of the sort.

Edward Tatnall Canby

Mozart: Symphonies Nos. 32, 35, and 36. English Baroque Soloists; John Eliot Gardiner, conductor.
Philips 422 419-2PH, CD; DDD; 73:05.

In recent years, recordings of the music of classical masters (Mozart, Beethoven, and Haydn among them) performed on period or ancient instruments have become increasingly popular. In fact, a number of orchestras specifically employ period instruments, and among the better known of these are the Academy of Ancient Music and the English Baroque Soloists.

John Eliot Gardiner is the scholarly conductor of the English Baroque Soloists, and here he elicits from them their usual highly disciplined playing and richly resonant sound in well-crafted performances of Mozart's Symphonies Nos. 32, 35 ("Haffner"), and 36 ("Linz"). These works were recorded in Greenwich, England. The hall is not specified, but it provides a lovely, natural sound with exceptionally smooth string tone and mellifluous woodwinds along with crisp, clean brass. The ambience is warm and rich, with a reverberation period of about 1.8 to 2.0 seconds. The period instruments afford these familiar works a musical texture different from the modern orchestral sound. It is probably fair to assume that this presentation is a reasonable approximation of what Mozart heard in his time.

Bert Whyte

Purcell: Sonnatas, Vol. 2. The Purcell Quartet.
Chandos CHAN 8663, CD; DDD; 53:20

The odd spelling, Sonnata, is in its way suggestive of the musical situation in Henry Purcell's England of the late 17th century, a generation or so before Handel.

Purcell was surely England's greatest wholly British genius composer, though his music was immensely affected by happenings on the Continent, notably Italy and France. Like Mozart, like Schubert, Purcell burnt himself out young. He composed enormously, but music was in enormous upheaval. Nothing settled down. There were no polished and familiar formats. Always a new fad, a new jolt from abroad to keep things unsteady.

There was the Old (not *that* old, but stylistically out of date) and the New. Purcell's greatest is in the queerly dissonant and tortured Old language of Monteverdi and the earliest baroque composers. The New was the straightforward and predictable sound of Corelli, and later, of Handel. Purcell's late works show this trend, and to our ears they are often less interesting than his strange earlier ones.

The Purcell Quartet, four individuals with a fifth assistant, plays largely trios here, which tend to be duets, with continuo accompaniment—the indispensable harmonic framework for the New music. Yet the Sonnatas are wildly diverse in their size and shape, unlike the predictable later music of the big baroquers, where a concerto was supposed to have three movements and a sonata four, slow-fast-slow-fast, etc., etc. This is thus wandering music, this way, that way, full of Purcell's favorite chaconne, variations on a ground bass.

Fine performance, on old, smoothly played instruments. If you like this, there is volume 1 before it.

Edward Tatnall Canby

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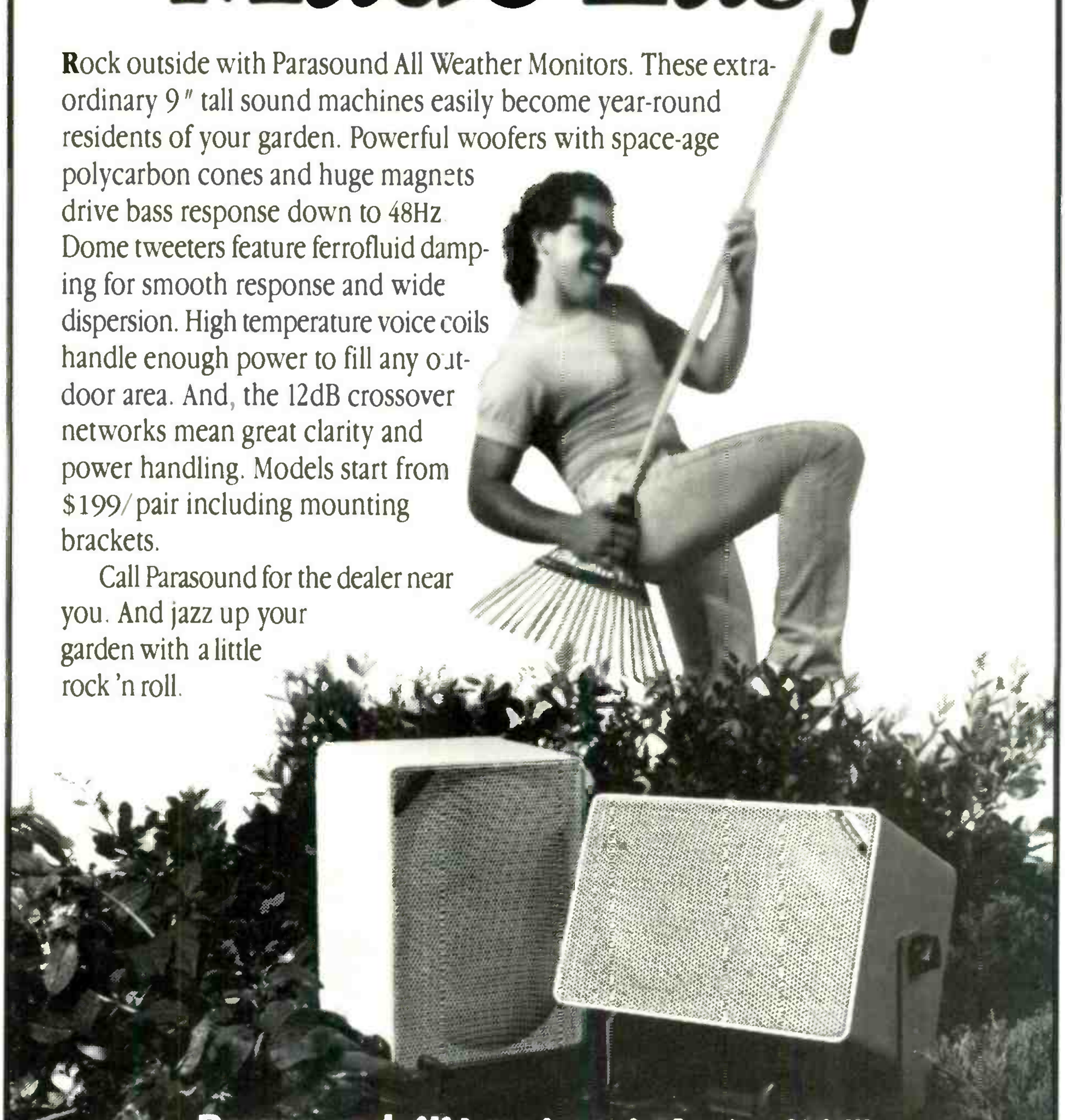

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WHEN SONNY PLAYS TRUE

Photograph: © David Gahr

Falling in Love with Jazz: Sonny Rollins
Milestone MCD-9179-2, CD; DDD; 47:00.

Sound: A– Performance: A

Anyone who's spent any time listening to Sonny Rollins knows, for all intent, even his best studio albums fall short of his best live performances. However, on *Falling In Love With Jazz*, with the aid of three varying casts, the Saxophone Colossus comes damn close. There is so much music in any one of the seven Compact Disc cuts (one is a bonus track) that the 1989 recording, his first studio effort in two years, strikes quickly at the heart of the matter.

As Rollins turns 60, his playing has never sounded stronger or more full bodied. Stylistically, he's deceptively engaging with his subtle waves of intervals. He's never snuck in more choice notes per solo than he does on this aptly titled adventure. Mostly contained within what we think of as commonplace compositions (tunes such as "Tennessee Waltz") virtually every solo—in classic Sonny Rollins form—commands attention.

"For All We Know" contains playful call-and-response between the great one and one of his devotees, Branford Marsalis, who counterbalances Rollins' slightly gruff tone with silkier, smoother, and breathier Ben Webster-Coleman Hawkins-like approach. Add to this Tommy Flanagan, the most elegant of all pianists, who last recorded with Rollins some years back on *Saxophone Colossus*, multi-instrumentalist Jerome Harris on bass guitar, and drummer Jeff Watts and it's quite a delightful quintet. The two-tenor lineup also makes whoopie on "I Should Care," the Sammy Cahn co-written ballad arranged convincingly in layers that, in some ways, rekindle Dexter Gordon's spirit. The presentation appears relaxed and understated but thoroughly emotional. The entire group fills in for each other but no one has more success than Flanagan, who solos after the horns have taken their turns. With his Monk quote, Flanagan makes the keys ooze. His gem of an effort is further highlighted when the entire ensemble returns for the finale.

For much of the proceedings, Rollins employs essentially his regular working ensemble, which includes trombonist Clifton Anderson, who shares the front line, Harris on electric guitar, long-time Rollins' associate Bob Cranshaw on electric bass, and Mark Soskin on piano and synthesizer. Jack DeJohnette was the drummer for these dates although Rollins has lately worked with Al Foster.

Understandably, sometimes Rollins, unintentionally, blows his colleagues off the stage or out of the studio. However, I've never heard Soskin better than on the quintessential Rollins funk number "Sister," where he registers some percussive "Tyner-isms" on acoustic piano. Ditto for the date's most commercial effort, the CD-only Rollins composition "Amanda"—a smoker. I'm not enamored with Soskin's use of the Korg M1 synth, but Rollins riffs hard and stretches his solo out in just the right way; he more than compensates for any shortcomings. Anderson, who from time to time Rollins tends to overwhelm, is captured better here than on any other previous engagement. He's been with Rollins for close to a decade now.

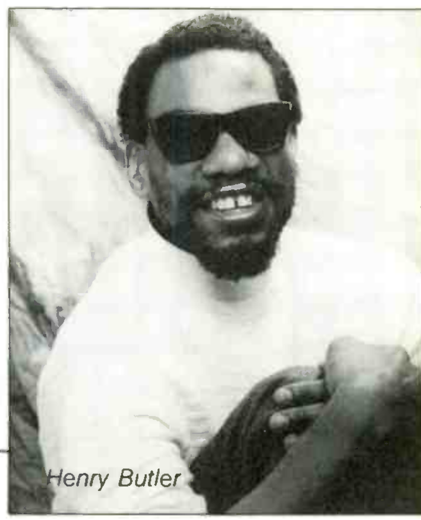
Ultimately, "Little Girl Blue" (a drumless arrangement featuring Harris, Soskin, and Cranshaw) and "Falling in Love with Love" may stand as the best performances on *Falling In Love With Jazz*. Both Rogers and Hart compositions, the first showcases a Rollins solo enveloped in the ballad form. The second serves as yet another tribute to Rollins, for he's never sounded more up to date—so much so that one wonders when the World Saxophone Quartet, in particular David Murray, will invite him along for a ride.

For now, with *Falling In Love With Jazz*, Sonny Rollins remains king of the tenors. *Jon W. Poses*

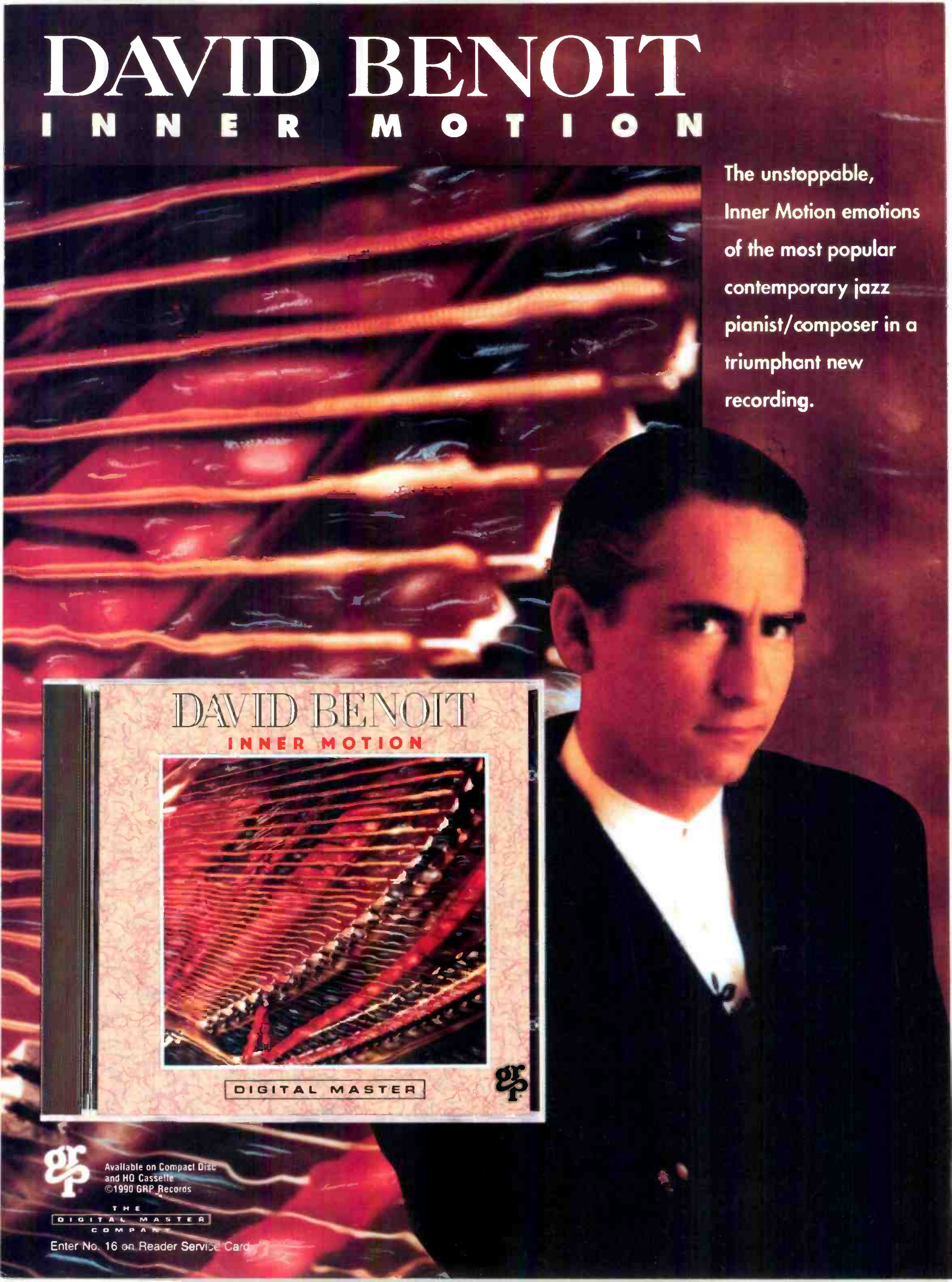
Orleans Inspiration: Henry Butler
Windham Hill WH-0122, CD; DDD; 46:58.

Sound: B– Performance: B

New Orleans has played home and host to a slew of keyboard wizards



Henry Butler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Epitaph is the essence of Charles Mingus' gift, combining gut-bucket emotion with cerebral, complex structures.

Photograph: © David Gahr

since the era of the sporting house and parlor pianist, which provides plenty of justification for Henry Butler's wide-ranging homage, *Orleans Inspiration*. There are certain logistical problems, however, when trying to deliver musical impressions of a localized genre that encompasses everything from the bawdy, ragtime wit of Jelly Roll Morton and the lilting jump of Fats Domino to the sometimes psychedelic gris-gris of Dr. John.

It's not that Butler endeavors to evoke the spirits of New Orleans piano, but a player of his stature doesn't overlook the rich legacy spawned by the likes of the bluesy second-liner Professor Longhair, the elegant "Tuts" Washington, the rambunctious James Booker, the punctilious popmeister Allen Toussaint, or the quirky Huey "Piano" Smith. And, there are those such as Lloyd Price, Little Richard, and Ray Charles who used the Crescent City's studios and musicians as a springboard to national success. Unfortunately, Butler, like an Art Tatum or Oscar Peterson, is such a facile pianist that his impressions re-create both the brilliant and the mediocre.

Orleans Inspiration was recorded at Tipitina's, the New Orleans club named after a Professor Longhair composition of the same name. It is more grab bag than mixed bag. Butler is joined by former Meters guitarist Leo Nocentelli, drummer Herman Jackson, bassist Chris Severin, and Michael Goods on synthesizer. The covers of N'Awlins standards are slashing, jazzy interpretations. Butler's prelude to Chris Kenner's "Something You Got" weaves through the old Negro national anthem, "Lift Every Voice and Sing," before bouncing into the chunky rhythm of the original. Longhair's "Tipitina" and "Mardi Gras in New Orleans" are made denser by virtue of Butler's thunderous left hand and plentiful cross-rhythms. Butler also dresses up the drawling blues chestnut "Goin' Down Slow" like an oyster po' boy.

Butler's originals don't stray far from some obvious influences, such as Toussaint (on the everything-I-do-gon'-be-funky riff of "Orleans Inspiration"), Booker (on "Dr. James"), and generic second line and voodoo (on "Mama Roux" and the countryish trot, "Dixie Walker"). Only thing is, Butler embellishes the frivolity and sensuality out of most of the music on *Inspiration*. His playing is solid, as is Nocentelli's, but there's a level of seriousness that dampens what should be a carnival-time atmosphere. Worse yet, Butler dabbles in exercises in virtuosity that result in such maudlin, tortured efforts as "Somewhere" from *West Side Story*. Nonetheless, I still want to like *Orleans Inspiration* because Butler has the tools and ingredients to make a great N'Awlins piano album. He just has to let his hair down and go for the soul, not the filigree. *Don Palmer*

Epitaph: Charles Mingus
Columbia C2K-45428, CD; DDD; disc one: 72:52, disc two: 54:30.

Sound: B– Performance: A–

Epitaph is a monumental, if flawed, large-scale work for jazz orchestra that embodies the essence of Charles Mingus' gift, combining gut-bucket emotion with cerebral, complex structures. Classical composers talk of composition as frozen improvisation and jazz composers talk of improvisation as spontaneous composition, but only Mingus blurred the distinctions.

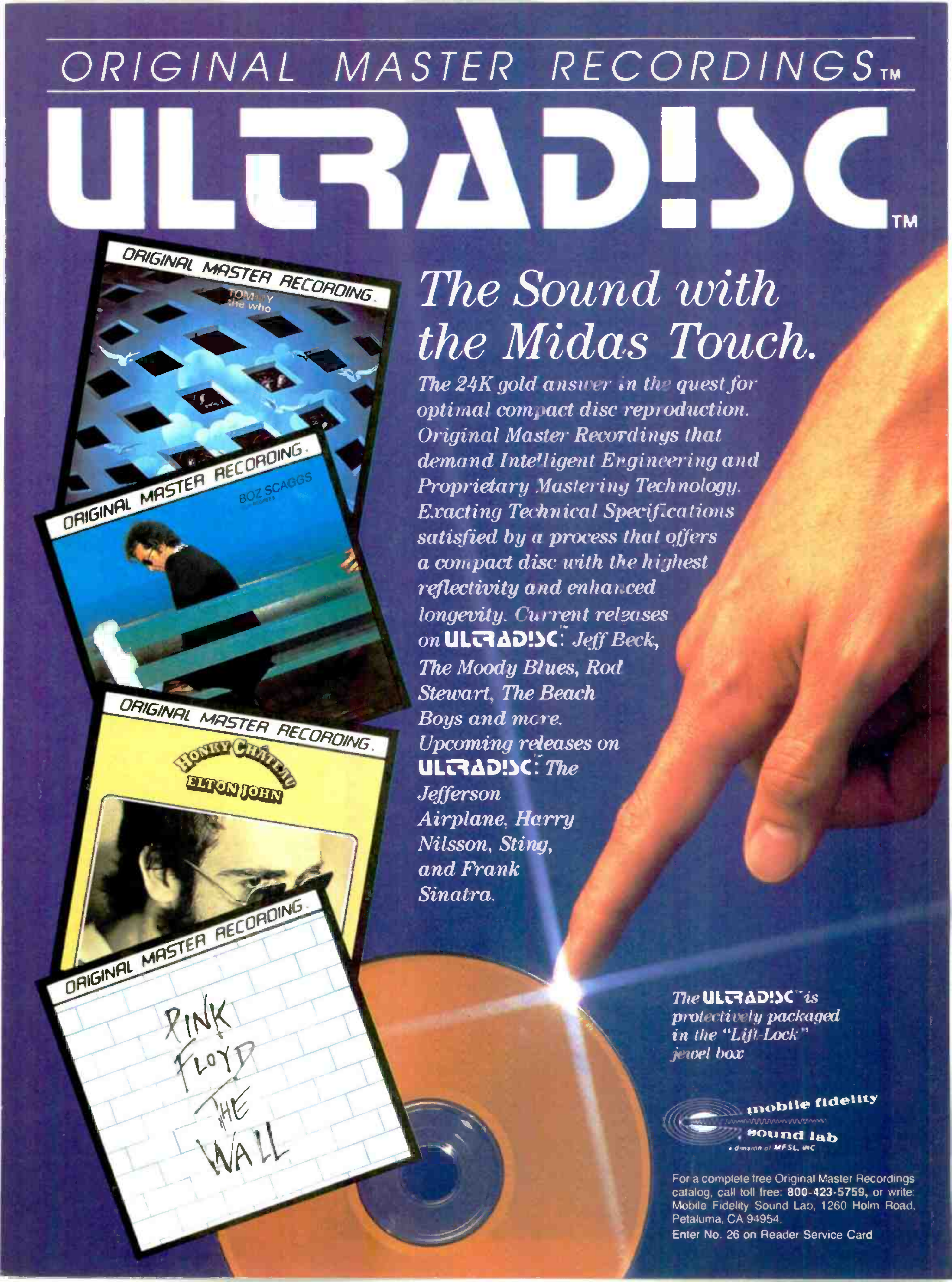
Epitaph has its genesis in the Town Hall concert of 1962, an abortive attempt to realize Mingus' large scale orchestral vision. It's resurrected here by scholar and composer Gunther Schuller, who has reconstructed the score and subsequent revisions, sometimes working from pages with numerous sections taped together in seemingly non sequitor fashion. Schuller's results are only occasonally as fragmentary as the sources. However, he has skillfully arranged this opus for an all-star ensemble that includes Wynton Marsalis, John Hicks, Sir Roland Hanna, John Abercrombie, and Mingus alumni Jack Walrath, John Handy, and George Adams.

This recording ties together many strains of Mingus' music. His deep jazz roots are evident in Jelly Roll Morton's "Wolverine Blues," played in a ragged, almost free-form style. Mingus' music often breathed the urban chaos of New York City like orchestrated traffic, which is evident on "Moods In Mambo," a through-composed piece that sounds improvised.

The shadow of Duke Ellington infuses the whole composition, but is especially apparent on "Self Portrait/Chill of Death" where he moves from marches to swing grooves, from free-form rambles to so-called "jungle music," the percussive tribal stomps that Ellington created. On "Monk, Bunk & Vice Versa" he quotes from Thelonius Monk's "Well, You Needn't" then deconstructs it, adding "Tea for Two" in the baritone line.

Mingus was an energy funnel, marshalling his players into his disciplined forms but also knowing when to let them rip. Brilliant, free-wheeling solos abound throughout *Epitaph*. Some highlights include George Adams charging through "Better Get It In Your Soul," a Mingus staple he honed throughout the 1970s, and Wynton Marsalis taking a vicious, growling plunger solo on "Ballad (In Other Words, I Am Three)."

Recorded live in 1989, *Epitaph* has little sense of ambient space and flat instrumental sound. Closer miking and some judicious processing might have further illuminated Mingus' orchestral colors. The performance is also ragged, with occasionally sluggish ensemble passages and slow movements, notably "Main Score Part 2," an uncomfortable mix of classical atonality and jazz.



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Charles Lloyd takes you through an incredible variety of moods, feelings, fantasies, and remembrances.

Schuller has clearly accomplished a Herculean task, better understood with the accompanying encyclopedic liner notes that trace the compositions' evolution. *Epitaph* is not the definitive recording it might have been had Mingus realized it himself, but it's a pinnacle few artists ever reach. *John Diliberto*

Fish Out of Water: Charles Lloyd
ECM 1398 841 088-2, CD; DDD; 57:48.

Sound: A Performance: A

After an absence of several years, Charles Lloyd has returned with *Fish Out of Water*. His hiatus, however, served to bring him to a style with increased maturity and depth of feeling. Lloyd's recent compositions depend not so much on contrasts, but rather on shadings of tonal color, dynamics, and harmonies. If you have a system that reproduces subtle sounds well, you'll enjoy listening to *Fish Out of Water*. It's the kind of recording that sounds wonderful on any reasonably good system and makes the outstanding ones really shine.

You'll hear imaginative sonic touches throughout the recording. For instance, the opening notes of solo sax in the title track convey a plaintive, lonely feeling. The room acoustic seems reverberant while music is playing but the room is dead, too absorbent, and the reverb dies away much too quickly, reinforcing the *Fish Out of Water* feeling.

In "Haghia Sofia," Lloyd starts with a flute solo reminiscent of Paul Horn's recordings in large stone structures. Later he returns to his sax, creating a distinctly Middle Eastern feeling with melodic inflections along with Jon Christensen's quiet percussion colorations. Even the bass uses some sliding tones to contribute to the effect. What you won't hear is the point where the room acoustic changes from the cathedral to a more typical room for a jazz ensemble. Only later do you realize that Lloyd and producer Manfred Eicher have electronically transported you to another place.

"Mirror" puts you and the ensemble into a rather live, reflective room as you might expect, but the effect is restrained, playing on that shadowy area of perception between reverberation and discrete reflections in an impressionistic way. Clearly, Lloyd had Debussy and Ravel in mind when he wrote this piece. Listen near the end, at about 9:03, for a series of chords moving up and down the whole tone scale, dissolving the key feeling as the music ends.

"Eyes of Love" starts with a long, slow, piano solo. The bass joins at about 1:45 and finally the sax enters as the music takes off in a faster tempo. But at 2:30, the piano takes over for another long solo, followed by an intriguing bass solo. Bobo Stenson's solo piano phrases come closer and closer to breaking down the key and pulse (especially around 3:25), but each phrase lands back on track just before that happens. At 4:21 Palle Danielsson takes over with a bass solo filled with surprisingly delicate figurations. Finally at 5:34, Lloyd returns with a concluding sax solo. Both times he makes you wait for his solo, which adds a subtle sensuous dimension to the piece.

By the end of the disc, Lloyd has taken you through an incredible variety of moods, feelings, fantasies, and remembrances. The booklet, which offers thoughtful background information and nice color photos, neatly reinforces the musical experience From the perspectives of both the audio and musical qualities, I liked this recording the first time I played it, and my admiration has grown with each listening.

Steve Birchall

Nouveau Flamenco: Ottmar Liebert
Higher Octave HOMCD 7026, CD; AAD; 50:30.

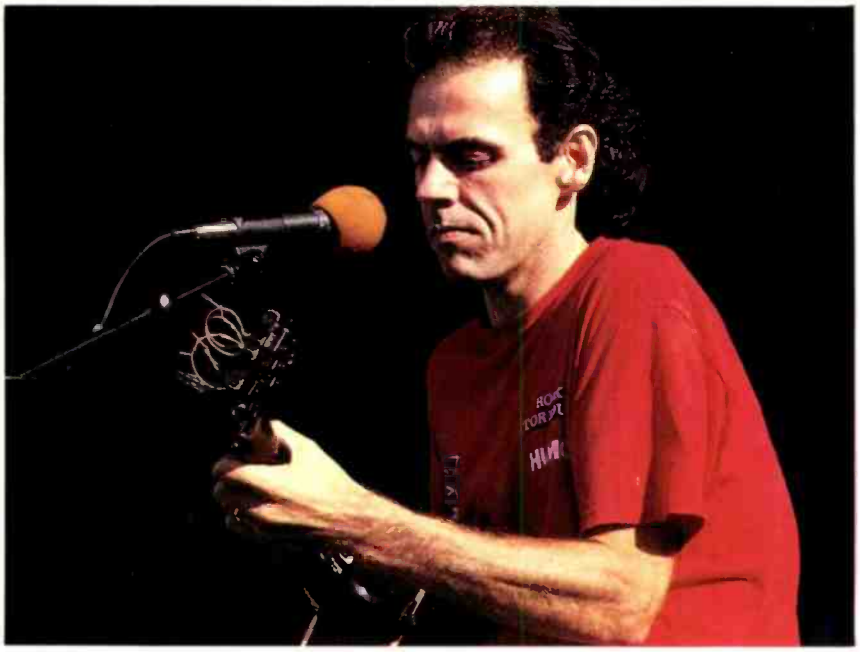
Sound: B — Performance: A–

Straight out of left field comes this delightful record of Ottmar Liebert's modern flamenco-inspired music. German by birth but now based in New Mexico, Liebert's guitar inventions ring out with the feel and romantic rhythms of flamenco. There's a whole lot of heart in his playing and that is what seduced me, by surprise I must admit, the very first time I heard his album.

Liebert is supported by electric bass, light percussion, rhythm guitar, and occasional atmospheric keyboard. The album sports an uncluttered sound with real eloquence. It is light listening to be sure, but this is not airy wallpaper music. There is sinew in the performance that demands attention. *Nouveau Flamenco* is not traditional, but it is of the tradition, and it is a lot of fun.

Michael Tearson

SETTLING DOWN



Photograph: © David Gahr

Stolen Moments: John Hiatt
A&M 75021 5310 2, CD; AAD; 52:58.
Sound: A Performance: A+

It has always been a truism that to produce really great work, an artist must suffer conflict and adversity. With *Stolen Moments*, John Hiatt completely puts this myth to rest with his cycle of songs about the joys of making kids and living the family life. These are themes that Hiatt has been exploring on his previous A&M albums, *Bring the Family* and *Slow Turning*, both widely regarded as critics' darlings. I liked those albums, although they didn't knock me out. *Stolen Moments*, however, is a triumph.

From the first notes of "Real Fine Love," and throughout the entire album, Hiatt's songs and performance radiate confidence laced with a healthy dose of humility and grace that is apparent in the lines of the opener: "A real fine love/One I am unworthy of" and "A little joy/A little peace/And a whole lot of light." Next is "Seven Little Indians," the strangest piece here. This saga of a Native American family's forebearance through bad times and good, held together by the mother and "the big chief," is half spoken and half sung over a percolating throb. "Child of the Wild Blue Yonder" should be Hiatt's breakthrough single if there is any justice. It is an irresistibly catchy ode to a new daughter.

"Back of My Mind" and "Stolen Moments" both reflect on the thoughts of a reformed drinker who went through hell to find clarity. "Back of My Mind" flashes back from childhood through the darkness to the present, treasuring these better times. The first verse includes a delicious line: "These days the only bar I ever see/Has got lettuce and tomatoes." It goes on to reflect the joys of living at home with the woman you love nearby. "Bring Back Your Love to Me" is a doo-wop inflected love song that spotlights the sweet vocal harmonies of Bobby King, Willie Green, and Hiatt.

"The Rest of the Dream" is yet another catchy song, this time about making babies. "Thirty Years of Tears" is a mostly acoustically played waltz; a sadder-but-wiser catharsis of a lifetime of pain. "Rock Back Billy" is about the redemptive power of playing rock 'n' roll complete with encouragement for the young ones: "In a room somewhere/With a beat-up guitar/And some funny looking hair." "Listening to Old Voices" is a song of acceptance and hope. "Through Your Hands," a duet with Karen Peris of the excellent group The Innocence Mission, is about healing. The rocking "One Kiss" is a most appropriate closer, as it summarizes the album's themes and once again celebrates the joys of the family unit.

Hiatt's songwriting has never been sharper or more joyous than it is here. His songs make *Stolen Moments* a powerfully uplifting statement, but there is more to the album than that. There is great guitar playing with slide leads by Michael Henderson and Mac Gayden, and electric leads by Michael Landau, Ethan Johns, and Hiatt himself. Hiatt is a very underrated guitarist who, at the other end of the '80s, toured extensively, trading leads with Ry Cooder in Ry's hot band. Hiatt also does superb rhythm guitar parts, both acoustic and electric. Pat Donaldson's bass work is exemplary throughout. Most of the percussion work is done by Ethan Johns and Little Feat's Ritchie Hayward, with David Kemper and Michael Porter each playing drums for one cut. As with Hiatt's previous A&M albums, Glyn Johns produced and has really done a swell job. The recording is vibrant and lively with excellent dynamic range.

John Hiatt has been one of the very best songwriters for years. That's why people like Rosanne Cash, Bonnie Raitt, Emmylou Harris, The Desert Rose Band, John Doe, and even Bob Dylan cover his songs. In over 15 years of recording for four labels, Hiatt has never made a better record than *Stolen Moments*. It has brought me and my new wife a whole lot of joy, and it keeps bringing more. Very highest recommendation. *Michael Tearson*

Days of Open Hand: Suzanne Vega
A&M 7502-15293-2, CD; ADD; 45:51.
Sound: A Performance: C−

Those of us long familiar with Suzanne Vega from the *Fast Folk* record series and the New York City folk music circuit might be more critical of *Days of Open Hand* than others. Or perhaps not. From any objective standpoint, Vega's third major-label album is as uninspired as salt.

Part of the problem is one that afflicts many follow-ups to albums containing hits: Expectations are high, and second-guessing by artists and (more to the point) their advisors is rampant. On this album, Vega seems to want to move toward pop and away from her folk roots, a valid path that Joni Mitch-

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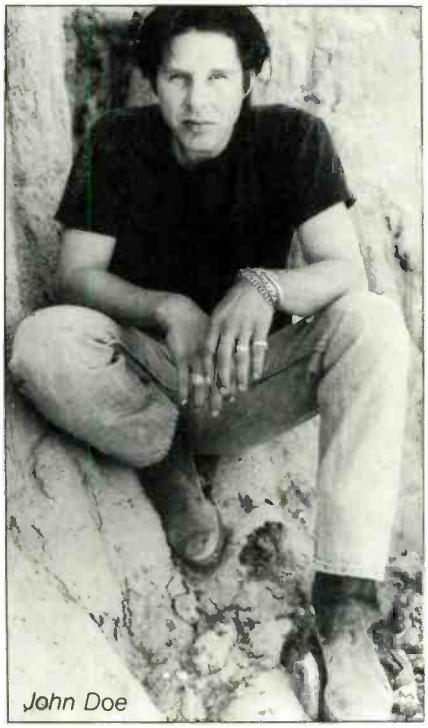
Suzanne Vega best exhibits her enormous talent when she is serving up acute observations and telling detail.

ell, among others, has taken marvelously. Unfortunately, *Days of Open Hand* has melded the worst aspects of both idioms.

On "Those Whole Girls (Run in Grace)" and "Predictions," for instance, Vega doesn't sing but rather talks her way through the lyrics, against bare musical accompaniment. This is fine when stark, powerful lyrics can gain added strength from a subdued delivery, as on "Fifty-Fifty Chance," about a friend's attempted suicide. But otherwise, it sounds simply as if Vega and co-producer and sometime-collaborator Anton Sanko couldn't think up an original melody—an especial shame since the musicianship—from ringing acoustic guitars to shadowy, exotic Middle Eastern sounds—is so heartfelt and precise.

The star of Vega's show is usually her lyrics, but here they are the major disappointment. In *Days of Open Hand*, she seems to be weaving a theme about self-reliance and, pardon the literalness, hands-on experience. In "Men in a War," she sings of something "filled in by hand;" in "Book of Dreams," she tells someone to "underline in Magic Marker"—by hand, necessarily. In "Institution Green," we have to "Pull the level/Push the curtain closed"—again, by hand—and in "Fifty-Fifty Chance," the sense of touch is an important motif. Yet these references and allusions are so vague and abstruse, there's just as much chance that all this is coincidence, and that the title and the self-consciously mystical/astrological hands pictured through the lyric booklet and on the cover are just for show.

Indeed, there's a self-conscious poesy throughout. Where Vega at her best serves up acute observations and the telling detail—again, as on "Fifty-Fifty Chance"—she exhibits her enormous talent. But when she tries to write Stevie Nicks pop lyrics, the kind that don't necessarily *mean* anything but sound good and mellifluous and dulcet when sung, Vega is at a loss. And for good reason: That's not her forte, and it makes her lyrics sound forced and false. There's some of the old Vega here, like the woman in "Room off the Street" whose ". . . dress is so tight/You can see every breath that she takes." But more often, we're given such maddeningly vague generalities as "Between the pen and the paperwork/I know there's passion in the language/Between the muscle and the brainwork/There must be feeling in the pipeline."



John Doe

Would that there were more here.

Frank Lovece

Meet John Doe: John Doe
DGC 9 24291-D2, CD; AAD; 46:47.

Sound: B Performance: B+

I never could warm up to that early art punk band, X, but the first solo project of its erstwhile leader, John Doe, has caught my interest with its various forms of genuinely American music.

On the snappy rocker "Let's Be Mad," which opens the set, there is a kaleidoscope of styles. "A Matter of Degrees" sounds like it was routed via Thunder Road. There is country twang in "Dyin' to Get Home" and "Take #52." "With Someone Like You" is a straightforward love song and "By the Light" is a folky little thing. "Touch me, Baby" is a bluesy shuffle and "My Offering" is a tender closer. *Meet John Doe* does hit a lot of bases, but it doesn't feel disjointed because of its diversity. To the contrary, there is a real underlying sense of unity to the project.

There are three covers among the 12 selections: Hank Cochran's 1966 weeper "It's Only Love," John Hiatt's hopeful "The Real One," and Butch Hornsby's "Knockin' Around."

The strength of Doe's band helps a lot, and the guitarists are the key. Jon Dee Graham, late of Austin's True Believers, provides the muscle while former Televisioner Richard Lloyd plays more supple parts. They are the pillars of the album.

In the end, *Meet John Doe* is a surprisingly listener-friendly album—not offputting like X could be but instead really warm and human.

Michael Tearson

Passion and Warfare: Steve Vai
Relativity 88561-1037-2, CD; AAD and ADD; 53:21

Sound: A Performance: A

About every 20 years it seems, revolutionary things happen to guitar music. In 1948, a brilliant guitarist and inventor named Les Paul gave us the visionary sounds of "Lover," the world's first truly multi-tracked and tape-manipulated instrumental. Two decades later Jimi Hendrix arrived. Fast-forward another 20 years and we find several young musicians moving us the next quantum leap forward, most notably two friends from Carle Place, New York, Joe Satriani and Steve Vai.

Passion And Warfare is Vai's second solo album, the first since leaving Frank Zappa's tutelege to conquer hard rock through notable stints with David Lee Roth and Whitesnake. It's a

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the Love of God." Sweet acoustic guitar? "Sisters."

All songs are instrumentals although occasional spoken words appear for philosophical effect. "The Audience is Listening," for instance, is an amusing, if slightly adolescent, look back at Vai's own past and a sendup of his primary school teacher who, while talking throughout the piece, vainly tries to control her class.

Sterling accompaniment is provided by bass whiz Stu Hamm and drummer Chris Frazier. The album was recorded at Vai's 48-track home studio where he recently installed an Otari 32-track digital tape machine. (Success certainly brings its rewards!)

It's interesting to note that Vai plays a seven-string (not six) guitar to achieve greater harmonic possibilities. Such an idea goes back at least to the late Renaissance when lutanists began adding courses to their lutes. More recent examples can be heard in jazzmen George Van Eps, Bucky and John Pizzarelli, Ron Eschete, fingerstylists Lenny Breau and Howard Morgan, and classical player Narciso Yepes (who plays a ten-string).

Passion And Warfare is a concept album of sorts in that it charts a series of dream sequences based on Vai's personal experiences. At first pass you may be tempted to approach it as a hard rock record but closer listening yields endless delight in audio detail, intelligent composition (you'll recognize Zappa's lessons), and spirited, inspired musicianship. Imagine that

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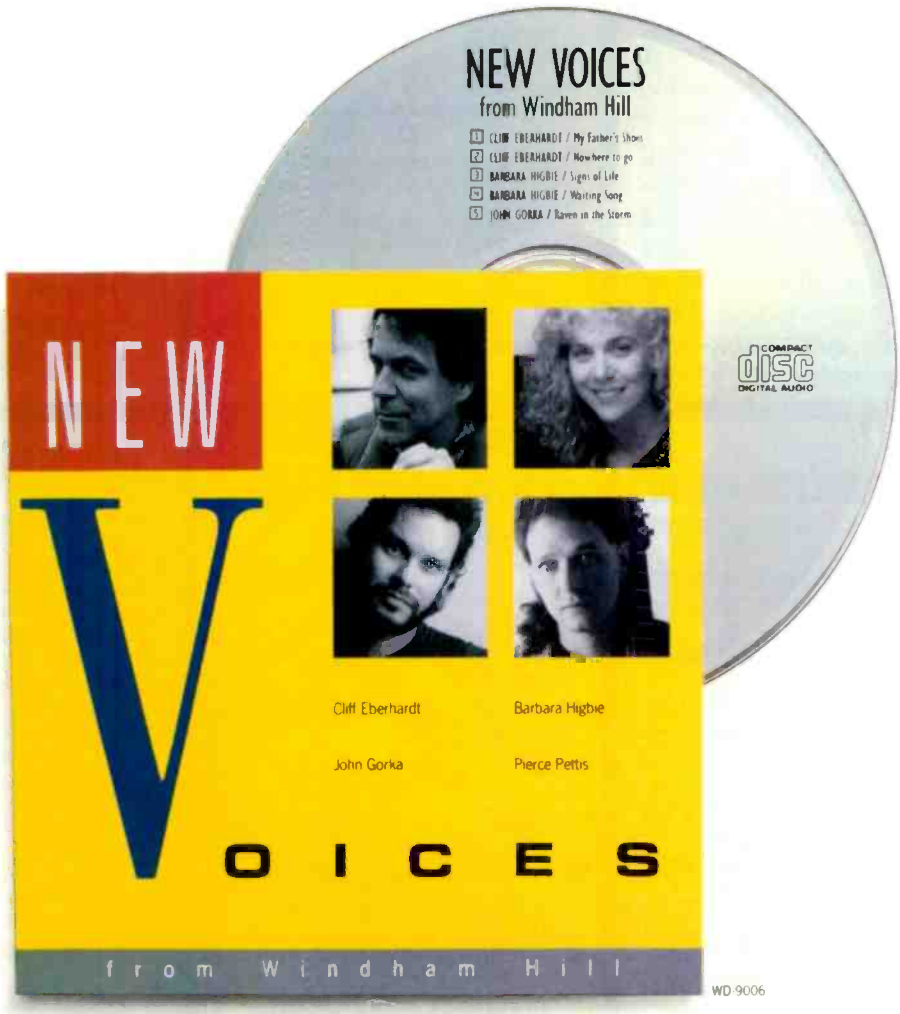

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The better you know the songs of Marti Jones, the harder they are to shake out of your mind.

some child is being born as this music hits the universe, and in another 20 years or so, who knows where he or she will take us. For now, don't miss this. *Michael Wright*

Any Kind of Lie: Marti Jones
RCA 2040-2-R, CD; 39:37.

Sound: B Performance: A–

Marti Jones is a thrush. Through her three albums for A&M, she made a smashing impression as a terrific interpreter of song while participating in the songwriting only sporadically. For her RCA debut, she and Don Dixon, her producer and writing and life partner, seem to have made a conscious decision to write much more, and the results are impressive. Eight of the 11 cuts are Dixon/Jones compositions, and they are bouncy, shimmering pop songs with stories to tell. The better you get to know them, the more substantial they feel and the harder they are to shake out of your mind—as with most good pop songs.

Dixon's production goes directly to the heart of a song, but he adds smart touches, such as the vibes he plays on the title song, the wonderful pedal steel and button accordion contributions of Fats Kaplin to three songs, and Bruce Hornsby's signature piano on two cuts and accordion on a cover of Loudon Wainwright III's bittersweet "Old Friend." There's the slightly loopy reggae-cum-clarinet resetting of Clive Gregson's "Second Choice" followed by the sweet, slow waltz of Dixon's own "Cliché," which features Sonny Landreth on Dobro and E-Bow. Throughout the set, the backing vocals perform unusual and ear-catching contrapuntal tricks. The album's sequence of songs smartly emphasizes the musical variety, which in turn helps to properly showcase Marti's singing. She displays in her performance a real surge of confidence to go along with her writing surge.

Marti Jones has fallen through the cracks for too long. She and Dixon deliver excellent work in albums that beg to be played over and over again. *Any Kind of Lie* may be their best yet (it is still growing, in my estimation). It is the kind of album that becomes a tried and true friend, and it deserves serious consideration. *Michael Tearson*

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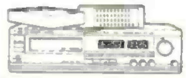

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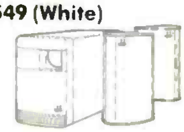

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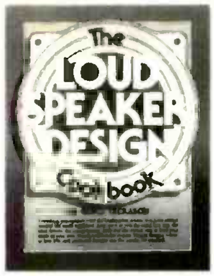

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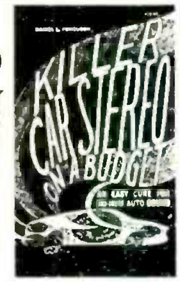

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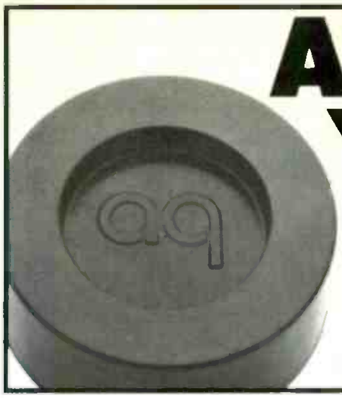

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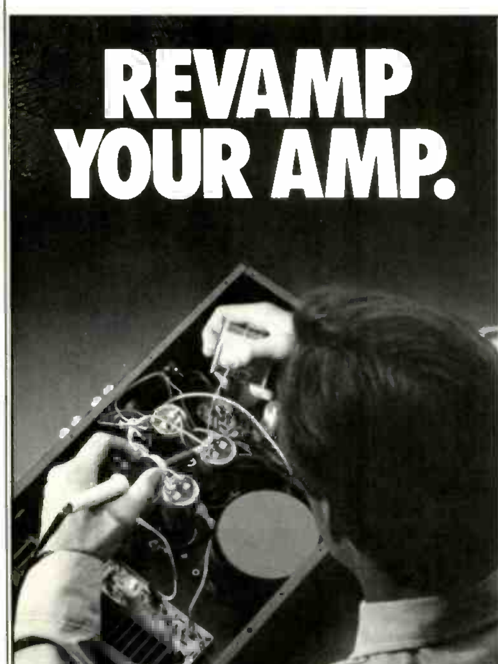

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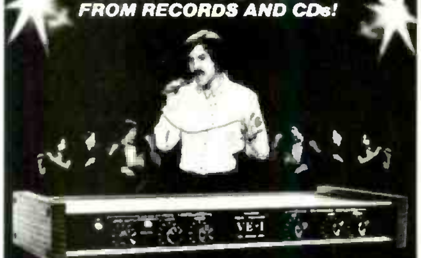

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